

BID FORM

**DEPARTMENT OF PUBLIC WORKS
NASSAU COUNTY, NEW YORK**

**CEDAR CREEK WPCP AND GLEN COVE WWTP
SCADA SYSTEM IMPROVEMENTS
CONTRACT NO. S35117-03GR**

NAME OF BIDDER: _____

TO BE COMPLETED BY BIDDER SUBMITTING BID ON
DEPARTMENT OF PUBLIC WORKS
NASSAU COUNTY, NEW YORK

CEDAR CREEK WPCP AND GLEN COVE WWTP
SCADA SYSTEM IMPROVEMENTS
CONTRACT NO. S35117-03GR

ITEM NO.	TYPE	DESCRIPTION		
1	Base Bid (Lump Sum)	LUMP SUM PRICE for furnishing all labor, materials and equipment required for all General Construction work for the Cedar Creek Water Pollution Control Plant SCADA System Improvements as specified and shown on the drawings, complete and ready for operation.		
2	Base Bid (Lump Sum)	LUMP SUM PRICE for furnishing all labor, materials and equipment required for all General Construction work for the Glen Cove Wastewater Treatment Plant SCADA System Improvements as specified and shown on the drawings, complete and ready for operation.		
3	Lump Sum	LUMP SUM PRICE for furnishing HMI System Software (Section 13315) for the Cedar Creek WPCP and Glen Cove WWTP SCADA System Improvements complete and ready for installation and configuration.	\$132,661	70
4	Allowance	ALLOWANCE NO. 1: for retaining the services of a UV system supplier to furnish equipment and startup services associated with the control system upgrade of the existing Trojan UV disinfection system at the Glen Cove Wastewater Treatment Plant, as detailed in Section 01020 – Allowances.	\$160,000	00
5	Allowance	ALLOWANCE NO. 2: For furnishing all labor, materials, equipment and incidentals for Miscellaneous Additional Work for the Cedar Creek WPCP and Glen Cove WWTP SCADA System Improvements as ordered by the County.	\$ 100,000	00

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ITEM NO.	TYPE	DESCRIPTION		
6	Unit Price- Six (6) pneumatic actuators	Unit price to furnish all labor, demolition, materials, equipment, and incidentals required for all construction work, as shown and specified in Division 1 through 16 to install six (6) new pneumatic actuators for the existing 24-inch settled wastewater butterfly valves, including all required controls and appurtenances as specified and shown on the drawings, complete and ready for operation.		
7	Unit Price- Six (6) pneumatic actuators	Unit price to furnish all labor, demolition, materials, equipment, and incidentals required for all construction work, as shown and specified in Division 1 through 16 to install six (6) new pneumatic actuators for the existing 30-inch settled wastewater butterfly valves, including all required controls and appurtenances as specified and shown on the drawings, complete and ready for operation.		
8	Unit Price- Twelve (12) pneumatic actuators	Unit price to furnish all labor, demolition, materials, equipment, and incidentals required for all construction work, as shown and specified in Division 1 through 16 to install twelve (12) new pneumatic actuators for the existing 14-inch return sludge butterfly valves, including all required controls and appurtenances as specified and shown on the drawings, complete and ready for operation.		
9	Unit Price- Six (6) butterfly valves	Unit price to furnish all labor, demolition, materials, equipment, and incidentals required to install six (6) new 24" settled wastewater butterfly valves as specified and shown on the drawings complete and ready for operation.		

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ITEM NO.	TYPE	DESCRIPTION		
10	Unit Price- Six (6) butterfly valves	Unit price to furnish all labor, demolition, materials, equipment, and incidentals required to install six (6) new 30" settled wastewater butterfly valves as specified and shown on the drawings complete and ready for operation.		
11	Unit Price- Twelve (12) butterfly valves	Unit price to furnish all labor, demolition, materials, equipment, and incidentals required to install twelve (12) new 14" return sludge butterfly valves as specified and shown on the drawings complete and ready for operation.		
12	Unit Price - 12-Pair Multimode Fiber Optic Cable	Unit price per foot to furnish, install, and test 12-pair multimode fiber optic cable as specified. This unit price shall be used to add and/or remove material and labor from the contract as directed by the Engineer and is above and beyond the cost of fiber optic cable that is required by the bid documents and included in lump sum bid items 1 and 2.	Material per foot Labor per Foot	Material per foot Labor per Foot
13	Unit Price - 3-Pair Multimode Fiber Optic Cable	Unit price per foot to furnish, install, and test 3-pair multimode fiber optic cable as specified. This unit price shall be used to add and/or remove material and labor from the contract as directed by the Engineer and is above and beyond the cost of fiber optic cable that is required by the bid documents and included in lump sum bid items 1 and 2.	Material per foot Labor per Foot	Material per foot Labor per Foot
14	Unit Price - 4" Rigid Galvanized Steel Conduit	Unit price per foot to furnish and install 4" rigid galvanized steel conduit as specified. This unit price shall be used to add and/or remove material and labor from the contract as directed by the Engineer and is above and beyond the cost of conduit that is required by the bid documents and included in lump sum bid items 1 and 2.	Material per foot Labor per Foot	Material per foot Labor per Foot

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CONTRACT NO. S35117-03GR

ITEM NO.	TYPE	DESCRIPTION		
15	Unit Price - 4" PVC Coated Rigid Galvanized Steel Conduit	Unit price per foot to furnish and install 4" rigid galvanized steel conduit as specified. This unit price shall be used to add and/or remove material and labor from the contract as directed by the Engineer and is above and beyond the cost of conduit that is required by the bid documents and included in lump sum bid items 1 and 2.	Material per foot	Material per foot
			Labor per Foot	Labor per Foot

TOTAL BID PRICE OF ITEMS 1 THRU 11 WRITTEN IN NUMBERS		
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TOTAL BID PRICE OF ITEM NO. 1 THRU 11 WRITTEN IN WORDS:

NOTE TO BIDDER: Include a separately sealed envelope containing a list of all subcontractors the bidder will use to perform (a) plumbing and gas fitting, (b) heating, ventilating and air conditioning, and (c) electric wiring and standard illuminating fixtures; and the respective agreed-upon amount to be paid to each subcontractor. Write on the outside of the envelope the bidder's name, the contract number, and the words "List of Subcontractors".

PROPOSAL

CEDAR CREEK WPCP AND GLEN COVE WWTP
SCADA SYSTEM IMPROVEMENTS
CDM SMITH PROJECT NO.: 5044-102537

DEPARTMENT OF PUBLIC WORKS
NASSAU COUNTY, NEW YORK
CONTRACT NO.: S35117-03GR

ALLOWANCES

It is expressly understood and agreed that the total Bid presented in this Proposal is the basis for establishing the amount of the Bid Security and includes the following allowances:

- Item No. 4: An allowance of One Hundred and Sixty Thousand (\$160,000.00) for costs associated with the existing UV System Control Upgrades.
- Item No. 5: An allowance of One Hundred Thousand Dollars (\$100,000.00) for costs associated with unforeseen conditions.

All in accordance with the requirements of Division 1, Special Conditions; Section 01010, Summary of Work; Section 01020, Allowances; and Section 01500, Temporary Facilities and Controls.

Final Contract Payment for allowance items shall be based upon actual payments, and not on the approximate amounts cited herein.

ALTERNATES

It is expressly understood and agreed that the total Bid presented in this Proposal is the basis for establishing the amount of the Bid Security. The following Deduct Alternate bid items may be eliminated by the Owner in the order listed prior to finalizing the Contract Agreement, which will potentially decrease the total Bid presented in this Proposal and be the basis for establishing the amount of the Bid Security:

- {NONE}.

All in accordance with the requirements of Division 1, Special Conditions; Section 01010, Summary of Work; Section 01030; Alternates; and Section 01500, Temporary Facilities and Controls.

Final Contract Payment for allowance items shall be based upon actual payments, and not on the approximate amounts cited herein.

DETERMINATION OF LOW BID

Determination of low Bid will be made by comparing the total Bid which shall include the lump sum Base Bid price, unit price totals and allowances, minus the Deduct Alternate(s), taken in order, or none of them, whichever amount(s) shall be judged by the Commissioner of Public Works to be in the best interest of the County.

**NASSAU COUNTY
DEPARTMENT OF PUBLIC WORKS
GENERAL CONDITIONS**

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GC-1 APPLICATION OF GENERAL CONDITIONS

The Provisions of the General Conditions as hereinafter stipulated shall form a part of each Prime Contract and/or separate trade specification except insofar as any such provision or provisions may be manifestly not applicable to any such trade specification.

It shall be the duty of the Contractors to fully familiarize themselves with all of the provisions of the Contract Documents.

GC-2 CORRELATION AND INTENT OF DOCUMENTS

The Contract Documents are complementary, and what is called for by any one shall be as binding as if called for by all.

The intent of the Contract Documents is to include everything necessary for the proper execution of the complete finished Work.

GC-3 ORAL MODIFICATIONS

No oral statement of any person shall be allowed in any manner or degree to modify or otherwise affect the terms of the Contract.

GC-4 KNOWLEDGE OF CONDITIONS

(See Instructions to Bidders, Section II, Bidder's Responsibility.)

GC-5 DRAWINGS AND SPECIFICATIONS

- A. The Drawings and Specifications prepared by the Engineer are intended to agree and anything shown or called for on the Drawings and not mentioned in the Specifications, or vice versa, or any Work or materials necessary to, and usually included in the complete finish of the Work and/or materials of the character to be furnished by the Contractors, shall be considered to be included herein and shall be performed and furnished by the Contractors without any extra charge, as though the same were both shown and specified. In the case of a conflict, the specifications shall take precedence over the Contract Drawings.

The Engineer will furnish in addition to the Drawings listed in the Contract Documents, such other and additional Drawings and such explanations in writing as may, in the Engineer's opinion, be necessary for the performance of the Work by the Contractors, and all such details and explanations shall be binding upon and shall be strictly followed and complied with by the Contractors. All such Drawings shall be consistent with the Contract Documents, true developments thereof, and reasonably inferable there from.

- B. All Drawings, and such notes, interlineations, figures and details, as may be noted thereon, shall be considered as a part of and complementary to the

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Specifications. Full size Drawings and large scale details shall, in General, govern and take precedence over the small scale Drawings which they are intended to amplify. Figure dimensions shall govern in laying out the Work, and no Work shall be executed from dimensions obtained by scaling the drawings.

While the Specifications are subdivided into divisions and sections, (but only for the purpose of facilitating the Work) Contractors shall, nevertheless, furnish all labor and materials necessary to complete all the Work in accordance with the Contract despite the fact that it may not appear under the Work specified for the particular division and section under which it would be normally classified.

- C. The Contractors shall check all supplementary information furnished them immediately upon their receipt. The supplementary information shall not be altered by the Contractors, but should any error or inconsistency appear, or in the event of any doubt or question arising in respect to the true meaning and intent of the Drawings or Specifications, or should anything be omitted from the Drawings or Specifications which is necessary to a clear understanding of the Work, they shall report same in writing within five (5) days to the Engineer who will make any necessary rectification and decisions.
- D. If, at any time, the County shall fail to supply sufficient or clear information to enable the Contractor to proceed with the Work, the Contractor shall immediately notify the Engineer in writing, and in no case, will the lack of such information, or failure to understand the Drawings or Specifications, or ignorance of the contents of either, be considered or received as an excuse for improper or inferior construction, workmanship or materials, or for any delay in performing the Work, or as justification for any claim for Extra Work or materials.

Should any question or disagreement arise concerning the meaning of Drawings or Specifications, such question or disagreement shall be settled by the Engineer, whose decision in writing shall be final.

- E. The Contractors will be furnished by the County, without charge, the following number of copies of the Contract Drawings and Specifications:

<u>Contract</u>	<u>No. of Copies</u>
General Construction	6

Any sets of contract Drawings and Specification which the contractors may require in addition to these will be furnished at cost of reproduction and handling.

- F. The Contractor shall keep at least one copy of all Drawings and Specifications at the Site in good order and available to the County, the Engineer, or their representatives. These Drawings and Specifications shall be kept up to date at all times and show all changes.

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GC-6 OWNERSHIP OF DRAWINGS AND SPECIFICATIONS

All Drawings and Specifications are and shall remain the property of the County. These are furnished to the Contractors as instruments of service. They are not to be used on any other work.

GC-7 COORDINATION WITH OTHER CONTRACTORS

- A. During progress of the Work on this Contract, other contractors may be engaged in performing Work within the Contract area and in areas adjacent to this contract area.
1. The Contractor's attention is specifically directed to the fact that because of the work on other contracts within and adjacent to the limits of this Contract he may not have exclusive occupancy of the territory within or adjacent to the limits of this contracts.
 2. The Contractor will be required to cooperate with other Prime Contractors and the owners of the various utilities and to coordinate and arrange the sequence of this Work in such a manner that all work, proposed or in progress within or adjacent to the limits of the Contract, can be progressed with as little interference as possible.
 3. In case of interference between the operations of a Contractor and / or utility owners and / or other Contractors, the Commissioner shall be the sole judge of the rights of each party and the sequence for Work necessary to expedite the completion of all the work progressed or about to be progressed within or adjacent to the contract limits.
- B. The direction or the Commissioner on the order and sequence of the Work shall not in itself constitute a basis for extra compensation or an Extension of Time.

GC-8 MEETINGS

- A. Pre-Construction Meeting
1. After the Contract has been awarded, but prior to the start of actual construction, a Pre-Construction Meeting will be scheduled by the County.
 2. The meeting shall be attended by representatives of the Nassau County Department of Public Works, the Contractor, Subcontractors as requested, and the Engineer. The purpose of this Meeting will be generally administrative and will include but not necessarily be limited to discussion of County requirements, use of Subcontractors, submissions required from the Contractor prior to start of Work, major equipment deliveries and priorities, construction procedures, payment criteria, time for completions and any specific or unique criteria to be followed.

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B. Progress Meetings

1. Regular Meetings will be held twice a month at the Construction Manager's Field Office during the performance of the Work of this Contract. Additional Meetings may be called as progress of the Work dictates.
2. Responsible representation from major equipment manufacturers will be the Contractors' responsibility at Progress Meetings on demand from the County. Refer to all Divisions of the Technical Specification for other requirements.
3. Attendance:
 - a. County
 - b. Engineer
 - c. Contractor
 - d. Subcontractors, only with Engineer's approval or request, as pertinent to the agenda.
4. Minimum Agenda
 - a. Review minutes of previous meetings.
 - b. Review progress of Work since last meeting.
 - c. Note and identify problems which impede planned progress.
 - d. Develop corrective measures and procedures to regain planned schedule.
 - e. Revise construction Schedule as indicated and plan progress during next Work period.
 - f. Plan to maintain quality and work standards.
 - g. Complete other current business.

GC-9 BID BREAKDOWN

(See Agreement, Article XXXIII, "Submission of Bid Breakdown".)

GC-10 SUPERINTENDENCE AND WORKMEN

(See Agreement, Articles XXVIII, "Character and Competency" and XXIX, "Superintendence".)

GC-11 LAWS AND ORDINANCES

The Contractors accept the Drawings and Specifications and other Contract documents, submitted by the Engineer. On the basis that such Drawings, Specifications and other Contract Documents do not constitute a release of responsibility on the part of the Contractors to know and supervise the actual construction in all its parts so that such construction complies with all legal regulation. The Contractors shall be held to be both responsible and accountable

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for any damage which the County may suffer as a result of non-compliance with any or all legal regulation.

The Work shall be performed by the Contractors, in all respects, in strict conformity to all laws, rules, regulations, requirements and ordinances of the federal, state and local governments and all departments and bureaus thereof, and of the National Fire Protection Association. Should the Drawings or the Specifications conflict with the law, the contractors shall immediately notify the Engineer in writing of such conflict, and shall thereafter follow the written instruction of the Engineer in respect thereto; or should the Drawings or Specifications require more than the law requires, the Drawings and Specifications shall be followed nevertheless.

Each prime Contractor shall obtain and pay for all permits and fees required by Compliance with the foregoing requirement the Work performed under his Contract. Notwithstanding the requirements of the preceding paragraphs, all Contractors shall be additionally governed by OSHA requirements. All electrical Work shall comply with the N.E.C. and the respective Contractor will be required to furnish for his Work, Under-writers certificates issued by Underwriters Laboratories for compliance.

Compliance with the foregoing requirements shall not relieve the contractors of any other of their obligation under this Contract (See Agreement Articles III, "Contractor's Responsibility" and IV, "Compliance with Laws".)

GC-12 PERMITS

(See Agreement, Article IV, "Compliance with Laws".)

GC-13 ACCIDENTS

- A. If death, serious injuries or serious damages are caused, the accident shall be reported immediately by telephone or messenger to both the Commissioner and the Engineer.
- B. Contractor shall promptly report in writing to the Engineer all accidents whatsoever arising out of, or connection with, the performance of the Work, which cause death, personal injury or property damage, giving full details and statements of witnesses.
- C. If any claim is made by anyone against the contractor or Subcontractor on account of any accidents, the Contractor shall promptly report the facts in writing to the Engineer, giving full details of the claim.

GC-14 CONTRACTOR SUBMISSIONS

In accordance with the requirements of the contract Documents, the Contractor shall furnish all required submittals which shall include, but not be limited to, the following tabulation of contractor submissions.

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A. Materials and Equipment

1. Suppliers and manufactures:

Within fifteen (15) days after Notice to Proceed, the Contractor shall submit to the Commissioner and the Engineer a list of materials and equipment suppliers and manufacturers for approval in accordance with the requirements of the General Conditions, Article GC-17. "Materials and Equipment Approvals, Substitutions, and Deviations".

2. Material and Equipment Orders Schedule:

a. Within fifteen (15) days after Notice to Proceed, Contractor shall prepare and submit his tabulation and schedule of principal items and equipment and materials to be purchased to the Engineer for review and approval. The Schedule shall be revised until approved by Engineer.

b. The Schedule shall be updated biweekly and one copy submitted to the Engineer.

c. Five (5) updated copies of the schedule shall be submitted to the Engineer with the application for partial payment.

d. Schedule shall be submitted until all of the data is incorporated into the construction schedule for the project.

3. Form of Schedule: Schedule shall be in tabular form with appropriate spaces to insert the following information for principal items of equipment and materials:

a. Date on which shop drawings are requested and received from the manufacturer.

b. Dates on which certification is received from the manufacturer and transmitted to the Engineer.

c. Date on which shop drawings are submitted to the Engineer and returned by the Engineer for revision.

d. Dates on which shop drawings are revised by manufacturer and resubmitted to the Engineer.

e. Date on which shop drawings are returned by Engineer annotated either "Approved" or "Approved as Noted".

f. Date on which accepted shop drawings are transmitted to manufacturer.

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- g. Date of manufacturer's scheduled delivery.
- h. Date on which delivery is actually made.

B. Substitutions:

- 1. Within a ten (10) day period from the Notice to Proceed, Request for substitutes may be proposed to the Commissioner. This Period for submitting requests will be strictly enforced. Such requests shall conform to the requirements of General Conditions, Article GC-17, "Materials and Equipment, Approvals, Substitutions and Deviations".
- 2. Requests for substitutions will be received and considered from Prime Contractors only and not from manufacturers, suppliers, subcontractors, or other parties.

C. Shop Drawings:

- 1. Within fifteen (15) days after the Notice to Proceed, the Contractor shall prepare and submit three (3) copies of his schedule of shop drawings submissions to the Engineer for review and approval.
- 2. In order to maintain the construction schedule for this project the Contractor shall submit all shop drawings within forty-five (45) days after the Notice to Proceed. The Contractor's schedule of shop drawing submissions shall conform to these requirements.
- 3. Shop drawings shall be submitted without fail in time to permit correction, resubmission and final approval, as hereinafter specified, without causing any delay in the construction of any work. Formal submission of shop drawings will begin after execution of the Contract by the County Executive and the Notice to Proceed.

D. Coordination Drawings:

- 1. Coordination drawings shall be completed by all Contractors within sixty (60) days from the notice to proceed.
- 2. Coordination Drawings shall be initiated, completed and submitted for distribution so as not to delay the construction.

E. Layout and Installation Drawings:

- 1. Layout and installation drawings shall be completed by all Contractors within ninety (90) days from the Notice to Proceed.
- 2. Layout and installation, drawings submitted for review by the Engineer shall include all equipment, pipes, valves, fitting, drains, ventilation ducts,

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all electrical, heating ventilating and other conduits, electrical cable trays, lighting fixture layouts, and circuiting, instrumentation, power supply, alarm circuits, etc., under this Contract.

F. Operations and Maintenance Manuals:

1. Two (2) copies of Preliminary Operations and Maintenance Manuals shall be submitted with the shop drawings for each major item of equipment.

G. Maintenance and Lubrication Schedules:

1. A maintenance and lubrication schedule for each piece of equipment shall be submitted with the shop drawings. Submission shall be seven (7) copies.

H. Samples:

1. Samples and Shop drawings which are related to the same unit of work or Specification Section shall be submitted at the same time. If related shop drawings and samples are submitted different times, they cannot be reviewed until both are furnished to the Engineer.
2. Shop drawings include, but are not limited to, shop drawings, layout and installation drawings in plan and elevation, certified wiring diagrams, inter connecting wiring diagrams, manufacturer's data, etc. The Contractor shall be responsible for securing all of the information, details, dimensions, drawings, etc., necessary to prepare the shop drawings required as necessary under this Contract and to fulfill all other requirements of his Contract. The Contractor shall secure such information, details drawings, etc., from all possible sources including the Contract Drawings, drawing prepared by subcontractors, suppliers, etc.
3. All shop drawings submitted by the Contractors which involve a change at variance with the contract drawings shall be noted by the Contractors by advising the Engineer in writing as to the recommended change and the reason therefore.
4. Contract drawings are for engineering and general arrangement purposes only and are not to be used as shop drawings.
5. Shop drawings shall accurately and clearly present the following:
 - a. All working and installation dimensions.
 - b. Arrangement and sectional views.
 - c. Units of equipment in the proposed positions for installation, details of required attachments and connections, and dimensioned locations between units and in relation to the structures.

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- d. Necessary details and information for making connection between the various trades including, but not limited to, power supplies and interconnecting wiring between units, accessories and appurtenances, etc.
- 6. Structural and all other layout drawings prepared specifically for the Project shall have a plan scale of not less than 1/4-inch equal to 1 foot and they shall be not larger than the size of the Contract Drawings.
- 7. Where manufacturer's publications in the form of catalogs, brochures, illustrations, compliance certificates, or other data sheets are submitted in lieu of prepared shop drawings, such submissions shall specifically indicate the item for which approval is requested. Identification of items shall be made in ink, and submissions showing only general information are not acceptable.
- 8. The Contractor shall provide all required copies for the use of the various trades at the site, and one (1) copy of approved shop drawings shall be provided by the Contractor to the other Prime Contractors.
- 9. A submittal record form shall accompany each submittal. A facsimile copy of the record form will be provided by the County. This is the only form to be used by the Contractor for submittals.
- 10. Contractor Responsibilities
 - a. Before submitting shop drawings to the Engineer, all submittals from subcontractors, manufacturers or suppliers shall be sent directly to the Contractor for preliminary review, coordination and checking. The Contractor shall be responsible for their submission at the proper time so as to prevent delays in delivery of material or equipment. The Contractor shall thoroughly check all drawings for accuracy and conformance to the intent of the Contract Documents. Drawings found to be inaccurate or otherwise in error shall be returned to the subcontractors, manufacturers, or suppliers by the Contractor for correction.
 - b. All submittals, including shop drawings prepared by or under the direction of the various Contractors, shall be thoroughly checked by the Contractor for accuracy and conformance to the intent of the Contract Documents before being submitted to the Engineer and shall bear the contractor's signature of approval certifying that they have been so checked. Submittals without the Contractor's signature of approval will not be reviewed by the Engineer and will be returned to the Contractor stamped "Rejected". Before submitting them to the Engineer, all submittals shall be bound, properly labeled and consecutively numbered. In a clear space

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above the title block, or on the back, the Contractor shall hand stamp the following, and enter the required information:

“NASSAU COUNTY

NAME OF PROJECT

Date:_____

Contract No.:_____

Equipment Identification No.:_____

Contract Drawing No.:_____

Specification Section:_____

The document has been reviewed, coordinated and checked in detail for accuracy of content and for compliance with the Contract Documents and is hereby approved. The information contained herein has been coordinated with all involved contractors.

Contractor:_____

Signed:_____”

- c. Shop Drawings shall be submitted as a single package including all associated drawings for any operating system and shall include all items of equipment and any mechanical units involved or necessary for the functioning of such system. Where applicable, the submittal shall include elementary wiring diagrams showing circuit functioning and necessary interconnecting wiring diagrams for construction.
 - d. If the submittals contain any departures from the Contract Documents, specific mention thereof shall be made in the Contractor’s letter of transmittal. Otherwise, the review of such submittals shall not constitute approval of the departure. The Contractor shall call the Engineer’s attention to any changes by the use of large rubber stamp, or larger letters on shop drawings. If this is not done, even if the work is incorporated in the construction, it will not be accepted by the Engineer even if shop drawings are “Approved”.
 - e. No materials or equipment shall be ordered, fabricated or shipped or any work performed until the Engineer returns to the Contractor the submittals herein required, annotated “Approved”.
 - f. Where errors, deviations, and / or omissions are discovered at a later date in any of the submittals, the Engineer’s prior review of the submittals does not relieve the Contractor of the responsibility for correcting all errors deviations and / or omissions.
11. Procedure for Review by the Engineer:

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- a. Shop Drawings will be checked for design conformance with the Contract Documents and general arrangement only.
- b. Submittals shall be transmitted in sufficient time to allow the Engineer adequate time for review and processing so as not to delay the Project.
- c. For all drawings greater than 8-1/2 inches by 11 inches in size, the contractor shall transmit one (1) reproducible transparency and one (1) print of each submittal directly to the Engineer for review. Concurrently a copy of the transmittal letter and one (1) print shall be sent by the Contractor to the County. For submittals of the 8-1/2 inches by 11 inches in size, the Contractor shall submit two (2) copies to the Engineer and a copy of the transmittal letter and one copy of the shop drawing to the County. Prints from the reproducible transparencies shall be legible with a sharp, clear definition of all line work and lettering. Reproducible transparencies and resultant prints which in the opinion of the Engineer are not legible will not be reviewed and will be returned to the Contractor annotated "Rejected".

When a submittal is "Disapproved" or "Rejected", the Engineer will make the necessary copies required to permit the following distribution:

County – Transmittal only
Contractor – 2 copies
Engineer – 2 copies

When a submittal reaches "Approved" or "Approved as Noted", the Engineer will make the additional copies required to permit the following distribution:

County – 6 copies
Contractor – 2 copies
Engineer – 2 copies

- d. Submittals shall be accompanied by a submittal record from hereinbefore specified and shall be accompanied with any notification of departures and any pertinent data to facilitate review. If data for more than one Section of the specification is submitted, a separate transmittal letter shall accompany the data submitted for each Section. A number shall be assigned to each submittal by the Contractor starting with the Number 1 and thence numbered consecutively. Resubmittals shall be identified by the same number followed by the suffix "A" for the first resubmittal and the suffix "B" for the second resubmittal, etc.

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- e. Submittals will be annotated by the Engineer in one of the following ways:
- “Approved” – no exceptions are taken.
- “Approved as Noted” – minor corrections are noted and shall be made and resubmittal is required.
- “Disapproved” – minor corrections are noted and shall be made and resubmittal is required.
- “Rejected” – based on the information submitted, the submission is not in conformance with the Contract Documents. The deviations from the Contract Documents are too numerous to list and a completely revised submission of the proposed equipment for a submission of other equipment is required.
- Or
- Reproducible transparencies and resultant prints are not legible and will not be reviewed and resubmittal is required.
- f. If a submittal is satisfactory to the Engineer, the Engineer will annotate the submittal “Approved” and return three (3) copies to the Contractor. If reproducible transparencies are submitted, the Engineer will retain the copies and return the reproducible transparencies to the Contractor, plus two (2) prints.
- g. If a resubmittal is required the Engineer will annotate the submittal “Approved as Noted” or “Disapproved” or “Rejected” and return three (3) copies to the Contractor for appropriate action. If reproducible transparencies are submitted, the Engineer will retain the copies and return the reproducible transparencies to the Contractor, plus two (2) prints. The Contractor shall resubmit in accordance with paragraph C.3, hereof.
- h. Contractor shall revise and resubmit submittals as required by the Engineer until submittals are “Approved” by the Engineer.
- i. Approval of a Shop Drawing by the Engineer will constitute approval of the subject matter for which the drawing was submitted and not for any other structure, material, and equipment for appurtenances shown.
- j. Coordination Drawings Requirements:
1. The General Construction Contactor shall initiate coordinating the installations of all the contracts (HVAC, Electrical and General Construction) by means of

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Coordination Drawings, as specified herein. The Coordination Drawings may lack complete data in certain instances pending receipt of shop drawings, but sufficient space shall be allotted for the items affected. When final information is received, such data shall be promptly inserted on the Coordination Drawings.

2. The General Construction Contractor shall prepare a set of Mylar transparencies indicating equipment and appurtenances, at not less than 3/8 inch scale. The Drawings shall also show beams, ceiling heights, walls, floor to floor dimensions, floors, partitions, columns, windows, door and other major architectural and structural features shown on the General Construction Drawings. Site coordination drawings shall be at not less than 1" = 20'-0" scale. Two sets of prints from the transparencies shall be furnished to the County's review for conformance with the intent of this Section. Correction, if required, shall be made to the transparencies.
3. The General Construction Contractor shall deliver the set of Mylar to the HVAC Contractor who will draw his work to scale on these drawings. Then the HVAC Contractor shall deliver the set of Mylar to the Electrical contractor, who will superimpose his work on the Coordination Drawings. Then the Electrical Contractor shall return the set of Mylar to the General contractor.
4. In the preparation of all the coordination drawings, composite drawings, and large scale details as well as cross and longitudinal sections shall be made as required, or as directed by the Engineer, to fully delineate all conditions. Particular attention shall be given to the locations, size and clearance dimensions of equipment items, shafts and similar features. In preparing the Coordination Drawings, minor changes in duct, pipe or conduit routings that do not affect the intended function may be made as required to avoid space conflicts, when mutually agreed, but items may not be resized or exposed items relocated without the County's approval. No changes shall be made in any wall or chase locations, ceiling height, door swings or shall be made in any wall or chase location, ceiling heights, door swings or locations, windows or other openings, or other features affecting the function or aesthetic effect of the work among themselves. If conflicts or interferences cannot be satisfactorily resolved, the County shall be notified and its decision obtained.

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5. No preference or advantage shall be given to any contractor in considering resolution of conflicts, or grant priority to any one Contractor in the allocation of space. If the Contractors are unable to reach agreement on matter of interference, the matter shall be submitted to the County for its binding decision. At the completion of this phase of the Coordination Drawings preparation, the County shall hold coordination meetings with the Prime Contractors to eliminate any interference among the trades that the drawings indicate and to avoid any conflicts during the installation of the work.
6. At the completion of these meetings, and after the General Construction Contractor's set of Mylar has been coordinated and all necessary changes have been made, the County shall hold a final coordination meeting where these Drawings shall then be signed off by each of the Contractors, indicating their awareness of, and agreement with, the indicated routings and layouts and their interrelationship with the adjoining or contiguous work of all contracts. Thereafter no unauthorized deviations will be permitted and if made without the knowledge or agreement of the County or other affected contractors, will be subject to removal and correction at no additional cost to the County.
7. After the final Coordination Drawings have been agreed upon and signed by all Contractors, the General Construction Contractor shall provide and distribute four (4) copies of each to the Contractor and fifteen (15) copies to the County, for reference and record purposes. Contractors desiring additional copies of such drawings, beyond the basic distribution indicated above, shall arrange and pay for cost of same.
8. The record copies of final Coordination Drawings shall be retained by each Contractor as a working reference. All shop drawings, prior to their submittal to the County, shall be compared with the Coordination Drawings and developed accordingly by the Contractor responsible. Any revisions to the Coordination Drawings which may become necessary during the progress of the work shall be noted by all Contractors and shall be neatly and accurately recorded on the copies. Each Contractor shall be responsible for the up-to-date maintenance of his own record copies of the Coordination Drawings and to keep one (1) copy available at the Site. The Coordination Drawings and any subsequent changes thereto, shall be

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utilized by each Contractor in the development of his as-built drawings.

9. No extra compensation will be paid by the County to any Contractor for relocating any duct, pipe, conduit or other material that has been installed without proper coordination among all the contractors and the trades involved. If any improperly coordinated work, or work installed that is not in accordance with the approved Coordination Drawings, necessitates additional work by the other Contractors, the cost of such additional work shall be assessed to the Contractor responsible, as determined by the County.
 10. All changes in the work on any Contract, whether a change in price is given or not, shall be shown on the Coordination Drawings.
 11. All work on the Coordination Drawings shall be performed by competent draftsmen, in clear, legible manner. The County shall be the sole judge of the acceptability of the Coordination Drawings.
 12. Coordination Drawings shall not be used for "as built" drawings.
- k. Layout and Installation Drawings Requirements:
1. Layout and installation drawings are to be submitted in accordance with the requirements hereinbefore specified under Paragraph I, Shop Drawing Requirements.
 2. Layout and installation drawings are required for both interior and exterior piping valves, fittings, sewers, drains, heating and ventilation duct, conduits, plumbing lines, electrical cable trays, etc. The final dimensions, elevations, locations, etc. of various items may depend upon the dimensions of equipment, valves, etc. to be furnished by the Contractor.
 3. Layout and installation drawings shall show connections to structures, equipment sleeves, valves, fittings, etc.
 4. Drawings shall show the location and type of all supports, hangers, foundations etc., and the required clearances to operate valves, equipment, etc.
 5. The drawings for pipe, ducts, conduits, etc. shall show all electrical conduits and pressure piping, electrical cable trays, heating and ventilation ducts or pipes structures,

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manholes or any other feature within four (4) feet (measured as the clear dimension) from the pipe, duct, conduit, etc. for which the profile is drawn.

GC-15 SAMPLES

A. General:

1. Where required in the specification for the various trades or otherwise requested by the County or Engineer, samples of any materials to be used and of the finish to be applied in the work, shall be submitted by the Contractor for approval in accordance with the General Conditions, Article GC-14, "Contractor Submission". Samples shall be of such a nature to fully illustrate the character of the finished work or as may be more fully described in the trade specifications.
2. Samples shall be furnished so as no to delay fabrication, allowing the Engineer reasonable time for the consideration of the samples submitted.
3. Contractor shall store and protect large samples and mock-ups until the Project is complete or until a time approved by the Engineer.
4. Accepted samples will establish the standards by which the completed work will be judged.

B. Samples:

1. Samples shall be of sufficient size or quantity to clearly illustrate the quality, type, range of color, finish or texture and shall be properly identified.
2. Samples shall be checked by the Contractor for conformance to the Contract Documents before being submitted to the Engineer and shall bear the Contractor's stamp of approval certifying that they have been checked.
3. Samples shall be submitted in triplicate and each sample shall be identified with the name and number of the project, reference to Specification Section, Contact drawing number, nature of the material, trade name of manufacturer and the locations of its intended placement. Written approval shall be obtained, and the work furnished shall conform strictly to the samples approve by the engineer. No approval of a sample shall be taken in itself to change or modify any of the requirements of the contract.
4. Transportation charges or samples submitted to the Engineer shall be prepaid by the Contractor. Samples shall be delivered to the Engineer's field office. If the Contactor required a sample for his use, he shall notify the Engineer in writing.

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5. If samples are disapproved, the Contractor shall make all corrections required and shall resubmit the require number of new samples until approval is received.

C. Job Mock-Ups:

1. Job mock-ups (sample panels shall be constructed on Site by the Contractor and only one (1) of each type will be required. Mock-ups shall be constructed only after the individual samples and components used in the mock-up have been approved by the Engineer. If a mock-up is not approved, the Contractor shall construct additional ones until approval is received.

D. Samples for Tests:

1. Contractor shall furnish such samples of material as may be required for examination and test. All samples of materials for tests shall be taken according to standard methods and as required by the Contract drawings.

GC-16 TEMPLATES AND PATTERNS

Templates and patterns shall be prepared and provided as required for the proper execution of the Work under the various Prime Contracts, by the various trades.]

GC-17 MATERIALS AND EQUIPMENT, APPROVALS, SUBSTITUTIONS AND DEVIATIONS.

A. Approval of Materials and Equipment Suppliers and Manufacturers:

1. The Contractor shall submit to the Commissioner and the Engineer for approval a list of materials and equipment suppliers and manufacturers who are to furnish items of materials or equipment. This submission is to be made in accordance with the time conditions stipulated in General Conditions, Article GC-14, and "Contractor Submissions".
2. Where the acceptability of any equipment or material specified herein is conditioned upon that item having a record of satisfactory operation for a specified period of time, such acceptability may be considered lacking such record, only if the manufacturer and or supplier can provide a bond or cash deposit which will guarantee replacement at no cost to the County in the event of failure occurring prior to the expiration of the experience record term specified. The item proposed must meet all other technical requirements stipulate d in the Specifications.
3. If the materials and equipment submitted are offered as substitutes to the Contract Documents the contractor shall advise the County and the Engineer of the substitution and comply with the requirements hereinafter specified in the Article.

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B. Storage and Protection of Equipment and Materials:

The Contractor shall make every effort to minimize extended storage periods for materials and equipment at the site by judiciously scheduling deliveries to coincide with construction needs. The Contractor shall store his material and equipment in accordance with the requirements of Division 1, Special conditions of the Technical Specifications. The Contractor shall not store unnecessary materials or equipment at the site and shall take care to prevent any structure from being loaded with a weight which will endanger its integrity or the safety of persons. The Contractor shall follow the instructions of the Engineer, regarding the posting of regulatory signs for loading on structures and other safety precautions. The contractor shall obtain from the equipment manufacturers a letter detailing their method of storage and the maintenance of the stored equipment for the Engineers review. All storage and methods of protection for material and equipment at the site shall be subject to the prior approval of the Engineer. Any costs associated with the storage and protection of materials and equipment shall be deemed to be included under the contract and no additional payment will be made.

1. Materials:

- a. Materials may be stored out of doors if supported on wood runners above ground surface and protected with approved, effective durable covers.
- b. Materials shall not be placed within ten (10) feet of fire hydrants.
- c. Avenues for personnel and vehicular movement, gutters, drainage channels and inlet shall be kept unobstructed at all times.

2. Major Equipment:

- a. No major Equipment item shall be brought to the site until the following conditions are met:
 - (1) The County must have received the manufacturer's recommendations for on site storage in writing.
 - (2) The structure in which the equipment is to be installed is roofed (roofing must be watertight) and has such protection of doorways, windows and other openings that will provide reasonable protection from the weather.

3. Special Equipment:

- a. The Storage of special equipment shall be in accordance with the requirements specified in Division 1 of the Technical Specifications.

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4. Equipment other than Major Equipment:
- a. The contractor shall not ship any equipment to the site until approval is received from the County. Under no circumstances shall equipment be delivered to the site more than one month prior to installation without written authorization from the County.
 - b. Storage of any mechanical or electrical equipment out of doors at any time is absolutely prohibited regardless of the protection furnished. Storage of mechanical and electrical equipment within structures at the Site will not be permitted until all structural work has been completed and the structure is made weather tight.
 - c. All mechanical and electrical equipment shall be coated , wrapped and otherwise protected from snow, rain, drippings of any sort, dust, dirt, condensed water vapor, etc. during shipment, storage, and subsequent to installation and until placed in service.
 - d. Should storage of mechanical and electrical equipment become necessary before it can be stored at the Site, the contractor shall provide storage in a weather proof warehouse.
 - e. All costs for equipment protection including warehousing or other work to meet the scheduled completion date shall be deemed to be included under the Contract and no additional payment will be made.
 - f. All equipment having moving parts such as gears, electric motors, etc. and /or instruments shall be stored in a temperature and humidity controlled building approved by the County, until such time as the equipment is to be installed.
 - g. All equipment shall be stored fully lubricated with oil, grease, etc., unless otherwise instructed by the manufacturer.
 - h. Manufacturer's storage instruction shall be carefully studied by the Contractor and reviewed with the County by him. These instructions shall be carefully followed and a written record of this kept by the Contractor.
 - i. Moving parts shall be rotated a minimum once weekly to insure proper lubrication and to avoid metal to metal "welding". Upon installation of the equipment, the Contractor shall start the equipment, at least half load, once weekly for an adequate period of time to insure that the equipment does not deteriorate from lack of use.
 - j. Lubricants shall be changed upon completion of installation and as frequently as required thereafter during the period between

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installation and acceptance. New lubricants shall be put into the equipment at the time of acceptance.

- k. Prior to acceptance of the equipment, the Contractor shall have the manufacturer inspect the equipment and certify that is a condition has not been detrimentally affected by the long storage period. Such certifications by the manufacturer shall be deemed to mean that the equipment is judged by the manufacturer to be in a condition equal to that of equipment that has been shipped, installed, tested and accepted in a minimum time period. As such, the manufacturer will guaranty the equipment equally in both instances. If such a certification is not given, the equipment shall be judged to be defective. It shall be removed and replaced at the Contractor's expense.
- l. Where equipment must be installed before the erection of adequate protective structures, the Contractor, without additional compensation shall provide approved, effective, and durable covers and provide such other protection as required for fully protecting such equipment from damage from the elements or other causes.

C. Installation of Equipment:

1. General

- a. Contractor shall have on hand sufficient personnel, proper equipment, and machinery of ample capacity to facilitate the work.
- b. Contractor shall be responsible for locating, aligning and leveling all equipment to the accuracy required.
- c. Complete manufacturer's installation instructions, including permissible tolerances, shall be furnished in duplicate with each unit of equipment or set of identical units before installation.
- d. All equipment shall be installed in accordance with the approved shop drawings: inclusive of manufacturer's specification, drawings and tolerances.
- e. Equipment shall be erected in a neat and workmanlike manner on the foundations at the locations and elevations shown on the drawings unless directed otherwise by the engineer during installation.

2. Installation

- a. Special care shall be used in locating, aligning and leveling all equipment and parts thereof to insure that each item is in the

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proper position relative to other equipment, and that all parts are aligned within allowable tolerances. The Contractor shall be responsible for this accuracy, and shall notify the Engineer of any conditions in prior work which would prevent this alignment before proceeding with the work.

- b. Concrete foundations for equipment shall be approved design and shall be adequate in size, suitable for the equipment erected thereon.

D. Name Plates:

- 1. Each unit of equipment shall bear the manufacturer's name or trademark on a corrosion resistant nameplate securely affixed in a conspicuous place. The manufacturer's name or trademark may be cast integrally, stamped, or otherwise permanently marked upon the item of equipment.
- 2. Such other information as the manufacturer may consider necessary to complete identification, or as specified, shall be shown on the nameplate.

E. Painting:

- 1. Except as otherwise specified or required, equipment shall be primed and finish painted at the factory, in accordance with the recommendations of the approved manufacturer.
- 2. All field painting is included under the individual Prime Contract.
- 3. Any damage to shop coating shall be corrected to the satisfaction of the Engineer by the Prime Contractor responsible for the installation and protection of the shop coated item.

F. Damage during Tests and Instruction Periods:

Contractor shall be fully responsible for the proper operation of equipment during tests and instruction periods and he shall neither have nor make any claim for damage which may occur to equipment prior to the time when the County formally takes over the operation thereof.

G. Services of Manufacturer's Engineers:

The contract price shall include the cost of furnishing competent engineers or superintendents from each company manufacturing equipment for the Project to:

- 1. Assist the Contractor to adjust and test the equipment in conformity with the Contract Documents.

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2. Supervise start up operations and adequately instruct designated employees of the County in the proper operation and maintenance procedures of equipment installed.
3. The manufacturer's engineers shall devote, as a minimum, the full time specified in the installation and operation shall be at the expense of the Contractor. The manufacturer's representatives shall sign in and out in a book kept by the Engineer on every occasion they are on the site and shall indicate time of arrival and departure.
4. Be available to check equipment operation and maintenance procedures, when required by the County, throughout the guarantee period of the equipment.

H. Equipment Manufacturers Certification:

As a condition precedent to acceptance of equipment installed and operating, the Contractor will provide the County with written certification obtained from each company manufacturing equipment for the Project that the equipment is installed and does operate in accordance with the specifications and manufacturer's recommendations.

I. Substitutions:

1. Unless otherwise specified, all materials and equipment incorporated in the work under these Contracts shall be new.
2. Whenever specific references are made in the Specifications, to manufacturer's or brand names, the intent is to establish a standard of type, quality and function of the required material or equipment, at least one will include a specific catalog number or other identifying designation. The products of the other listed manufacturers must in the opinion of the Commissioner, be equivalent to the product material essentially meeting the standards of the referenced manufacturer or other Specification requirements shall not relieve the Contractor of responsibility for providing materials complying with such requirements. The fact that manufacturer's name are specified for any item shall not be construed as implying that such item need not comply with any additional performance, construction or other requirements specified for the item. In all cases, the Specifications requirements shall take precedence over the manufacturer's standard.
3. Requests for substitutions of equipment or materials shall be made in accordance with the time conditions stipulated in General conditions, Article GC-14, "Contractor Submission". This period for submitting requests will be strictly enforced. Such requests shall conform to the following requirements:

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- a. Contractor shall submit for each proposed substitution sufficient details, complete descriptive literature and performance data together with samples of the materials, where feasible, to enable the Commissioner to determine if the proposed substitution is equal.
 - b. Contractor shall submit certified test, where applicable, by an independent laboratory attesting that the proposed substitution is equal.
 - c. A list of installation where the proposed substitution is equal to the specified piece of equipment or materials.
 - d. Requests for substitutions shall include full information concerning differences in cost, and any savings in cost resulting from such substitutions shall be passed on to the County.
4. Request for substitutions after the period stipulated in General Conditions, Article GC-14, "Contractor Submissions", will not be accepted for evaluation except in case of strikes, discontinuance of manufacturer or other reason deemed valid by the Commissioner whereby the specified products or those approved are unobtainable. In such case the Contractor shall provide substantial proof that the acceptable products are unavailable.
5. Where the approval of a substitution requires revisions or redesign of any part of work including that of other contracts, all such revision and redesign and all new drawings and details required therefore, shall be provided by the Contractor at his own cost and expense, and shall be subject to the approval of the Commissioner.
6. In the event that the Engineer is required to provide additional engineering services, then the Engineer's charges for such additional services shall be charged to the Contractor by the County in accordance with the requirements of the General Conditions, Article GC-18, "Contractor Costs for Engineering Services".
7. Any modification in the work required under other contract to accommodate the changed design will be incorporated in the appropriate Contracts and any resulting increases in contract prices will be deducted by the County from payments otherwise due the Contractor who initiates the changed design. In all cases the Commissioner shall be the judge as to whether a proposed substitution is to be approved. The Contractor shall abide by his decision when proposed substitute items are judged to be unacceptable and shall in such instances furnish the item specified or indicated. No substitute items shall be used in the work without written approval of the Commissioner.
8. In making request for substitution, contractor represents that:

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- a. Contractor has investigated proposed substitution, and determined that is equal to or superior in all respects to the product, manufacturer or method specified.
 - b. Contractor will provide the same or better warranties or bonds for proposed substitution as for product, manufacturer or method specified.
 - c. Contractor waives all claims for additional costs or extension of time related to proposed substitution that subsequently may become apparent.
 - d. Contractor shall have and made no claim for any extension of time or for damages by reason of the time taken by the County and Engineer in considering a substitution proposed by the Contractor or by reason of the failure of the County and Engineer to approve a substitution proposed by the Contractor. Any delays arising out of consideration for an approval of a substitution shall be the sole responsibility of the Contractor requesting that substitution and he shall arrange his operations to make up the time lost.
9. Proposed substitutions will not be accepted if:
- a. Acceptance will require substantial revision of contract Documents.
 - b. They will change design concepts or Technical Specifications.
 - c. They will delay completion of the work, or the work of other Contractors.
 - d. They are indicated or implied on a Shop Drawing and are not accompanied by a formal request for substitution from Contractor.
10. Only those products originally specified and/or added by approved requests for substitutions submitted in accordance with the preceding paragraphs may be use in the work. Whenever requests for substitutions are approved, it shall be understood that such approval is conditional upon strict conformance with all requirements of the Contract and further subject to the following.
- a. Any materials or article submitted for approval in accordance with the above procedure must be equal, in the sole opinion of the Commissioner, to the material or article specified. It must be readily available in sufficient quantity to prevent delay of any work, inspection or tests; it must be available in a reasonable equivalent range of colors, textures, dimensions, gauges, types and finishes as the material or article specified; it must be equal to the

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specified item in strength, durability, efficiency, serviceability, compatibility with the design and not necessitate design modifications by the Engineer; its use must not impose additional work, or require changes in the work of any other Contractor without the written agreement of such Contractor. Availability of spare parts shall be assured for the useful life of the Project.

- b. Request for all substitutions shall be accompanied by all information needed for the Commissioner to make an evaluation, including manufacturer's brand or trade names, model numbers, description of specification of item, performance data, test reports, samples, history of service, and other data as applicable.
 - c. The Commissioner reserves the right to disapprove, for aesthetic reasons any material or equipment on the basis of design or color considerations alone, without prejudice to the quality of the material or equipment, if the manufacturer cannot meet the required colors or design.
 - d. All requests for substitutions of materials or other changes from the Contract requirements shall be accompanied by an itemized list of all other items affected by such substitution or change. The Commissioner shall have the right, if such is not done, to rescind any approval for substitutes or changes and to order such work removed and replaced with work conforming to requirements of the Contract, all at the Contractor's expense, or to assess all additional costs resulting from the substitution to the Contractor.
11. Approval of a substitution will not relieve contractor from the requirement for submission of Shop Drawings or any of the provisions of the Contract Documents.

J. Deviations:

- 1. Within ten (10) days after the Notice to Proceed, requests for deviations from the contract Documents and the reasons therefore may be proposed to the Commissioner. This period for submitting requests will be strictly enforced. The Contractor waives all claims for additional costs or extension of time related to proposed deviations that subsequently may become apparent.
- 2. Deviations shall mean the departure by the Contractor from the performance of his work in accordance with the Contract Documents.
- 3. In all cases the Commissioner shall be the judge as to whether a proposed deviation is to be approved. The Contractor shall abide by his decision when proposed deviations are rejected and shall in such instances perform the work in accordance with the meaning and intent of the Contract Documents.

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4. Any delays arising out of consideration for an approval of a deviation shall be the sole responsibility of the Contractor, and he shall arrange his operations to make up the time lost.

GC-18 CONTRACTOR COSTS FOR ENGINEERING SERVICES

- A. In the event that the Engineer is required to provide additional engineering services as a result of substitution of materials or equipment which are not "or equal" by the Contractor, or changes by the Contractor in dimension, weight, power requirements, etc., of the equipment and accessories furnished, or as a result of Contractor's errors, omissions or failure to conform to the requirements of the Contract Documents or if the Engineer is required to examine and evaluate any changes proposed by the Contractor solely for the convenience of the Contractor, then the Engineer's charges in connection with such additional services shall be charged to the Contractor by the County.
- B. Structural design shown on the Drawings is base upon the configuration of and maximum loading for major items of equipment as indicated on the Drawings and specified. If the equipment furnished differs from said features, the Contractor shall assume the responsibility for all costs of redesign and for any construction changes required to accommodate the equipment furnished, including the Engineer's charges in connection therewith.
- C. The Contractor shall respond to required submittals with complete information and accuracy to achieve required approvals within three (3) submissions. All costs to the Engineer involved with subsequent submissions of Shop Drawings, Samples or other items requiring approval, will be back charged to the Contractor, at the rate by deducting such costs from payments due for Work completed. In the event an approved item is requested by the contractor to be changed or substituted fro, all involved costs in the reviewing and approval process will likewise be back charged to the Contractor unless judged by the Engineer that the need for such deviation from previously approved data is beyond the control of the Contractor.

GC-19 INSPECTION AND TESTING

Inspection shall be as specified in the Agreement, Article V, "Inspection", and as hereinafter stipulated.

- A. Testing Laboratory Services:
 1. General
 - a. The County will perform all tests including but no limited to: Concrete slump, concrete cylinder, concrete materials, concrete air content, soils density test, and paving materials. The Contractor shall plan and conduct his operations to permit taking of field samples and test specimens, as required, and allow

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adequate time for laboratory tests by the County. The collection, filed preparation and storage of filed samples and test specimens shall be as directed by the County and Engineer, and shall be the responsibility of the Contractor.

- b. Test performed by the County shall not relieve the Contractor from the responsibility of supplying certificates from manufacturers or suppliers to demonstrate conformance with the Specifications.
- c. The County reserves the right to test any and all materials being manufactured expressly for this Project, offered to be furnished or delivered at the Site, or installed in place.

2. Test Reports:

- a. During the progress of the Work, two (2) copies of all test reports shall be submitted directly to the Engineer from the testing laboratory, as they are completed, with a copy sent to the Contractor.
- b. Each test report shall be signed and certified by a responsible officer of the testing laboratory.

3. Significance of Tests:

Test results shall be binding on both the Contractor and the County, and shall be considered irrefutable evidence of compliance or noncompliance with the Specification requirements, unless supplementary testing shall prove, to the satisfaction of the County, that the initial samples were not representative of actual conditions.

4. Supplementary and Other Testing:

The Contractor may conduct additional tests as he may require. Should the Contractor at any time request the County to consider such test results, the test reports shall be certified by an independent testing laboratory acceptable to the County. Testing of this nature shall be conducted at the Contractor's expense.

B. Water tightness of Structures

1. General

- a. It is the intent of these Specifications that all concrete Work, sealing Work around built-in items and penetrations be performed as required to insure that:
 - (1) Groundwater, surface water and water or liquids in liquid retainment structures will not intrude into any structures,

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chambers, manholes, equipment rooms, pipe galleries, habitable areas or other generally dry areas.

- (2) Leakage in process tankage or other liquid retainment structures do not exfiltrate through to the exterior.
- b. The required water tightness shall be achieved by quality construction, proper sealing of all joints and penetrations and repair of existing joints and penetrations.
 - c. Each unit shall be tested separately and the leakage tests shall be made prior to backfilling and before equipment is installed. Only potable water shall be used for the tests unless specified otherwise.
 - d. The Contractor shall provide at this own expense all labor materials, temporary bulkheads, pumps, water measuring devices, etc. necessary to perform the required tests unless specified otherwise.
- 2. Built-in Items and Penetrations
 - a. All pipe sleeves, built-in items and penetrations shall be sealed as detailed and as required to insure a continuous water tight seal.
 - b. Penetration through built-up roofing areas shall be made prior to application of the built-up roofing utilizing suitable sleeves and flashings as required. If roofing surfaces are penetrated after roofing has been applied, the waterproofing integrity shall be restored by the roofer and paid by the Contractor responsible for the penetration.
- 3. Enclosing structure
 - a. All underground structures enclosing operational and other dry areas to be constructed under this Contract shall be repaired by the Contractor where there are visible internal signs of leakage. Particular attention to this matter is required when dewatering activities are terminated and the groundwater table returns to natural levels.
 - b. If required, such Work shall be performed on exterior surfaces of the structures and shall include the necessary excavation, sheeting, dewatering, repair, backfill, etc., associated with the repair.
- 4. Leak Repair

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The Contractor shall perform remedial work required to eliminate or reduce leaks to allowable amounts per the Specifications, if the Contractor fails to comply, the County shall have the authority to have these leaks repaired by other. The cost of repairs, by others, shall be deducted from monies due or to become due to the Contractor.

C. Filed Testing of Equipment:

1. General

All equipment shall be set, aligned, assembled and tested in conformance with the approved Shop Drawings, manufacturer's drawings and instructions, and as indicated in the Specifications.

2. Field Tests

- a. Upon completion of the installation, and at a time approved by the Engineer equipment shall be tested by operating it as a unit with all related piping, ducting electrical control and mechanical operations.
- b. All costs in connection with such test including all materials, equipment instruments, labor, etc. shall be borne by the Contractor.

GC-20 (NOT USED)

GC-21 PROTECTION REQUIREMENTS

The Contractor shall be responsible for protection against vandalism, theft or malicious mischief of all of this Work, materials and equipment at all times from the start to Final Acceptance of the Work.

A. Protection of Property:

1. The Contractor shall be responsible for the preservation and protection of property on or adjacent to the Work Site against damage or injury a result of this operation under this Contract. Any damage or injury occurring on account of any act, omission or neglect on the part of the Contractor shall be restored in a proper and satisfactory manner or replaced by and at the expense of the Contractor to an equal or superior condition than previously existed.
2. In the event of any claims for damage or alleged damage to property as a result of Work under this Contract, the Contractor shall be responsible for all costs in connection with the settlement of or defense against such claims. Prior to commencement of Work in the vicinity of property adjacent to the Work Site, the Contractor at his own expense shall take such surveys as may necessary to establish the existing condition of the

**NASSAU COUNTY
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property. Before Final Payment can be made, the Contactor shall furnish satisfactory evidence that all claims for damage have been legally settled or sufficient funds to cover such claims have been placed in escrow, or that an adequate bond to cover such claims has been obtained.

3. The Contractor shall not, except after written consent from proper parties, enter or occupy with men, tools, materials or equipment, privately-owned land except on easements provided herein. In the event that the Contractor has trespassed upon private property in the prosecution of the Work of this Contractor, the County may withhold payment for the value of the claim, but in any case no less than a sum of five hundred dollars (\$500) for each incident, until the Contractor has secured a release from the property owner upon whose property the trespass was committed.
4. The Contractor expressly undertakes to place upon the Work, or any part thereof, only such loads as are consistent with the safety of that portion of the Work.

B. Open Excavations:

1. All open excavations shall be adequately safeguarded by providing temporary barricades, caution signs, lights and other means to prevent accidents to persons, and damage to property. The Contractor shall, at his own expense, provide suitable and safe bridge and other crossings for accommodating travel by pedestrians and workmen. Bridges provided for access during construction shall be removed when no longer required. The length or size of excavation will be controlled by the particular surrounding conditions, but shall always be confined to the limits prescribed by the County. If the excavation becomes a hazard, or if it excessively restricts traffic at any point, the County may require special construction procedures such as limiting the length of the open trench, prohibiting stacking excavated material in the street, and requiring that the trench shall not remain open overnight.
2. The Contractor shall take precautions to prevent injury to the public and County personnel due to open trenches. All trenches, excavated material, equipment or other obstacles which could be dangerous to the public and County personnel shall be well lighted at night.

C. Fire Protection:

1. Contractor shall take all necessary precautions to prevent fires at or adjacent to the Work, buildings etc., and shall provide adequate facilities for extinguishing fire which do occur. No burning of trash or debris will be permitted.
2. When fire or explosion hazards are created in the vicinity of the Work as result of the locations of fuel tanks, or similar hazardous utilities or devices, the Contractor shall immediately alert the Nassau County Fire

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Marshall and the Engineer of such hazards. The Contractor shall exercise all safety precautions and shall comply with all instructions issued by the Fire Marshall and the Engineer to prevent the occurrence of fire or explosion.

D. Chemicals:

All chemicals used during Project construction or furnished for Project operation, whether herbicide, pesticide, disinfectant, polymer, or reactant of other classification, must show approval of the EPA and other recognized certifying Agencies. Use of all such chemicals and disposal of residues shall be in strict conformance with regulatory requirements.

E. Explosives:

Use of explosives is prohibited unless approved by the County

F. Protection of Persons:

The Contractor shall take all necessary precautions for the safety of employees on the Work and shall comply with all applicable provisions of federal, state and municipal safety laws and building codes to prevent accidents or injury to person on, about or adjacent to the premises where the Work is being performed. He shall erect and properly maintain at all times, as required by the conditions and progress of the Work, all necessary safeguards for the protection of workman and the public and shall post danger signs warning against the hazards created by such features of construction as protruding nails, hoists, well holes elevator hatchways, scaffolding, window openings, stairways, trenches, and other excavations, and falling materials and he shall designate a responsible member of his organization on the Work, whose duty shall be the prevention of accidents. The name and position of any person so designated shall be reported to the Engineer by the Contractor. The person so designated shall be available by phone during non-working hours.

G. Contractor's Right to Act:

1. In case of an emergency which threatens loss or injury of property and / or safety of life, the Contractor will be allowed to act, without previous instruction from the County, in a diligent manner. He shall notify the County immediately thereafter.
2. The amount of reimbursement claimed by the Contractor on the account of any emergency action shall be determined in the manner provided in the Agreement, Article XXII, "Extra Work."

GC-22 ACCESS ROADS AND PARKING AREAS

A. Access Roads:

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1. Not applicable.

B. Maintenance of Traffic:

1. All excavated material shall be placed so that vehicular and pedestrian traffic may be maintained at all times. If the contractor's operations cause traffic hazards, he shall repair the road surface, provide temporary ways, erect wheel guards or fences, or take other measures for safety satisfactory to the County.
2. Detours around construction will be subject to the approval of the County. Periods when traffic is being detoured will be subject to approval of the County.
3. Request for road closings or detours shall be submitted to the County for approval a minimum of seven (7) days prior to the proposed closing or detour. Requests shall be accompanied by a schedule indicating the duration of closing or detour.

C. Parking Areas:

Parking of vehicles shall be in accordance with local parking laws in the area of each work site. Overnight parking of equipment on local streets is prohibited unless permission is granted by the County. Park only in area which will not create a nuisance to traffic or local residences and businesses.

D. Restoration:

At the completion of the Work, the surfaces of land used for access roads and parking areas shall be restored by the General Construction Contractor as per the requirements of the Contract Documents. In the absence of specific requirements, the general Construction Contractor shall restore the surfaces to their original condition.

GC-23 TRAFFIC REGULATIONS

- A. The Contractor shall obey all traffic laws and comply with all requirements, rules and regulations of the New York Department of Transportation and local authorities having jurisdiction to maintain adequate warning signs, lights, barriers, etc. for the protection of traffic on public roadways.
- B. The Contractor's vehicles and mobile equipment shall adhere to the speed limits posted in the Project area. The General Construction Contractor shall post the necessary speed limit signs.
- C. The Contractor shall provide flagmen at junctions of public traffic and Contractor vehicles and equipment.

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GC-24 BARRICADES, WARINING SIGNS AND LIGHTS

- A. Each Contractor shall provide, erect and maintain as necessary for his Work, storing and suitable barricades, danger signs and warning lights along all roads accessible to the public, as required by the authority having jurisdiction, to insure safety to the public. All barricades and obstructions along public roads shall be illuminated at night an all lights for this purpose shall be kept burning from sunset to sunrise. Sufficient barricades shall be erected and maintained to keep vehicles from being driven on or into Work under construction.
- B. Each Contractor shall provide and maintain such other warning signs and barricades I other areas and around their respective Work as may be required for the safety of all those employed in the Work, operation personnel, or those visiting the site.

GC-25 DUST CONTROL AND SPILLAGE

- A. Each Contractor shall take all necessary measures to control dust from his operations and to prevent spillage of excavated materials on roads:
- B. Each Contractor shall remove all spillage of excavated materials, debris or dust from roads by methods as approved by the Engineer.
- C. The General Construction Contractor shall sprinkle calcium chloride at locations and in such quantities and at such frequencies as may be required to control dust as directed by the Engineer.

GC-26 VERMIN CONTROL

All piping duct, conduit, etc., passing through walls, floors, ceiling and / or other solid construction, shall be sealed to prevent the passage of vermin. Seals shall be made by means of rock wool or other approved inert materials, packed sleeves or other approved construction.

GC-27 FIRST AID FACILITIES

The Contractor shall provide at the Site such equipment and facilities as are necessary to supply first aid to any of his personnel who may be injured in connection with the Work.

GC-28 LAYOUT AND LEVELS

- A. The location of the work is shown on the plans.
 - 1. The Contractor for General Construction Work shall layout the proposed work correctly and shall be responsible for any damage caused the County due to incorrect laying out of the Work.

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2. The Contractor for General construction Work shall verify all grades, lines levels and dimensions as shown on the Drawings and he shall report any errors or inconsistencies in them to the Engineer before commencing Work.
 3. The Contractor shall use the bench marks furnished to him by the County.
 4. The Contractor for General Construction Work shall employ a licensed surveyor to layout work and give levels to which all measurement shall be referred.
 5. Each Prime Contractor shall have the responsibility to carefully preserve the bench marks, reference points and stakes, and in the case of destruction thereof by the Contractor or resulting from his negligence the Contractor shall be charged with the expense and damage resulting therefrom and shall be responsible for any mistakes that may be caused by the unnecessary loss or disturbance of such bench marks, reference points and stakes.
 6. Existing or new control points, property markers and monuments that will be or are destroyed during the normal course of construction shall be reestablished by the General Construction Contractor and all reference ties recorded therefore shall be furnished the Engineer. All computations necessary to establish the exact position of the Work shall be made and preserved by the General Construction Contractor.
 7. The Engineer may check all or any portion of the Work and the General Construction Contractor shall afford all necessary assistance to the engineer in carrying out such checks. Any necessary corrections to the Work shall be immediately made by the General Construction Contractor. Such checking by the Engineer shall by shall not relieve the General Construction Contractor of any responsibilities for the accuracy or completeness of his Work.

B. All other Work:

Each Contractor is responsible for layout of his Work including but not limited to substructures, foundations, manholes, utility lines, equipment pads based upon the reference lines and grades established herein.

1. Contractor shall keep neat legible notes of all measurements and calculations made by him while surveying and laying out the Work.
2. Two copies of all notes and other records shall be furnished to the County monthly. Furnish complete notes upon final completion.

GC-29 CUTTING AND PATCHING

A. Contractor Requirements

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1. The Contractors shall perform all cutting and patching necessary for the Work of the Contract in accordance with the requirements of the Drawings and Specifications. Work performed by another contractor shall not be cut or altered without the approval of the Engineer.
2. Before doing any cutting, the Contractor shall obtain the approval of the Engineer as to the location, size and method of making such openings.
3. All cutting, rough patching and finish patching as defined by the Engineer will be performed by each respective Prime Contractor.
4. All cutting shall be performed in such a manner as to limit the extent of patching.
5. All patching shall be done in a manner to match the surrounding existing surfaces as closely as possible.
6. All painted surfaces which are patched shall have the patch painted to match the existing wall surfaces as closely as possible. The Engineer shall be the sole judge of the color/texture match of finish.
7. All holes cut through concrete walls or slabs shall be core drilled unless otherwise specified or shown. Prior to core drilling, Contractor shall drill sufficient number of small exploratory holes to establish that the areas to be core drilled is free of existing embedded conduits. No structural members shall be cut without approval of the Engineer and all such cutting shall be done in a manner directed by him. No holes, except for small screws, may be drilled in beams or other structural members without obtaining prior approval. All work shall be done in a neat manner by mechanics skilled in their trades and as approved.
8. Contractors shall install sleeves for their Work for all pipes and conduits passing through any wall or floor slabs.

B. Errors and Omissions

Details and procedures are as stipulated in Paragraph A of this Article. Contractor responsible for error or omission will be responsible for all costs associated with cutting and patching.

GC-30 OPENINGS AND CHASES

- A. Each respective Contractor shall provide all openings and chases in his Work to fit his own Work. All such openings or chases shown on the Contract Drawings, or reasonably implied thereby, or as confirmed or modified by Shop Drawings approved by the Engineer, shall be provided by the Prime Contractor who requires the work.

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- B. Where equipment frames or supports are to be installed as integral parts of an opening, the opening frames or supports shall be furnished and installed by the Contractors installing the equipment.
- C. When required by the Progress Schedule or requested by the General Construction Contractor, the Contractor installing the equipment frames and supports and Contractors who require openings or chases in slabs and walls for passage of ducts, mounting of equipment, etc. shall furnish all necessary information and instruction of the required openings, chases, frames, etc. When such items are secured in position by the installing Contractor and just prior to construction of the surrounding slab or wall, the installing Contractor shall ascertain the proper number, locations and settings thereof; and the General construction Contractor shall schedule his operations so as to provide a reasonable opportunity and time interval for such inspection.
- D. Any cost resulting from correction a defective, ill- timed, or mislocated Work, or for subsequent Work which becomes necessary because of omitted openings, chases, frames etc., shall be borne by the Contractor responsible therefore. To this end, no Contractor shall arbitrarily cut, drill, alter, damage, or otherwise endanger the Work of another Contractor. The nature and extent of any corrective or additional Work shall be subject to the approval of the Engineer following consultation with the Contractor involved.

GC-31 SLEEVES, INSERTS AND WALL CASTINGS

Each Contractor shall furnish and install in place, conduits, outlets, piping sleeves, boxes, inserts, other materials and equipment necessary to be built into Work to be performed by the Contractor for General construction as soon as the requirements of the Progress Schedule require them. All Contractors shall cooperate fully in connection with the performance of the above Work, as cutting into new Work is neither contemplated nor will it be tolerated.

In the event timely delivery of sleeves or other materials cannot be made, if approved by the Engineer, and to avoid delay, the affected Contractor shall arrange to have boxes or forms set at location where piping or other material is to pass through or in slabs, walls or other Work. Upon subsequent installation of sleeves or other material, the General Construction Contractor shall fill around them with materials as required by Contract or by the Engineer. Necessary expenditure incurred for boxing out or filling shall be borne without extra costs to the County by Contractor or Contractors responsible therefore.

GC-32 SCAFFOLDING, RIGGING AND HOISTING

Each Contractor shall furnish all adequately designed scaffolding, rigging, hoisting and services necessary for erection and delivery or removal of any equipment and apparatus under his Contract. The Contractor shall remove same for Work involved when no longer required. Each Contractor involved in this type of activity shall take all precautions to prevent accidents or damage to persons or

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property about the Work involved and shall erect and maintain proper warning signs and guard rails.

GC-33 CLEANING

A. Rubbish Removal and Cleaning:

The General Construction Contractor shall remove from the Project, and dispose of, all debris and rubbish resulting from the Work of all Contractors, at least once a week and more often if same interferes with the Work under any contract, plant operations or presents a fire hazard. All debris and rubbish shall be removed from the County property and legally disposed of. Each Contractor shall be responsible for consolidating all debris and rubbish resulting from his Work to one location in his work area. During course of demolition or new construction, the General Construction Contractor shall maintain and keep free of debris or building material required egress in accordance with Fire Safety Regulations and the Nassau County Fire Commission.

B. County's Right to Clean:

Should the Contractor fail, refuse or neglect to remove rubbish and waste materials and temporary Work or clean the building and premises as required herein, then the County may or shall, without obligation to do so, remove and dispose of the said rubbish, waste materials and temporary work, clean the building and premises and deduct the cost thereof from any money due, or to become due, the Contractor under this Contract.

GC-34 (NOT USED)

GC-35 OPERATION AND MAINTENANCE MANUALS

County requirements stipulate time limitations for submittals and approval of operations and maintenance manuals. See Division 1, Special Conditions of the Technical Specifications, for specific requirements.

GC-36 RECORDING DRAWINGS

The County shall furnish to each Prime contractor a set of Mylar reproducible of the Contract Drawings for his Contract.

Each Prime Contractor shall maintain in the construction office at the job a set of prints of the Contract Drawings. A daily record in red pencil shall be kept on these prints of the Work installed and all modifications or changes therein. This set of prints shall be available at all times to the Engineer for inspection.

During the progress of the construction, each Contractor shall transfer once each month all information from field prints to the tracings and submit to the Engineer with his monthly payment request, two (2) prints of the tracings showing the Work completed and highlighting the change made. When roughing is completed, it

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must be shown. The use of approved shop drawings for record drawings is not acceptable.

Upon completion of all Work each Contactor shall complete the Mylar reproducible and sign them indicating that the Work was installed as shown. One set of paper print shall be submitted to the Engineer for review and acceptance. Upon receipt of the Engineer's acceptance, the Contractor shall submit the Mylar reproducible and one set of paper prints stamped "Record Drawings of Work as Built", stamped and certified and also provide on CD, format as required by the County, computer files of the Record Drawings.

The submittal of Record Drawings acceptable to the Engineer as specified herein, shall be a condition precedent to payments to the Contractor that may otherwise be then due.

GC-37 PHOTOGRAPHS

- A. The General Construction Contractor shall engage the Services of an experienced photographer, approved by the Commissioner, to take job photographs. The photographer will be required to take preliminary photographs of the site prior to the commencement of work as directed by the Engineer. Subsequent photo graphs as determined by the Engineer shall be taken during the construction phase. The price bid shall be based on the following:
1. The Photographer shall visit the site and take photographs as directed by the Engineer as the work progresses.
 2. Taking of a total of one hundred fifty (150) color photographs, on a monthly frequency basis; for the purpose of this section, a photograph shall be defined as one exposure. The Engineer shall have the right to reject any photograph that is not clear or definitive. Any photograph so rejected shall be subtracted from the total exposure before computations for payment for credit under this section.
 3. Supplying three (3) prints and one (1) negative of each photograph. In the event that less than one hundred fifty photographs are required, the Contractor shall credit the County Fifteen Dollars (\$15.00) for each photograph under one hundred fifty photographs.

Should more than one hundred fifty photographs be required, the Contractor will be paid Twenty Dollars (\$20.00) for each photograph over one hundred fifty photographs.

Three 8" x 10" glossy prints and 4" x 5" negatives of the photograph shall be submitted to the Engineer with the Contractor's monthly estimate. The prints shall be mounted on cloth with a flap for binding and shall have indelibly printed on their reverse side of the following:

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Project Name: _____
Photo Number: _____

View and description, indicating location of camera, general description of what photograph represents and whether this is a preliminary or construction photograph.

The Contractor shall also furnish three hard-back binders to hold all three sets of prints.

No separate payment will be made for job photographs; payment shall be included in the lump sum bid for the General Construction Contract.

GC-38 PROJECT CLOSEOUT

Division 1, Special Conditions, and other provisions of the Technical Specification stipulate requirements for Project closeout. Items such as final cleaning, lubrication survey, spare parts and special tools, equipment start-up services and other items specified are included. Final Payment will be contingent on each Contractor complying with these requirements.

GC-39 (NOT USED)

GC-40 (NOT USED)

GC-41 NOTIFICATION OF SUBCONTRACTOR

Each Prime Contractor and Subcontractor shall include by reference the EEO clause and applicable bid Conditions in all advertisements or other solicitations for bids, and shall include the EEO clause and applicable Bid Conditions in all contracts.

GC-42 JURISDICTIONAL DISPUTES

It shall be the responsibility of the contractor to pay all costs that may be required to perform any of the Work shown on the Drawings or specified herein in order to avoid any Work stoppages due to jurisdictional disputes. The basis for subletting Work in question, if any, shall conform to precedent agreements and decisions on record with the Building and Construction Trades Department, AFL-CIO, date June 1973 including any amendments thereto.

END OF SECTION

NONE

END of Supplemental Conditions

LETTER OF ASSENT

County of Nassau
Department of Public Works
1194 Prospect Avenue
Westbury, NY 11590

Att: Commissioner of Public Works

Re: Nassau County Cedar Creek WPCP and Glen Cove WWTP SCADA System Improvements
Contract No. S35117-03GR
Project Labor Agreement

The undersigned party confirms that it agrees to be a party to and be bound by the Nassau County Project Labor Agreement, NCM-PLA, for the designated Project added to the Agreement by Addendum 045, dated January 16, 2019 as such agreement may, from time to time, be amended by the parties or interpreted pursuant to its terms. The terms of the NCM-PLA, Schedules, Addenda and Exhibits are hereby incorporated by reference herein.

The undersigned, as a Contractor or Subcontractor (hereinafter Contractor) on the specific project added by the prior stated addendum (hereinafter PROJECT), for and in consideration of the award to it of a contract to perform work on said PROJECT, and in further consideration of the mutual promises made in the NCM-PLA, a copy of which was received and is acknowledged, hereby:

1. Accepts and agrees to be bound by the terms and conditions of the Agreement, together with any and all schedules; amendments and supplements now existing or which are later made thereto. Agrees to be bound by the legally established collective bargaining agreements and local trust agreements to the extent set forth in the NCM-PLA.
2. Authorizes the parties to such local trust agreements to appoint trustees and successor trustees to administer the trust funds and hereby ratifies and accepts the trustees so appointed as if made by the Contractor.
3. Certifies that it has no commitments or agreements that would preclude its full and complete compliance with the terms and conditions of said NCM-PLA.
4. Agrees to employ labor that can work in harmony with all other labor on the Project and shall require labor harmony from every lower tier subcontractor it engaged to work on the Project, Labor harmony disputes/issues shall be subject to the Labor Management Committee's Pre-Job conference provisions.
5. Agrees to secure from any Contractor(s) (as defined in said Agreement) which is or becomes a Subcontractor (of any tier), to it, a duly executed Agreement to be Bound in form identical to this document.
6. Agrees that it will not invoke the Most Favored Nations Clause that may be contained in any of its Collective Bargaining Agreements with affiliated unions as a result of the application of this NCM-PLA to this project.

(PRINT NAME OF OFFICER OF CONTRACTOR)

(SIGNATURE OF OFFICER OF CONTRACTOR)

COMPANY NAME

.....

.....

.....

ADDRESS AND TELEPHONE NUMBER

SUBSCRIBED AND SWORN TO BEFORE

THIS _____ DAY OF _____ 20____

NOTARY PUBLIC

**NASSAU COUNTY DEPARTMENT OF PUBLIC WORKS
CEDAR CREEK WPCP AND GLEN COVE WWTP
SCADA SYSTEM IMPROVEMENTS
TECHNICAL SPECIFICATIONS**

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SECTION 01010
SUMMARY OF WORK

PART 1 GENERAL

1.01 LOCATION OF WORK

- A. The work of this Contract is located at the Cedar Creek Water Pollution Control Plant (Cedar Creek) and the Glen Cove Waste Water Treatment Plant (Glen Cove) in Nassau County, NY.

1.02 SCOPE OF WORK

- A. The Work to be done under this Contract and in accordance with these Specifications consists of furnishing of equipment, superintendence, labor, skill, material and all other items necessary for upgrading the SCADA control systems at Cedar Creek and at Glen Cove, Contract No. S35117-03GR. Perform all Work required for such construction in accordance with the Contract Documents and subject to the terms and conditions of the Contract, complete and ready for use.
- B. The principal features of the Work to be performed and equipment to be provided for this Project under this Contract includes, but is not limited to, the following:
1. All labor, equipment, fees, permits, and other related costs necessary to provide for SCADA system upgrades:
 - a. Demolition of existing equipment
 - b. Concrete pads
 - c. Electrical and standby power systems
 - d. Electrical termination cabinets
 - e. Conduit, wire, and fiber optic cabling
 - f. Network communication
 - g. Instrumentation
 - h. Control panels
 - i. Temporary facilities
 - j. Compliance with funding agency requirements
 - k. Work under allowance items.
 2. All labor, materials, equipment and incidentals, fees, permits, and other related costs necessary to perform the work below in its entirety as shown on the Drawings and as specified herein.
 3. Furnish and install a full SCADA system upgrade of Cedar Creek and Glen Cove, including a fault-tolerant fiber optic network, SCADA software, operator workstations, network switches, and control panels.
 4. Furnish all instrumentation at Cedar Creek and Glen Cove as indicated on the drawings and per the instrument list.
 5. Provide overall installation and configuration of instrumentation, programmable logic controllers (PLCs), Remote I/O (RIO) Racks, PLC and RIO enclosures, SCADA computer equipment and software, networking equipment, and other control system equipment as specified herein.

6. Provide all PLC programming and Human Machine Interface (HMI) configuration including development of control programs, database configuration, graphic screens, communication links, historical archiving, and all testing as specified herein.
 7. Install electrical systems as required including conduit, wire, fiber optic cable, fiber optic cable enclosures, junction boxes, wire terminations, etc.
 8. Produce point-to-point interconnection wiring diagrams as defined in Specification Section 13300.
- C. Work to be performed and equipment to be provided, specific to the Cedar Creek WPCP, for this Project under this Contract includes, but is not limited to, the following:
1. Provide unit pricing for demolishing the existing, and furnishing and installing new valve actuators to replace the following actuators:
 - a. Six (6) 24-inch settled wastewater valves (primary tank effluent valves) feeding the aeration tanks in the West Aeration Gallery.
 - b. Six (6) 30-inch settled wastewater valves (primary tank effluent valves) feeding the aeration tanks in the West Aeration Gallery.
 - c. Twelve (12) 14-inch return activated sludge valves feeding the aeration tanks in the West Aeration Gallery.Refer to the contract drawings, specifications, and bid form.
 2. Provide unit pricing for demolishing the existing, and furnishing and installing new valves to replace the following valves:
 - a. Six (6) 24-inch settled wastewater valves (primary tank effluent valves) feeding the aeration tanks in the West Aeration Gallery.
 - b. Six (6) 30-inch settled wastewater valves (primary tank effluent valves) feeding the aeration tanks in the West Aeration Gallery.
 - c. Twelve (12) 14-inch return activated sludge valves feeding the aeration tanks in the West Aeration Gallery.Refer to the contract drawings, specifications, and bid form.
 3. Relocation of the fire extinguisher and re-routing of fire extinguisher piping in Building W to allow for installation of the fiber optic network enclosure.
 4. Perform modification of existing Blowers 1 through 4 local control panels to remove the Local/Remote switch such that Blowers 1 through 4 are controlled in the same manner as Blowers 5, 6, and 7.
 5. Provide wiring and programming to monitor the 10 existing protected water flowmeters from the SCADA system.
 6. Provide wiring and programming to monitor the 8 existing digester gas flowmeters from the SCADA system.
 7. Furnish and install a new combustible gas monitoring system in the Building J digester area, including 22 combustible gas sensors gas monitoring controllers as required by the specification. Tie the new combustible gas sensors into the existing horns and strobe lights. Provide programming to monitor the new gas detectors from the SCADA system.

8. Furnish and install instrumentation for measurement of the digester cover levels on the 9 digesters. Provide programming to monitor the digester cover levels from the SCADA system.
 9. Install conduit, CAT6 cable, and signal wire to the existing digester gas dryer system control panel. Also run wire. Provide programming to monitor the gas dryer system from the SCADA system.
 10. Install conduit, CAT6 cable, and fiber optic cable as required to interface with the new plant switchgear and substation equipment (furnished under separate contracts). Provide programming to interface with the switchgear equipment from the SCADA system.
- D. Work to be performed and equipment to be provided, specific to the Glen Cove WWTP, for this Project under this Contract includes, but is not limited to, the following:
1. Furnish and install a new SCADA server rack with fault-tolerant servers, network switches, and communication equipment.
 2. Furnish and install new valve actuators for the eight (8) aeration tank air valves located outside at the effluent end of the aeration tanks.
 3. Furnish and install sixteen (16) new Dissolved oxygen instruments in the aeration tanks, two per tank (total of 8 tanks) as specified. Furnish and install one (1) dissolved oxygen instrument for monitoring the combined aeration tank effluent water.
 4. Furnish and install eight (8) new differential pressure sensors for monitoring each aeration tank's air flow through the existing insertion venturi flowmeters.
 5. Furnish and install a new multi-gas monitoring system in the Headworks building, including twelve (12) gas sensors, a central gas monitoring controller, and alarm beacons and horns as required by the specifications. Provide programming to monitor the new gas detectors from the SCADA system.
 6. Perform modification of existing APG Neuros and Turblex Blower PLCs required to transmit and receive control signals over the Ethernet network as required to operate the blowers as described in the Control Descriptions (Section 13305).
 7. Install conduit, CAT6 cable, and fiber optic cable as required to interface with the existing plant substation power monitoring equipment. Provide programming to interface with the switchgear equipment from the SCADA system.
 8. Install new local control stations for the return activated sludge pumps as required by the electrical drawings.
 9. Furnish equipment and services provided by a UV disinfection system supplier related to control upgrades of the existing UV system as described in Allowances (Section 01020).
 10. Installation of the UV System Control Center (SCC), instrumentation, and associated appurtenances.

11. Furnish and install wiring and conduit and make terminations related to the UV controls upgrade.
- E. The foregoing stated in Paragraph 1.02 B are general descriptions only and shall not be construed as complete descriptions of the Work to be performed for the Project.
- F. Delays due to lack of available labor, supervision, equipment, etc. will not be acceptable.
- G. The existing facility will be maintained in continuous operation during the entire construction period. Work under this Contract shall be so scheduled and conducted by the Contractor that such Work will not impede any operation, reduce the capacity or cause odor or other nuisance. In performing the Work shown and specified, plan and schedule the Work to meet the facility and collection system operating requirements.
- H. The construction sequence, as described in Section 01310, Maintenance of Plant Operations, must be maintained so that the Owner will meet the appropriate State Pollutant Discharge Elimination System Permit.
- I. Additional details concerning storm water permit compliance and pollution prevention plans can be found in the Federal Regulations 40 CFR 122 & 123.

1.03 WORK SEQUENCE

- A. Completion dates of the various stages shall be in accordance with the approved construction schedule submitted by the Contractor. The sequence shall be as follows:

CEDAR CREEK WPCP:

1. Perform installation and testing of the fiber optic cable and the fiber optic communication enclosures.
2. Perform installation and testing of the new virtual machines and Cimplicity software on the existing fault-tolerant server at the Cedar Creek Administration Building.
3. Perform installation and testing of the new operator workstations and monitors at the Administration Building Control Room.
4. Perform the installation, cutover, startup, and testing of each plant area, one area at a time, per the construction sequence, as described in Section 01310, Maintenance of Plant Operations.

GLEN COVE WWTP:

5. Perform installation and testing of the new equipment located in the 19" server rack. Virtual machines and Cimplicity software shall be configured on the fault-tolerant server at the Glen Cove Control Building. Perform installation and testing of the operator workstations and monitors at located throughout the Control Building.
6. Perform installation and testing of the fiber optic cable and the fiber optic communication enclosures.

7. Perform the installation, cutover, startup, and testing of each plant area, one area at a time, per the construction sequence, as described in Section 01310, Maintenance of Plant Operations.

1.04 GENERAL

- A. The Instructions to Bidders, Agreement, General Conditions, and Division 1, General Requirements, specifications shall apply to all Work under the Contract for this Project.
- B. Where articles of the Instructions to Bidders, Agreement, and General Conditions are repeated in the Sections of Division 1, General Requirements, it is intended to elaborate or qualify such articles. It is not intended that other articles of the above documents shall be omitted or that additional requirements set forth in the above documents and noted herein shall be excluded from Contract requirements unless specifically noted as such hereinafter.
- C. Where the words "Contract" and "Contractor" are used in Sections of Division 1, General Requirements, they shall apply equally to all parties entering into agreements with the Owner to perform Work specified herein and to all Contracts derived from said agreements.

1.05 CONTRACT DOCUMENTS

- A. The Contract Documents consist of the Notice and Instructions to Bidders, Bid Bond, Proposal, Agreement, General Conditions, the Technical Specifications, and the Contract Drawings.

1.06 GENERAL ARRANGEMENT

- A. The Contract Drawings indicate the extent and general arrangement of the Work. The specific equipment proposed for use by the Contractor on the Project may require changes in the construction detailed on the Contract Drawings, and all such changes shall be performed in accordance with the requirements of the General Conditions, Article GC 17, "Materials and Equipment, Approvals, Substitutions and Deviations", and shall be made without additional cost to the Owner and shall include the increase in costs of the other Contracts.

1.07 TIME OF WORK

- A. Overtime work by the Contractor necessary to conform to the requirements of Division 1, General Requirements, Section 01310, Maintenance of Plant Operations, shall be considered as normal procedure under this Contract, and the Contractor shall make no claims for extra compensation as a result thereof. The Contractor shall be prepared to work around the clock and supply multiple work crews as necessary to complete the Work including testing and acceptance as specified, within the specified time frame and the time of completion set forth in the Contract Documents.
- B. The normal working hours for the project are between 7:00 AM and 3:30 PM Monday through Friday. When required to meet the Contract Completion dates, the Contractor is advised that they shall work scheduled overtime or second shifts as needed. The Contractors shall have sufficient construction materials, labor, equipment, tools and supervision to support scheduled overtime or second shifts when required.

- C. It is understood that the Contractor has reviewed the schedule and has included in their bid sufficient monies to meet the schedule and will make no claim for extra compensation because of additional costs to meet scheduled dates.
- D. The Contractor is advised that they will be directed to take remedial action as necessary to recover lost time on any critical items as determined from the Construction Schedule.
- E. If it shall become imperative to perform Work at night, the Owner shall be informed at least 24 hours in advance of Work done during off hours. Temporary lighting and all other necessary facilities for performing and inspecting the Work shall be provided as required and as specified in Division- I, Section 01500, Temporary Facilities and Controls, or as directed by the Engineer.
- F. Unless otherwise specifically permitted, all Work that would be subject to damage shall be stopped during inclement, stormy or freezing weather. Only such work that will not cause injury to workmanship or materials will be permitted. The Contractor shall carefully protect his Work against damage or injury from the weather, and when Work is permitted during freezing weather, he/she shall provide and maintain approved facilities for heating the materials and for protecting the finished Work.
- G. The Contractor shall require permission, in writing, to perform contractual work outside the regular Owner working hours of 7:00 AM to 3:30 PM, Monday through Friday, or on official Owner holidays. This written request should be received by the Owner 24 hours in advance of beginning the work. The Contractor is responsible for coordination with the Owner and Engineer and/or his duly authorized representative, prior to the start of the work to determine the dates of observance of the official Owner holidays that may occur during the course of the Contract. The official Owner holidays are:
 - 1. New Year's Day
 - 2. Martin Luther King,, Jr. Day
 - 3. Lincoln's Birthday
 - 4. Washington's Birthday
 - 5. Memorial Day
 - 6. Independence Day
 - 7. Labor Day
 - 8. Columbus Day
 - 9. Election Day
 - 10. Veteran's Day
 - 11. Thanksgiving Day
 - 12. Friday after Thanksgiving Day

13. Christmas Day

Failure of the Contractor to consider official Owner holidays during the preparation of their work plans and schedules shall not be cause for a delay claim against the Owner.

- H. Obtain permission from Owner, Owner's Representative and/or Owners management and staff prior to prosecuting any portion of the Work beyond the standard working days or hours. Should circumstances arise during the course of the Contract, where the Contractor works outside of the Owner's regular working hours (7:00 am to 3:30 pm, or as otherwise established for the project) or on weekends or official Owner holidays, regardless if this work is performed as a result of the Contractor's request or as required by the contract documents, or as required by the approved baseline schedule (resource loaded); the Contractor will reimburse the Owner for the cost of providing inspection and/or facility assistance, at the rate of \$175 per hour per staff member. The Owner, Owner's Representative and facility management and staff will review the scope of the operations and determine on a case-by-case basis the extent of construction oversight that may be required. Furthermore, failure of the Contractor to have considered such contingency cost in his bid price shall not be cause for an additional cost claim to the Owner.

1.08 REGULATORY AGENCY ACCESS TO CONSTRUCTION SITE

- A. Whenever construction work is in progress or preparation, permit access and inspection and provide proper and necessary facilities to the representatives of the Owner, Engineer and Regulatory Agencies including, but not limited to, the New York State Department of Environmental Conservation and the New York State Environmental Facilities Corporation.

1.09 CONTRACTOR'S USE OF PREMISES

- A. Contractor shall limit the use of the premises for his/her Work and for storage to allow for:
 - 1. Work by other contractors.
 - 2. Owner occupancy
 - 3. Public use.
- B. Coordinate use of premises with the Engineer.
- C. Contractor shall assume full responsibility for security of all his/her and his/her subcontractors materials and equipment stored on the site.
- D. If directed by the Engineer, move any stored items which interfere with operations of Owner or other contractors.
- E. Obtain and pay for use of additional storage or work areas if needed to perform the Work.

1.10 OWNER OCCUPANCY

- A. Owner will occupy premises during performance of the work for the conduct of his/her normal operations. Coordinate all construction operations with Engineer to minimize conflict and to facilitate Owner usage.

END OF SECTION

SECTION 01020
ALLOWANCES

PART 1: GENERAL

1.01 DESCRIPTION

- A. The allowances described below are to provide specific services, materials or work related to the Cedar Creek Water Pollution Control Plant and Glen Cove Waste Water Treatment Plant SCADA System Improvements and related work included herein and shall be included in the Contractor's Bid. The use of the allowances by the Contractor shall only be by written authorization or instruction from the Engineer and Owner. Any amounts not expended at the completion of the work shall be deducted from the Contract price.

1.02 SCHEDULE OF ALLOWANCES

- A. General Construction Contractor.

The item references refer to the Bid Form in the Proposal.

1. Item No. 4: An allowance in the amount of One Hundred and Sixty Thousand Dollars (\$160,000.00) for retaining the services of an Ultraviolet (UV) disinfection system supplier to furnish equipment and startup services associated with the control system upgrade of the existing Trojan UV disinfection system at the Glen Cove Wastewater Treatment Plant as specified in the scope of work below. Following is the required scope of work for the UV System Supplier. All related installation, wiring, conduit, terminations, administration, coordination, and superintendence shall be performed by the Contractor and included in Bid Item 2.
 - a. Furnish a new NEMA 4X stainless steel UV System Control Center (SCC) control panel. The SCC shall provide overall control of all UV channels and banks and the Hydraulic System Center (HSC). The SCC shall include the following.
 - 1) A PLC based control system containing a set of a Hot-Standby controllers and associated remote I/O. In the event the primary CPU fails, the secondary CPU shall automatically assume control allowing for uninterrupted operation.
 - 2) An Operator Interface Terminal for displaying system statuses and for use by the operator to make control adjustments to the UV System.
 - 3) The new SCC shall include provisions for monitoring and adjusting control parameters from the plant SCADA system. Data from the SCC shall be transmitted via EtherNet/IP. A register list of all available signals shall be provided for use by the Division 40 Process Control System Supplier.
 - 4) The SCC shall be furnished with input and output cards used for controlling future electric gate actuators used to isolate flow from each UV channel.
 - 5) The SCC shall be furnished with a serial module used to communicate with the existing UV system Power Distribution Centers (PDC) and HSC.
 - 6) The SCC shall be furnished with the required PLC equipment (power supplies, chassis, redundancy modules, ethernet communication modules, etc.) necessary for a complete system.

Allowances
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- 7) The SCC shall be provided with an internal Uninterruptible Power Supply to power all panel equipment.
 - 8) The SCC shall be provided with an internal heater to prevent condensation.
 - 9) The SCC shall be furnished with a stainless-steel sunshade to prevent the enclosure from direct sunlight, in order to prevent panel overheating. The UV System Vendor shall perform heat calculations on the control panel based on the installed equipment. If the panel temperature calculations indicate that the internal panel temperature shall exceed 104 degrees F, an air conditioner shall be provided. Air conditioners shall maintain the panel rating.
 - 10) Factory testing of the control panel shall be performed to ensure proper operation prior to onsite installation.
- b. Furnish, install, and configure new control hardware for replacing the obsolete control equipment located in the existing Hydraulic System Center (HSC). The UV system supplier shall remove the existing controller and install the new equipment in the existing control panel.
 - c. Furnish a new UVT analyzer for use with the SCC. The SCC shall be utilize the UVT feedback in order to control the UV system's power levels and satisfy the dose setpoint.
 - d. Provide startup and commissioning services of all UV equipment provided under this contract. All travel related expenses shall be included.
2. Item No. 5: An allowance in the amount of One Hundred Thousand Dollars (\$100,000) for miscellaneous additional work.

1.03 BASIS FOR PAYMENT

- A. The basis for payment of each allowance item shall be as listed below. The item references refer to the Bid Form in the Proposal.
 1. Item No. 4: Payments under the allowance for services and equipment by the UV system supplier performing an upgrade of the existing Glen Cove Trojan Ultraviolet (UV) disinfection system shall be based on an invoice provided by the UV system supplier, in accordance with agreements, and approved by the Owner. Payment of the Contractor's overhead and profit, and the cost of related installation, conduit, wire, administration, coordination, and superintendence shall be included in Bid Item 2.
 2. Item No. 5: The amount of compensation to be paid to the contractor under the allowance for miscellaneous additional work, as directed or authorized by the County, shall be determined (1) by such applicable unit prices, if any, as are set forth in the Contract; or, (2) by lump sum or unit prices mutually agreed upon by the Commissioner and the Contractor; or, (3) the cost may be determined by the actual cost of labor and materials, plus overhead and profit, cost to be determined as the work progresses in the manner specified in Agreement Article XXII ("ExtraWork"), paragraph C.

END OF SECTION

SECTION 01025
MEASUREMENT AND PAYMENT

PART 1 GENERAL

1.01 DESCRIPTION

- A. The items listed below, beginning with Article refer to and are the same pay items listed in the Bid Schedule. They constitute all of the pay items for the completion of the Work. No direct or separate payment will be made for providing miscellaneous temporary or accessory works, plant services, Contractor's or Engineer's field offices, layout surveys, job signs, sanitary requirements, testing, safety devices, approval and Record Drawings, water supplies, power, maintaining traffic, removal of waste, security personnel, Bonds, insurance, and all other requirements of the Agreement, General Conditions and the Special Conditions. Compensation for all such services, items and materials shall be included in the prices stipulated for the lump sum and unit pay items listed herein. Unless otherwise specified, no separate payment will be made for stored equipment.

1.02 RELATED PROVISIONS SPECIFIED ELSEWHERE

- A. Payments to the Contractor: Refer to the Agreement and the General Conditions.

1.03 CONTRACT NO. S35117-03GR – GENERAL CONSTRUCTION

- A. Item 1 - General Construction Contract:
1. Payment for Item 1 will be the lump sum bid under this item and will be full compensation for completing the Cedar Creek Water Pollution Control Plant SCADA System Improvements Work described in Section 01010, Summary of Work, as shown on the Contract Drawings, and as specified under Divisions 1 through 16.
- B. Item 2 - General Construction Contract:
1. Payment for Item 2 will be the lump sum bid under this item and will be full compensation for completing the Glen Cove Wastewater Treatment Plant SCADA System Improvements Work described in Section 01010, Summary of Work, as shown on the Contract Drawings, and as specified under Divisions 1 through 16.
- C. Item 3 - HMI System Software:
1. Payment for Item 3 will be the lump sum bid under this item and will be full compensation for furnishing all labor, materials and equipment for HMI System Software (Section 13315) complete and ready for operation.
- D. Measurements and payments of Allowance Items 4 and 5 shall be in accordance with the bid form and Section 01020 of the Contract Documents.
- E. Item 6 - Unit Price - Six (6) 24-inch Valve Pneumatic Actuators
1. Payment for Item 6 will be unit price per six (6) pneumatic actuators (for 24" wastewater valves) installed under this item and will be full compensation for furnishing all labor, materials and equipment to make complete and ready for operation.

- F. Item 7 - Unit Price - Six (6) 30-inch Valve Pneumatic Actuators
 - 1. Payment for Item 7 will be unit price per six (6) pneumatic actuators (for 30" wastewater valves) installed under this item and will be full compensation for furnishing all labor, materials and equipment to make complete and ready for operation.
- G. Item 8 - Unit Price - Twelve (12) 14-inch Valve Pneumatic Actuators
 - 1. Payment for Item 8 will be unit price per twelve (12) pneumatic actuators (for 14" return sludge valves) installed under this item and will be full compensation for furnishing all labor, materials and equipment to make complete and ready for operation.
- H. Item 9 - Unit Price - Six (6) 24-inch Butterfly Valves
 - 1. Payment for Item 9 will be unit price per six (6) 24" settled wastewater butterfly valves installed under this item and will be full compensation for furnishing all labor, materials and equipment to make complete and ready for operation.
- I. Item 10 - Unit Price - Six (6) 30-inch Butterfly Valves
 - 1. Payment for Item 10 will be unit price per six (6) 30" settled wastewater butterfly valves installed under this item and will be full compensation for furnishing all labor, materials and equipment to make complete and ready for operation.
- J. Item 11 - Unit Price - Twelve (12) 14-inch Butterfly Valves
 - 1. Payment for Item 11 will be unit price per twelve (12) 14" return sludge butterfly valves installed under this item and will be full compensation for furnishing all labor, materials and equipment to make complete and ready for operation.
- K. Item 12 - Unit Price - 12-Pair Multimode Fiber Optic Cable
 - 1. Payment for Item 12 will be unit price per foot to furnish, install, and test 12-pair multimode fiber optic cable as specified under Division 13. This unit price shall be used to add and/or remove material and labor from the contract as directed by the Engineer and is above and beyond the cost of fiber optic cable that is required by the bid documents and included in lump sum bid items 1 and 2.
- L. Item 13 - Unit Price - 3-Pair Multimode Fiber Optic Cable
 - 1. Payment for Item 13 will be unit price per foot to furnish, install, and test 3-pair multimode fiber optic cable as specified under Division 13. This unit price shall be used to add and/or remove material and labor from the contract as directed by the Engineer and is above and beyond the cost of fiber optic cable that is required by the bid documents and included in lump sum bid items 1 and 2.
- M. Item 14 - Unit Price - 4" Rigid Galvanized Steel Conduit
 - 1. Payment for Item 14 will be unit price per foot to furnish and install 4" rigid galvanized steel conduit as specified under Division 16. This unit price shall be used to add and/or remove material and labor from the contract as directed by the Engineer and is above and beyond the cost of fiber optic cable that is required by the bid documents and included in lump sum bid items 1 and 2.
- N. Item 15 - Unit Price - 4" PVC Coated Rigid Galvanized Steel Conduit
 - 1. Payment for Item 15 will be unit price per foot to furnish and install 4" PVC Coated rigid galvanized steel conduit as specified under Division 16. This unit price shall be used to add and/or remove material and labor from the contract as directed by the Engineer and is

above and beyond the cost of fiber optic cable that is required by the bid documents and included in lump sum bid items 1 and 2.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

NO TEXT ON THIS PAGE

SECTION 01045
CUTTING, CORING AND PATCHING

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. This Section covers the cutting, coring, rough and finished patching of holes and openings. Holes and opening maybe in existing construction, or in parts of new construction. Procedures for cutting and patching will be the same for either condition.
- B. All cutting, coring, and rough patching shall be performed by the Contractor requiring the opening. Finish patching shall be the responsibility of the Contractor requiring the opening and shall be performed by the trade associated with the application of the particular finish.
- C. Provide all cutting, fitting and patching, including attendant excavation and backfill, required to complete the work or to:
 - 1. Make its several parts fit together properly.
 - 2. Uncover portions of the work to provide for installation of ill-timed or improperly scheduled work.
 - 3. Remove and replace defective work.
 - 4. Remove and replace work not conforming to requirements of Contract Documents.
 - 5. Remove samples of installed work as specified for testing.
 - 6. Provide penetrations of structural surfaces and materials for installation of electrical conduit.
 - 7. Provide penetrations of non-structural surfaces and materials for installation of electrical conduit. The determination of what is a nonstructural surface or material shall be made by the Engineer.
 - 8. Remove, install, or relocate materials or equipment.

1.02 RELATED WORK

- A. Summary of Work is included in Section 01010.
- B. Conduit sealing methods is included in Division 16.
- C. Fire safing is included in Division 16.
- D. Firestopping is included in Section in Division 07210.

1.03 SUBMITTALS

- A. Submit, in accordance with Section 01300, a written request prior to executing any cutting or alteration which is not shown or detailed on the contract documents which affects or requires:

1. Cutting structural members.
 2. Holes drilled in beams or other structural members.
 3. Work of the Owner or any separate contractor.
 4. Structural value or integrity of any element of the project.
 5. Integrity or effectiveness of weather-exposed or moisture-resistant elements or systems.
 6. Efficiency, operational life, maintenance or safety of operational elements.
 7. Visual qualities of sight-exposed elements.
- B. Request shall include:
1. Identification of the project.
 2. Description of affected work.
 3. The reason for cutting, alteration or excavation.
 4. Effect on work of Owner or any separate contractor, or on structural or weatherproof integrity of project.
 5. Description of proposed work:
 - a. Method and extent of cutting, patching, alteration, or excavation.
 - b. Trades who will execute the work.
 - c. Products proposed to be used.
 - d. Extent of refinishing to be done.
 6. Alternatives to cutting and patching.
 7. If the work is considered out of scope, provide a cost proposal.
 8. Confirmation of coordination with any separate contractor whose work will be affected.
 9. Related shutdown requests if required to do the work.
 10. Request for hot work permit if required to do the work.
- C. Submit written notice to the Engineer designating the date and the time the work will be uncovered.
- D. When a written request is required, do not proceed with the work until a written notice to proceed is received from the Engineer.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Comply with specifications and standards for each specific product involved. Where there is no equivalent specification, the Contractor shall notify the Engineer who will provide a specification for the materials to be used.
- B. Concrete and grout for rough patching shall be as specified in Divisions 03 and 04.
- C. Materials for finish patching shall be equal to those of adjacent construction. Where existing materials are no longer available, use materials with equivalent properties and that will provide the same appearance. The materials are to be approved by the Engineer prior to their use.

PART 3 EXECUTION

3.01 INSPECTION

- A. Inspect existing conditions of project, including elements subject to damage or to movement during cutting and patching.
- B. After uncovering work, inspect conditions affecting installation of products, or performance of work.
- C. Report unsatisfactory or questionable conditions to the Engineer in writing; do not proceed with work until the Engineer.

3.02 PREPARATION

- A. Provide adequate temporary support as necessary to assure structural value or integrity of affected portion of work.
- B. Protect surrounding materials and equipment prior to starting work.
- C. Contain and control cooling liquids and slurry produced by the cutting and coring operations.
- D. When the cutting or coring will result in the structure or equipment being exposed to provide adequate weather protection.

3.03 PERFORMANCE

- A. Execute cutting and demolition by methods which will prevent damage to other work and will provide proper surfaces to receive installation of repairs.
- B. All equipment and workplace safety shall conform to OSHA standards and specifications pertaining to plugs, noise and fume pollution, wiring and maintenance.
- C. Where possible, employ original installer or fabricator to perform cutting and patching for:
 - 1. Weather-exposed or moisture-resistant elements.
 - 2. Sight-exposed finished surfaces.

- D. Execute fitting and adjustment of products to provide a finished installation to comply with specified products, functions, tolerances and finishes.
- E. Restore work which has been cut or removed; install new products to provide completed work in accordance with requirements of Contract Documents.
- F. Refinish entire surfaces as necessary to provide an even finish to match adjacent finishes:
 - 1. For continuous surfaces, refinish to nearest intersection.
 - 2. For an assembly, refinish entire unit.
- G. Remove rubble and excess patching materials from the premises.

3.04 CORING

- A. All coring shall be performed in such a manner as to limit the extent of patching. Locate the rebar before coring to minimize cut throughs.
- B. Coring shall be performed with an approved non-impact rotary tool with diamond core drills.
- C. Size of holes shall be suitable for pipe, conduit, sleeves, equipment or mechanical seals to be installed.
- D. Fit work to minimize space to pipes, sleeves, ducts, conduit and other penetrations through surfaces.
- E. Fit to pipes and other penetrations in tanks to be water tight using seals or other methods defined in the specifications.
- F. All holes cut through concrete and masonry walls, slabs or arches shall be core drilled unless otherwise approved. All work shall be performed by mechanics skilled in this type of work.
- G. If holes are cored through floor slabs they shall be drilled from below where possible. If holes are drilled from above, provide protection and containment below the area being drilled to catch the plug and contain liquid and slurry.

3.05 CUTTING

- A. All cutting shall be performed in such a manner as to limit the extent of patching.
- B. Fit work to minimize space to pipes, sleeves, ducts, conduit and other penetrations through surfaces.
- C. Cutting shall be performed with a concrete saw and diamond saw blades of proper size.
- D. Provide for control of slurry generated by sawing operation on both sides of wall and from below if cutting a floor.
- E. When cutting a reinforced concrete wall or floor, the cutting shall be done so as not to damage the bond between the concrete and reinforcing steel left in structure. Cut shall be made so that steel neither protrudes nor is recessed from face of the cut.

- F. Adequate bracing of area to be cut shall be installed prior to start of cutting. Check area during sawing operations for partial cracking and provide additional bracing as required to prevent a partial release of cut area during sawing operations.
- G. Provide equipment of adequate size to remove cut panel.
- H. Saw cut concrete and masonry prior to breaking out sections.
- I. Install work at such time as to require the minimum amount of cutting and patching.
- J. All cutting of structural members shall be done in a manner directed by the Engineer.
- K. Cut opening only large enough to allow easy installation of the equipment, ducting, piping or conduit.
- L. When existing conduits or pipe sleeves are cut off at the floor line or wall line, they shall be filled with grout or suitable patching material.

3.06 PROTECTION

- A. Provide devices and methods to protect other portions of project from damage.
- B. Provide protection from elements for that portion of the project which may be exposed by cutting and patching work.
- C. Maintain excavations free from water.

3.07 PATCHING

- A. Rough patching shall be such as to bring the cut or cored area flush with existing construction unless otherwise shown.
- B. Finish patching shall match existing surfaces as approved.
- C. Patching shall be of the same kind and quality of material as was removed.
- D. The completed patching work shall restore the surface to its original appearance or better.
- E. Patching of waterproofed surfaces shall render the area of the patching completely waterproofed to include the joint between the existing material and the patch.
- F. Equipment damaged during cutting and patching shall be replaced or repaired by the equipment manufacturer, at the Engineer's sole discretion and at the expense of the Contractor doing the work.
- G. Repaint any damage to factory applied paint finishes using touch-up paint furnished by the equipment manufacturer. The entire damaged panel or section shall be repainted in accordance with the field painting requirements specified in Section 09902 at the expense of the Contractor doing the work.
- H. Slurry or tailings resulting from coring or cutting operations shall be contained and vacuumed or otherwise removed from the area following drilling or cut.

- I. Equipment shall be protected against mechanical and water damage during cutting and patching. Provide protective covers or use other means such as temporary relocation to protect equipment that is at risk of damage from the cutting and patching
- J. Provide protection for existing equipment, utilities and critical areas against water or other damage caused by drilling operation.

END OF SECTION

SECTION 01110
ENVIRONMENTAL PROTECTION PROCEDURES

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Furnish all labor, materials and equipment and perform all work required for the prevention of environmental pollution in conformance with applicable laws and regulations, during and as the result of construction operations under this Contract. For the purpose of this Section, environmental pollution is defined as the presence of chemical, physical, or biological elements or agents which adversely affect human health or welfare; unfavorably alter ecological balances of importance to human life; affect other species of importance to man; or degrade the utility of the environment for aesthetic and/or recreational purposes.
- B. The control of environmental pollution requires consideration of air, water and land, and involves management of noise and solid waste, as well as other pollutants.
- C. Schedule and conduct all work in a manner that will minimize the erosion of soils in the area of the work. Provide erosion control measures such as diversion channels, sedimentation or filtration systems, berms, staked hay bales, seeding, mulching or other special surface treatments as are required to prevent silting and muddying of streams, rivers, impoundments, lakes, etc.
- D. This Section is intended to ensure that construction is achieved with a minimum of disturbance to the existing ecological balance between a water resource and its surroundings. These are general guidelines. It is the Contractor's responsibility to determine the specific construction techniques to meet these guidelines.

1.02 APPLICABLE REGULATIONS

- A. Comply with all applicable Federal, State and local laws and regulations concerning environmental pollution control and abatement.

1.03 NOTIFICATIONS

- A. The Engineer will notify the Contractor in writing of any non-compliance with the foregoing provisions or of any environmentally objectionable acts and corrective action to be taken. State or local agencies responsible for verification of certain aspects of the environmental protection requirements shall notify the Contractor in writing, through the Engineer, of any non-compliance with State or local requirements. After receipt of such notice from the Engineer or from the regulatory agency through the Engineer, immediately take corrective action. Such notice, when delivered to the Contractor or his authorized representative at the site of the work, shall be deemed sufficient for the purpose. If the Contractor fails or refuses to comply promptly, the Owner may issue an order stopping all or part of the work until satisfactory corrective action has been taken. No part of the time lost due to any such stop orders shall be made the subject of a claim for extension of time or for excess costs or damages by the Contractor unless it is later determined that the Contractor was in compliance.

1.04 IMPLEMENTATION

- A. Prior to commencement of the work, meet with the Engineer to develop mutual understandings relative to compliance with these provisions and administration of the environmental pollution control program.
- B. Remove temporary environmental control features, when approved by the Engineer and incorporate permanent control features into the project at the earliest practicable time.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 PROTECTION OF STREAMS AND SURFACE WATERS

- A. All debris and excess material will be disposed of outside wetland or floodplain areas in an environmentally sound manner.

3.02 NOISE CONTROL

- A. Make every effort to minimize noises caused by the construction operations. Equipment shall be equipped with silencers or mufflers designed to operate with the least possible noise in compliance with Federal and State regulations.

3.03 MAINTENANCE OF POLLUTION CONTROL FACILITIES DURING CONSTRUCTION

- A. Maintain all facilities constructed for pollution control as long as the operations creating the particular pollutant are being carried out or until the material concerned has become stabilized to the extent that pollution is no longer being created.

END OF SECTION

SECTION 01170
SPECIAL PROVISIONS

PART 1 GENERAL

1.01 INSTALLATION OF EQUIPMENT

- A. Special care shall be taken to ensure proper alignment of all equipment. The units shall be carefully aligned on their foundations by qualified millwrights after their sole plates have been shimmed to true alignment at the anchor bolts. The anchor bolts shall be set in place and the nuts tightened against the shims. After the foundation alignments have been approved by the Engineer, the bedplates or wing feet of the equipment shall be securely bolted in place. The alignment of equipment shall be further checked after securing to the foundations, and after conformation of all alignments, the sole plates shall be finally grouted in place. The Contractor shall be responsible for the exact alignment of equipment.
- B. All wedges, shims, filling pieces, keys, packing, grout, or other materials necessary to properly align, level and secure apparatus in place shall be furnished by the Contractor. All parts intended to be plumb or level must be proven exactly so. Perform all grinding necessary to bring parts to proper bearing after erection.

1.02 SLEEVES AND OPENINGS

- A. Provide all openings, channels, chases, etc, in new construction and furnish and install anchor bolts and other items to be embedded in concrete, as required to complete the work under this Contract. Perform all cutting, coring and rough and finish patching required in existing construction for the work of all trades [as provided in Section 01045.
- B. Contractors shall furnish all sleeves, inserts, hangers, anchor bolts, etc, required for the execution of their work. It shall be their responsibility before the work of the Contractor is begun to furnish him with the above items and with templates, drawings or written information covering chases, openings, etc, which they require and to follow up the work of the Contractor as it progresses, making sure that their drawings and written instructions are carried out. Failing to do this, they shall be responsible for the cost of any corrective measures which may be required to provide necessary openings, etc. If the Contractor fails to carry out the directions given him, covering details and locations of openings, etc., he shall be responsible for any cutting and refinishing required to make the necessary corrections. In no case shall beams, lintels, or other structural members be cut without the approval of the Engineer.

1.03 SUBMITTALS

- A. Submit to the Engineer in accordance with Section 01300, a valve schedule as specified in Paragraph 1.10.

1.04 TOOLS

- A. Any special tools (including grease guns or other lubricating devices) which may be necessary for the adjustment, operation and maintenance of any equipment shall be furnished with the respective equipment.
- B. Tools shall be furnished in heavy steel tool boxes complete with lock and duplicate keys.

1.05 NOISE LIMITATIONS

- A. All equipment to be furnished under this Contract, unless specified otherwise in the technical specifications, shall be designed to ensure that the sound pressure level does not exceed 85 decibels over a frequency range of 37.8 to 9600 cycles per second at a distance of 3-ft from any portion of the equipment, under any load condition, when tested using standard equipment and methods. Noise levels shall include the noise from the motor. Mufflers or external baffles shall not be acceptable for the purpose of reducing noise. Data on noise levels shall be included with the shop drawing submittal.

1.06 SPARE PARTS

- A. Where spare parts are specified in the technical sections, furnish all spare parts recommended by the manufacturer or system supplier for one year of service. In addition, furnish all spare parts itemized in each Section.
- B. Collect and store all spare parts in an area to be designated by the Engineer. Furnish the Engineer with an inventory listing all spare parts, the equipment they are associated with, the name and address of the supplier and the delivered cost of each item. Copies of actual invoices for each item shall be furnished with the inventory to substantiate the delivery cost.
- C. Spare parts shall be packed in cartons, properly labeled with indelible markings with complete descriptive information including manufacturer, part number, part name and equipment for which the part is to be used and shall be properly treated for one year of storage.

1.07 HURRICANE PREPAREDNESS PLAN

- A. Within 30 days of the date of Notice to Proceed, submit a Hurricane Preparedness Plan to the Engineer and the Owner for approval. The Plan shall describe in detail the necessary measures which the Contractor will perform, at no additional costs to the Owner, in case of a hurricane warning. Revise Plan as required by the Engineer and Owner.

1.08 WEATHER PROTECTION

- A. In the event of inclement weather, the Contractor [and subcontractors] shall protect the Work and materials from damage or injury from the weather. If, in the opinion of the Engineer, any portion of the Work or materials has been damaged by reason of failure on the part of the Contractor [or subcontractors] to so protect the Work, such Work and materials shall be removed and replaced with new materials and Work to the satisfaction of the Engineer.

1.09 FINAL/ACCEPTANCE TESTING

- A. Prior to startup, all equipment and appurtenances installed under this Contract shall be subjected to final/acceptance tests as specified or required to prove compliance with the Contract Documents. Contractor shall furnish labor, fuel, lubricants and all other materials, equipment and instruments necessary for all acceptance tests. All power/ energy for testing shall be provided by the Owner, unless otherwise specified in the Contract Documents. Water for testing shall be provided by the Owner. Tests shall be supervised by the manufacturer's representative in accordance with Section 01730.

- B. At minimum, final/acceptance testing shall include:
 - 1. Verification that equipment has been properly aligned, adjusted and lubricated.
 - 2. Verification that equipment shall meet all specified performance requirements and shall perform without any unusual noise, vibration, or other signs of possible malfunction.
 - 3. Verification that all controls (both electrical and mechanical) are properly connected and operating.
 - 4. Verification that each mode and/or function is properly performing for multi-mode and/or multi-operation equipment.
- A. Motor field testing where required and specified.

1.10 WORK HOURS

- A. Unless otherwise permitted by the Engineer no work shall be done between the hours of 6:00 pm and 7:00 am, not on Saturdays or Sundays, except as necessary for the proper care and protection of work already performed and except as necessary to comply with the requirements of Section 01310 Maintenance of Plant Operations.

1.11 CLEAN UP AND REMOVAL OF TEMPORARY STRUCTURES

- A. Upon completion of work in any area, each Contractor shall remove all equipment, rubbish, debris and surplus materials from the work site. Waste materials shall be disposed of at a waste disposal facility approved by the Engineer. The premises shall be left in a neat, clean and acceptable condition at the end of each workday.
- B. On or before the completion of the work, each Contractor shall at their own expense remove all temporary structures and buildings built by them for facilitating the conduct of the work. The Contractors shall remove all rubbish of all kinds from the grounds which they have occupied, shall restore any damaged grounds and shall leave the entire work and premises clean, neat and in good condition. Each Contractor shall, at their own expense, provide suitable disposal sites, approved by the Engineer, for all rubbish and other waste material removed from the site. When the necessity for protecting traffic ends, the Contractor shall remove all signs, lighting devices, barricades and temporary railings from the site of the work.

1.12 USE OF OWNER'S MONORAILS, HOISTS AND OTHER EQUIPMENT

- A. The Contractor may only use the Owner's monorails and hoists located at the facility for the loading of equipment and materials or use any other Owner owned equipment at the facility, with the express written approval of the Owner and Engineer and upon execution of the Release and Waiver form attached to this section. If authorized to use any monorails, hoists or other Owner owned equipment, the Contractor shall be fully responsible for confirming its load capacity and/or operability. Such confirmation shall be performed by an experienced hoist and monorail service and inspection firm, who shall provide written certification for the operability and capacity of the hoist. The cost for such inspection and certification shall be borne by the Contractor. Should the inspection firm determine that repairs are required to the hoist to make it operable, the Contractor shall have such repairs made prior to utilizing the hoist. The Contractor shall bare all costs for such repairs. The Contractor shall assume full responsibility as it relates to the use of the monorails, hoists or other Owner owned equipment and any subsequent damage to materials, equipment and/or injury to personnel thereto.

RELEASE AND WAIVER

In consideration of the Work as part of the Cedar Creek Water Pollution Control Plant and the Glen Cove Waste Water Treatment Plant SCADA System Improvements Project, herein referred to as the "Project", more specifically the use of the existing monorails and hoists located at the facility for the loading and unloading of materials and equipment or any other County owned equipment used by the Contractor during the performance of the Work, the Contractor shall assume full responsibility as it relates to the use of the monorails, hoists or other Owner owned equipment and any subsequent damage to materials, equipment and/or injury to personnel thereto, and does hereby agree on behalf of themselves, their heirs, successors and assigns, subcontractors and any third parties who may have claim by, through or against the Contractor, to forever release and discharge the County of Nassau, its officials, representatives, employees, agents, successors and assigns, and Camp Dresser McKee & Smith (CDM Smith) from any and all claims, obligations, demands, causes of action, agreements, promises, variances, fees, costs and damages whatsoever, which the Contractor has or may have which relate in any way to the use of any of the monorails, hoists or any other County owned equipment used by the Contractor in performance of the Work located at the County Facilities, including without limitation failure or inoperability of the equipment while in use by the Contractor during performance of the Work.

IN WITNESS WHEREOF, Contractor has executed this Release and Waiver on

_____.

WITNESS

CONTRACTOR

Date: _____

Date: _____

Date: _____

END OF SECTION

SECTION 01300
SUBMITTALS

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. This Section includes the requirements for compiling, processing and transmitting submittals required for execution of the project.
- B. Submittals are categorized into two types: Action Submittals and Informational Submittals, as follows:
 - 1. Action Submittal: Written and graphic information submitted by the Contractor that requires the Engineer's approval. The following are examples of action submittals:
 - a. Shop drawings (including working drawings, valve schedule in accordance with Section 01170, and product data)
 - b. Samples
 - c. Operation & maintenance manuals
 - d. Site Usage Plan (Contractor's staging - including trailer siting and material laydown area)
 - e. Schedule of values
 - f. Payment application format
 - 2. Informational Submittal: Information submitted by the Contractor that does not require the Engineer's approval. The following are examples of informational submittals:
 - a. Shop Drawing Schedule
 - b. Construction Schedule
 - c. Statements of Qualifications
 - d. Health and Safety Plans
 - e. Construction Photography and Videography
 - f. Work Plans
 - g. Maintenance of Traffic Plans
 - h. Outage Requests
 - i. Proposed Testing Procedures
 - j. Test Records and Reports
 - k. Vendor Training Outlines/Plans
 - l. Test and Start-Up Reports
 - m. Certifications
 - n. Record Drawings
 - o. Record Shop Drawings
 - p. Submittals required by laws, regulations and governing agencies
 - q. Submittals required by funding agencies
 - r. Other requirements found within the technical specifications
 - s. Warranties and Bonds
 - t. As-Built Surveys
 - u. Contract Close-out Documents

1.02 RELATED WORK

- A. Additional requirements may be specified in the General Conditions for the Contract.
- B. Additional submittal requirements may be specified in the respective technical Specification Sections.
- C. Operation and Maintenance manuals are included in Section 01730.
- D. Contract closeout submittals are included in Section 01700.
- E. Warranties and Bonds are included in Section 01740.
- F. Construction Schedules are included in Section 01310.
- G. Project Record Documents are included in Section 01720.

1.03 CONTRACTOR'S RESPONSIBILITIES

- A. All submittals shall be clearly identified as follows:
 - 1. Date of Submission.
 - 2. Project Number.
 - 3. Project Name.
 - 4. Contractor Identification.
 - a. Contractor.
 - b. Supplier.
 - c. Manufacturer.
 - d. Manufacturer or supplier representative.
 - 5. Identification of the Product.
 - 6. Reference to Contract Drawing.
 - 7. Reference to specification section number, page and paragraph(s).
 - 8. Reference to applicable standards, such as ASTM or Federal Standards numbers.
 - 9. Indication of Contractor's approval.
 - 10. Contractor's Certification statement.
 - 11. Identification of deviations from the Contract Documents, if any.
 - 12. Reference to previous submittal (for resubmittals).
 - 13. Made in America (when required by the Contract).

- B. Submittals shall be clear and legible, and of sufficient size for legibility and clarity of the presented data.
- C. Submittal Log. Maintain a log of all submittals. The submittal log shall be kept accurate and up to date. This log should include the following items (as applicable):
 - 1. Description.
 - 2. Submittal Number.
 - 3. Date transmitted to the Engineer.
 - 4. Date returned to Contractor (from Engineer).
 - 5. Status of Submittal (Approved/Not Approved/etc.).
 - 6. Date of Resubmittal to Engineer and Return from Engineer (if applicable and repeat as necessary).
 - 7. Date material released for fabrication.
 - 8. Projected (or actual) delivery date.
- D. Numbering System. Utilize the following submittal identification numbering system:
 - 1. The first character shall be a D, S, M or I which represents Shop Drawing (including working drawings and product data), Sample, Manual (Operating & Maintenance) or Informational, respectively.
 - 2. The next five digits shall be the applicable Section Number.
 - 3. The next three digits shall be the sequential number of each separate item or drawing submitted under each Specification Section, in the chronological order submitted, starting at 001.
 - 4. The last character shall be a letter, A to Z, indicating the submission (or resubmission) of the same submittal, i.e., "A" = 1st submission, "B" = 2nd submission, "C" = 3rd submission, etc. A typical submittal number would be as follows:
 - a. D-03300-008-B.
 - b. D = Shop Drawing 03300 = Section for Concrete.
 - c. 008 = the eighth different submittal under this Section.
 - d. B = the second submission (first resubmission) of that particular shop drawing.
- E. Variances
 - 1. Notify the Engineer in writing, at the time of submittal, of any deviations in the submittals from the requirements of the Contract Documents.
 - 2. Notify the Engineer in writing, at the time of re-submittal (resubmission), of all deviations from previous submissions of that particular shop drawing, except those deviations which are the specific result of prior comments from the Engineer.

F. Action Submittals

1. Shop Drawings, Working Drawings, Product Data and Samples.
 - a. Shop Drawings.
 - 1) Shop drawings as defined in the General Conditions, and as specified in individual Sections may include, but are not necessarily limited to, custom prepared data such as fabrication and erection/installation (working) drawings, scheduled information, setting diagrams, actual shop work manufacturing instructions, custom templates, valve schedules, wiring diagrams, coordination drawings, equipment inspection and test reports, and performance curves and certifications, as applicable to the work.
 - 2) Contractor shall verify all field measurements, field construction criteria, materials, dimensions, catalog numbers and similar data, and coordinate each item with other related shop drawings and the Contract requirements.
 - 3) All details on shop drawings shall clearly show the relation of the various parts to the main members and lines of the structure and where correct fabrication of the work depends upon field measurements, such measurements shall be made and noted on the drawings before being submitted.
 - 4) All shop drawings submitted by subcontractors and vendors shall be reviewed by the Contractor. Contractor shall confirm, materials, dimensions, catalog numbers, technical data and performance criteria; and shall coordinate with other related shop drawings and the Contract requirements. In addition, Contractor shall confirm existing field conditions and dimensions and assure that the submittal is coordinated and compatible with existing conditions. Submittals directly from subcontractors or vendors will not be accepted by the Engineer.
 - 5) The Contractor shall be responsible the accuracy of the subcontractor's or vendor's submittal; and, for their submission in a timely manner to support the requirements of the Contractor's construction schedule. Shop drawings found to be inaccurate or otherwise in error shall be returned to the subcontractor or vendor to correct, before submission to the Engineer. All shop Drawings shall be approved by the Contractor.
 - 6) Delays to construction due to the untimely submission of submittals will constitute inexcusable delays, for which Contactor shall not be eligible for additional cost nor additional contract time. Inexcusable delays consist of any delay within the Contactor's control.
 - 7) Submittals for equipment specified under Divisions 11, 13, 14, 15 and 16 shall include a listing of installations where identical or similar equipment manufactured by that manufacturer has been installed and in operation for a period of at least five years.
 - b. Working Drawings
 - 1) Detailed installation drawings (sewers, equipment, piping, electrical conduits and controls, HVAC work, and plumbing, etc.) shall be prepared and submitted for review and approval by the Engineer prior to installing such work. Installation drawings shall be to-scale and shall be fully dimensioned.
 - 2) Piping working drawings shall show the laying dimensions of all pipes, fittings, valves, as well as the equipment to which it is being connected. In addition, all pipe supports shall be shown.
 - 3) Equipment working drawings shall show all equipment dimensions, anchor bolts, support pads, piping connections and electrical connections. In addition, show clearances required around such equipment for maintenance of the equipment.

- 4) Electrical working drawings shall show conduits, junction boxes, disconnects, control devices, lighting fixtures, support details, control panels, lighting and power panels, and Motor Control Centers. Coordinate all locations with the Contract Documents and the Contractor's other working drawings.
 - c. Product Data
 - 1) Product data, as specified in individual Specification Sections, include, but are not limited to, the manufacturer's standard prepared data for manufactured products (catalog data), such as the product specifications, installation instructions, availability of colors and patterns, rough-in diagrams and templates, product photographs (or diagrams), wiring diagrams, performance curves, quality control inspection and reports, certifications of compliance (as specified or otherwise required), mill reports, product operating and maintenance instructions, recommended spare parts and product warranties, as applicable.
 - d. Samples
 - 1) Furnish, samples required by the Contract Documents for the Engineer's approval. Samples shall be delivered to the Engineer as specified or directed. Unless specified otherwise, provide at least two samples of each required item. Materials or equipment for which samples are required shall not be used in the work unless and until approved by the Engineer.
 - 2) Samples specified in individual Specification Sections, include, but are not limited to: physical examples of the work (such as sections of manufactured or fabricated work), small cuts or containers of materials, complete units of repetitively-used products, color/texture/pattern swatches and range sets, specimens for coordination of visual effect, graphic symbols, and other specified units of work.
 - 3) Approval of a sample shall be only for the characteristics or use named in such approval and shall not be construed to change or modify and Contract Requirements.
 - 4) Approved samples not destroyed in testing shall be sent to the Engineer or stored at the site of the work. Approved samples of the hardware in good condition will be marked for identification and may be used in the work. Materials and equipment incorporated in work shall match the approved samples. Samples which fail testing or are not approved will be returned to the Contractor at his expense, if so requested at time of submission.
 - e. Professional Engineer (P.E.) Certification Form
 - 1) If specifically required in any of the technical Specification Sections, submit a Professional Engineer (P.E.) Certification for each item required, using the form appended to this Section.
2. Contractor's Certification
- a. Each shop drawing, working drawings, product data, and sample shall have affixed to it the following Certification Statement:
 - 1) "Certification Statement: by this submittal, I hereby represent that I have determined and verified all field measurements, field construction criteria, materials, dimensions, catalog numbers and similar data and I have checked and coordinated each item with other applicable approved shop drawings and all Contract requirements."

- b. Shop drawings, working drawings, and product data sheets 11-in x 17-in and smaller shall be bound together in an orderly fashion and bear the above Certification Statement on the cover sheet. The transmittal cover sheet for each identified shop drawing shall fully describe the packaged data and include a listing of all items within the package.
3. The review and approval of shop drawings, working drawings, product data, or samples by the Engineer shall not relieve the Contractor from the responsibility for the fulfillment of the terms of the Contract. All risks of error and omission are assumed by the Contractor and the Engineer will have no responsibility therefor.
4. Project work, materials, fabrication, and installation shall conform to approved shop drawings (including working drawings and product data) and applicable samples.
5. No portion of the work requiring a shop drawing (including working drawings and product data) or sample shall be started, nor shall any materials be fabricated or installed before approval of such item. Procurement, fabrication, delivery or installation of products or materials that do not conform to approved shop drawings shall be at the Contractor's risk. Furthermore, such products or materials delivered or installed without approved shop drawings, or in non-conformance with the approved shop drawings will not be eligible for progress payment until such time as the product or material is approved or brought into compliance with approved shop drawings. Neither the Owner nor Engineer will be liable for any expense or delay due to corrections or remedies required to accomplish conformity.
6. Operation and Maintenance Data
 - a. Operation and maintenance data shall be submitted in assembled manuals as specified. Such manuals shall include detailed instructions for Owner personnel on safe operation procedures, controls, start-up, shut-down, emergency procedures, storage, protection, lubrication, testing, trouble-shooting, adjustments, repair procedures, and other maintenance requirements.
7. Schedule of Values
 - 1) On projects consisting of lump sums (in whole or in part) submit a proposed schedule of values providing a breakdown of lump sum items in to reasonably small components – generally disaggregated by building, area, and/or discipline. The purpose of the schedule of values is for processing partial payment applications. If requested by the Engineer, provide sufficient substantiation for all or some items as necessary to determine the proposed schedule of values is a reasonable representation of the true cost breakdown of the Work. The schedule of values shall not be unbalanced to achieve early payment or over-payment in excess of the value of work or any other mis-distribution of the costs. If, in the opinion of the Engineer, the schedule of values is unbalanced, Contractor shall reallocate components to achieve a balanced schedule acceptable to Engineer.
8. Payment Application Format
 - 1) If an application form is included in the Contract Documents, use that form unless otherwise approved by the Engineer and Owner. If an application form is not included in the Contract Documents, Contractor may propose a form for approval.

9. Site Usage
 - a. Submit a proposed site staging plan, including but not limited to the location of office trailers, storage trailers and material laydown. Such plan shall be a graphic presentation (drawing) of the proposed locations; and, shall include on-site traffic modifications, and temporary utilities, as may be applicable.

G. Informational Submittals

1. Shop Drawing Schedule
 - a. Prepare and submit a schedule indicating when shop drawings are required to be submitted to support the as-planned construction schedule. The submittal schedule shall allow sufficient time for preparation and submittal, review and approval, and fabrication and delivery to support the construction schedule.
2. Construction Schedule
 - a. Prepare and submit construction schedules and monthly status reports as specified.
3. Statements of Qualifications
 - a. Provide evidence of qualification, certification, or registration, as required in the Contract Documents, to verify qualifications of licensed land surveyor, professional engineer, materials testing laboratory, specialty subcontractor, technical specialist, consultant, specialty installer, and other professionals.
 - b. Health and Safety Plans
 - 1) When specified, prepare and submit a general company Health and Safety Plan (HSP), modified or supplemented to include job-specific considerations.
4. Construction Photography and Videography
 - a. Provide periodic construction photographs and videography as specified – including but not limited to preconstruction photographs and/or video, monthly progress photos and/or video and post-construction photographs and/or video.
5. Work Plans
 - a. Prepare and submit copies of all work plans needed to demonstrate to the Owner that Contractor has adequately thought-out the means and methods of construction and their interface with existing facilities.
6. Maintenance of Traffic Plans
 - a. Prepare maintenance of traffic plans where and when required by the Contract Documents and by local ordinances or regulations. If Contractor is not already knowledgeable about local ordinances and regulations regarding maintenance of traffic requirements, become familiar with such requirements and include all costs for preparation and submittal of traffic management plans and all associated costs for permits and fees to implement the traffic management plan, in the bid amount. In addition, unless a supplemental payment provision is provided in the bid form, include the cost of police attendance, when required.
7. Outage Requests
 - a. Provide sufficient notification of any outages required (electrical, flow processes, etc.) as may be required to tie-in new work into existing facilities. Unless specified otherwise elsewhere, a minimum of seven calendar days' notice shall be provided.

8. Proposed Testing Procedures
 - a. Prepare and submit testing procedures it proposes to use to perform testing required by the various technical specifications.
9. Test Records and Reports
 - a. Provide copies of all test records and reports as specified in the various technical specifications.
10. Vendor Training Outlines/Plans
 - a. At least two weeks before scheduled training of Owner's personnel, provide lesson plans for vendor training in accordance with the specification for O&M manuals.
11. Test and Start-up Reports
 - a. Manufacture shall perform all pre-start-up installation inspection, calibrations, alignments, and performance testing as specified in the respective Specification Section. Provide copies of all such test and start-up reports.
12. Certifications
 - a. Provide various certifications as required by the technical specifications. Such certifications shall be signed by an officer (of the firm) or other individual authorized to sign documents on behalf of that entity.
 - b. Certifications may include, but are not limited to:
 - 1) Welding certifications and welders qualifications
 - 2) Certifications of Installation, Testing and Training for all equipment
 - 3) Material Testing reports furnished by an independent testing firm
 - 4) Certifications from manufacturer(s) for specified factory testing
 - 5) Certifications required to indicate compliance with any sustainability or LEEDS accreditation requirements indicated in the Contract Documents
13. Record Drawings
 - a. No later than Substantial Completion, submit a record of all changes during construction not already incorporated into drawings – in accordance with specification on Project Record Documents.
14. Record Shop Drawings
 - a. Before final payment is made, furnish one set of record shop drawings to the Engineer. These record shop drawings shall be in conformance with the approved documents and should show any field conditions which may affect their accuracy.
 - b. Submittals required by laws, regulations and governing agencies
 - 1) Prepare and submit all documentation required by state or local law, regulation or government agency directly to the applicable agency. This includes, but is not limited to, notifications, reports, certifications, certified payroll (for projects subject to wage requirements) and other documentation required to satisfy all requirements. Provide to Engineer one copy of each submittal made in accordance with this paragraph.
 - c. Submittals required by funding agencies
 - 1) Prepare and submit all documentation required by funding agencies. This includes, but is not limited to segregated pay applications and change orders when required to properly allocate funds to different funding sources; and certified payrolls for projects subject to wage requirements. Provide one copy of each submittal made in accordance with this paragraph to the Engineer.

15. Other requirements of the technical Specification Sections
 - a. Comply with all other requirements of the technical specifications.
16. Warranties and Bonds
 - a. Assemble a booklet or binder of all warranties and bonds as specified in the various technical specifications and in accordance with the specification on Warranties and Bonds; and provide two originals to the Engineer.
17. As-Built Surveys
 - a. Engage the services of a licensed land surveyor in accordance with the Project Controls (Surveying) specification. Prior to Final Completion, provide an as-built survey of the constructed facility, as specified.
18. Contract Close-Out Documents
 - a. Submit Contract documentation as indicated in the specification for Contract Close-out.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 SUBMITTAL SCHEDULE

- A. Provide an initial submittal schedule at the pre-construction meeting for review by Owner and Engineer. Incorporate comments from Owner or Engineer into a revised submittal schedule.
- B. Maintain the submittal schedule and provide sufficient copies for review by Owner and Engineer. An up-to-date submittal schedule shall be provided at each project progress meeting.

3.02 TRANSMITTALS

- A. Prepare separate transmittal sheets for each submittal. Each transmittal sheet shall include at least the following: the Contractor's name and address, Owner's name, project name, project number, submittal number, description of submittal and number of copies submitted.
- B. Submittals shall be transmitted or delivered directly to the office of the Engineer, as indicated in the Contract Documents or as otherwise directed by the Engineer.
- C. Provide copies of transmittals forms or cover letters (without attachments) directly to the Resident Project Representative.

3.03 PROCEDURES

A. Action Submittals

1. Contractor's Responsibilities

- a. Coordination of Submittal Times: Prepare and transmit each submittal sufficiently in advance of performing the related work or other applicable activities, or within the time specified in the individual work of other related Sections, so that the installation will not be delayed by processing times including disapproval and resubmittal (if required). Coordinate with other submittals, testing, purchasing, fabrication, delivery and similar sequenced activities. Extensions to the Contract Time will not be approved for the Contractor's failure to transmit submittals sufficiently in advance of the Work.
- b. The submittals of all shop drawings (including working drawings and product data) shall be sufficiently in advance of construction requirements to allow for possible need of re-submittals, including the specified review time for the Engineer.
- c. No less than 30 calendar days will be required for Engineer's review time for shop drawings and O&M manuals involving only one engineering discipline. No less than 45 calendar days will be required for Engineer's review time for shop drawings and O&M manuals that require review by more than one engineering discipline. Resubmittals will be subject to the same review time.
- d. Submittals of operation and maintenance data shall be provided within 30 days of approval of the related shop drawing(s).
- e. Before submission to the Engineer, review shop drawings as follows:
 - 1) make corrections and add field measurements, as required
 - 2) use any color for its notations except red (reserved for the Engineer's notations) and black (to be able to distinguish notations on black and white documents)
 - 3) identify and describe each and every deviation or variation from Contract documents or from previous submissions, except those specifically resulting from a comment from the Engineer on a previous submission
 - 4) include the required Contractor's Certification statement
 - 5) provide field measurements (as needed)
 - 6) coordinate with other submittals
 - 7) indicate relationships to other features of the Work
 - 8) highlight information applicable to the Work and/or delete information not applicable to the Work
- f. Submit the following number of copies:
 - 1) Shop drawings (including working drawings and product data) – Submit no fewer than six, and no more than nine; five of which will be retained by the Engineer.
 - 2) Samples – three
 - 3) Site Usage Plan – three copies
 - 4) Schedule of values – four copies
 - 5) Payment application format – four copies
- g. If Contractor considers any correction indicated on the shop drawings to constitute a change to the Contract Documents, provide written notice thereof to the Engineer immediately; and do not release for manufacture before such notice has been received by the Engineer.
- h. When the shop drawings have been completed to the satisfaction of the Engineer, carry out the construction in accordance therewith; and make no further changes therein except upon written instructions from the Engineer.

2. Engineer's Responsibilities
 - a. Engineer will not review shop drawings (including working drawings and product data) that do not include the Contractor's approval stamp and required certification statement. Such submittals will be returned to the Contractor, without action, for correction.
 - b. Partial shop drawings (including working drawings and product data) will not be reviewed. If, in the opinion of the Engineer, a submittal is incomplete, that submittal will be returned to the Contractor for completion. Such submittals may be returned with comments from Engineer indicating the deficiencies requiring correction.
 - c. If shop drawings (including working drawings and product data) meet the submittal requirements, Engineer will forward copies to appropriate reviewer(s). Otherwise, noncompliant submittals will be returned to the Contractor without action - with the Engineer retaining one copy.
 - d. Submittals which are transmitted in accordance with the specified requirements will be reviewed by the Engineer within the time specified herein. The time for review will commence upon receipt of submittal by Engineer.
3. Review of Shop Drawings (Including Working Drawings and Product Data) and Samples
 - a. The review of shop drawings, working drawings, data and samples will be for general conformance with the design concept and Contract Documents. They shall not be construed:
 - 1) as permitting any departure from the Contract requirements
 - 2) as relieving the Contractor of responsibility for any errors, including details, dimensions, and materials
 - 3) as approving departures from details furnished by the Engineer, except as otherwise provided herein
 - b. The Contractor remains responsible for details and accuracy, for coordinating the work with all other associated work and trades, for selecting fabrication processes, for techniques of assembly, and for performing work in a safe manner.
 - c. If the shop drawings (including working drawings and product data) or samples as submitted describe variations and indicate a deviation from the Contract requirements that, in the opinion of the Engineer are in the interest of the Owner and are so minor as not to involve a change in Contract Price or Contract Time, the Engineer may return the reviewed drawings without noting an exception.
 - d. Only the Engineer will utilize the color "RED" in marking submittals.
 - e. Shop drawings will be returned to the Contractor with one of the following codes.
 - 1) "APPROVED" – This code is assigned when there are no notations or comments on the submittal. When returned under this code the Contractor may release the equipment and/or material for manufacture.
 - 2) "APPROVED AS NOTED" - This code is assigned when a confirmation of the notations and comments IS NOT required by the Contractor. The Contractor may release the equipment or material for manufacture; however, all notations and comments must be incorporated into the final product.
 - 3) "APPROVED AS NOTED/CONFIRM" - This combination of codes is assigned when a confirmation of the notations and comments is required by the Contractor. The Contractor may release the equipment or material for manufacture; however, all notations and comments must be incorporated into the final product. This confirmation shall specifically address each omission and nonconforming item that was noted. Confirmation is to be received by the Engineer within 15 calendar days of the date of the Engineer's transmittal requiring the confirmation.

- 4) "APPROVED AS NOTED/RESUBMIT" - This combination of codes is assigned when notations and comments are extensive enough to require a resubmittal of the entire package. This resubmittal is to address all comments, omissions and non-conforming items that were noted. Resubmittal is to be received by the Engineer within 30 calendar days of the date of the Engineer's transmittal requiring the resubmittal.
 - 5) "NOT APPROVED" – This code is assigned when the submittal does not meet the intent of the contract documents. The Contractor must resubmit the entire package revised to bring the submittal into conformance. It may be necessary to resubmit using a different manufacturer/vendor to meet the requirements of the contract documents.
 - 6) "COMMENTS ATTACHED" – This code is assigned where there are comments attached to the returned submittal, which provide additional data to aid the Contractor.
 - 7) "RECEIPT ACKNOWLEDGED (Not subject to Engineer's Review or Approval)" – This code is assigned to acknowledge receipt of a submittal that is not subject to the Engineer's review and approval, and is being filed for informational purposes only. This code is generally used in acknowledging receipt of means and methods of construction work plans, field conformance test reports, and health and safety plans.
 - f. Repetitive Reviews: Shop drawings, O&M manuals and other submittals will be reviewed no more than twice at the Owner's expense. All subsequent reviews will be performed at the Contractor's expense. Reimburse the Owner for all costs invoiced by Engineer for the third and subsequent reviews.
4. Electronic Transmission
- a. Action Submittals may be transmitted by electronic means provided the following conditions are met:
 - 1) The above-specified transmittal form is included.
 - 2) All other requirements specified above have been met including, but not limited to, coordination by the Contractor, review and approval by the Contractor, and the Contractor's Certification.
 - 3) The submittal contains no pages or sheets large than 11 x 17 inches.
 - 4) With the exception of the transmittal sheet, the entire submittal is included in a single file.
 - 5) The electronic files are PDF format (with printing enabled).
 - 6) In addition, transmit three hard-copy (paper) originals to the Engineer.
 - 7) The Engineer's review time will commence upon receipt of the hard copies of the submittal.
 - 8) For Submittals that require certification, corporate seal, or professional embossment (i.e., P.E.s, Surveyors, etc.) transmit at least two hard-copy originals to the Engineer. In addition, provide additional photocopied or scanned copies, as specified above, showing the required certification, corporate seal, or professional seal.

B. Informational Submittals

1. Contractor's Responsibilities
 - a. Number of copies: Submit three copies, unless otherwise indicated in individual Specification sections

- b. Refer to individual technical Specification Sections for specific submittal requirements.
- 2. Engineer's Responsibilities
 - a. The Engineer will review each informational submittal within 15 days. If the informational submittal complies with the Contract requirements, Engineer will file for the project record and transmit a copy to the Owner. Engineer may elect not to respond to Contractor regarding informational submittals meeting the Contract requirements.
 - b. If an informational submittal does not comply with the Contract requirements, Engineer will respond accordingly to the Contractor within 15 days. Thereafter, the Contractor shall perform the required corrective action, including retesting, if needed, until the submittal, in the opinion of the Engineer, is in conformance with the Contract Documents.
- 3. Electronic Transmission
 - a. Informational submittals may be transmitted by electronic means providing all of the following conditions are met:
 - 1) The above-specified transmittal form is included.
 - 2) The submittal contains no pages or sheets large than 11 x 17 inches.
 - 3) With the exception of the transmittal sheet, the entire submittal is included in a single file.
 - 4) The electronic files are PDF format (with printing enabled).
 - 5) For Submittals that require certification, corporate seal, or professional embossment (i.e., P.E.s, Surveyors, etc.)) transmit two hard-copy originals to the Engineer.

END OF SECTION

P.E. CERTIFICATION FORM

The undersigned hereby certifies that he/she is a professional engineer registered in the State
of _____ and that he/she has been employed by

_____ to design
(Company Name)

(Insert P.E. Responsibilities)

In accordance with Specification Section _____ for the

_____.
(Name of Project)

The undersigned further certifies that he/she has performed the said design in conformance with all applicable local, state and federal codes, rules and regulations; and, that his/her signature and P.E. stamp have been affixed to all calculations and drawings used in, and resulting from, the design.

The undersigned hereby agrees to make all original design drawings and calculations available to the

(Insert Name of Owner)

or Owner's representative within seven days following written request therefor by the Owner.

P.E. Name

Company Name

Signature

Signature

P.E. Registration Number

Title

Address

Address

SECTION 01310
MAINTENANCE OF PLANT OPERATIONS

PART 1: GENERAL

1.01 GENERAL REQUIREMENTS

- A It shall be understood the term contract, as used in the Section, shall be taken to mean S35117-03GR. Further, it shall be understood the term Contractor shall be taken to mean the Contractor for the above stated Contract.
- B The work must be performed in such a manner that continuous, uninterrupted conveyance, of waste water, and all essential services and facilities are maintained operational throughout the construction period. Work under the contract shall be so scheduled and conducted by the Contractor such that work will not impede any treatment process, create potential hazards to operating equipment or personnel, reduce the quality of the plant effluent or cause odor or other nuisance. In performing the work shown or as specified, each Contractor shall plan and schedule work to meet the plant operating requirements and additional constraints outlined in this Section.

Each Contractor has the option of providing additional temporary controls that can eliminate a constraint, provided it is done without cost to the Owner and provided that all requirements of these specifications are fulfilled.

Major work items included, but not limited to, is as follows:

1. Furnish and install a full SCADA system upgrade of the Cedar Creek Water Pollution Control Plant (Cedar Creek), including a fault-tolerant fiber optic network, SCADA software, operator workstations, network switches, and control panels.
2. Furnish and install a full SCADA system upgrade of the Glen Cove Waste Water Treatment Plant (Glen Cove), including a fault-tolerant SCADA server, a fault-tolerant fiber optic network, SCADA software, operator workstations, network switches, and control panels.
3. Furnish all instrumentation at Cedar Creek and Glen Cove as indicated on the drawings and per the instrument list.
4. Provide overall installation and configuration of instrumentation, programmable logic controllers (PLCs), PLC enclosures, SCADA computer equipment and software, networking equipment, and other control system equipment as specified herein.
5. Provide all PLC programming and Human Machine Interface (HMI) configuration including development of control programs, database configuration, graphic screens, communication links, historical archiving, and all testing as specified herein.
6. Install electrical systems as required including conduit, wire, fiber optic cable, fiber optic cable enclosures, junction boxes, wire terminations, etc.

- C For brevity, the Contractor is advised that this Section of the specifications contains several references to instrumentation, control panels, communication equipment, and appurtenances to be removed or reinstalled. The Contractor shall refer to other Specification Sections and the Contract Drawings for additional details of equipment, wiring, conduit, material and appurtenances to be demolished and removed from the site by the Contractor.
- D The contractor shall submit a cutover plan for approval. The cutover plan shall be as defined in the Submittals section of specification section 13300. No site work shall commence until the Engineer and Owner have reviewed and approved the cutover plan.

1.02 RELATED WORK

- A Special provisions are included in Section 01170.
- B Construction scheduling is included in Section 01311.
- C Temporary facilities are included in Section 01500.
- D Equipment is specified in Divisions 13 and 16.

1.03 GENERAL CONSTRAINTS

- A In PART 3: EXECUTION of this Section, the sequence and shutdown of control systems which are to be taken out of service and demolished or rehabilitated are presented. The operational status of new or existing units other than the designated units shall not be interrupted by a Contractor during the specified time periods. New units may only be used after the specified testing and acceptance of the units by the Owner.

The following constraints shall be applied to all equipment, treatment units and appurtenant utility systems on the plant site.

1. Internal Roads Access

Except as otherwise permitted, vehicular access to all plants, pump stations, and ejection stations must be maintained at all times. All construction traffic on internal roads shall be as approved by the Engineer and shall in no way prevent the Owner's personnel from gaining access to areas of their work.

2. Personnel Access

County personnel must have safe access to all areas, which remain in operation throughout the construction period.

3. Electric Power, Light and Communication Systems

Electric power, lighting service and communication systems shall be maintained in uninterrupted operation in all areas, which remain in operation.

Temporary electrical installations for the purpose of maintaining plant operations shall conform to the material and installation requirements of Division 16 of the specifications. Requests for variances from these requirements shall be submitted to the Engineer in writing for review and approval.

4. Shutdowns

- a. Shutdown shall be defined to indicate that the normal operation of a plant system or unit process has to be suspended or taken out of service in order to perform the specified work. For each shutdown, the responsible Contractor shall compile an inventory of labor and materials required to perform the tasks, an estimate of the time required and a written description of the steps required to complete the tasks. The inventory, time estimate and written procedure shall be submitted to the Engineer for review fourteen (14) consecutive calendar days prior to the start date of the shutdown. No shutdown shall be initiated until the list of materials and labor is verified as on site at least one week prior to the proposed start date.
- b. The work specified herein and any other work required by the Owner which may interrupt the normal plant operations shall be accomplished at such times that will be convenient to the Owner.
- c. Each Contractor shall also have on hand, located in close proximity to the work area(s), all tools, equipment and materials, both temporary and permanent, necessary to complete each work category, without interruption. Prefabrication of all piping and other assemblies shall be completed to the greatest degree possible, prior to any shutdowns. The Engineer must be satisfied that the Contractor has complied with these requirements, to the fullest extent possible, before any shutdowns will be authorized.

5. Shutdown of Electrical Systems

- a. At the Contractor's request, the Owner shall shutdown an existing electric system. Each Contractor shall be responsible for following and implementing the appropriate lock out and tag out procedures for systems de-energized by the Owner, and shall check cables and wires to be sure that they are de-energized before work begins. Upon completion of the work which necessitated the shutdown, each Contractor shall remove the locks and advise the Engineer that the facilities are available for use.

6. Time of Work and Overtime

- a. Overtime work by each Contractor necessary to comply with the requirements of the Contract Documents shall be considered as normal procedure under this Contract, and the Contractor shall make no claims for extra compensation as a result thereof. The Contractor shall be prepared to work around-the-clock and supply multiple work crews as necessary to complete the work including testing and acceptance as specified, within the specified time frame and the time of completion set forth in the Contract Documents.
- b. If it shall become imperative to perform Work at night, the County shall be informed a reasonable time in advance of the beginning of such Work. Temporary lighting and all other necessary facilities for performing and inspecting the Work shall be provided as required and as specified in Division 1, Section 01500, Temporary Facilities.

- c. Unless otherwise specifically permitted, all Work that would be subject to damage shall be stopped during inclement, stormy or freezing weather. Only such work that will not cause injury to workmanship or materials will be permitted. The Contractor shall carefully protect his Work against damage or injury from the weather, and when Work is permitted during freezing weather, he/she shall provide and maintain approved facilities for heating the materials and for protecting the finished Work.
- d. The Contractor shall request permission, in writing, to perform contractual work outside the regular County working hours of 7:00 AM to 3:30 PM, Monday through Friday, or on Official County Holidays. This written request should be received by the County 24 hours in advance of beginning the work. The Contractor is responsible for coordination with the County Engineer and/or his duly authorized representative prior to the start of the work to determine the dates of observance of the Official County Holidays that may occur during the course of this Contract. The Official County Holidays are:

New Year's Day	Martin Luther King, Jr. Day	Lincoln's Birthday
Washington's Birthday	Memorial Day	Independence day
Labor Day	Columbus Day	Election Day
Veteran's Day	Thanksgiving Day	Friday after
Thanksgiving Day	Christmas Day	

Failure of the Contractor to consider Official County Holidays during the preparation of their work plans and schedules shall not be cause for a delay claim against the County.

Should circumstances arise, during the course of the Contract, where the Contractor request approval to work outside the County's working hours (7:00 AM to 3:30 PM) or on Official County Holidays, testing, or work deemed necessary by the County to have County personnel present and it is granted, the Contractor will reimburse the County for the cost of providing inspection or plant assistance. Furthermore, failure of the Contractor to have considered such contingency cost in his Bid price shall not be cause for an extra work claim to the County at a later date.

7. Weather Constrained

Unless otherwise specifically permitted, all work that would be subject to damage shall be stopped during inclement, stormy or freezing weather. Only such work as will not suffer injury to workmanship or materials will be permitted. Contractor shall carefully protect his Work against damage or injury from the weather, and when work is permitted during freezing weather shall provide and maintain approved facilities for heating the materials and for protecting the finished Work.

8. Illumination

As a minimum, construction areas, roadways, offices, shops, corridors, process areas, storage areas, etc. shall be lighted in conformance with OSHA (Electrical, Construction Part 1926) to not less than the minimum illumination intensities (foot candles) listed in Table D.3 while any work is in progress. The County reserves the right to request additional lighting at no additional cost to the Owner.

1.03 SEQUENCE OF CONSTRUCTION AND OPERATION

- A In order to maintain continuous operation during construction, a phased removal and construction sequence shall be required as described herein. Specific constraints are outlined for each item. The items and their time constraints are intended to provide a required sequence and timing for specific activities related to that particular item.

CEDAR CREEK WPCP MAINTENANCE OF PLANT OPERATIONS - INDEX OF ITEMS

- Item 1: Perform installation and testing of the fiber optic cable and the fiber optic communication enclosures.
- Item 2: Perform installation and testing of the new virtual machines and Cimplicity software on the existing fault-tolerant server at the Cedar Creek Administration Building. Perform installation and testing of the new operator workstations and monitors at the Administration Building Control Room.
- Item 3: Perform the installation, cutover, startup, and testing of each plant area, one area at a time per the following sequence and per the Maintenance of Plant Operations Table below:
1. Building J – Digesters:
 - a. PLC-DIG Control Panel
 - b. RIO-DIG-1
 2. Aeration Tanks and Main Air Tunnels
 - a. PLC-ATCC-1 Control Panel
 - b. PLC-ATCC-2 Control Panel
 - c. PLC-ATCC-3 Control Panel
 - d. PLC-ATCC-4 Control Panel
 3. Buildings G and F – Grit Tanks and Primary Sedimentation:
 - a. PLC-PST-1 Control Panel
 - b. PLC-PST-2 Control Panel
 4. Building BB – Generator Building:
 - a. PLC-ECR
 5. HVAC System Control Panels:
 - a. PLC-HVAC-B (Boiler Plant Control Panel)
 - b. RIO-HVAC-A: (Administration Building Basement)
 - c. RIO-HVAC-C: (Employee Building Basement)
 - d. RIO-HVAC-J: (Digester Building Control Room)
 - e. RIO-HVAC-K: (Sewer Maintenance Building)
 - f. RIO-HVAC-R: (Tertiary Treatment Building Basement)
 6. Existing Control Panel Modifications:
 - a. Gravity Belt Thickener PLC (Building H)
 - b. Influent Screening Control Panel (Building E)
 - c. Effluent Pump Control Panel (Building L)
 - d. Dewatering Control Panel (Building S)

- Item 4: Merge all existing Cimplicity database points and graphics into the fault-tolerant SCADA server, and tie in the existing Ethernet-based control panels to the new SCADA network per the following sequence and per the Maintenance of Plant Operations Table below:
1. Building S – Dewatering Building :
 - a. Belt Filter Press Cimplicity Servers
 - b. Centrifuge No. 1 Control Panel
 - c. Centrifuge No. 2 Control Panel
 - d. Polymer Control Panel
 2. Building BB – Generator Building:
 - a. Engine Generator Cimplicity Servers
 3. Building F – Grit Building :
 - a. PLC-Grit Control Panel
 4. Building HH – Sludge Thickening Building
 - a. GBT Main Control Panel
 5. Building L – Effluent Screening and Chlorination Building
 - a. Outfall Pump Control Panel
 - b. Screened Effluent Control Panel
 - c. Chlorination Control Panel
 - d. Sluice Gates Control Panel
 - e. Outfall Level Control Panel
 6. Building B – Main Equipment Control Building
 - a. Main Boiler Plant Control Panel

GLEN COVE WWTP MAINTENANCE OF PLANT OPERATIONS - INDEX OF ITEMS

- Item 1: Perform installation and testing of the new equipment located in the 19” server rack. Virtual machines and Cimplicity software shall be configured on the fault-tolerant server at the Glen Cove Control Building. Perform installation and testing of the operator workstations and monitors located throughout the Control Building.
- Item 2: Perform trenching between the Sodium Hypochlorite and Control Building associated with the fiber optic cabling. Perform installation of the fiber optic cable, fiber optic communication enclosures, RIO-IPS, and RIO-FINAL panels. Perform testing of the fiber optic cabling to establish network communications.
- Item 3: Perform the installation, cutover, startup, and testing of each plant area, one area at a time per the following sequence and per the Maintenance of Plant Operations Table below:
1. Control Building Electrical Room
 - a. PLC-ELEC Control Panel
 2. Headworks Building:
 - a. Gas Detection Equipment
 - b. RIO-IPS Control Panel I/O
 3. Sodium Hypochlorite Building
 - a. RIO-FINAL I/O

- 4. Control Building
 - a. RIO-ADMIN
- 5. Blower Room
 - a. Aeration Valve Power Panel (AVPP)
 - b. PLC-MACP

Item 4: Tie in the existing control panels to the new SCADA network per the following sequence and per the Maintenance of Plant Operations Table below:

- 1. Blower Room:
 - a. APG Neuros Blower Local Controller
 - b. Turblex Blower Local Control Panel
 - c. UV System Control Center (SCC)
- 2. Sludge Thickening Building:
 - a. CP-01 Control Panel (Main BFP Control Panel)

PART 2: PRODUCTS

None This Section

PART 3: EXECUTION

3.01 See following tables for MOPO items and their timing constraints

CEDAR CREEK WPCP MAINTENANCE OF PLANT OPERATIONS

ITEM NO	ITEM DESCRIPTION	TIME CONSTRAINTS	PROCESS UNITS OPERATING DURING SHUTDOWN	PROCESS UNITS OUT OF SERVICE FOR CONSTRUCTION WORK	SEQUENCE OF WORK	REMARKS
1	Perform installation and testing of the fiber optic cable and the fiber optic communication enclosures.	Any demolition of existing roads or structures required for conduit installation shall be repaired within one day.	No shutdown is required for this task. Plant and remote pump stations shall remain fully operational.	None	<p><u>Contractor</u> shall install new conduit as required by the contract.</p> <p><u>Contractor</u> shall install new fiber optic communication enclosures (FOCEs) including patch panels and Ethernet switches.</p> <p><u>Contractor</u> shall test fiber optic cable prior to installation as required by Section 16121.</p> <p><u>Contractor</u> shall install fiber optic cable within conduit and terminate each strand to patch panel.</p> <p><u>Contractor</u> shall terminate fiber optic patch cables between patch panels and Ethernet switches in the FOCEs.</p> <p><u>Contractor</u> shall test communication between all switches and test the failover of the fault-tolerant fiber network by disconnecting each fiber segment and confirming alarming and communication.</p>	Contractor shall run conduit through plant tunnels as much as possible to avoid demolition of existing plant roads or structures. Plant personnel must be notified prior to performing any work that may cause equipment shutdown.

CEDAR CREEK WPCP MAINTENANCE OF PLANT OPERATIONS

ITEM NO	ITEM DESCRIPTION	TIME CONSTRAINTS	PROCESS UNITS OPERATING DURING SHUTDOWN	PROCESS UNITS OUT OF SERVICE FOR CONSTRUCTION WORK	SEQUENCE OF WORK	REMARKS
2	Perform installation and testing of the new virtual machines and Cimplicity software on the existing fault-tolerant server at the Cedar Creek Administration Building. Perform installation and testing of the new operator workstations and monitors at the Administration Building Control Room.	Time constraints are limited by the overall project schedule constraints.	No shutdown is required for this task. Plant and remote pump stations shall remain fully operational.	None.	<p><u>Contractor</u> shall Install and configure new virtual machines for the two new redundant plant Cimplicity SCADA servers onto the existing fault-tolerant server.</p> <p><u>Contractor</u> shall Install the new workstations in the control room and the associated monitors. Test communication with the new virtual SCADA servers.</p> <p><u>Contractor</u> shall test the SCADA server redundancy</p>	This work requires software installation on the existing fault-tolerant server, which contains existing virtual machines for the pump station SCADA servers. The pump station SCADA servers must remain uninterrupted during this work unless permission is granted by the Owner.

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CEDAR CREEK WPCP MAINTENANCE OF PLANT OPERATIONS

ITEM NO	ITEM DESCRIPTION	TIME CONSTRAINTS	PROCESS UNITS OPERATING DURING SHUTDOWN	PROCESS UNITS OUT OF SERVICE FOR CONSTRUCTION WORK	SEQUENCE OF WORK	REMARKS
3.1	<p>Perform the installation of the local control stations for the digester recirculation pumps.</p> <p>Perform the installation, cutover, startup, and testing of PLC-DIG in the digester area and RIO-DIG in the DAF control room</p>	<p>None.</p> <p>2 weeks</p>	<p>Only one pump will be shut down at a time. Remaining sludge recirculation pumps will be operable.</p> <p>All digester equipment must remain in operation, therefore the Contractor is only permitted to relocate and extend one existing conduit at a time.</p>	<p>Sludge circulation pumps will need to be shut down one at a time to install new local control stations</p> <p>Digester and DAF Control panels will be demolished.</p>	<p><u>Contractor</u> shall install local control stations for one pump at a time.</p> <p><u>Contractor</u> The new PLC-DIG must be operational prior to demolishing the DAF control panel.</p> <p><u>Contractor</u> shall first trace, confirm, and label all existing wiring in the existing digester control panel.</p> <p><u>Contractor</u> shall, prior to demolishing digester control panels, ensure that the gas sphere pressure signal is visible to the plant operations from the local instrument.</p> <p><u>Contractor</u> will install and test new digester control panels first. Then extension of existing conduits and demolition of the existing control panels will occur. Each process shall be tested once it is relocated to the new control panel.</p> <p><u>Contractor</u> shall only extend one conduit at a time and shall not proceed to next conduit until associated wiring is terminated, and tested.</p> <p><u>Contractor</u> shall follow similar steps for demolition of the DAF control panel and installation of RIO-DIG.</p>	<p>Refer to plans and specifications for additional detail. A detailed MOPO plan shall be provided to Engineer for review and approval prior to any work beginning. A detailed schedule of work and equipment shutdown shall be included.</p>

CEDAR CREEK WPCP MAINTENANCE OF PLANT OPERATIONS

ITEM NO	ITEM DESCRIPTION	TIME CONSTRAINTS	PROCESS UNITS OPERATING DURING SHUTDOWN	PROCESS UNITS OUT OF SERVICE FOR CONSTRUCTION WORK	SEQUENCE OF WORK	REMARKS
3.2	Perform the installation, cutover, startup, and testing of PLC-ATCC-1,2,3, and 4. The MOPO requirements for all 4 enclosures are similar.	8 hours once each control panel is removed from service.	Plant must remain running, but will need to be controlled from local VFDs and from local valve actuators during this time.	<p>Remote Monitoring and Control of the following equipment will not be available: PLC-ATCC-1: South RAS Pump Station Equipment and valves. PLC-ATCC-2: Aeration Tank Flows and Valves and settled sewage valves on Tanks 4-6</p> <p>PLC-ATCC-3: North RAS Pump Station Equipment and valves.</p> <p>PLC-ATCC-4: Aeration Tank Flows and Valves and settled sewage valves on Tanks 4-6</p>	<p><u>Contractor</u> shall trace, confirm, and label all existing signal wiring that will be tied into the new PLC.</p> <p><u>Contractor</u> shall remove and discard the panel-mounted instruments, cover holes with steel plate, and install new OIT if re-using existing enclosure; or demolish completely if a new enclosure is being furnished.</p> <p><u>Contractor</u> shall demolish the internal components of if re-using the existing enclosure, or demolish the control panel completely if a new enclosure is being furnished.</p> <p><u>Contractor</u> shall install the new subpanel and/or control panel, re-terminate field wiring, and perform testing.</p> <p><u>Contractor</u> shall test new controls locally and from the associated plant SCADA servers.</p>	Add alternate Item 5 below, if accepted, needs to be completed prior to performing this item

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CEDAR CREEK WPCP MAINTENANCE OF PLANT OPERATIONS

ITEM NO	ITEM DESCRIPTION	TIME CONSTRAINTS	PROCESS UNITS OPERATING DURING SHUTDOWN	PROCESS UNITS OUT OF SERVICE FOR CONSTRUCTION WORK	SEQUENCE OF WORK	REMARKS
3.3	Perform the installation, cutover, startup, and testing of PLC-PST1 and PLC-PST-2. The MOPO requirements for both enclosures are similar.	8 hours once each control panel is removed from service.	Plant must remain running. Collectors and sludge pumps will need to be controlled from local hand switches.	Remote Monitoring and Control of the following equipment will not be available: <u>PLC-PST-1:</u> Primary Tanks and Pumps 1-6 <u>PLC-PST-2:</u> Primary Tanks and Pumps 7-10	<p><u>Contractor</u> shall trace, confirm, and label all existing signal wiring that will be tied into the new PLC.</p> <p><u>Contractor</u> shall demolish the existing control panel.</p> <p><u>Contractor</u> shall install the new control panel, re-terminate field wiring, and perform testing.</p> <p><u>Contractor</u> shall test new controls locally and from the associated plant SCADA servers.</p>	

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CEDAR CREEK WPCP MAINTENANCE OF PLANT OPERATIONS

ITEM NO	ITEM DESCRIPTION	TIME CONSTRAINTS	PROCESS UNITS OPERATING DURING SHUTDOWN	PROCESS UNITS OUT OF SERVICE FOR CONSTRUCTION WORK	SEQUENCE OF WORK	REMARKS
3.4	Perform the installation, cutover, startup, and testing of PLC-ECR	8 hours once the existing control panel is removed from service.	Plant must remain running. Control of the Blowers, Influent Pumps, and Outfall Pumps must be operated from the local control panels.	Control of the Blowers, Influent Pumps, and Outfall Pumps will not be available from the Engine control room.	<p><u>Contractor</u> shall, prior to any demolition, ensure that the Blowers, Influent Pumps, and Outfall Pumps can be operated from the respective local control panels after the existing New Remote Status control panel is removed from service. Temporary wiring and hand switch must be installed as necessary to achieve this. Any required modifications to the existing control system to accomplish this shall be submitted to Engineer for review and approval.</p> <p><u>Contractor</u> shall trace, confirm, and label all existing signal wiring in the New Remote Status Panel that will be tied into the new PLC.</p> <p><u>Contractor</u> shall install the new control panel adjacent to the existing control panel.</p> <p><u>Contractor</u> shall install new wiring and conduit as required by the contract.</p> <p><u>Contractor</u> shall terminate all signal wire.</p> <p><u>Contractor</u> shall test new controls locally and from the associated plant SCADA servers.</p> <p><u>Contractor</u> shall demolish the existing New Remote Status Panel.</p>	

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CEDAR CREEK WPCP MAINTENANCE OF PLANT OPERATIONS

ITEM NO	ITEM DESCRIPTION	TIME CONSTRAINTS	PROCESS UNITS OPERATING DURING SHUTDOWN	PROCESS UNITS OUT OF SERVICE FOR CONSTRUCTION WORK	SEQUENCE OF WORK	REMARKS
3.5	Perform the installation, cutover, startup, and testing of PLC-HVAC-B, RIO-HVAC-A, RIO-HVAC-C, RIO-HVAC-J, RIO-HVAC-K, and RIO-HVAC-R	8 hours once each control panel is removed from service.	Plant must remain running. Each HVAC System will continue to run	Remote Monitoring and Control of each HVAC system will not be available from the boiler control room when its control panel is taken down.	<p><u>Contractor</u> shall install the new PLC-HVAC-B control panel.</p> <p><u>Contractor</u> shall install new wiring and conduit as required by the contract.</p> <p><u>Contractor</u> shall trace, confirm, and label all existing signal wiring in each existing HVAC RTU panel and in the existing boiler control panel for all I/O that will be tied into the new control panels.</p> <p><u>Contractor</u> shall demolish the existing RTU-A.</p> <p><u>Contractor</u> shall install RIO-HVAC-A and re-terminate field wiring, and perform testing. Ensure that PLC-HVAC-B and RIO-HVAC-A can communicate over the HVAC VLAN.</p> <p><u>Contractor</u> shall, one at a time, replace the remaining HVAC RTU control panels. Re-terminate field wiring, and perform testing. Ensure that PLC-HVAC-B and all new RIO-HVAC panels can communicate over the HVAC VLAN.</p> <p><u>Contractor</u> shall terminate any signals from the existing boiler control panel to the new PLC-HVAC-B and perform testing.</p> <p><u>Contractor</u> shall demolish the existing 90-70 PLC and unused devices within the existing boiler control panel.</p>	

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CEDAR CREEK WPCP MAINTENANCE OF PLANT OPERATIONS

ITEM NO	ITEM DESCRIPTION	TIME CONSTRAINTS	PROCESS UNITS OPERATING DURING SHUTDOWN	PROCESS UNITS OUT OF SERVICE FOR CONSTRUCTION WORK	SEQUENCE OF WORK	REMARKS
3.6	Perform programming modifications of existing PLCs for the Gravity Belt Thickener PLC (Building H), the Influent Screening Control Panel (Building E), the Effluent Pump Control Panel (Building L), and the Dewatering Control Panel (Building S) for new flow signals being tied in. The MOPO requirements for all PLCs are similar.	Plant disruptions due to PLC modifications must be limited to 15 minutes.	Plant must remain running.	A temporary disruption of the equipment operation associated with the PLC program being modified can be expected.	<p><u>Contractor</u> shall, for each PLC program being modified, notify plant personnel before any downloads occur. Inform the plant personnel of potential equipment shutdowns. Take precautions, such as placing equipment into hand mode during the shutdown with approval of the plant personnel.</p> <p><u>Contractor</u> shall perform the PLC download.</p> <p><u>Contractor</u> will notify the plant personnel once download is complete.</p> <p><u>Owner</u> shall assist with returning the plant operation to its normal state after the download.</p> <p><u>Contractor</u> shall test modified logic and graphic displays.</p>	Plant personnel must be notified prior to performing any work that may cause equipment shutdown

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ITEM NO	ITEM DESCRIPTION	TIME CONSTRAINTS	PROCESS UNITS OPERATING DURING SHUTDOWN	PROCESS UNITS OUT OF SERVICE FOR CONSTRUCTION WORK	SEQUENCE OF WORK	REMARKS
4	Merge all existing Cimplicity database points and graphics into the fault-tolerant SCADA server, and tie in the existing Ethernet-based control panels to the new SCADA network. This procedure is similar for all Cimplicity servers listed in Paragraph 1.03A-Item 4 Above.	Time constraints are limited by the overall project schedule constraints.	No shutdown is required for this task. Plant and remote pump stations shall remain fully operational.	None	<p><u>Contractor</u> shall, configure the I/O driver on the Cimplicity virtual SCADA servers to include communication with all control panels listed in Paragraph 1.03A Item 4 above.</p> <p><u>Contractor</u> shall, for each SCADA server listed in Paragraph 1.03A Item 4 above, merge the existing Cimplicity database points into the new Cimplicity virtual SCADA servers.</p> <p><u>Contractor</u> shall, for each Control Panel listed in Paragraph 1.03A Item 4 above, import new Cimplicity database points into the new Cimplicity virtual SCADA servers.</p> <p><u>Contractor</u> shall, merge all Cimplicity graphic displays into all workstations.</p>	

CEDAR CREEK WPCP MAINTENANCE OF PLANT OPERATIONS

ITEM NO	ITEM DESCRIPTION	TIME CONSTRAINTS	PROCESS UNITS OPERATING DURING SHUTDOWN	PROCESS UNITS OUT OF SERVICE FOR CONSTRUCTION WORK	SEQUENCE OF WORK	REMARKS
5	Installation of new Settled WW and RAS actuators	Contractor shall limit the amount of time the valves are isolated to the greatest extent possible.	Aeration and return sludge systems may not be taken out of service for this work. The Contractor shall coordinate with the Owner when isolation is required to install and test the new actuators.	Only one tank can be isolated at a time.	<p><u>Owner</u> shall identify the order in which the settled wastewater and RAS valves can be isolated from service to facilitate the installation of testing of the new actuators.</p> <p><u>Contractor</u> to install all electrical, mechanical and control work associated with the new actuators.</p> <p><u>Contractor</u> to perform all required testing.</p>	This add alternate item, if accepted, shall be performed in parallel with Items 1 thru 4. Because the valve actuators are required for automating the RAS and settled waste valves. This item must be completed prior performing Item 3.2 above.

GLEN COVE WWTP MAINTENANCE OF PLANT OPERATIONS

ITEM NO	ITEM DESCRIPTION	TIME CONSTRAINTS	PROCESS UNITS OPERATING DURING SHUTDOWN	PROCESS UNITS OUT OF SERVICE FOR CONSTRUCTION WORK	SEQUENCE OF WORK	REMARKS
1	Perform installation and testing of the new equipment located in the 19" server rack. Virtual machines and Cimplicity software shall be configured on the fault-tolerant server at the Glen Cove Control Building. Perform installation and testing of the operator workstations and monitors located throughout the Control Building.	Existing network and server equipment shall be removed from service and reinstalled in the new server rack within 4 hours.	No process shutdown is required for this task. Plant and remote pump stations shall remain fully operational.	None.	<p><u>Contractor</u> shall coordinate with the plant operator's IT department to create a procedure for moving the existing equipment into the new server rack. The new server rack shall be placed next to the existing server rack such that the existing equipment can be removed from the old rack and immediately installed into the new rack. Once all equipment is removed from the existing rack, the rack shall be removed and returned to the IT department. The new rack shall be moved into place.</p> <p><u>Contractor</u> shall install, commission, and test the new server and communication equipment and verify that it is ready for communication with plant equipment.</p> <p><u>Contractor</u> shall configure remote connections to the Cedar Creek and Bay Park facilities and verify that Control data is transmitted properly between the plants.</p> <p><u>Contractor</u> shall Install the new workstations in the Control Building and the associated monitors. Test communication with the SCADA servers.</p> <p><u>Contractor</u> shall test the SCADA server redundancy</p>	

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ITEM NO	ITEM DESCRIPTION	TIME CONSTRAINTS	PROCESS UNITS OPERATING DURING SHUTDOWN	PROCESS UNITS OUT OF SERVICE FOR CONSTRUCTION WORK	SEQUENCE OF WORK	REMARKS
2	<p>Trenching required to route fiber between the Sodium Hypochlorite Building and the Control Building.</p> <p>Perform installation and testing of the fiber optic cable and the fiber optic communication enclosures.</p> <p>Installation of RIO-IPS and RIO-FINAL.</p>	Trenching shall be completed within 10 business days.	No shutdown is required for this task. Plant shall remain fully operational.	None	<p><u>Contractor</u> shall install new conduit as required by the contract. Trenching between the Sodium Hypochlorite Building and the Control Building shall be performed.</p> <p><u>Contractor</u> shall install new fiber optic communication enclosures (FOCEs) including patch panels and Ethernet switches. The contractor shall install the RIO-IPS and RIO-FINAL, which houses FOCEs. Termination of I/O associated with RIO-IPS and RIO-FINAL is not required during this step.</p> <p><u>Contractor</u> shall test fiber optic cable prior to installation as required by Section 16121.</p> <p><u>Contractor</u> shall install fiber optic cable within conduit and terminate each strand to patch panel.</p> <p><u>Contractor</u> shall terminate fiber optic patch cables between patch panels and Ethernet switches in the FOCEs.</p> <p><u>Contractor</u> shall test communication between all switches and test the failover of the fault-tolerant fiber network by disconnecting each fiber segment and confirming alarming and communication.</p>	<p>This task may be performed concurrently with Task 1; however, Task 1 must be completed before this task, in order to test fault-tolerant fiber network alarming.</p>

GLEN COVE WWTP MAINTENANCE OF PLANT OPERATIONS

ITEM NO	ITEM DESCRIPTION	TIME CONSTRAINTS	PROCESS UNITS OPERATING DURING SHUTDOWN	PROCESS UNITS OUT OF SERVICE FOR CONSTRUCTION WORK	SEQUENCE OF WORK	REMARKS
3.1a	Perform the installation of the local control stations for the Return Activated Sludge pumps	None.	Only one pump will be shut down at a time. Remaining RAS pumps will be operable.	RAS pumps will need to be shut down one at a time to install new local control stations	<u>Contractor</u> shall install local control stations for one pump at a time.	Refer to plans and specifications for additional detail. A detailed MOPO plan shall be provided to the Engineer for review and approval prior to any work beginning. A detailed schedule of work and equipment shutdown shall be included.
3.1b	Perform the installation, cutover, startup, and testing of PLC-ELEC in the Control Building electrical room.	The Contractor shall have two work days to make all modifications and final terminations which require a shutdown, for each piece of equipment. Cutover for equipment must be completed prior to the end of business hours on Friday.	All processes must remain in operation; therefore, the Contractor shall cutover equipment one at a time.	None	<u>Contractor</u> will install and test the new control panel. <u>Contractor:</u> New wiring and conduit may be routed to the equipment one at a time or all at once, however, final terminations to the existing equipment will be performed one at a time and tested before the next equipment may be connected. <u>Contractor</u> shall verify that the PLC-ELEC has been properly configured to accept signals from the RIO panels provided under this contract, such that communications will be established when RIO panels are connected in the following steps.	

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ITEM NO	ITEM DESCRIPTION	TIME CONSTRAINTS	PROCESS UNITS OPERATING DURING SHUTDOWN	PROCESS UNITS OUT OF SERVICE FOR CONSTRUCTION WORK	SEQUENCE OF WORK	REMARKS
3.2a	Perform the installation, cutover, startup, and testing of Gas Detection Equipment in the Headworks Building.	Time constraints are limited by the overall project schedule constraints.	The existing gas detection system shall remain fully operational until the new system is accepted by the Engineer and Owner. Acceptance of the new system shall be prior to demolition of the existing detection system.	None	<p>Contractor install new gas detection equipment, alarms and beacons. The new gas detection equipment shall be fully calibrated per the manufacturer's requirements, tested, and accepted by the Owner and Engineer.</p> <p>Contractor shall demolish the existing gas detection equipment, conduit, and wiring following approval of the new system.</p>	Refer to plans and specifications for additional detail. A detailed MOPO plan shall be provided to the Engineer for review and approval prior to any work beginning. A detailed schedule of work and equipment shutdown shall be included.
3.2b	Perform the cutover, startup, and testing of RIO-IPS in the Headworks Building electrical room		All equipment must remain in operation; therefore, the Contractor shall cutover equipment one at a time.	None	<p>Contractor shall test connection with the PLC-ELEC. (Note: RIO-IPS has already been installed under Task 2)</p> <p>Contractor shall terminate I/O and test new controls locally and from the associated plant SCADA servers.</p>	

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ITEM NO	ITEM DESCRIPTION	TIME CONSTRAINTS	PROCESS UNITS OPERATING DURING SHUTDOWN	PROCESS UNITS OUT OF SERVICE FOR CONSTRUCTION WORK	SEQUENCE OF WORK	REMARKS
3.3	Perform the cutover, and startup, and testing of RIO-FINAL in the Sodium Hypochlorite building.	Time constraints are limited by the overall project schedule constraints.	Plant must remain running. UV system may not be powered down to establish connections to the new RIO-FINAL panel.		<p><u>Contractor</u> shall test connection with the PLC-ELEC. (Note: RIO-IPS has already been installed under Task 2)</p> <p><u>Contractor</u> shall terminate I/O and test new controls locally and from the associated plant SCADA servers.</p>	Connections to the UV system must occur while the UV system is in operation.

GLEN COVE WWTP MAINTENANCE OF PLANT OPERATIONS

ITEM NO	ITEM DESCRIPTION	TIME CONSTRAINTS	PROCESS UNITS OPERATING DURING SHUTDOWN	PROCESS UNITS OUT OF SERVICE FOR CONSTRUCTION WORK	SEQUENCE OF WORK	REMARKS
3.4	Perform the installation, cutover, startup, and testing of RIO-ADMIN in the Control Building.	Autodialer alarms disconnected from the existing system shall be reconnected to the RIO-FINAL and tested prior to the end of the same working day. Cutover of the WAS valve shall be completed within one work day.	Alarm dialer, WAS Valve	None	<p><u>Contractor</u> shall install the new RIO-ADMIN control equipment inside the existing graphic panel.</p> <p><u>Contractor</u> shall install new wiring and conduit as required by the contract.</p> <p><u>Contractor</u> shall terminate all signal wire. Alarm dialer signals shall be cut over one at a time and tested.</p> <p><u>Contractor</u> shall test new signals locally and from the associated plant SCADA servers.</p>	Refer to plans and specifications for additional detail. A detailed MOPO plan shall be provided to the Engineer for review and approval prior to any work beginning. A detailed schedule of work and equipment shutdown shall be included.

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GLEN COVE WWTP MAINTENANCE OF PLANT OPERATIONS

ITEM NO	ITEM DESCRIPTION	TIME CONSTRAINTS	PROCESS UNITS OPERATING DURING SHUTDOWN	PROCESS UNITS OUT OF SERVICE FOR CONSTRUCTION WORK	SEQUENCE OF WORK	REMARKS
3.5	Perform installation, and cutover of the new Aeration Valve Power Panel (AVPP).	480V power shall be disconnected from the MACP and reconnected to the new 480V power panelboard in one working day.	Plant must remain running. Aeration tanks shall continue to run.	Automatic valve control, flow, and Dissolved Oxygen (DO) monitoring will not be available during the cutover. Aeration tanks should be cutover one at a time. Blower control shall be coordinated with the Plant.	<p><u>Contractor</u> shall install the new AVPP.</p> <p><u>Contractor</u> shall disconnect the 480V power supply from the existing MACP and reconnect to the AVPP.</p> <p><u>Contractor</u> shall wire a temporary circuit back to the existing master control panel for temporarily powering the existing valve actuators.</p> <p><u>Contractor</u> shall install the new PLC-MACP control panel.</p> <p><u>Contractor</u> shall trace, confirm, and label all existing signal wiring for each tank for all I/O that will be tied into the new MACP control panel.</p> <p><u>Contractor</u> shall install new wiring and conduit as required by the contract.</p> <p><u>Contractor</u> shall install the DO probes, flowmeter, and valve actuator for the first tank. Once new equipment is installed, wiring shall be terminated at the new MACP instead of the existing MACP. New valves shall be connected to the new AVPP. After the last tank has been cutover, the temporary 480V connection between the AVPP and the existing MACP can be disconnected and the existing MACP removed from service.</p>	The existing MACP and connections between the existing MACP and the existing blower controls shall not be removed until after the blowers are connected to the new system as required in Item 4 of the MOPO.
	Perform the installation, cutover, startup, and testing of PLC-MACP in the Control Building Blower Room.					

GLEN COVE WWTP MAINTENANCE OF PLANT OPERATIONS

ITEM NO	ITEM DESCRIPTION	TIME CONSTRAINTS	PROCESS UNITS OPERATING DURING SHUTDOWN	PROCESS UNITS OUT OF SERVICE FOR CONSTRUCTION WORK	SEQUENCE OF WORK	REMARKS
4.1	Tie in the existing APG Neuros and Turblex control panels to the new SCADA system.	APG Neuros blower shall be cutover to the new system within 16 hours (2 working days).	Shutdown of the APG Neuros blower is anticipated in order to establish communication link between the APG Neuros Controller and the new MACP. During this period of time the Turblex blower shall be used for air flow to the aeration tanks. Shutdown shall be coordinated with plant staff.	None	<p><u>Contractor</u> shall, install a new CPU and configure the Turblex blower so that it may communicate with the new MACP.</p> <p><u>Contractor</u> shall, test the automatic flow and DO control descriptions required for the aeration tanks using the Turblex blower. The Turblex blower shall be fully functional before changes are made to the APG Neuros blower.</p> <p><u>Contractor</u> shall, establish communications with the APG Neuros Blower using the register list provided in Appendix B of Section 13300. Tests performed for the Turblex blower shall be demonstrated again but using the APG Neuros blower to maintain flow and DO.</p> <p><u>Contractor</u> shall, configure the Cimplicity SCADA server I/O drivers to establish communications between the Blower control panels and the HMI system.</p> <p><u>Contractor</u> shall, remove any remaining components and communication links to the existing MACP.</p>	

GLEN COVE WWTP MAINTENANCE OF PLANT OPERATIONS

ITEM NO	ITEM DESCRIPTION	TIME CONSTRAINTS	PROCESS UNITS OPERATING DURING SHUTDOWN	PROCESS UNITS OUT OF SERVICE FOR CONSTRUCTION WORK	SEQUENCE OF WORK	REMARKS
4.2	Tie in the existing CP-01 Belt Filter Press Main control panel to the new SCADA system.	Time constraints are limited by the overall project schedule constraints.	None	None	<u>Contractor</u> shall configure the Cimplicity SCADA server I/O drivers to establish communications between the Blower control panels and the HMI system.	

GLEN COVE WWTP MAINTENANCE OF PLANT OPERATIONS

ITEM NO	ITEM DESCRIPTION	TIME CONSTRAINTS	PROCESS UNITS OPERATING DURING SHUTDOWN	PROCESS UNITS OUT OF SERVICE FOR CONSTRUCTION WORK	SEQUENCE OF WORK	REMARKS
4.3	Perform Installation and Cutover of new UV System Control Center (SCC)	Cutover of the new UV System Control Center (SCC) shall be limited to 3 days.	Complete shutdown of the UV system will not be permitted at any time. The UV system will continue to treat the plant flow throughout the duration of the cutover process.	The cutover shall be coordinated with the Operator. If is determined that one UV channel is sufficient for treating all plant flow, it is acceptable to isolate a channel for cutover one at a time.	<p><u>Contractor</u> shall install UV System Control Center (SCC) and associated conduit and wiring as indicated on the drawings.</p> <p><u>Contractor</u> shall terminate all wiring except for the serial cable connecting the existing SCC to the existing Power Distribution Center (PDC) and the flow signal connecting the existing SCC and the existing effluent flow meter. These wires shall be terminated when the UV system supplier's certified technician is onsite to perform startup and commissioning of the system.</p> <p><u>Contractor</u> shall run UV channels in local with assistance from the Operator and UV System supplier to ensure uninterrupted treatment during cutover.</p> <p><u>Vendor</u> (UV System Supplier) shall assist the contractor in making final terminations from a previous step. The UV System Supplier shall perform the cutover of the UV system so that the system is controlled with the new SCC.</p>	
	Perform Installation and Cutover Hydraulic System Center (HSC) Controls	Cutover to the new HSC controls shall be limited to 1 day.		System cleaning (wiping) will not be available during the HSC upgrade.	<p><u>Contractor</u> shall manually initiate a cleaning cycle with assistance from the operator and UV System Supplier immediately prior to cutover occurring.</p> <p><u>Vendor</u> (UV System Supplier) install and test the new HSC control equipment so that cleaning is performed with the new controller.</p>	

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END OF SECTION

SECTION 01311
CONSTRUCTION SCHEDULING

PART 1 GENERAL

1.01 DESCRIPTION

- A. The work shall consist of preparing, submitting, and maintaining a computerized CPM (Critical Path Method) progress schedule using Primavera P6 software.
- B. The purpose of the computerized CPM progress schedule is to ensure timely completion of the contract and to establish a standard methodology for time adjustment analysis based on the principles of the Critical Path Method of Scheduling.
- C. For this specification, 'Engineer' means County authorized Construction Manager.
- D. The Contractor shall ensure that any and all computer files submitted to the Engineer are in a format that can be imported directly using Primavera P6 software, version 16.2 or later.
- E. The Contractor will retain a CPM Consultant, approved by the Engineer, to assist in the development and preparation of the CPM schedule, and in subsequent schedule updating. The CPM Consultant shall have acceptable certifications such as AACE's Planning & Scheduling Professional (PSP), Project Management Institute's PMI-SP, or approved equal. The CPM Consultant is required to attend the Monthly Schedule Update Meetings. The Contractor is deemed to have included in the Bid price sufficient monies to pay all expenses required to develop the CPM Schedule and to guarantee its successful operation, implementation and maintenance.

1.02 DETAILS

A. PRE-CONSTRUCTION SCHEDULING MEETING

- 1. The Engineer will schedule and conduct a Pre-construction Scheduling Meeting with the Contractor within ten (10) working days after Notice to Proceed. The requirements of this specification will be reviewed at this meeting. Additionally, the following topics will be discussed:
 - a. Specifics of any contract Time-Related Clauses.
 - b. The representation in the schedule of the Time Related work.
 - c. The calendar, activity coding, and resource definition requirements unique to and consistent with the contract.
 - d. The Contractor's schedule methodology employed, proposed work sequence and any proposed deviations of sequences from the contract plans.
 - e. The factors that the Contractor determines to control the completion of the project and any milestone completions contained therein.
 - f. Narrative content for Initial Baseline and Monthly Updates.
 - g. Schedule submission protocol for Initial Baseline and Monthly Updates.
- 2. The Contractors attendance at the Pre-construction Scheduling Meeting is mandatory. No field work will be allowed, with the exception of set up of the field office, until this meeting is held.

B. INITIAL BASELINE CPM CONSTRUCTION SCHEDULE

1. Within sixty (60) workdays following the Notice to Proceed, the Contractor shall prepare and submit to the Engineer the Initial Baseline CPM Construction Schedule for the entire project. This submission shall include the electronic Schedule file and paper reports as required and approved by the Engineer.
2. The Initial Baseline Schedule must be Cost and resource loaded and shall represent the Contractor's plan to construct the project. This schedule shall include all work and activities necessary to complete the project including but not limited to activities for the preparation, submittal, review, approval, fabrication, and delivery of all procurement related items. The Initial Baseline CPM Construction Schedule must be set up to conform to the staging/phasing and other requirements defined in or required by the contract.
3. The Initial Baseline Schedule shall meet all interim milestone dates and shall not extend beyond the contract completion date.

C. SCHEDULE REQUIREMENTS

1. The Contractors Initial Baseline CPM Construction Schedule shall meet the following requirements:
 - a. CPM ACTIVITY NETWORK FORMAT - The schedule network shall use the Precedence Diagramming Method.
 - b. PROJECT DEFINITIONS - The following project specific properties within the schedule shall be defined:
 - 1) CALENDAR - All calendars created shall encompass and account for the total duration of the contract time period. The standard calendar shall be 8-hour days, five days per week and shall account for holidays and non-working days as defined in the contract documents. Additional calendars shall be created and included as required for:
 - a) Work week (5 or 6 day). (When or if the contractor elects to utilize a 6-day work week he shall be responsible for the county's overtime costs as applicable by the contract requirements).
 - b) Seasonal restrictions (asphalt, landscape, etc.).
 - c) Concrete curing/calendar days.
 - d) Any project specifics as required by the Engineer.
 - e) Expected and contemplated weather conditions shall be accounted for in the schedule and described in the narrative.
 - 2) ACTIVITY CODE - As a minimum following activity codes shall be established:
 - a) Responsibility - The party responsible for each activity. Only one party can be responsible for an activity. Include Values for "Nassau County Department of Public Works (NC)", "Prime Contractor" and third parties to the contract as appropriate (utilities, etc.).
 - b) Phase- Phasing consistent with Contract plans where each activity is performed; Include Values for "None", and "Project Wide".
 - c) Location - Location of activity work by Stationing; Include Value for "None", and "Project Wide".
 - d) Type- The type of work for each activity; Include a Value for "Administrative".
 - e) Added Work- Work added to the Contract and incorporated into the schedule with the Engineers Approval.

- f) As Required by Project - Any coding unique to or as required by the Engineer to facilitate the use and analysis of the Schedule. This coding shall be established in consultation with the Engineer at the Pre-construction Scheduling Meeting.
- 3) RESOURCES - The Resource Dictionary shall be established as required by the Engineer. The Resource Dictionary shall be limited to Labor and Equipment. Labor may be represented by work crews. The composition of each crew must be detailed and included as an appendix to the Narrative Report. Sub-Contractors shall be represented as a labor crew(s).
- 4) COST LOADING - Basis of cost loading will be the approved Schedule of Values.
- 5) ACTIVITY DATA
 - a) ACTIVITY IDENTIFICATION - Each activity shall have a unique identifier. The identifier may be alpha-numeric, but at a minimum must be a unique number.
 - b) ACTIVITY DESCRIPTION - Each activity shall be unambiguously described. Descriptions such as "construct 30% of Y" are unacceptable. Activities shall be discrete to the extent necessary to accurately schedule the work.
 - c) ACTIVITY DURATION - Durations of individual work activities shall not exceed twenty (20) working days. The minimum activity duration increment is one full day. Durations of individual shop drawing review activities may exceed fifteen working days and shall be consistent with Contract Requirements. Exceptions to this will be reviewed by the Engineer on an activity-by-activity basis. If requested by the Engineer, production rates or other supporting information shall be supplied justifying the reasonableness of any given activity time duration. A Method Statement including the labor, equipment, production rates and any additional information, required to achieve a given activity shall be supplied within 5 working days when requested by the Engineer.
 - d) ACTIVITY RELATIONSHIPS - Activity relationships shall be finish-to-start with no lags unless directed otherwise by the Engineer. Contractor requests for exemptions will be made on a case by case basis. Each activity with the exception of the required "Project Notice To Proceed" and "Completion" activities shall have a predecessor and a successor activity relationship.
 - e) ACTIVITY START and FINISH DATES - The earliest start date, earliest finish date, latest start date, and latest finish date shall be calculated for each activity.
 - f) ACTIVITY TOTAL FLOAT - The total float shall be calculated for each activity. Total float is the full amount of time by which the start on an activity may be delayed without causing the project to last longer.
 - g) ACTIVITY CALENDARS - The appropriate calendar assignment shall be made to each activity.
 - h) ACTIVITY CODES - Coding shall be assigned to each activity from the defined activity dictionary. Each code shall have a value assigned in a given activity.

- i) **ACTIVITY CONSTRAINTS** - The start or completion of any activity shall not be constrained. Exceptions to this must receive prior approval in writing by the Engineer. A “Must-Finish-By” Date for the overall project is a constraint and must be pre-approved by the Engineer.
 - j) **ACTIVITY RESOURCES** - The schedule shall be “Resource” loaded as required by the Engineer. The resources required to accomplish each activity shall be assigned to that activity from the ‘Resource Dictionary.’”
- 6) **REQUIRED ACTIVITIES** – The following activities shall be incorporated into the Schedule:

Activity ID	Activity Description	Activity Type	Logic Relationship
000010	Contract Notice to Proceed	Start Milestone	No Predecessors to this First Schedule Activity
999999	Completion	Finish Milestone	No Successor to this Last Schedule Activity

- 7) **DATA DATE** – The Data Date and Project Start Date in the Initial Baseline Schedule shall be the NOTICE TO PROCEED DATE. The Data Date for each Monthly Update shall be the first workday of the month.

D. REVIEW AND ACCEPTANCE OF THE INITIAL BASELINE CPM CONSTRUCTION SCHEDULE

1. The Contractor shall submit to the Engineer the following items to facilitate review of the Initial Baseline CPM Construction Schedule:
 - a. **Narrative** - A statement explaining the general sequence of work in the Contractor's schedule, a detailed definition of the work on the Critical Path, a statement regarding the meeting of any Time Restrictive Clause dates, and the explanation of any other ambiguities in the schedule.
2. The following Activity Reports generated from the software shall be provided or as required and approved by the Engineer:
 - a. **Critical Path Activity Sort** - The activities that comprise the projects Critical Path. The list shall start with the first activity in the path and then ascend by Early Start date to the final activity in the path.
 - b. **Critical Path Activity Sort** - The activities that comprise the projects Critical Path. The list shall start with the first activity in the path and then ascend by Early Start date to the final activity in the path.
 - c. **Constraint Activity Sort** - Listing of Constrained Activities and type of constraint.
 - d. **Listing of Calendars and Activity Coding** incorporated in the Schedule.
3. Electronic copies of the Initial CPM Construction Schedule shall be provided in format approved by the Engineer.
4. The Engineer will review the Initial Baseline CPM Construction Schedule and forward any comments, revisions, or requests to the Contractor. Within ten (10) workdays of the Engineer’s reply, the Contractor shall make adjustment to the Initial Baseline CPM Construction Schedule in accordance with the Engineer’s comments and resubmit copies for review consistent with the above directives.

5. Upon final revisions, the Contractor shall submit electronic file copies of the Initial Baseline CPM Construction Schedule to the Engineer. A sort of activities scheduled to start (ES) & finish (EF) in the next update period shall be included. The Logic Diagram shall be submitted as directed by the Engineer. The final submission shall be submitted for approval within five (5) workdays of the Contractor's receipt of the final comments by the Engineer.
6. Approval of the Initial Baseline CPM Construction Schedule by the Engineer shall not be construed to imply approval of any particular method or sequence of construction or to relieve the Contractor of providing sufficient materials, equipment, and labor to guarantee completion of the project in accordance with the contract proposal, plans, and specifications. Approval shall not be construed to modify or amend the completion date. Completion dates can only be modified or amended by standard contractual means.
7. Failure to include in the Initial Baseline CPM Construction Schedule any element of work required for the performance of the contract shall not excuse the Contractor from completing all work required within the completion date(s) specified in the contract.

E. SCHEDULE UPDATES

1. MONTHLY PROGRESS UPDATES
 - a. The Contractor shall update the schedule monthly. The schedule shall be updated to include all work and progress up to and including the last working day of the month. This will establish the "Data Date". The Monthly update shall detail progress based on actual dates of activities started and completed, the percent of work completed to date on each activity started but not yet completed and the status of procurement of critical materials. The updated schedule data shall be submitted in an electronic file format acceptable to the Engineer.
2. A Narrative Report is required for each update and shall provide the following information:
 - a. Contractors transmittal letter to the Engineer stating the update period and schedule "Data Date".
 - b. Work started, completed and ongoing during the update period by activity with "Actual Dates."
 - c. Description of current Critical Path and any change from previous Critical Path.
 - d. Any activities added or deleted and any proposed changes in Activity Logic (Engineer's approval in writing is required).
 - e. Current Delays or Advancements
 - 1) Delayed or Advanced Activities.
 - 2) Proposed corrective action and schedule adjustments to address any Delays.
 - 3) Impact of Delays or Advancement on other activities (duration, ES, EF, LS, LF), milestone and completion dates.
 - 4) Impact of Delays or Advancement on the Critical Path.
 - f. Outstanding Items that effect the schedule and status thereof (including but not limited to):
 - 1) Permits.
 - 2) Shop Drawings.
 - 3) Change Orders.
 - 4) Reviews of submittals.
 - 5) Approvals.
 - 6) Fabrication and Delivery.

- g. Scheduled Completion Date Status
 - 1) Contract Completion.
 - 2) Interim Milestones / Time Frame if any.
- 3. The following Activity Reports generated from the Software shall be provided:
 - a. Current Critical Path Activity Sort.
 - b. Near Critical Activities Sort.
 - c. Report of Activities scheduled to start (ES) & finish (EF) in the next Monthly update period.
 - d. Any other “Report” as directed by the Engineer and/or as discussed in the pre-construction scheduling meeting.
- 4. The Monthly Progress Updates shall be submitted to the Engineer within five (5) workdays of the “Data Date”. The Engineer shall prepare a written response within five (5) workdays of receipt of the Monthly Update approving, approving with comments, or returning for resubmission within five (5) workdays.
- 5. If the Contractor fails to comply with the Monthly Progress Update submission requirements the Commissioner reserves the right to withhold any or all contract payments.
- 6. Monthly Schedule Meetings and Reports
 - a. Monthly, on a date established by the Engineer prior to the Data Date, a CPM Progress Meeting will be held, at which time the schedule update will be reviewed. The meeting shall be attended by the Engineer and representative(s) of the Contractor including the scheduling consultant. The Contractor representative(s) at the meeting shall have the competence and authority to make any necessary decisions and their statement shall commit the Contractor to the agreed procedures, sequencing of Work, coordination and time schedules.
 - b. Prior to the meeting, the CPM scheduling consultant shall obtain, through any required means including Site meetings, the necessary information to update the CPM schedule to reflect progress to date and to update/revise the schedule for the balance of the Project. The updated schedule and draft narrative report shall be furnished to the Engineer at least 48 hours prior to the meeting and be distributed by the Contractor in hard copy at the meeting for review. To update the CPM schedule, the Contractor shall:
 - 1) Enter actual start and completion dates for those Activities started and/or completed during the previous reporting period.
 - 2) For Activities in progress, indicate the Remaining Duration correlating to an accurate forecasted completion date and physical percentage complete to date (Percent Complete is to reflect the actual quantity of Work completed, and is separate from any actual or Remaining Duration calculation). Review, and revise as necessary, the network logic for the Remaining Duration of the Work from the update to the estimated completion date.
 - 3) For activities not yet started, review, and revise as required, the necessary Logic, the Durations of Work and the estimated start and completion dates.
 - 4) Enter, for each applicable Activity, actual installed quantities information.

- c. The total Duration to be initially added to any schedule update reflecting the Change Order Activities from identification to the approval of any specific change order shall be in approved by the Engineer and shall be incorporated into the monthly schedule update following the identification of the changed Work. The forecasted construction Activities shall be logically tied to the appropriate predecessor and successor base Contract Activities and contain all of the required Logic, Duration, Coding and Resources/Cost Loading specified for the detailed CPM schedule activities.
- d. In the event the Contractor begins performance in the field of Extra Work during the update period, the monthly progress schedule update shall reflect the actual start date of the Work, and any predecessor Logic ties or restraints shall be broken in order to accurately forecast complete of the identified Extra Work Activity. This will allow for accurate forecasting of the successor Work Activities and completion Milestones.
- e. Default progress data provided from the scheduling system is not allowed. Actual start and finish dates and Remaining Durations of Activities shall not be automatically updated by default mechanisms that may be included in CPM scheduling software systems. Actual start and finish dates on the CPM schedule shall match those dates provided from the Contractor's Daily Quality Control Reports. Failure of the Contractor to document the actual start and finish dates on the Contractor Daily Quality Control Report for every in-progress or completed Activity and ensure that the data contained on the Contractor Daily Quality Control Report is the sole basis for schedule updating shall result in the disapproval of the Contractor's submittal.
- f. Activities that have reported progress without predecessor Activities being completed (out-of-sequence progress) will not be allowed except on a case-by-case basis with the approval of the Engineer. A written explanation for each instance shall be included in the monthly submittal.
- g. The Contractor shall not constrain the schedule with artificial Logic ties and/or constraint dates and/or any other scheduling techniques that may distort the Activity Float and Total Float associated with the critical Path Activities and the schedule in general.

F. TOTAL FLOAT OWNERSHIP

- 1. Total Float belongs to the contract and shall not be considered as available for the exclusive use or benefit of either the County or the Contractor. Total Float is the number of days an activity may be delayed without extending the completion of either the project or an interim milestone. Float is available on a first-come, first-served basis to all identified "Responsible" parties in the schedule.

G. FLOAT MANIPULATION NOT PERMITTED

- 1. The Schedule shall not sequester float through such strategies as calendar manipulation, resource/labor manipulation or the extension of activity durations to fill up available float time. The Initial Baseline CPM Construction Schedule shall not attribute negative float to any activity.

H. CHANGES TO THE SCHEDULE

1. The Initial Baseline CPM Construction Schedule shall accurately reflect the manner in which the Contractor intends to proceed with the project. Changes to the schedule (the addition or deletion of activities, logic changes, and duration changes) shall be submitted in writing to the Engineer for approval and inclusion in the next Monthly Progress Update. The process of comparing the Schedule Update to Baseline shall be followed throughout the contract. Revision to any contract milestones, or contractually mandated schedule provisions will not be permitted without written authorization from the Engineer.

I. CRITICAL ACTIVITIES AND BASIS FOR TIME ADJUSTMENTS

1. The measure for Time Adjustments in the schedule shall be based on the criticality, and responsibility of the delay or advancement. Criticality is defined as the presence of the delayed or advanced activity on the projects Critical Path. The Critical Path is defined to be the longest continuous chain of activities through the schedule network that establishes the minimum overall duration in the absence of constraints in the program software. Time adjustment does not mean an extension of time for this contract.

J. CHANGES TO THE CONTRACT

1. In the event a notice of a change to the contract is received the Contractor shall notify the Engineer in writing within 10 (ten) calendar days of the effect of such change to the schedule. Change to the contract includes, but is not limited to, extra work, change orders, work suspensions, changed condition, Value Engineering Change Proposal, etc. The effect of the change to the contract on the projects Critical Path shall be stated. Any proposed revisions to the Schedule to incorporate the change to the contract shall be stated. No changes shall be made to the Schedule without prior written approval of the Engineer. The approved changes shall be incorporated in the next Monthly Progress Update.

1.03 TIME IMPACT ANALYSIS

- A. This analysis will be performed by the Engineer (CM's scheduler) based on schedule updates as accepted in monthly schedule updates.
- B. Events, actions, and progress that cause delays or gains to the Project Schedule will be analyzed solely by the "Contemporaneous Period Analysis" method. The Contemporaneous Period Analysis evaluates delays or gains in the period in which it occurred. The analysis period for the purpose of this Specification shall be the period covered in each Monthly update to the schedule.
- C. Impact of delay will be evaluated at the completion of the project. However, an interim extension of time for payment purposes only may be granted by the Commissioner at his or her sole discretion at the end of contractual completion date.

1.04 RECOVERY SCHEDULES

A. General Provisions for Recovery Schedules:

1. When updated Progress Schedule indicates and the Engineer determines that the ability to comply with the Contract Times falls behind schedule due to delay attributed to the CONTRACTOR, the Contractor shall prepare and submit a Progress Schedule demonstrating responsible Contractor's plan to accelerate related work to achieve compliance with the Contract Times ("recovery schedule") for Engineer's acceptance.
2. Submit recovery schedule within 10 workdays after submittal of updated Progress Schedule where need for recovery schedule is indicated or include in next update as directed by the Engineer.

B. Implementation of Recovery Schedule:

1. At no additional cost to OWNER, do one or more of the following: furnish additional labor, provide additional construction equipment, provide suitable materials, employ additional work shifts, expedite procurement of materials and equipment to be incorporated into the Work, and other measures necessary to complete the Work within the Contract Times.
2. Item 1 above is also applicable when the Contractor is required to accelerate their Work to recover lost time.
3. Upon acceptance of recovery schedule by Engineer, incorporate recovery schedule into the next Progress Schedule update.

C. Lack of Action:

1. The Contractor's refusal, failure, or neglect to take appropriate recovery action, or the Contractor's refusal to submit a recovery schedule and take appropriate recovery action, shall constitute reasonable evidence that CONTRACTOR is not prosecuting the Work or separable part thereof with the diligence that will ensure completion within the Contract Times. Such lack of action shall constitute sufficient basis for OWNER to exercise remedies available to OWNER under the Contract Documents.

1.05 METHOD OF MEASUREMENT

- A. The CPM Progress Schedule will be measured for payment on a Lump Sum Basis.

1.06 BASIS OF PAYMENT

- A. The lump sum price bid for the Critical Path Method Scheduling system shall include the cost of preparation and submission of the Initial Baseline Schedule and the preparation and submission of the monthly updates.

B. Payment shall be as follows:

1. Upon submission of the Initial Baseline CPM Construction Schedule. 20%
2. Upon acceptance of the Baseline CPM Construction Schedule. 20%

3. The balance will be paid in equal monthly payments distributed over the contract. These payments will be contingent on the submission of acceptable monthly updates. 60%
4. No additional payment over and above the lump sum price bid will be made for addition or deletion of work, delays, or any other reason whatsoever.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

NO TEXT ON THIS PAGE

SECTION 01370
SCHEDULE OF VALUES

PART 1 GENERAL

1.01 REQUIREMENTS INCLUDED

- A. Submit a Schedule of Values allocated to the various portions of the work.
- B. Upon request of the Engineer, support the values with data which will substantiate their correctness.
- C. The accepted Schedule of Values shall be used only as the basis for the Contractor's Applications for Payment.

1.02 RELATED REQUIREMENTS

- A. Standard General Conditions of the Construction Contract and the Agreement.

1.03 FORM AND CONTENT OF SCHEDULE OF VALUES

- A. Type schedule on an 8-1/2-in by 11-in or 8-1/2-in by 14-in white paper furnished by the Owner; Contractor's standard forms and automated printout will be considered for approval by the Engineer upon Contractor's request. Identify schedule with:
 - 1. Title of Project and location.
 - 2. Engineer and Project number.
 - 3. Name and Address of Contractor.
 - 4. Contract designation.
 - 5. Date of submission.
- B. Schedule shall list the installed value of the component parts of the work in sufficient detail to serve as a basis for computing values for progress payments during construction.
- C. Identify each line item with the number and title of the respective Section.
- D. For each major line item list sub-values of major products or operations under the item.
- E. For the various portions of the work:
 - 1. Each item shall include a directly proportional amount of the Contractor's overhead and profit.
 - 2. For items on which progress payments will be requested for stored materials, break down the value into:
 - a. The cost of the materials, delivered and unloaded, with taxes paid. Paid invoices are required for materials upon request by the Engineer.
 - b. The total installed value.

- F. The sum of all values listed in the schedule shall equal the total Contract Sum.

1.04 SUBSCHEDULE OF UNIT MATERIAL VALUES

- A. Submit a sub-schedule of unit costs and quantities for:
 - 1. Products on which progress payments will be requested for stored products.
- B. The form of submittal shall parallel that of the Schedule of Values, with each item identified the same as the line item in the Schedule of Values.
- C. The unit quantity for bulk materials shall include an allowance for normal waste.
- D. The unit values for the materials shall be broken down into:
 - 1. Cost of the material, delivered and unloaded at the site, with taxes paid.
 - 2. Copies of invoices for component material shall be included with the payment request in which the material first appears.
 - 3. Paid invoices shall be provided with the second payment request in which the material appears or no payment shall be allowed and/or may be deleted from the request.
- E. The installed unit value multiplied by the quantity listed shall equal the cost of that item in the Schedule of Values.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01465
EQUIPMENT TESTING AND STARTUP

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Perform specified equipment field performance tests, final acceptance tests and startup services.

1.02 RELATED WORK

- A. Operation and Maintenance Data is included in Section 01730.
- B. Performance and acceptance testing and startup requirements are included in the respective sections of Division 13.

1.03 SUBMITTALS

- A. Submit, in accordance with Sections 01300 and 13302, detailed testing procedures for shop tests, field performance tests and final acceptance tests as specified in the various equipment sections.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 WITNESS REQUIREMENTS

- A. Shop tests or factory tests may be witnessed by the Owner and/or Owner's representatives, as required by Specification 13302.
- B. Field performance and acceptance tests shall be performed in the presence of the Owner, the Owner's designed personnel and/or Owner's representatives.

3.02 STARTUP AND ACCEPTANCE OF THE SCADA CONTROLS AND RELATED SYSTEMS

A. General Requirements

1. Successfully execute the step-by-step procedure of startup, normal operation, shutdown, and performance demonstration specified herein.
2. The startup and performance demonstration shall be successfully executed prior to Substantial Completion and acceptance by the Owner of the facility and its related systems.
3. All performance tests and inspections shall be scheduled at least 10 working days in advance or as otherwise specified with the Owner and the Engineer. All performance tests and inspections shall be conducted during the work week of Monday through Friday, unless otherwise specified.

B. Preparation for Startup

1. All electrical and instrumentation equipment shall be checked to ensure that it is in good working order and properly connected.
2. All instruments and controls shall be calibrated through their full range. All other adjustments required for proper operation of all instrumentation and control equipment shall be made.
3. Perform all other tasks needed for preparing and conditioning the facility for proper operation.

C. Facilities Startup

1. Startup period shall not begin until all new equipment has been tested and is ready for operation. The Owner shall receive spare parts, tools and maintenance equipment prior to this startup.
2. Demonstrate a seven consecutive 24-hour day period of successful operation of each facility as a prerequisite of Substantial Completion and Acceptance for that particular facility.
3. In the event of failure to demonstrate satisfactory performance of the facility on a first or any subsequent attempt, all necessary alterations, adjustments, repairs and replacements shall be made. When the facility is again ready for operation, it shall be brought online, and a new test shall be started. This procedure shall be repeated as often as necessary until the facility has operated continuously to the satisfaction of the Owner and Engineer, for the specified duration.
4. The Owner will furnish all operating personnel (other than vendor's or subcontractor's service personnel) needed to operate equipment during the final test period; however, said personnel will perform their duties under Contractor's direct supervision. Until performance tests are completed and units and systems are accepted by the Owner as substantially complete, the Contractor shall be fully responsible for the operation and maintenance of all new facilities.
5. Do not, at any time, allow the facility to be operated in a manner which subjects equipment to conditions that are more severe than the maximum allowable operating conditions for which the equipment was designed.

EQUIPMENT SUPPLIER'S CERTIFICATE OF INSTALLATION

Owner _____

Project _____

Contract No. _____

EQUIPMENT SPECIFICATION SECTION _____

EQUIPMENT DESCRIPTION _____

I _____, Authorized representative of
(Print Name)

(Print Manufacturer's Name)

hereby CERTIFY that _____
(Print equipment name and model with serial no.)

installed for the subject project has (have) been installed in a satisfactory manner, has (have) been tested and adjusted, and is (are) ready for final acceptance testing and operation on:

Date _____

Time _____

CERTIFIED BY: _____
(Signature of Manufacturer's Representative)

Date: _____

END OF SECTION

SECTION 01500
TEMPORARY FACILITIES

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Furnish all labor, equipment, materials, and incidentals necessary and provide separate temporary facilities for the Contractor's use and the Engineer's use, as specified herein and as shown on the drawings.
- B. Operate and maintain temporary facilities for the duration of the project and as directed by the Engineer. All cost and use charges for temporary facilities shall be included in the Contract Price.

1.02 RELATED WORK

- A. Special Provisions is included in Section 01170.

1.03 SUBMITTALS

- A. Submit shop drawings and product data, in accordance with Section 01310, showing materials of construction and details of installation for:
 - 1. Site Plan: Show the proposed locations for temporary facilities including offices, temporary utilities, storage containers/buildings, vehicle access and parking areas, material laydown and staging areas, temporary fencing, and other security measures.
 - 2. Temporary Fence: Layout drawings which indicate dimensions, access to fire hydrants, gate locations and opening sizes, and other site specific requirements.
 - 3. Project Sign: Layout, graphics, and wording.
- B. Submittals shall be received by the Engineer no later than the date of the Preconstruction Meeting.

1.04 QUALITY ASSURANCE

- A. Temporary facilities shall comply with all applicable state and local ordinances, codes and regulations.
- B. Coordinate with authorities having jurisdiction to inspect (and test if required) temporary facilities.
- C. Obtain all required permits for temporary facilities.

1.05 DEFINITIONS

- A. Duration of the project: The period of time from the date of the Notice to Proceed to the date of Final Completion, inclusive.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Temporary Fence: Fabric shall be No. 9 gauge galvanized wire woven in 2-in diamond mesh with top and bottom twisted selvage. Intermediate and terminal posts shall be galvanized steel H or pipe, minimum 2-3/8-in OD line posts, 2-7/8-in OD corner and pull posts, and 1-5/8-in OD top rails.

2.02 EQUIPMENT

- A. Fire Extinguishers: Provide portable, UL-rated with class and extinguishing agent required by locations and classes of fire exposure. Provide at least one for each trailer/office.
- B. Temporary Heat: Provide vented, self-contained, liquid propane gas or fuel oil heaters with individual space thermostatic control. Equipment shall be listed and labeled for type of fuel consumed and marked for intended use.

PART 3 EXECUTION

3.01 CONTRACTOR'S FIELD OFFICE

- A. The contractor shall provide a temporary field office at the Cedar Creek Water Pollution Control Plant (WPCP) and at the Glen Cove Wastewater Treatment Plant (WWTP) for the Contractor's use for the duration of the project. An authorized representative of the Contractor shall be present in the associated field office at all times while the Work is in progress at that site. Instructions received at the Contractors field office from the Engineer shall be considered delivered to the Contractor.
- B. The Contractor's field office at each plant shall be located in the respective Staging Area, as coordinated with the Engineer and Owner.
- C. The field office at the Cedar Creek WPCP and at the Glen Cove WWTP shall be provided with the minimum facilities specified herein, including temporary power, light, water service, heat, weather protection, sanitary facilities, construction aids, etc. Provide all required storage and work sheds.
- D. The contractor shall have the Contract Documents, latest approved Shop Drawings, and all Project related correspondence (Change Orders, etc.) readily accessible at the field office.
- E. Establish and occupy field office within 30 days of the Notice to Proceed, unless otherwise approved by the Engineer or Owner.
- F. The field office shall be furnished as follows as a minimum:
 - 1. Field Office and Furnishing:
 - a. Acceptable appearance, weatherproof building or trailer with lockable door.
 - b. Telephone service.
 - c. Six (6) protective helmets for visitor's use.
 - d. Exterior identifying sign.
 - e. Company sign no larger than 4 feet by 8 feet.

3.02 TEMPORARY POWER AND LIGHT

- A. The Contractor shall furnish temporary light and power, including 220 Volt service for welding, complete with wiring, lamps and similar equipment as required to adequately light all work areas and with sufficient power capacity to meet the project needs. Make all necessary arrangements with the local electric company for temporary electric service and pay all expenses in connection therewith.
- B. If power is obtained from the plant's power source Contractor shall coordinate field office power service with facility Operator and Owner and furnish all material, labor and incidentals necessary to establish connection, inclusive of facility Owner approved energy meter.
- C. Contractor shall provide electric meters(s) necessary to measure electric usage during construction. Contractor, Owner and Owner's Representative shall verify meter reading at start and completion of use of electric for the Project. Usage shall be back charged to the Contractor at rate paid by Owner.
- D. Provide properly configured NEMA polarized outlets to prevent insertion of 110-120 Volt plugs into higher voltage outlets. For connection of power tools and equipment, provide outlets equipped with ground-fault circuit interrupters, reset button and pilot light.
- E. Provide grounded extension cords. Use heavy duty cords where exposed to abrasion and traffic. Provide waterproof connectors to connect separate lengths of electric cords if more than one length is required.
- F. Provide general service incandescent lamps as required for adequate illumination. Provide guard cages or tempered glass enclosures where exposed to breakage. Provide exterior fixtures where exposed to moisture.

3.03 TEMPORARY HEAT

- A. Provide heat as may be necessary for thawing out and heating the ground or materials and for proper execution, protection and drying-out of the Work.

3.04 WEATHER PROTECTION

- A. Contractor shall furnish, install and maintain temporary heat and enclosures to provide adequate working areas for personnel during the cold weather months.
- B. The Contractor shall furnish temporary heating units (UL or FM listed) to maintain reasonable temperatures within temporary enclosures.
- C. All windows and the door shall be equipped with adequate locking devices, alarmed and be weatherproof and screened to provide adequate ventilation.

3.05 TEMPORARY WATER SERVICE

- A. Connect to Owner's existing water service facilities. Clean and maintain water service facilities in a condition acceptable to Owner. Contractor shall coordinate field office water service with facility Operator and furnish all material, labor and incidentals necessary to establish connection.

- B. At Substantial Completion, restore these facilities to condition existing before initial use. Provide backflow prevention device in accordance with Owner's requirements.

3.06 SANITARY FACILITIES

- A. Provide temporary toilets, wash facilities, and drinking water for use of construction personnel. Comply with requirements of authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.

3.07 CONSTRUCTION AIDS

- A. Provide temporary elevators, hoists, cranes, scaffolding and platforms as necessary to perform the Work. Provide temporary stairs where ladders are not adequate. Protect permanent stairs from damage from construction operations.

3.08 VEHICLE ACCESS AND PARKING

- A. Provide temporary access roads, parking areas, traffic control devices and staging areas as approved by the Engineer and Owner.
- B. Provide minimum 12-ft by 24-ft by 6-in deep dense graded crushed stone or paved parking area adjacent to Engineer's field office for exclusive use by the Engineer for the duration of the project.
- C. Clear snow and ice from all drives, walks, and stairs to maintain safe vehicle and pedestrian access to the site and facilities as directed by the Engineer.

3.09 WASTE MANAGEMENT

- A. Provide covered dumpster, minimum 4-cubic yards, dedicated for field office waste. Provide separate covered dumpster of adequate size for construction debris. Empty dumpsters on a regular basis and as directed by the Engineer. Dumpsters shall not exceed their capacities at any time.

3.10 REMOVAL AND RESTORATION

- A. Remove each temporary facility complete when need for its service has ended and as approved by the Engineer. Coordinate removal of temporary facilities with authorities having jurisdiction.
- B. Restore all improvements damaged by the installation, operation, and removal of the temporary facilities. Obtain prior approval from Owner and Engineer for restoration work. Comply with the restoration requirements of Section 01046.

END OF SECTION

SECTION 01600
DELIVERY, STORAGE AND HANDLING

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. This Section specifies the general requirements for the delivery handling, storage and protection for all items required in the construction of the work. Specific requirements, if any, are specified with the related item.

1.02 TRANSPORTATION AND DELIVERY

- A. Transport and handle items in accordance with manufacturer's instructions.
- B. Schedule delivery to reduce long term on-site storage prior to installation and/or operation. Under no circumstances shall equipment be delivered to the site more than one month prior to installation without written authorization from the Engineer.
- C. Coordinate delivery with installation to ensure minimum holding time for items that are hazardous, flammable, easily damaged or sensitive to deterioration.
- D. Deliver products to the site in manufacturer's original sealed containers or other packing systems, complete with instructions for handling, storing, unpacking, protecting and installing.
- E. All items delivered to the site shall be unloaded and placed in a manner which will not hamper the Contractor's normal construction operation or those of subcontractors and other contractors and will not interfere with the flow of necessary traffic.
- F. Provide necessary equipment and personnel to unload all items delivered to the site.
- G. Promptly inspect shipment to assure that products comply with requirements, quantities are correct and items are undamaged. For items furnished by others (i.e., Owner, other Contractors), perform inspection in the presence of the Engineer. Notify Engineer verbally, and in writing, of any problems.
- H. If any item has been damaged, such damage shall be repaired at no additional cost to the Owner.

1.03 STORAGE AND PROTECTION

- A. Store and protect products in accordance with the manufacturer's instructions, with seals and labels intact and legible. Storage instruction shall be studied by the Contractor and reviewed with the Engineer by him/her. Instruction shall be carefully followed and a written record of this kept by the Contractor. Arrange storage to permit access for inspection.
- B. Store loose granular materials on solid flat surfaces in a well-drained area. Prevent mixing with foreign matter.

- C. Cement and lime shall be stored under a roof and off the ground and shall be kept completely dry at all times. All structural, miscellaneous and reinforcing steel shall be stored off the ground or otherwise to prevent accumulations of dirt or grease and in a position to prevent accumulations of standing water and to minimize rusting. Beams shall be stored with the webs vertical. Precast concrete shall be handled and stored in a manner to prevent accumulations of dirt, standing water, staining, chipping or cracking. Brick, block and similar masonry products shall be handled and stored in a manner to reduce breakage, cracking and spalling to a minimum.
- D. All mechanical and electrical equipment and instruments subject to corrosive damage by the atmosphere if stored outdoors (even though covered by canvas) shall be stored in a weathertight building to prevent injury. The building may be a temporary structure on the site or elsewhere, but it must be satisfactory to the Engineer. Building shall be provided with adequate ventilation to prevent condensation. Maintain temperature and humidity within range required by manufacturer.
 - 1. All equipment shall be stored fully lubricated with oil, grease and other lubricants unless otherwise instructed by the manufacturer.
 - 2. Moving parts shall be rotated a minimum of once weekly to ensure proper lubrication and to avoid metal-to-metal "welding". Upon installation of the equipment, the Contractor shall start the equipment, at least half load, once weekly for an adequate period of time to ensure that the equipment does not deteriorate from lack of use.
 - 3. Lubricants shall be changed upon completion of installation and as frequently as required thereafter during the period between installation and acceptance. New lubricants shall be put into the equipment at the time of acceptance.
 - 4. Prior to acceptance of the equipment, the Contractor shall have the manufacturer inspect the equipment and certify that its condition has not been detrimentally affected by the long storage period. Such certifications by the manufacturer shall be deemed to mean that the equipment is judged by the manufacturer to be in a condition equal to that of equipment that has been shipped, installed, tested and accepted in a minimum time period. As such, the manufacturer will guaranty the equipment equally in both instances. If such a certification is not given, the equipment shall be judged to be defective. It shall be removed and replaced at the Contractor's expense.
- E. All paint and other coating products shall be stored in areas protected from the weather. Follow all storage requirements set forth by the paint and coating manufacturers.

END OF SECTION

SECTION 01660
QUALITY CONTROL

1.01 GENERAL REQUIREMENTS

- A. All materials and equipment will be tested and inspected to insure full and complete compliance with the Specifications as determined by the County. All testing shall be in accordance with the American Society for Testing Materials and other Specifications as specified herein. Responsibility for performing testing shall be in accordance with the Detailed Specifications.
- B. The County will perform the tests tabulated in the General Conditions, Article GC-19, "Inspection and Testing".
- C. The Contractor shall perform all other testing laboratory services and furnish all test reports in accordance with the requirements of the General Conditions, Article GC-19, "Inspection and Testing".

1.02 SUBMITTALS

- A. Submit name, address and resume of proposed field services technicians at least 30 days in advance of the need for such services.
- B. Submit, in accordance with Section 01300, detailed testing procedures for shop tests, field performance tests and final acceptance tests as specified in the various equipment sections. Submittals shall include the following:
 - 1. Test procedures shall be submitted at least 30 days in advance of the proposed test dates and shall include at least the following information:
 - a. Name of equipment to be tested, including reference to specifications section number and title.
 - b. Testing schedule of proposed dates and times for testing.
 - c. Summary of power, lighting, chemical, water, sludge, gas, etc, needs and identification of who will provide them.
 - d. Outline specific assignment of the responsibilities of the Contractor and manufacturers' factory representatives or field service personnel.
 - e. Detailed description of step-by-step testing requirements, with reference to appropriate standardized testing procedures and laboratory analyses by established technical organizations (e.g., ASTM, WPCF Standard Methods, etc).
 - f. Samples of forms to be used to collect and record test data and to present tabulated test results.
 - g. Approved operation and maintenance manuals.

2. Copies of test reports upon completion of specified shop, performance and acceptance tests. Test reports shall incorporate the information provided in the test procedures submittals, modified to reflect actual conduct of the tests and the following additional information:
 - a. Copy of all test data sheets and results of lab analyses.
 - b. Summary comparison of specified test and performance requirements vs. actual test results.
 - c. Should actual test results fail to meet specified test and performance requirements, describe action to be taken prior to re-testing equipment.
3. Copies of the manufacturer's field service technician's report summarizing the results of his/her initial inspection, operation, adjustment and pre-tests. The report shall include detailed descriptions and tabulations of the points inspected, tests and adjustments made, quantitative results obtained, suggestions for precautions to be taken to ensure proper maintenance, and the equipment supplier's Certificate of Installation in the format specified herein.

1.03 REFERENCE STANDARDS

- A. American Water Works Association (AWWA)
 1. AWWA C653 - Disinfection for Water Treatment Plants.
- B. American Society for Testing and Materials (ASTM)
- C. Water Pollution Control Federation (WPCF)
- D. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

PART 3 EXECUTION

3.01 GENERAL REQUIREMENTS

1. Start-up and testing of the SCADA equipment shall be performed sequentially for each plant area as the work is completed. Refer to Section 01310 – Maintenance of Plant Operation for sequencing requirements.

3.02 FIELD TESTING OF EQUIPMENT

- A. General:
 1. Field testing of equipment shall conform to the requirements of the General Conditions, Article GC-19, "Inspection and Testing", the Technical Specifications and as hereinafter specified.

B. Preliminary Field Tests, Yellow Tag:

1. As soon as conditions permit, after the equipment has been secured in its permanent position, the Contractor shall check the equipment for functionality and absence of defects.
2. Purpose of tests is to determine if equipment:
 - a. Is properly installed.
 - b. Complies with operating cycles.
 - c. Is operating and free from overheating, overloading, vibration or other operating problems.
3. The Contractor shall flush all bearings, gear housings, etc., in accordance with the manufacturer's recommendations, to remove any foreign matter accumulated during shipment, storage or erection. Lubricants shall be added as required by the manufacturer's instructions.
4. The Contractor shall furnish all labor, materials, instruments, fuel, incidentals, and expendables required, unless otherwise provided.
5. The Contractor shall make all changes, adjustments and replacements required to place equipment in service and test it.
6. The Engineer and the County shall be given sufficient prior notice to witness tests.
7. When the Contractor has demonstrated to the Engineer that the equipment is ready for operation, a yellow tag will be issued. The tag will be signed by the Engineer or his designated representative and attached to the equipment. The tag shall not be removed.
8. Preliminary field tests, yellow tag, must be completed before equipment is subjected to final field tests, blue tag.

C. Final Field Tests, Blue Tag:

1. Upon completion of the installation, and at a time approved by the Engineer, equipment will be tested by operating it as a unit with all related piping, ductwork, electrical controls and mechanical operations.
2. To the maximum extent possible, the Contractor shall perform final field tests of equipment prior to initial start-up and operation of the Project. Where this is not practicable, final field tests shall be performed during initial start-up and operation of the Project.
3. Purpose of the tests is to demonstrate that equipment is:
 - a. Properly installed.

- b. Completely ready for operation by the County personnel.
 - c. In compliance with design conditions, material specifications and all other requirements of the Contract Documents.
- 4. The Contractor shall submit the test procedure for approval by the Engineer. The procedure shall specify the duration and the parameters of the test.
 - 5. The Contractor shall notify the Engineer at least 24 hours prior to beginning of tests. The Contractor shall keep notes and data on tests and submit copy to the Engineer. The Engineer and the County's operating personnel shall witness all tests.
 - 6. The equipment will be replaced in continuous operations as prescribed or required and witnessed by the Engineer or his designated representative.
 - 7. Until final field tests are acceptable to the Engineer, the Contractor shall make all necessary changes, readjustments and replacements at no additional cost to the County.
 - 8. Defects which cannot be corrected by installation adjustments will be sufficient grounds for rejection of any equipment.
 - 9. Upon acceptance of the field tests a blue tag will be issued. The tag will be signed by the Engineer and attached to the unit. The tag shall not be removed and no further construction Work will be performed on the unit, except as required during start-up operations and directed by the Engineer.
 - 9. All costs in connection with such tests including all materials, equipment, instruments, labor, etc. shall be borne by the Contractor.

D. Facilities Startup

- 1. Startup period for each phase shall not begin until all new facilities and equipment have been tested as specified and are ready for operation. The Owner shall receive spare parts, safety equipment, tools and maintenance equipment, lubricants, approved operation and maintenance data and the specified operation and maintenance instruction prior to the startup. All tagging shall also be complete prior to this startup.
- 2. In the event of failure to demonstrate satisfactory performance of the facility on the first or any subsequent attempt, all necessary alterations, adjustments, repairs and replacements shall be made. When the facility is again ready for operation, it shall be brought online, and a new test shall be started. This procedure shall be repeated as often as necessary until the facility has operated continuously to the satisfaction of the Owner and Engineer, for the specified duration.

3. The Contractor shall furnish all operating personnel needed to operate equipment during the final test period; however, said personnel will perform their duties under observation by County personnel. Until system performance tests are completed and units and systems are accepted by the Owner as substantially complete, the Contractor shall be fully responsible for the operation and maintenance of all new facilities.
5. The Contractor will provide all necessary chemicals and electricity. Contractor shall also provide all necessary personnel of the various construction trades, i.e., electricians, plumbers, etc, and field service personnel of the major equipment suppliers on an 8 hour per day basis at the facilities during the startup period. Major equipment suppliers shall include, but not be limited to, the following:
 - a. SCADA System Equipment
6. Do not, at any time, during startup allow the facility to be operated in a manner which subjects equipment to conditions that are more severe than the maximum allowable operating conditions for which the equipment was designed.

END OF SECTION

EQUIPMENT SUPPLIER'S CERTIFICATE OF INSTALLATION

Owner _____

Project _____

Contract No. _____

EQUIPMENT SPECIFICATION SECTION _____

EQUIPMENT DESCRIPTION _____

I _____, Authorized representative of
(Print Name)

(Print Manufacturer's Name)

hereby CERTIFY that _____
(Print equipment name and model with serial no.)

installed for the subject project has (have) been installed in a satisfactory manner, has (have) been tested and adjusted, and is (are) ready for final acceptance testing and operation on :

Date _____

Time _____

CERTIFIED BY: _____
(Signature of Manufacturer's Representative)

Date: _____

SECTION 01700
CONTRACT CLOSEOUT

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. This Section specifies administrative, verification and procedural requirements for project closeout, including but not limited to:
 - 1. Final cleaning (Section 01710).
 - 2. Project Record Documents (Section 01720).
 - 3. Record Shop Drawings (Section 01300).
 - 4. Warranties, guarantees, and bonds (Section 01740) and applicable Sections in Technical Division 13.
 - 5. As-built construction schedule (Section 01311).
 - 6. Permit close-outs including Certificate of Occupancy or Certificate of Completion.

1.02 RELATED WORK

- A. Operation and Maintenance (O&M) data and manuals (Section 01730) and applicable Sections in Technical Divisions.

1.03 CLOSEOUT PROCEDURES

- A. Provide all deliverables as specified, prior to submitting the final payment application.
- B. Provide submittals to Engineer that are required by governing or other authorities having applicable jurisdiction including but not limited to permit close out information, certificates of occupancy, etc.
- C. Submit Application for Final Payment identifying total adjusted Contract Sum, previous payments and sum remaining due, following submittal and approval of Record Documents and Record Drawings.
- D. Submit Contractor's Final Release and Release of Liens with final payment application.

1.04 FINAL CLEANING

- A. Contractor to complete final cleaning prior to submittal of the final application for payment.
- B. Contractor to comply with requirements as specified in Section 01710.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01710 CLEANING

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Execute cleaning, during progress of the work, and at completion of the work, as required by General Conditions.

1.02 RELATED WORK

- A. Standard General Conditions of the Construction Contract are included in Section 00700.
- B. Each Section: Cleaning for specific products or work.

1.03 DISPOSAL AND CLEANING

- A. Conduct cleaning and disposal operations to comply with codes, ordinances, regulations and anti-pollution laws.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Use only those cleaning materials which will not create hazards to health or property and which will not damage surfaces.
- B. Use only those cleaning materials and methods recommended by manufacturer of the surface material to be cleaned.
- C. Use cleaning materials only on surfaces recommended by cleaning material manufacturer.

PART 3 EXECUTION

3.01 DURING CONSTRUCTION

- A. Execute periodic cleaning to keep the work, the site and adjacent properties free from accumulations of waste materials, rubbish and windblown debris, resulting from construction operations.
- B. Provide on-site containers for the collection of waste materials, debris and rubbish.
- C. Remove waste materials, debris and rubbish from the site periodically and dispose of at legal disposal areas away from the site.

3.02 DUST CONTROL

- A. Clean interior spaces prior to the start of finish painting and continue cleaning on an as-needed basis until painting is finished.

- B. Schedule operations so that dust and other contaminants resulting from cleaning process will not fall on wet or newly-coated surfaces.

3.03 FINAL CLEANING

- A. Employ skilled workmen for final cleaning.
- B. Remove grease, mastic, adhesives, dust, dirt, stains, fingerprints, labels and other foreign materials from sight-exposed interior and exterior surfaces.
- C. Wash and shine glazing and mirrors.
- D. Polish glossy surfaces to a clear shine.
- E. Ventilating Systems:
 - 1. Clean permanent filters and replace disposable filters if units were operated during construction.
 - 2. Clean ducts, blowers and coils if units were operated without filters during construction.
- F. Broom clean exterior paved surfaces; rake clean other surfaces of the grounds.
- G. Prior to final completion, or Owner occupancy, conduct an inspection of sight-exposed interior and exterior surfaces and all work areas, to verify that the entire work is clean.

END OF SECTION

SECTION 01720
PROJECT RECORD DOCUMENTS

PART 1 GENERAL

1.01 SCOPE

- A. The Contractor shall keep and maintain, at the job site, a copy of contract documents, marked up to indicate all changes made during the course of a project, as specified herein.

1.02 RELATED REQUIREMENTS

- A. Contract close-out submittals are included in Section 01700.
- B. Warranties and bonds are included in Section 01740.
- C. As-built construction schedules are included in Section 01311.
- D. As-built wiring diagrams are included in Section 01730.
- E. Record shop drawings are included in Section 01300.

1.03 REQUIREMENTS INCLUDED

- A. Contractor shall maintain a record copy of the following documents, marked up to indicate all changes made during the course of a project:
 - 1. Contract Drawings
 - 2. Specifications
- B. Contractor shall assemble copies of the following documents for turnover to the Engineer at the end of the project, as specified.
 - 1. Field Orders, Change Orders, Design Modifications, and RFIs
 - 2. Field Test records
 - 3. Permits and permit close-outs (final approvals)
 - 4. Certificate of Occupancy or Certificate of Completion, as applicable
 - 5. Laboratory test reports (e.g., bacteriological and primary & secondary water quality)
 - 6. Certificates of Compliance for materials and equipment
 - 7. Record Shop Drawings
 - 8. Samples

C. RECORD DRAWINGS

1. The Contractor shall annotate (mark-up) the Contract Drawings to indicate all project conditions, locations, configurations, and any other changes or deviations that vary from the original Contract Drawings. This requirement includes, but is not limited to, buried or concealed construction, and utility features that are revealed during the course of construction. Special attention shall be given to recording the locations (horizontal and vertical) and material of all buried utilities that are encountered during construction – whether or not they were indicated on the Contract Drawings. The record information added to the drawings may be supplemented by detailed sketches, if necessary, clearly indicating, the WORK, as constructed.
2. These annotated Contract Drawings constitute The Contractor's Record Drawings and are actual representations of as-built conditions, including all revisions made necessary by change orders, design modifications, requests for information and field orders.
3. Record drawings shall be accessible to the Owner and Engineer at all times during the construction period.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.01 MAINTENANCE OF RECORD DOCUMENTS AND SAMPLES

- A. Store documents and samples in Contractor's field office apart from documents used for construction.
 1. Provide files and racks for storage of the record documents.
 2. Provide locked cabinet(s) or secure storage space for storage of samples.
- B. File documents and samples in accordance with Construction Specifications Institute (CSI) format.
- C. Maintain documents in a clean, dry, legible, condition and in good order. Do not use record documents for construction purposes.
- D. Make documents and sample available for inspection by the Engineer or Owner at all times.
- E. Up-to-date Record Drawings may be a pre-requisite of processing periodic monthly pay applications, if so specified under the section for progress payments.

3.02 MARKING METHOD

- A. Use the color Red (indelible ink) to record information on the Drawings and Specifications,
- B. Label each document "PROJECT RECORD" in neat large printed letters.
- C. Unless otherwise specified elsewhere, notations shall be affixed to hardcopies of documents.
- D. Record information contemporaneously with construction progress.

E. Legibly mark drawings with as-built information:

1. Elevations and dimensions of structures and structural elements.
2. All underground utilities (piping and electrical), structures, and appurtenances
 - a. Changes to existing structure, piping and appurtenance locations.
 - b. Record horizontal and vertical locations of underground structures, piping, utilities and appurtenances, referenced to permanent surface improvements.
 - c. Record actual installed pipe material, class, size, joint type, etc.

3.03 RECORD INFORMATION COMPILATION

A. Do not conceal any work until the required information is acquired.

B. Items to be recorded include, but are not limited to:

1. Location of internal utilities and appurtenances concealed in the construction – referenced to visible and accessible features.
2. Field changes of dimensions and/or details;
 - a. Interior equipment and piping relocations.
 - b. Architectural and structural changes, including relocation of doors, windows, etc.
 - c. Architectural schedule changes.

C. Changes made by Field Order, Change Order, design modification, and RFI.

D. Details not indicated on the original Contract Drawings.

E. Specifications - legibly mark each Section to record:

1. Manufacturer, trade name, catalog number, and Supplier of each product and item of equipment actually installed.
2. Changes made by Field Order, Change Order, RFI, and approved shop drawing.

3.04 SUBMITTAL

A. If specified under the section for progress payments, monthly applications for payment will be contingent upon up-to-date Record Drawings. If requested by the Engineer or Owner, Contractor shall provide a copy of the Record Drawings, or present them for review prior to processing monthly applications for payment.

B. Upon substantial completion of the WORK and prior to final acceptance, the Contractor shall finalize and deliver a complete set of Record Drawings to the Engineer conforming to the construction records of the Contractor. The set of drawings shall consist of corrected and annotated drawings showing the recorded location(s) of the WORK. Unless specified otherwise elsewhere, Record Drawings shall be in the form of a set of prints with annotations carefully and neatly superimposed on the drawings in red.

- C. Upon substantial completion of the WORK and prior to final acceptance, the Contractor shall finalize and deliver a complete set of Record Documents to the Engineer conforming to the construction records of the Contractor. The set of documents shall consist of corrected and annotated documents showing the as-installed equipment and all other as-built conditions not indicated on the Record Drawings.
- D. The information submitted by the Contractor into the Record Drawings and Record Documents will be assumed to be correct, and the Contractor shall be responsible for the accuracy of such information, and shall bear the costs resulting from the correction of incorrect data.
- E. Delivery of Record Drawings and Record Documents to the Engineer will be a prerequisite to Final payment.
- F. The Contractor shall maintain a copy of all books, records, and documents pertinent to the performance under this Agreement for a period of five years following completion of the contract.

END OF SECTION

SECTION 01730
OPERATION AND MAINTENANCE DATA

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. This Section includes procedural requirements for compiling and submitting operation and maintenance data required to complete the project.

1.02 RELATED WORK

- A. Submittals are included in Section 01300.
- B. Contract closeout is included in Section 01700.
- C. Warranties and Bonds are included in Section 01740.

1.03 OPERATING MANUALS

- A. Provide specific operation and maintenance instructions for all electrical, mechanical, and instrumentation & controls equipment furnished under various technical specifications Sections.
- B. Separate manuals shall be provided for each type of equipment, or each Section number. Each manual shall contain the following:
 - 1. Format and Materials
 - a. Binders:
 - 1) Commercial quality three ring binders with durable and cleanable plastic covers
 - 2) Maximum ring width capacity: 3 inches
 - 3) When multiple binders are used, correlate the data into related consistent groupings/volumes.
 - b. Identification: Identify each volume on the cover and spine with typed or printed title "OPERATING AND MAINTENANCE INSTRUCTIONS". Include the following:
 - 1) Title of Project.
 - 2) Identify the general subject matter covered in the manual.
 - 3) Identify structure(s) and/or location(s), of the equipment provided.
 - 4) Specification Section number.
 - c. 20 lb. loose leaf paper, with hole reinforcement
 - d. Page size: 8-1/2 inch by 11 inch
 - e. Provide heavy-duty fly leaves (section separators), matching the table of contents, for each separate product, each piece of operating equipment, and organizational sections of the manual.
 - f. Provide reinforced punched binder tab; bind in with text.
 - g. Reduce larger drawings and fold to the size of text pages - but not larger than 11 inches x 17 inches - or provide a suitable clear plastic pocket (with drawing identification) for such folded drawings/diagrams.

2. Contents:
 - a. A table of contents/Index, divided into section reflective of the major components provided.
 - b. Specific description of each system and components
 - c. Name, address, telephone number(s) and e-mail address(es) of vendor(s) and local service representative(s)
 - d. Specific on-site operating instructions (including starting and stopping procedures)
 - e. Safety considerations
 - f. Project specific operational procedures and recommended log sheet(s).
 - g. Project specific maintenance procedures
 - h. Manufacturer's operating and maintenance instructions – specific to the project
 - i. Copy of each wiring diagram
 - j. Copy of approved shop drawing(s) and Contractor's coordination/layout drawing(s)
 - k. List of spare parts and recommended quantities
 - l. Product Data: Mark each sheet to clearly identify specific products and component parts and data applicable to installation. Delete inapplicable information.
 - m. Drawings: Supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams
 - n. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions specified.
 - o. Warranties and Bonds, as specified in the General Conditions
3. Transmittals
 - a. Prepare separate transmittal sheets for each manual. Each transmittal sheet shall include at least the following: the Contractor's name and address, Owner's name, project name, project number, submittal number, description of submittal and number of copies submitted.
 - b. Submittals shall be transmitted or delivered directly to the office of the Engineer, as indicated in the Contact Documents or as otherwise directed by the Engineer.
 - c. Provide copies of transmittals (only, i.e., without copies of the respective submittal) directly to the Resident Project Representative.
- C. Manuals for Equipment and Systems - In addition to the requirements listed above, for each System, provide the following:
 1. Overview of system and description of unit or system and component parts. Identify function, normal operating characteristics and limiting conditions. Include legible performance curves, with engineering data and tests and complete nomenclature and commercial number of replaceable parts.
 2. Panelboard circuit directories including electrical service characteristics, controls and communications and color-coded wiring diagrams as installed.
 3. Operating procedures: include start-up, break-in and routine normal operating instructions and sequences; regulation, control, stopping, shut-down and emergency instructions; and summer, winter and any special operating instructions.
 4. Maintenance Requirements
 - a. Procedures and guides for trouble-shooting; disassembly, repair, and reassembly instructions
 - b. Alignment, adjusting, balancing and checking instructions

- c. Servicing and lubrication schedule and list of recommended lubricants
 - d. Manufacturer's printed operation and maintenance instructions
 - e. Sequence of operation by instrumentation and controls manufacturer
 - f. Original manufacturer's parts list, illustrations, assembly drawings and diagrams required for maintenance
5. Control diagrams by controls manufacturer as installed (as-built)
 6. Contractor's coordination drawings, with color coded piping diagrams, as installed (as-built)
 7. Charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams. Include equipment and instrument tag numbers on diagrams.
 8. List of original manufacturer's spare parts and recommended quantities to be maintained in storage
 9. Test and balancing reports, as required
 10. Additional Requirements as specified in individual product specification
 11. Design data for systems engineered by the Contractor or its Suppliers

D. Electronic Transmission of O&M Manuals

1. Unless otherwise approved by the Engineer, O&M manuals may not be transmitted by electronic means other than by CD-ROM or USB flash drive. Electronic O&M manuals shall meet the following conditions:
 - a. The above-specified transmittal form is included.
 - b. All other requirements specified above have been met, including, but not limited to, coordination by the Contractor, review and approval by the Contractor.
 - c. The submittal contains no pages or sheets large than 11 x 17 inches.
 - d. With the exception of the transmittal sheet, the entire submittal is included in a single file.
 - e. Files are Portable Document Format (PDF) – with the printing function enabled.
 - f. All scanned manufacturer's O&M manuals must be quality checked after scanning to ensure the page are not crooked and all information is legible.
2. When electronic copies are provided, transmit two hard copy (paper) originals to the Engineer with an electronic copy on CD-ROM.
3. The electronic copy of the O&M manual shall be identical in organization, format and content to the hard copies of the manual.
4. The electronic O&M Manual shall be bookmarked identically to the paper manual table of contents to allow quick access to information. Electronic submittals that require extensive scrolling will not be accepted. The document shall be indexed and searchable.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 SUBMITTAL SCHEDULE

- A. Operation and maintenance manuals shall be delivered directly to the office of the Engineer, as follows:
 - 1. Provide preliminary copies of each manual to the office of the Engineer, no later than 30 days following approval of the respective shop drawings.
 - 2. Provide final copies of each completed manual prior to testing.
 - 3. Provide a letter that grants the Engineer and Owner to the limited right to use and reproduce each manual (in its entirety or any portion thereof) from the respective equipment manufacturer(s). Such limited right shall allow the Engineer and Owner to use each manual or any portion thereof for:
 - a. The potential assembly of a comprehensive facility operation and maintenance manual for the sole benefit of the Owner; and,
 - b. supplemental training of the Owner's personnel and operators, over and above the required vendor's training, regarding operation of the facility as a system.
- B. The Engineer will review Operation and Maintenance manuals submittals for operating equipment for conformance with the requirements of the applicable specification Section. The review will generally be based on the O&M Manual Review Checklist appended to this Section.
- C. If during test and start-up of equipment, any changes were made to the equipment, provide two hard copies of as-built drawings or any other amendments for insertion, by the contractor, in the previously transmitted final manuals. In addition, provide one revised electronic version including the as-built drawings and any other amendments. The manuals shall be completed, including updates, if any, within 30 days of start-up and testing of the facility.

3.02 VENDOR TRAINING/INSTRUCTIONS (TO OWNER'S PERSONNEL)

- A. Before final initiation of operation, Contractor's vendors shall train/instruct Owner's designated personnel in the operation, adjustment, and maintenance of products, equipment and systems at times convenient to the Owner.
- B. Unless specified otherwise under the respective equipment specification section, vendor training/instruction shall consist of eight hours of training for each type of equipment. Such training/instruction shall be scheduled and held at times to accommodate the work schedules of Owner's personnel, including splitting the required training/instruction time into separate sessions and/or presented at reasonable times other than the Contractor's "normal working hours" or the Owner's normal day shift.
- C. Use operation and maintenance manuals as basis for instruction. Train/instruct the Owner's personnel, in detail, based on the contents of manual explaining all aspects of operation and maintenance of the equipment. If the respective equipment is inter-related to the operation of other equipment, all interlock, constraints, and permissives shall be explained.

- D. At least two weeks prior to the schedule for vendor training, a detailed lesson plan, representative of the material to be covered during instruction, shall be submitted to the Engineer for approval. Lesson plans shall consist of in-depth outlines of the training material, including a table of contents, resume of the instructor, materials to be covered, start-up procedures, maintenance requirements, safety considerations, and shut-down procedures.
- E. Prepare and insert additional data in each Operation and Maintenance Manual when the need for such data becomes apparent during training/instruction.
- F. Vendor's training/instruction will be considered acceptable based on the completed Owner's Acknowledgement of Manufacturer's Instruction as indicated on the Equipment Manufacturer's Certification of Installation, Testing, and Instruction appended to this Section.

END OF SECTION

O&M Manual Review Checklist

Submittal No.: _____

Project No.: _____

Manufacturer: _____

Equipment Submitted: _____

Specification Section: _____

Date of Submittal: _____

General Data		
1.	Are the area representative's name, address, e-mail address and telephone number included?	
2.	Is the nameplate data for each component included?	
3.	Are all associated components related to the specific equipment included?	
4.	Is non-pertinent data crossed out or deleted?	
5.	Are drawings neatly folded and/or inserted into packets?	
6.	Are all pages properly aligned and scanned legibly?	
7.	Is the .PDF document bookmarked according to the table of contents?	
Operations and Maintenance Data		
8.	Is an overview description of the equipment and/or process included?	
9.	Does the description include the practical theory of operation?	
10.	Does each equipment component include specific details (design characteristics, operating parameters, control descriptions, and selector switch positions and functions)?	
11.	Are alarm and shutdown conditions specific to the equipment provided on this project clearly identified? Does it describe possible causes and recommended remedies?	
12.	Are step procedures for starting, stopping, and troubleshooting specific to the equipment provided included?	
13.	Is a list of operational parameters to monitor and record specific to the equipment provided included?	
14.	Is a proposed operating log sheet specific to the equipment provided included?	
15.	Is a spare parts inventory list included for each component?	
16.	Is a lubrication schedule for each component specific to the equipment provided included - or does it clearly state "No Lubrication Required"?	
17.	Is a maintenance schedule for each component specific to the equipment provided included?	
18..	Is a copy of the warranty information included?	

Review Comments

Is the submittal fully approved (yes/no)? _____

If not, the following points of rejection must be addressed and require resubmittal by the Contractor:

Item No.

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____
11. _____
12. _____
13. _____
14. _____
15. _____

Reviewed By: _____ Date: _____

Legend

1 = OK

2 = Not Adequate

3 = Not Included

Note: This submittal has been reviewed for compliance with the Contract Documents.

SECTION 01740 WARRANTIES AND BONDS

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. This Section specifies general administrative and procedural requirements for warranties and bonds required by the Contract Documents, including manufacturer's standard warranties on products and special warranties.
- B. Warranty period will commence when all sites are certified as substantially complete.

1.02 RELATED WORK

- A. Refer to Conditions of Contract for the general requirements relating to warranties and bonds.
- B. General closeout requirements are included in Section 01700 Project Closeout.
- C. Specific requirements for warranties for the work and products and installations that are specified to be warranted are included in the individual Sections.

1.03 SUBMITTALS

- A. Warranty period will commence when all sites are certified as substantially complete. Submit written warranty to the Owner prior to the commencement of the warranty period.
- B. When a special warranty is required to be executed by the Contractor, or the Contractor and a subcontractor, supplier or manufacturer, prepare a written document that contains appropriate terms and identification, ready for execution by the required parties. Submit a draft to the Owner for approval prior to final execution.
- C. Refer to individual Sections for specific content requirements, and particular requirements for submittal of special warranties.
- D. At Final Completion compile two copies of each required warranty and bond properly executed by the Contractor, or by the Contractor, subcontractor, supplier, or manufacturer. Organize the warranty documents into an orderly sequence based on the table of contents of the Project Manual.
- E. Bind warranties and bonds in heavy-duty, commercial quality, durable 3-ring vinyl covered loose-leaf binders, thickness as necessary to accommodate contents and sized to receive 8-1/2-in by 11-in paper.
- F. Table of Contents: Neatly typed, in the sequence of the Table of Contents of the Project Manual, with each item identified with the number and title of the Section in which specified and the name of the product or work item.

- G. Provide heavy paper dividers with celluloid covered tabs for each separate warranty. Mark the tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address and telephone number of the installer, supplier and manufacturer.
- H. Identify each binder on the front and the spine with the typed or printed title "WARRANTIES AND BONDS", the project title or name and the name, address and telephone number of the Contractor.
- I. When operating and maintenance manuals are required for warranted construction, provide additional copies of each required warranty, as necessary, for inclusion in each required manual.

1.04 WARRANTY REQUIREMENT

- A. Related Damages and Losses: When correcting warranted work that has failed, remove and replace other work that has been damaged as a result of such failure or that must be removed and replaced to provide access for correction of warranted work.
- B. Reinstatement of Warranty: When work covered by a warranty has failed and been corrected by replacement or rebuilding, reinstate the warranty by written endorsement. The reinstated warranty shall be equal to the original warranty with an equitable adjustment for depreciation.
- C. Replacement Cost: Upon determination that work covered by a warranty has failed, replace or rebuild the work to an acceptable condition complying with requirements of Contract Documents. The Contractor is responsible for the cost of replacing or rebuilding defective work regardless of whether the Owner has benefited from use of the work through a portion of its anticipated useful service life.
- D. Owner's Recourse: Written warranties made to the Owner are in addition to implied warranties, and shall not limit the duties, obligations, rights and remedies otherwise available under the law, nor shall warranty periods be interpreted as limitations on time in which the Owner can enforce such other duties, obligations, rights, or remedies.
- E. Rejection of Warranties: The Owner reserves the right to reject warranties and to limit selections to products with warranties not in conflict with requirements of the contract Documents.
- F. The Owner reserves the right to refuse to accept work for the project where a special warranty, certification, or similar commitment is required on such work or part of the work, until evidence is presented that entities required to countersign such commitments are willing to do so.
- G. Disclaimers and Limitations: Manufacturer's disclaimers and limitations on product warranties do not relieve the Contractor of the warranty on the work that incorporates the products, nor does it relieve suppliers, manufacturers and subcontractors required to countersign special warranties with the Contractor.
- H. Separate Prime Contracts: Each Prime Contractor is responsible for warranties related to its own Contract.

1.05 MANUFACTURERS CERTIFICATIONS

- A. Where required, the Contractor shall supply evidence, satisfactory to the Engineer, that the Contractor can obtain manufacturers' certifications as to the Contractor's installation of equipment.

1.06 DEFINITIONS

- A. Standard Product Warranties are preprinted written warranties published by individual manufacturers for particular products and are specifically endorsed by the manufacturer to the Owner.
- B. Special Warranties are written warranties required by or incorporated in the Contract Documents, either to extend time limits provided by standard warranties or to provide greater rights for the Owner.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

NO TEXT ON THIS PAGE

SECTION 02221
TRENCHING, BACKFILLING AND COMPACTION

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Furnish all labor, materials, equipment and incidentals required and perform all trenching for pipelines and appurtenances, including drainage, filling, backfilling, disposal of surplus material and restoration of trench surfaces and easements.
- B. Excavation shall extend to the width and depth shown on the Drawings or as specified herein and shall provide suitable room for installing pipe, structures and appurtenances.
- C. Furnish and place all sheeting, bracing and supports and shall remove from the excavation all materials which the Engineer may deem unsuitable for backfilling. The bottom of the excavation shall be firm, dry and in all respects, acceptable. If conditions warrant, deposit gravel for pipe bedding, or gravel refill for excavation below grade, directly on the bottom of the trench immediately after excavation has reached the proper depth and before the bottom of the trench has become softened or disturbed by any cause whatever. The length of open trench shall be related closely to the rate of pipe laying. All excavation shall be made in open trenches.
- D. All excavation, trenching and related sheeting, bracing, etc., shall comply with the requirements of OSHA excavation safety standards (29 CFR Part 1926.650 Subpart P) [and to the Massachusetts Department of Labor and Industries, Division of Industrial Safety "Rules and Regulations for the Prevention of Accidents in Construction Operations" (Chapter 454 CMR 10.00 et. seq. Where conflict between OSHA and State regulations exists, the more stringent requirements shall apply).
 - 1. Reference to above OSHA Standard.
 - 2. Written assurance that the bidder will comply with the trench safety standards.
 - 3. Separate item for bidder to identify the method or methods of compliance (i.e., sloping, shoring, trench box, etc.). (No price associated with this item.)
 - 4. Separate bid item identifying cost of compliance, based on the linear feet of trench to be excavated; or, in case of shoring, square feet of shoring to be used.
- E. Wherever the requirement for 92 percent compaction is referred to herein it shall mean "at least 92 percent of maximum density as determined by ASTM D1557, Method D".
- F. Prior to the start of work submit the proposed method of backfilling and compaction to the Engineer for review.
- G. Contractor shall be responsible for obtaining any permits required for trenching.

1.02 RELATED WORK

- A. Dewatering is included in Section 02140.

- B. Rock and boulder excavation is included in Section 02213.
- C. Granular fill material is included in Section 02230.
- D. Pavement repair and resurfacing is included in Section 02575.
- E. Topsoil and seeding is included in Section 02930.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 TRENCH EXCAVATION

- A. Trench excavation shall include material of every description and of whatever substance encountered, except rock and boulders. Pavement shall be cut with a saw, wheel or pneumatic chisel along straight lines before excavating.
- B. Strip and stockpile topsoil from grassed areas crossed by trenches. At the Contractor's option, topsoil may be otherwise disposed of and replaced, when required, with approved topsoil of equal quality.
- C. While excavating and backfilling is in progress, traffic shall be maintained, and all utilities and other property protected as provided in the General Conditions and General Requirements.
- D. Trenches shall be excavated to the depth indicated on the Drawings and in widths sufficient for laying the pipe, bracing and for pumping and drainage facilities. The bottom of the excavations shall be firm and dry and, in all respects, acceptable to the Engineer. Trench width shall be practical minimum.
- E. Excavation and dewatering shall be accomplished by methods which preserve the undisturbed state of subgrade soils. The trench may be excavated by machinery to, or just below the designated subgrade, provided that material remaining in the bottom of the trench is no more than slightly disturbed. Subgrade soils which become soft, loose, "quick", or otherwise unsatisfactory as a result of inadequate excavation, dewatering or other construction methods shall be removed and replaced by screened gravel fill as required by the Engineer at the Contractor's expense.
- F. Clay and organic silt soils are particularly susceptible to disturbance due to construction operations. When excavation is to end in such soils, use a smooth-edge bucket to excavate the last 1-ft of depth.
- G. Where pipe is to be laid in screened gravel bedding, the trench may be excavated by machinery to the normal depth of the pipe provided that the material remaining in the bottom of the trench is no more than slightly disturbed.
- H. Where pipe is to be laid directly on the trench bottom, final excavation at the bottom of the trench shall be performed manually, providing a flat-bottom true to grade upon undisturbed material. Bell holes shall be made as required.

3.02 DISPOSAL OF MATERIALS

- A. Excavated material shall be stacked without excessive surcharge on the trench bank or obstructing free access to hydrants and gate valves. Inconvenience to traffic and abutters shall be avoided as much as possible. Excavated material shall be segregated for use in backfilling as specified below.
- B. It is expressly understood that no excavated material shall be removed from the site of the work or disposed of, except as directed by the Engineer. When removal of surplus materials has been approved by the Engineer, dispose of such surplus material in approved designated areas.
- C. Should conditions make it impracticable or unsafe to stack material adjacent to the trench, the material shall be hauled and stored at a location provided. When required, it shall be re-handled and used in backfilling the trench.

3.03 SHEETING AND BRACING

- A. Furnish, put in place and maintain sheeting and bracing required by Federal, State or local safety requirements to support the sides of the excavation and prevent loss of ground which could endanger personnel, damage or delay the work or endanger adjacent structures. If the Engineer is of the opinion that at any point sufficient or proper supports have not been provided, he/she may order additional supports placed at the expense of the Contractor. Compliance with such order shall not relieve the Contractor from his/her responsibility for the sufficiency of such supports. Care shall be taken to prevent voids outside of the sheeting, but if voids are formed, they shall be immediately filled and rammed.
- B. Where sheeting and bracing is required to support the sides of trenches, engage a professional engineer, registered in the State of New York to design the sheeting and bracing. The sheeting and bracing installed shall be in conformity with the design and certification of this shall be provided by the professional engineer. Submit P.E. Certification Form contained in Section 01300 to show compliance with this requirement.
- C. When moveable trench bracing such as trench boxes, moveable sheeting, shoring or plates are used to support the sides of the trench, care shall be taken in placing and moving the boxes or supporting bracing to prevent movement of the pipe, or disturbance of the pipe bedding and the screened gravel backfill.
 - 1. When installing rigid pipe (R.C., V.C., A.C., etc.), any portion of the box extending below mid diameter shall be raised above this point prior to moving the box ahead to install the next pipe. This is to prevent the separation of installed pipe joints due to movement of the box.
 - 2. When installing flexible pipe (PVC, etc.), trench boxes, moveable sheeting, shoring or plates shall not be allowed to extend below mid-diameter of the pipe. As trench boxes, moveable sheeting, shoring or plates are moved, screened gravel shall be placed to fill any voids created and the screened gravel and backfill shall be recompacted to provide uniform side support for the pipe.

- D. Permission will be given to use steel sheeting in lieu of wood sheeting for the entire job wherever the use of sheeting is necessary. The cost for use of sheeting will be included in the bid items for pipe and shall include full compensation for driving, bracing and later removal of sheeting.
- E. All sheeting and bracing shall be carefully removed in such manner as not to endanger the construction of other structures, utilities, or property, whether public or private. All voids left after withdrawal of sheeting shall be immediately refilled with sand by ramming with tools especially adapted to that purpose, by watering or otherwise as directed.
- F. No payment will be given for sheeting, bracing, etc, during the progress of the work. No payment will be given for sheeting which has actually been left in the trench for the convenience of the Contractor.
- G. Sheeting driven below mid-diameter of any pipe shall remain in place from the driven elevation to at least 1-ft above the top of the pipe.

3.04 TEST PITS

- A. Excavation of test pits may be required for the purpose of locating underground utilities or structures as an aid in establishing the precise location of new work.
- B. Test pits shall be backfilled as soon as the desired information has been obtained. The backfilled surface shall be maintained in a satisfactory condition for travel until resurfaced as specified.

3.05 EXCAVATION BELOW GRADE AND REFILL

- A. Whatever the nature of unstable material encountered or the groundwater conditions, trench drainage shall be complete and effective.
- B. If the Contractor excavates below grade through error or for the Contractor's own convenience, or through failure to properly dewater the trench, or disturbs the subgrade before dewatering is sufficiently complete, he may be directed by the Engineer to excavate below grade as set forth in the following paragraph, in which case the work of excavating below grade and furnishing and placing the refill shall be performed at his own expense.
- C. If the material at the level of trench bottom consists of fine sand, sand and silt or soft earth which may work into the screened gravel notwithstanding effective drainage, the subgrade material shall be removed to the extent directed and the excavation refilled with a 6-in layer of coarse sand, or a mixture graded from coarse sand to the fine peastone, as approved by the Engineer, to form a filter layer preserving the voids in the gravel bed of the pipe. The composition and gradation of gravel shall be approved by the Engineer prior to placement. Screened gravel shall then be placed in 6-in layers thoroughly compacted up to the normal grade of the pipe. If directed by the Engineer, bank-run gravel shall be used for refill of excavation below grade.
- D. Geotextile filter fabric may be substituted for filter layer if approved by the Engineer. Filter fabric shall be Mirafi 140N; Supac equivalent, or equal.

3.06 BACKFILLING

- A. As soon as practicable after the pipe has been laid and jointed, backfilling shall begin and thereafter be prosecuted expeditiously. Bedding gravel, as specified for the type of pipe installed, shall be placed up to 1-ft over the pipe.
- B. An impervious dam or bulkhead cutoff of clay or other impervious material shall be constructed in the trench as directed, to interrupt the unnatural flow of groundwater after construction is completed. The dam shall be effectively keyed into the trench bottom and sidewalls. Provide at least one clay or other impervious material dam in the pipe bedding between each manhole where directed or every 300-ft, whichever is less.
- C. Where the pipes are laid cross-country, the remainder of the trench shall be filled with common fill material in layers not to exceed 3-ft and mounded 6-in above the existing grade or as directed. Where a loam or gravel surface exists prior to cross-country excavations, it shall be removed, conserved and replaced to the full original depth as part of the work under the pipe items. In some areas it may be necessary to remove excess material during the clean-up process, so that the ground may be restored to its original level and condition.
- D. Where the pipes are laid in streets, the remainder of the trench up to a depth of 12-in below the bottom of the specified permanent paving shall be backfilled with common fill material in layers not to exceed 1-ft and thoroughly compacted. The subbase layer for paving shall be of bank-run gravel thoroughly compacted in 6-in layers.
- E. To prevent longitudinal movement of the pipe, dumping backfill material into the trench and then spreading will not be permitted until selected material or screened gravel has been placed and compacted to a level 1-ft over the pipe.
- F. Backfill shall be brought up evenly on all sides. Each layer of backfill material shall be thoroughly compacted by rolling, tamping, or vibrating with mechanical compacting equipment or hand tamping, to 92 percent compaction. If rolling is employed, it shall be by use of a suitable roller or tractor, being careful to compact the fill throughout the full width of the trench.
- G. Water jetting or puddling may be used unless the refill contains too great a proportion of clay or loam to permit satisfactory drying. Water jetting shall consist of using a suitable length of pipe at least 1-1/4-in in diameter fitted with quick acting valve and sufficient hose to connect to hydrant or pump having adequate pressure and capacity. The full depth of backfill shall be thoroughly inundated by thrusting the pipe into the fill at frequent intervals with the valve open until all slumping ceases. Where backfill is compacted by puddling, it shall be done by depositing in water. Water for jetting or puddling may be obtained from Owner hydrants wherever possible. Water may be furnished by the Owner from these hydrants if reasonable care is exercised in its use and when approved by the Water Department.
- H. If water restrictions are in force, obtain water elsewhere, or compact the backfill by other approved methods at no additional cost to this Contract.
- I. Where other methods are not practicable, compaction shall be by use of hand or pneumatic ramming with tools weighing at least 20 lbs. The material being spread and compacted in layers not over 6-in thick. If necessary, sprinkling shall be employed in conjunction with rolling or ramming.

- J. Backfill around structures shall be selected common fill material, may be compacted by puddling where approved by the Engineer. All backfill shall be compacted, especially under and over pipes connected to the structures.
- K. Subject to the approval of the Engineer, fragments of ledge and boulders smaller than 6-in may be used in trench backfill providing that the quantity in the opinion of the Engineer is not excessive. Rock fragments shall not be placed until the pipe has at least 2-ft of earth cover. Small stones and rocks shall be placed in thin layers alternating with earth to ensure that all voids are completely filled. Fill shall not be dropped into the trench in a manner to endanger the pipe.
- L. Bituminous paving shall not be placed in backfilling unless specifically permitted, in which case it shall be broken up as directed. Frozen material shall not be used under any circumstances.
- M. All road surfaces shall be broomed and hose-cleaned immediately after backfilling. Dust control measures shall be employed at all times.

3.07 RESTORING TRENCH SURFACE

- A. Where the trench occurs adjacent to paved streets, in shoulders, sidewalks, or in cross-country areas, thoroughly consolidate the backfill and shall maintain the surface as the work progresses. If settlement takes place, immediately deposit additional fill to restore the level of the ground.
- B. In and adjacent to streets, the 12-in layer of trench backfill below the specified initial pavement shall consist of compacted bank-run gravel. Should the Contractor wish to use material excavated from the trench as gravel subbase for pavement replacement, the Contractor, at his/her own expense, have samples of the material tested by an independent testing laboratory at intervals not to exceed 500-ft, in order to establish its compliance with the specifications. Only material which has been tested and approved by the Engineer shall be allowed to be incorporated into the work.
- C. The surface of any driveway or any other area which is disturbed by the trench excavation and which is not a part of the paved road shall be restored to a condition at least equal to that existing before work began.
- D. In sections where the pipeline passes through grassed areas, and at the Contractor's own expense, remove and replace the sod, or loam and seed the surface to the satisfaction of the Engineer.

END OF SECTION

SECTION 02510
ASPHALT PAVING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Furnish all labor, materials, equipment and incidentals required for asphalt paving complete as shown on the Drawings and as specified herein.
- B. Section Includes:
 - 1. Cold milling of existing asphalt pavement.
 - 2. Hot-mix asphalt patching.
 - 3. Hot-mix asphalt paving.
 - 4. Hot-mix asphalt overlay.
 - 5. Asphalt curbs.
 - 6. Asphalt traffic-calming devices.
 - 7. Asphalt surface treatments.

1.02 RELATED WORK

- A. Subgrade preparation, fill material, unbound-aggregate subbase and base courses, and aggregate pavement shoulders is included in Section 02221.

1.03 SUBMITTALS

- A. Submit, in accordance with Section 01300, detailed information on materials proposed and installation methods.
- B. Product Data: For each type of product.
 - 1. Include technical data and tested physical and performance properties.
 - 2. Job-Mix Designs: Certification, by authorities having jurisdiction, of approval of each job mix proposed for the Work.
 - 3. Job-Mix Designs: For each job mix proposed for the Work.
- C. Samples for Verification: For the following product, in manufacturer's standard sizes unless otherwise indicated:
 - 1. Paving Fabric: 12 by 12 inches (300 by 300 mm) minimum.
- D. Material Certificates: For each paving material. Mixes containing recycled materials will perform equal to mixes produced from all new materials.

- E. Material Test Reports: For each paving material, by a qualified testing agency.
- F. Field quality-control reports.

1.04 REFERENCE STANDARDS

A. American Association of State Highway and Transportation Officials

- 1. AASHTO M 17-2007: Specification for Mineral Filler for Bituminous Paving Mixtures
- 2. AASHTO M 29-2003: Specification for Fine Aggregate for Bituminous Paving Mixtures
- 3. AASHTO M 140-2003: Specification for Emulsified Asphalt
- 4. AASHTO M 208-2001: Specification for Cationic Emulsified Asphalt
- 5. AASHTO M 288-2006: Geotextile Specification for Highway Applications
- 6. AASHTO M 320-2009: Specification for Performance Graded Asphalt Binder
- 7. AASHTO M 324-2008: Standard Practice for Joint and Crack Sealants, Hot-Applied, for Concrete and Asphalt Pavements
- 8. AASHTO T 168-2003: Specification for Sampling Bituminous Paving Mixtures
- 9. AASHTO T 245-1997 (Reapproved 2008): Method of Test for Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus

B. Asphalt Institute

- 1. AI MS-2-1997 (Sixth Edition): Mix Design Methods for Asphalt Concrete and Other Hot-Mix Types
- 2. AI MS-22-2001 (Second Edition): Construction of Hot Mix Asphalt Pavements

C. ASTM International

- 1. ASTM D 242/D 242M-09: Specification for Mineral Filler for Bituminous Paving Mixtures
- 2. ASTM D 692/D 692M-09: Specification for Coarse Aggregate for Bituminous Paving Mixtures
- 3. ASTM D 946/D 946M-09a: Specification for Penetration-Graded Asphalt Cement for Use in Pavement Construction
- 4. ASTM D 977-05: Specification for Emulsified Asphalt
- 5. ASTM D 979-01 (Reapproved 2006): Practice for Sampling Bituminous Paving Mixtures
- 6. ASTM D 1073-07: Specification for Fine Aggregate for Bituminous Paving Mixtures

7. ASTM D 1188-07: Test Method for Bulk Specific Gravity and Density of Compacted Bituminous Mixtures Using Coated Samples
 8. ASTM D 2027-97 (Reapproved 2004): Specification for Cutback Asphalt (Medium-Curing Type) ASTM D 2041-03a: Test Method for Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures
 9. ASTM D 2397-05: Specification for Cationic Emulsified Asphalt
 10. ASTM D 2726-09: Test Method for Bulk Specific Gravity and Density of Non-Absorptive Compacted Bituminous Mixtures
 11. ASTM D 2950-2009: Test Method for Density of Bituminous Concrete in Place by Nuclear Methods
 12. ASTM D 3141/D 3141M-09: Specification for Asphalt for Undersealing Portland-Cement Concrete Pavements
 13. ASTM D 3381/D 3381M-09a: Specification for Viscosity-Graded Asphalt Cement for Use in Pavement Construction
 14. ASTM D 3549-03: Test Method for Thickness or Height of Compacted Bituminous Paving Mixture Specimens
 15. ASTM D 3666-09a: Specification for Minimum Requirements for Agencies Testing and Inspecting Road and Paving Materials
 16. ASTM D 3910-07: Practices for Design, Testing, and Construction of Slurry Seal
 17. ASTM D 6690-07: Specification for Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements
 18. ASTM D 6927-06: Test Method for Marshall Stability and Flow of Bituminous Mixtures
- D. Unless noted otherwise, where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.05 PRE-INSTALLATION MEETINGS

- A. Pre-installation Conference: Conduct conference at Cedar Creek WPCP and Glen Cove WWTP.
1. Review methods and procedures related to hot-mix asphalt paving including, but not limited to, the following:
 - a. Review proposed sources of paving materials, including capabilities and location of plant that will manufacture hot-mix asphalt.
 - b. Review requirements for protecting paving work, including restriction of traffic during installation period and for remainder of construction period.

1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A paving-mix manufacturer registered with and approved by authorities having jurisdiction or the DOT of state in which Project is located

- B. Testing Agency Qualifications: Qualified according to ASTM D 3666 for testing indicated.
- C. Regulatory Requirements: Comply with materials, workmanship, and other applicable requirements of the State of New York for asphalt paving work.
 - 1. Measurement and payment provisions and safety program submittals included in standard specifications do not apply to this Section.

1.07 FIELD CONDITIONS

- A. Environmental Limitations: Do not apply asphalt materials if subgrade is wet or excessively damp, if rain is imminent or expected before time required for adequate cure, or if the following conditions are not met:
 - 1. Prime Coat: Minimum surface temperature of 60 deg F (15.6 deg C).
 - 2. Tack Coat: Minimum surface temperature of 60 deg F (15.6 deg C).
 - 3. Slurry Coat: Comply with weather limitations in ASTM D 3910.
 - 4. Asphalt Base Course: Minimum surface temperature of 40 deg F (4.4 deg C) and rising at time of placement.
 - 5. Asphalt Surface Course: Minimum surface temperature of 60 deg F (15.6 deg C) at time of placement.

PART 2 PRODUCTS

2.01 AGGREGATES

- A. General: Use materials and gradations that have performed satisfactorily in previous installations.
- B. Coarse Aggregate: ASTM D 692/D 692M, sound; angular crushed stone, crushed gravel, or cured, crushed blast-furnace slag.
- C. Fine Aggregate: ASTM D 1073 or AASHTO M 29, sharp-edged natural sand or sand prepared from stone, gravel, cured blast-furnace slag, or combinations thereof.
 - 1. For hot-mix asphalt, limit natural sand to a maximum of 20 percent by weight of the total aggregate mass.
- D. Mineral Filler: ASTM D 242/D 242M or AASHTO M 17, rock or slag dust, hydraulic cement, or other inert material.

2.02 ASPHALT MATERIALS

- A. Asphalt Binder: AASHTO M 320, PG 64-22
- B. Asphalt Cement: ASTM D 946/D 946M for penetration-graded material.
- C. Cutback Prime Coat: ASTM D 2027, medium-curing cutback asphalt, MC-30.

- D. Emulsified Asphalt Prime Coat: ASTM D 977 emulsified asphalt, or ASTM D 2397 cationic emulsified asphalt, slow setting, diluted in water, of suitable grade and consistency for application.
- E. Tack Coat: ASTM D 977 emulsified asphalt, or ASTM D 2397 cationic emulsified asphalt, slow setting, diluted in water, of suitable grade and consistency for application.
- F. Fog Seal: ASTM D 977 emulsified asphalt, or ASTM D 2397 cationic emulsified asphalt, slow setting, factory diluted in water, of suitable grade and consistency for application.
- G. Water: Potable.
- H. Undersealing Asphalt: ASTM D 3141/D 3141M; pumping consistency.

2.03 AUXILIARY MATERIALS

- A. Recycled Materials for Hot-Mix Asphalt Mixes: Reclaimed asphalt pavement; reclaimed, unbound-aggregate base material; and recycled [tires] [asphalt shingles] [or] [glass] from sources and gradations that have performed satisfactorily in previous installations, equal to performance of required hot-mix asphalt paving produced from all new materials.
- B. Herbicide: Commercial chemical for weed control, registered by the EPA, and not classified as "restricted use" for locations and conditions of application. Provide in granular, liquid, or wettable powder form.
- C. Sand: Grade No. 2 or No. 3.
- D. Paving Geotextile: AASHTO M 288 paving fabric; nonwoven polypropylene; resistant to chemical attack, rot, and mildew; and specifically designed for paving applications.
- E. Joint Sealant: hot-applied, single-component, polymer-modified bituminous sealant.

2.04 MIXES

- A. Surface Course Limit: Recycled content no more than 10 percent by weight.
- B. Hot-Mix Asphalt: Dense-graded, hot-laid, hot-mix asphalt plant mixes approved by authorities having jurisdiction and complying with the following requirements:
 - 1. Provide mixes with a history of satisfactory performance in geographical area where Project is located.
- C. Emulsified-Asphalt Slurry: ASTM D 3910, Type 1.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that subgrade is dry and in suitable condition to begin paving.
- B. Proof-roll subgrade below pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.

1. Completely proof-roll subgrade in one direction. Limit vehicle speed to 3 mph (5 km/h).
 2. Proof roll with a loaded 10-wheel, tandem-axle dump truck weighing not less than 15 tons (13.6 tonnes).
 3. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Engineer, and replace with compacted backfill or fill as directed.
- C. Proceed with paving only after unsatisfactory conditions have been corrected.

3.02 COLD MILLING

- A. Clean existing pavement surface of loose and deleterious material immediately before cold milling. Remove existing asphalt pavement by cold milling to grades and cross sections indicated.
1. Mill to a depth of 1-1/2 inches (38 mm).
 2. Mill to a uniform finished surface free of excessive gouges, grooves, and ridges.
 3. Control rate of milling to prevent tearing of existing asphalt course.
 4. Repair or replace curbs, manholes, and other construction damaged during cold milling.
 5. Excavate and trim unbound-aggregate base course, if encountered, and keep material separate from milled hot-mix asphalt.
 6. Patch surface depressions deeper than 1 inch (25 mm) after milling, before wearing course is laid.
 7. Handle milled asphalt material according to approved waste management plan required in Section 01741.
 8. Keep milled pavement surface free of loose material and dust.
 9. Do not allow milled materials to accumulate on-site.

3.03 PATCHING

- A. Asphalt Pavement: Saw cut perimeter of patch and excavate existing pavement section to sound base. Excavate rectangular or trapezoidal patches, extending 12 inches (300 mm) into perimeter of adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Remove excavated material. Recompect existing unbound-aggregate base course to form new subgrade.
- B. Portland Cement Concrete Pavement: Break cracked slabs and roll as required to reseat concrete pieces firmly.
1. Pump hot undersealing asphalt under rocking slab until slab is stabilized or, if necessary, crack slab into pieces and roll to reseat pieces firmly.

2. Remove disintegrated or badly cracked pavement. Excavate rectangular or trapezoidal patches, extending into perimeter of adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Recompact existing unbound-aggregate base course to form new subgrade.
- C. Tack Coat: Before placing patch material, apply tack coat uniformly to vertical asphalt surfaces abutting the patch. Apply at a rate of 0.05 to 0.15 gal./sq. yd. (0.2 to 0.7 L/sq. m).
 1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
 2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.
- D. Placing Patch Material: Fill excavated pavement areas with hot-mix asphalt base mix for full thickness of patch and, while still hot, compact flush with adjacent surface.
- E. Placing Patch Material: Partially fill excavated pavements with hot-mix asphalt base mix and, while still hot, compact. Cover asphalt base course with compacted, hot-mix surface layer finished flush with adjacent surfaces.

3.04 REPAIRS

- A. Leveling Course: Install and compact leveling course consisting of hot-mix asphalt surface course to level sags and fill depressions deeper than 1 inch (25 mm) in existing pavements.
 1. Install leveling wedges in compacted lifts not exceeding 3 inches (75 mm) thick.
- B. Crack and Joint Filling: Remove existing joint filler material from cracks or joints to a depth of 1/4 inch (6 mm).
 1. Clean cracks and joints in existing hot-mix asphalt pavement.
 2. Use emulsified-asphalt slurry to seal cracks and joints less than 1/4 inch (6 mm) wide. Fill flush with surface of existing pavement and remove excess.
 3. Use hot-applied joint sealant to seal cracks and joints more than 1/4 inch (6 mm) wide. Fill flush with surface of existing pavement and remove excess.

3.05 SURFACE PREPARATION

- A. General: Immediately before placing asphalt materials, remove loose and deleterious material from substrate surfaces. Ensure that prepared subgrade is ready to receive paving.
- B. Herbicide Treatment: Apply herbicide according to manufacturer's recommended rates and written application instructions. Apply to dry, prepared subgrade or surface of compacted-aggregate base before applying paving materials.
 1. Mix herbicide with prime coat if formulated by manufacturer for that purpose.
- C. Cutback Prime Coat: Apply uniformly over surface of compacted unbound-aggregate base course at a rate of 0.15 to 0.50 gal./sq. yd. (0.7 to 2.3 L/sq. m). Apply enough material to penetrate and seal, but not flood, surface. Allow prime coat to cure.

1. If prime coat is not entirely absorbed within 24 hours after application, spread sand over surface to blot excess asphalt. Use enough sand to prevent pickup under traffic. Remove loose sand by sweeping before pavement is placed and after volatiles have evaporated.
 2. Protect primed substrate from damage until ready to receive paving.
- D. Emulsified Asphalt Prime Coat: Apply uniformly over surface of compacted unbound-aggregate base course at a rate of 0.10 to 0.30 gal./sq. yd. per inch depth (0.5 to 1.40 L/sq. m per 25 mm depth). Apply enough material to penetrate and seal, but not flood, surface. Allow prime coat to cure.
1. If prime coat is not entirely absorbed within 24 hours after application, spread sand over surface to blot excess asphalt. Use enough sand to prevent pickup under traffic. Remove loose sand by sweeping before pavement is placed and after volatiles have evaporated.
 2. Protect primed substrate from damage until ready to receive paving.
- E. Tack Coat: Apply uniformly to surfaces of existing pavement at a rate of 0.05 to 0.15 gal./sq. yd. (0.2 to 0.7 L/sq. m).
1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
 2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

3.06 PAVING GEOTEXTILE INSTALLATION

- A. Apply asphalt binder uniformly to existing pavement surfaces at a rate of 0.20 to 0.30 gal./sq. yd. (0.8 to 1.2 L/sq. m).
- B. Place paving geotextile promptly according to manufacturer's written instructions. Broom or roll geotextile smooth and free of wrinkles and folds. Overlap longitudinal joints 4 inches (100 mm) and transverse joints 6 inches (150 mm).
- C. Protect paving geotextile from traffic and other damage, and place hot-mix asphalt overlay the same day.

3.07 PLACING HOT-MIX ASPHALT

- A. Machine place hot-mix asphalt on prepared surface, spread uniformly, and strike off. Place asphalt mix by hand in areas inaccessible to equipment in a manner that prevents segregation of mix. Place each course to required grade, cross section, and thickness when compacted.
 1. Place hot-mix asphalt base course in number of lifts and thicknesses indicated.
 2. Place hot-mix asphalt surface course in single lift.
 3. Spread mix at a minimum temperature of 250 deg F (121 deg C).
 4. Begin applying mix along centerline of crown for crowned sections and on high side of one-way slopes unless otherwise indicated.

5. Regulate paver machine speed to obtain smooth, continuous surface free of pulls and tears in asphalt-paving mat.
- B. Place paving in consecutive strips not less than 10 feet (3 m) wide unless infill edge strips of a lesser width are required.
 1. After first strip has been placed and rolled, place succeeding strips and extend rolling to overlap previous strips. Overlap mix placement about 1 to 1-1/2 inches (25 to 38 mm) from strip to strip to ensure proper compaction of mix along longitudinal joints.
 2. Complete a section of asphalt base course before placing asphalt surface course.
- C. Promptly correct surface irregularities in paving course behind paver. Use suitable hand tools to remove excess material forming high spots. Fill depressions with hot-mix asphalt to prevent segregation of mix; use suitable hand tools to smooth surface.

3.08 JOINTS

- A. Construct joints to ensure a continuous bond between adjoining paving sections. Construct joints free of depressions, with same texture and smoothness as other sections of hot-mix asphalt course.
 1. Clean contact surfaces and apply tack coat to joints.
 2. Offset longitudinal joints, in successive courses, a minimum of 6 inches (150 mm).
 3. Offset transverse joints, in successive courses, a minimum of 24 inches (600 mm).
 4. Construct transverse joints at each point where paver ends a day's work and resumes work at a subsequent time. Construct these joints using either "bulkhead" or "papered" method according to AI MS-22, for both "Ending a Lane" and "Resumption of Paving Operations."
 5. Compact joints as soon as hot-mix asphalt will bear roller weight without excessive displacement.
 6. Compact asphalt at joints to a density within 2 percent of specified course density.

3.09 COMPACTION

- A. General: Begin compaction as soon as placed hot-mix paving will bear roller weight without excessive displacement. Compact hot-mix paving with hot, hand tampers or with vibratory-plate compactors in areas inaccessible to rollers.
 1. Complete compaction before mix temperature cools to 185 deg F (85 deg C).
- B. Breakdown Rolling: Complete breakdown or initial rolling immediately after rolling joints and outside edge. Examine surface immediately after breakdown rolling for indicated crown, grade, and smoothness. Correct laydown and rolling operations to comply with requirements.
- C. Intermediate Rolling: Begin intermediate rolling immediately after breakdown rolling while hot-mix asphalt is still hot enough to achieve specified density. Continue rolling until hot-mix asphalt course has been uniformly compacted to the following density:

1. Average Density: 96 percent of reference laboratory density according to ASTM D 6927, but not less than 94 percent or greater than 100 percent.
 2. Average Density: 92 percent of reference maximum theoretical density according to ASTM D 2041, but not less than 90 percent or greater than 96 percent.
- D. Finish Rolling: Finish roll paved surfaces to remove roller marks while hot-mix asphalt is still warm.
- E. Edge Shaping: While surface is being compacted and finished, trim edges of pavement to proper alignment. Bevel edges while asphalt is still hot; compact thoroughly.
- F. Repairs: Remove paved areas that are defective or contaminated with foreign materials and replace with fresh, hot-mix asphalt. Compact by rolling to specified density and surface smoothness.
- G. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.
- H. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

3.10 ASPHALT CURBS

- A. Construct hot-mix asphalt curbs over compacted pavement surfaces. Apply a light tack coat unless pavement surface is still tacky and free from dust. Spread mix at a minimum temperature of 250 deg F (121 deg C).
1. Asphalt Mix: Same as pavement surface-course mix.
- B. Place hot-mix asphalt to curb cross section indicated or, if not indicated, to local standard shapes, by machine or by hand in wood or metal forms. Tamp hand-placed materials and screed to smooth finish. Remove forms after hot-mix asphalt has cooled.

3.11 INSTALLATION TOLERANCES

- A. Pavement Thickness: Compact each course to produce the thickness indicated within the following tolerances:
1. Base Course: Plus or minus 1/2 inch (13 mm).
 2. Surface Course: Plus 1/4 inch (6 mm), no minus.
- B. Pavement Surface Smoothness: Compact each course to produce a surface smoothness within the following tolerances as determined by using a 10-foot (3-m) straightedge applied transversely or longitudinally to paved areas:
1. Base Course: 1/4 inch (6 mm)
 2. Surface Course: 1/8 inch (3 mm)

3. Crowned Surfaces: Test with crowned template centered and at right angle to crown. Maximum allowable variance from template is 1/4 inch (6 mm).
- C. Asphalt Traffic-Calming Devices: Compact and form asphalt to produce the contour indicated and within a tolerance of plus or minus 1/8 inch (3 mm) of height indicated above pavement surface.

3.12 SURFACE TREATMENTS

- A. Fog Seals: Apply fog seal at a rate of 0.10 to 0.15 gal./sq. yd. (0.45 to 0.7 L/sq. m) to existing asphalt pavement and allow to cure. With fine sand, lightly dust areas receiving excess fog seal.
- B. Slurry Seals: Apply slurry coat in a uniform thickness according to ASTM D 3910 and allow to cure.
 1. Roll slurry seal to remove ridges and provide a uniform, smooth surface.

3.13 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Thickness: In-place compacted thickness of hot-mix asphalt courses will be determined according to ASTM D 3549.
- C. Surface Smoothness: Finished surface of each hot-mix asphalt course will be tested for compliance with smoothness tolerances.
- D. Asphalt Traffic-Calming Devices: Finished height of traffic-calming devices above pavement will be measured for compliance with tolerances.
- E. In-Place Density: Testing agency will take samples of uncompacted paving mixtures and compacted pavement according to ASTM D 979.
 1. Reference maximum theoretical density will be determined by averaging results from four samples of hot-mix asphalt-paving mixture delivered daily to site, prepared according to ASTM D 2041, and compacted according to job-mix specifications.
 2. In-place density of compacted pavement will be determined by testing core samples according to ASTM D 1188 or ASTM D 2726.
 - a. One core sample will be taken for every 1000 sq. yd. (836 sq. m) or less of installed pavement, with no fewer than three cores taken.
 - b. Field density of in-place compacted pavement may also be determined by nuclear method according to ASTM D 2950 and correlated with ASTM D 1188 or ASTM D 2726.
- F. Replace and compact hot-mix asphalt where core tests were taken.
- G. Remove and replace or install additional hot-mix asphalt where test results or measurements indicate that it does not comply with specified requirements.

3.14 WASTE HANDLING

- A. General: Handle asphalt-paving waste according to approved waste management plan required in Section 01741.

END OF SECTION

SECTION 02930
LOAMING AND SEEDING

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Furnish all labor, materials, equipment and incidentals required and place loam, finish grade, apply lime and fertilizer, hydraulically apply seed and mulch and maintain all seeded areas as shown on the Drawings and as specified herein, including all areas disturbed and all existing lawn areas.

1.02 RELATED WORK

- A. Site Preparation is included in Section 02100.
- B. Earthwork is included in Section 02200.

1.03 SUBMITTALS

- A. Submit, in accordance with Section 01300, complete shop drawings, materials and equipment furnished under this Section including seed mixtures and product label information.
- B. Samples of all materials shall be submitted for inspection and acceptance upon Engineer's request.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Loam shall be fertile, natural soil, typical of the locality, free from large stones, roots, sticks, clay, peat, weeds and sod and obtained from naturally well drained areas. It shall not be excessively acid or alkaline nor contain toxic material harmful to plant growth. Topsoil stockpiled under other Sections of this Division may be used, but the Contractor shall furnish additional loam at his/her own expense if required.
- B. Fertilizer shall be a complete commercial fertilizer, 10-10-10 grade for grass areas. It shall be delivered to the site in the original unopened containers each showing the manufacturer's guaranteed analysis. Store fertilizer so that when used it shall be dry and free flowing.
- C. Lime shall be ground limestone containing not less than 85 percent calcium and magnesium carbonates.
- D. Grass seed shall be from the same or previous year's crop; each variety of seed shall have a percentage of germination not less than 90, a percentage of purity not less than 85 and shall have not more than 1 percent weed content. The mixture shall consist of seed proportioned by weight as follows:
 - 1. Durable Coarse Grass
 - a. 70 percent KY-31 Tall Fescue (*Festuca Arundinacea*)
 - b. 20 percent Kentucky Blue Grass (*Poa Pratensis*)
 - c. 10 percent Perennial Rye Grass (*Lolium Perenne*)

2. Coarse Lawn Grass
 - a. 45 percent KY-31 Tall Fescue (*Festuca Arundinacea*)
 - b. 20 percent Penlawn Red Fescue
 - c. 25 percent Kentucky Bluegrass
 - d. 10 percent Annual Rye Grass or mixed with Weeping Lovegrass depending upon the season
 3. Fine Lawn Grass
 - a. 30 percent Merion Kentucky Blue Grass
 - b. 40 percent Kentucky Blue Grass
 - c. 20 percent Penlawn Red Fescue
 - d. 10 percent Annual Ryegrass
 4. Field Grass I
 - a. 15 percent Smooth Broom
 - b. 15 percent Orchard Grass
 - c. 15 percent Timmothy
 - d. 15 percent Red Clover
 - e. 10 percent Sweet Clover
 - f. 10 percent Korean Lespedeza
 - g. 10 percent Interstate Sercia
 - h. 10 percent Lespedeza
 5. Field Grass II
 - a. 4 -lbs of pure seed
 - b. Bachelor Button
 - c. Lance-Leaved Coreopsis
 - d. Babys Breath
 - e. Scarlet Flax
 - f. Purple Cone Flower
 - g. Evening Primrose
 - h. Baby Snapdragon
 - i. Calendula
 - j. Corn Poppy
 - k. Catchfly
 - l. Black-Eyed Susan
 - m. Lewis Flax
 - n. 26 lbs bulking agent-sheep fescue or equal northern mixture
- E. The seed shall be furnished and delivered premixed in the proportions specified above. A manufacturer's certificate of compliance to the specified mixes shall be submitted by the manufacturer for each seed type. These certificates shall include the guaranteed percentages of purity, weed content and germination of the seed and also the net weight and date of shipment. No seed may be sown until the certificates have been submitted.
- F. Mulch shall be a specially processed cellulose fiber containing no growth or germination-inhibiting factors. It shall be manufactured in such a manner that after addition and agitation in slurry tanks with water, the fibers in the material become uniformly suspended to form a homogeneous slurry. When sprayed on the ground, the material shall allow absorption and percolation of moisture. Each package of the cellulose fiber shall be marked by the manufacturer to show the air dry weight content.

PART 3 EXECUTION

3.01 APPLICATION

- A. Unless otherwise shown on the Drawings, loam shall be placed to a minimum depth of 6-in on all lawn areas and 4-in in areas indicated to be naturalized.
- B. For all areas to be seeded:
 - 1. Lime shall be applied at the rate of 25 lbs/1,000 sq ft.
 - 2. Fertilizer (10-10-10) shall be applied at the rate of 30 lbs/1,000 sq ft.
 - 3. Lawn grass seed shall be applied at the rate of 10 lbs/1,000 sq ft. Field Grass I seed shall be applied at the rate of 4 lbs/1,000 sq ft. Field Grass II seed shall be applied at the rate of 5 lbs/acre sq ft.
 - 4. Fiber mulch shall be applied at the rate of 20 lbs/1,000 sq ft.
- C. The application of fertilizer and lime may be performed hydraulically in one operation with hydroseeding and mulching. If lime is applied in this manner, clean all structures and paved areas of unwanted deposits.

3.02 INSTALLATION

- A. The subgrade of all areas to be loamed and seeded shall be raked and all rubbish, sticks, roots and stones larger than 2-in shall be removed. Subgrade surfaces shall be raked or otherwise loosened immediately prior to being covered with loam. Subgrade shall be inspected and approved by the Engineer before loam is placed.
- B. Loam shall be placed over approved areas to a depth sufficiently greater than required so that after natural settlement and light rolling, the complete work will conform to the lines, grades and elevations indicated. No loam shall be spread in water or while frozen or muddy.
- C. After loam has been spread, it shall be carefully prepared by scarifying or harrowing and hand raking. All large stiff clods, lumps, brush, roots, stumps, litter and other foreign material shall be removed from the loamed area and disposed of. The areas shall also be free of smaller stones, in excessive quantities, as determined by the Engineer. The whole surface shall then be rolled with a hand roller weighing not more than 100 lbs/ft of width. During the rolling, all depressions caused by settlement of rolling shall be filled with additional loam and the surface shall be regraded and rolled until a smooth and even finished grade is created.
- D. Seeding, mulching and conditioning shall only be performed during those periods within the seasons which are normal for such work as determined by the weather and locally accepted practice, as approved by the Engineer. Hydroseed only on a calm day.
- E. Areas with Field Grass II shall receive site preparation and be seeded according to the manufacturer's written instructions.
- F. Schedules for seeding and fertilizing shall be submitted to the Engineer for approval prior to the work.

- G. If lime and fertilizer are to be spread mechanically rather than in one operation with the hydroseeding, then:
 - 1. After the loam is placed and before it is raked to true lines and rolled, limestone shall be spread evenly over loam surface and thoroughly incorporated with loam by heavy raking to at least 1/2 the depth of loam.
 - 2. Fertilizer shall be uniformly spread and immediately mixed with the upper 2-in of topsoil.
- H. Seeding shall be done within 10 days following soil preparation. Seed shall be applied hydraulically at the rates and percentages indicated. The spraying equipment and mixture shall be so designed that when the mixture is sprayed over an area, the grass seed and mulch shall be equal in quantity to the specified rates. Prior to the start of work, the Engineer shall be furnished with a certified statement for approval as to the number of pounds of materials to be used per 100 gallons of water. This statement shall also specify the number of square feet of seeding that can be covered with the quantity of solution in the Hydroseeder.
- I. In order to prevent unnecessary erosion of newly graded slopes and unnecessary siltation of drainage ways, carry out seeding and mulching as soon as satisfactory completion of a unit or portion of the project. A unit of the work will be defined as not more than 20,000 sq ft.
- J. When protection of newly graded areas is necessary at a time that is outside of the normal seeding season, protect those areas by whatever means necessary (such as straw applied with a tar tack) or by other measures as approved by the Engineer.

3.03 SEEDING IN WOODED AND UNGRADED AREAS

- A. For preparation and seeding in wooded areas under this Contract and where no grading is required, all of the specified materials and procedures shall be utilized except that no disking shall be performed within the drip line of trees to be preserved. The seed bed shall be prepared by the addition of a thin layer of top soil roughly 1-in deep.

3.04 MAINTENANCE AND PROVISIONAL ACCEPTANCE

- A. Keep all seeded areas watered and in good condition, reseeding if and when necessary until a good, healthy, uniform growth is established over the entire area seeded and shall maintain these areas in an approved condition including a minimum of two mowings of the lawn areas until provisional acceptance.
- B. On slopes, provide against washouts by an approved method. Any washout that occurs shall be regraded and reseeded at the Contractor's expense until a good sod is established.
- C. The Engineer will inspect all work for provisional acceptance at the end of the 8 week grass maintenance period, upon the written request, received at least 10 days before the anticipated date of inspection.
- D. A satisfactory stand will be defined as a section of grass of 10,000 sq ft or larger that has:
 - 1. No bare spots larger than 3 sq ft.
 - 2. No more than 10 percent of total area with bare spots larger than 1 sq ft.

- 3. Not more than 15 percent of total area with bare spots larger than 6-in square.
- E. Furnish full and complete written instructions for maintenance of the lawns to the Owner at the time of provisional acceptance.
- F. The inspection by the Engineer will determine whether maintenance shall continue in any area of manner.
- G. After all necessary corrective work and clean-up has been completed and maintenance instructions have been received by the Owner, the Engineer will certify in writing the provisional acceptance of the lawn areas. Maintenance of lawns or parts of lawns shall cease on receipt of provisional acceptance.

3.05 GUARANTEE PERIOD AND FINAL ACCEPTANCE

- A. All seeded areas shall be guaranteed for not less than 1 full year from the time of provisional acceptance.
- B. At the end of the guarantee period, inspection will be made by the Engineer upon written request submitted at least 10 days before the anticipated date. Lawn areas not demonstrating satisfactory stands as outlined above, as determined by the Engineer, shall be renovated, reseeded and maintained meeting all requirements as specified herein.
- C. After all necessary corrective work has been completed, the Engineer shall certify in writing the final acceptance of the lawns.

END OF SECTION

SECTION 03300
CAST-IN-PLACE CONCRETE

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. Provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install cast-in-place concrete.
2. Concrete shall be in accordance with requirements of ACI 301 and ACI 350.5 unless otherwise specified.
3. The Work includes providing concrete consisting of portland cement, fine and coarse aggregate, water, and approved admixtures; combined, mixed, transported, placed, finished, and cured. The Work also includes:
 - a. Providing openings in concrete to accommodate the Work under this and other Sections, and building into the concrete all items such as sleeves, frames, anchorage devices, inserts, and all other items to be embedded in concrete Work.

B. Coordination:

1. Review installation procedures under other Sections and coordinate installation of items to be installed in the concrete Work.

C. Classifications of Concrete:

1. Class “A” concrete includes the following:
 - a. All concrete, unless otherwise shown or indicated.
2. Class “AF” concrete may be used in lieu of Class “A” concrete for the following:
 - a. Walls and foundations thicker than 16 inches.
3. Class “AS” concrete shall be provided, where shown or indicated, for slabs not exposed to freezing and thawing where troweled finish is required.
4. Class “B” concrete shall be placed without forms or with simple forms, with little or no reinforcing, and includes the following, unless otherwise shown or indicated:
 - a. Concrete fill within structures.
 - b. Duct banks.
 - c. Unreinforced encasements.
 - d. Curbs and gutters.
 - e. Sidewalks.
 - f. Thrust blocks.
5. Class “C” concrete shall be provided where shown or indicated for slabs that require enhanced durability against wear.
6. Class “D” concrete shall be unreinforced and used where required as concrete fill under foundations, filling abandoned piping, and where “lean concrete” or “mudmat” is shown or indicated in the Contract Documents.

D. Related Sections:

1. Section 03600, Grout.

1.2 REFERENCES

A. Standards referenced in this Section are:

1. AASHTO M 182, Specification for Burlap Cloth Made From Jute or Kenaf and Cotton Materials.
2. AASHTO TP23, Test Method for Water Content of Freshly Mixed Concrete Using Microwave Oven Drying.
3. ACI 117, Specifications for Tolerances for Concrete Construction and Materials and Commentary.
4. ACI 301, Specifications for Structural Concrete.
5. ACI 305.1, Specification for Hot Weather Concreting.
6. ACI 306.1, Standard Specification for Cold Weather Concreting.
7. ACI 308.1, Specification for Curing Concrete.
8. ACI 318, Building Code Requirements for Structural Concrete and Commentary.
9. ACI 350/350R, Code Requirements for Environmental Engineering Concrete Structures and Commentary.
10. ACI 350.5, Specifications for Environmental Concrete Structures.
11. ASTM C31/C31M, Practice for Making and Curing Concrete Test Specimens in the Field.
12. ASTM C33, Specification for Concrete Aggregates.
13. ASTM C39/C39M, Test Method for Compressive Strength of Cylindrical Concrete Specimens.
14. ASTM C42/C42M, Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
15. ASTM C94/C94M, Specification for Ready-Mixed Concrete.
16. ASTM C109/C109M, Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or [50-mm] Cube Specimens).
17. ASTM C138/C138M, Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete.
18. ASTM C143/C143M, Test Method for Slump of Hydraulic-Cement Concrete.
19. ASTM C150, Specification for Portland Cement.
20. ASTM C157/C157M, Test Method for Length Change of Hardened Hydraulic-Cement Mortar and Concrete.
21. ASTM C171, Specification for Sheet Materials for Curing Concrete.
22. ASTM C172, Practice for Sampling Freshly Mixed Concrete.
23. ASTM C231, Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
24. ASTM C260, Specification for Air-Entraining Admixtures for Concrete.
25. ASTM C309, Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
26. ASTM C494/C494M, Specification for Chemical Admixtures for Concrete.
27. ASTM C618, Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.
28. ASTM C882/C882M, Test Method for Bond Strength of Epoxy-Resin Systems Used with Concrete by Slant Shear.
29. ASTM C989, Specification for Slag Cement for Use in Concrete and Mortars.
30. ASTM C1017, Specification for Chemical Admixtures for Use in Producing Flowing Concrete.
31. ASTM C1064/C1064M, Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete.
32. ASTM C1077, Practice for Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation.

33. ASTM C1240, Specification for Silica Fume Used in Cementitious Mixtures.
34. ASTM C1260, Test Method for Potential Alkali Reactivity of Aggregates (Mortar-Bar Method).
35. ASTM C1293, Test Method for Determination of Length Change of Concrete Due to Alkali-Silica Reaction.
36. ASTM C1567, Test Method for Determination of Length Change of Concrete Due to Alkali-Silica Reaction.
37. ASTM D1042, Test Method for Linear Dimensional Changes of Plastics Caused by Exposure to Heat and Moisture.
38. ASTM D3574, Test Methods for Flexible Cellular Materials—Slab, Bonded, and Molded Urethane Foams.
39. ASTM E96/E96M, Test Methods for Water Vapor Transmission of Materials
40. ASTM E329, Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection.
41. ASTM E1643, Practice for Selection, Design, Installation, and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs.
42. ASTM E1745, Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs.
43. NRMCA, National Ready Mixed Concrete Association.

1.3 QUALITY ASSURANCE

A. Qualifications:

1. Concrete Testing Laboratory:
 - a. Employ independent testing laboratory experienced in design and testing of concrete materials and mixes to perform material evaluation tests and to design concrete mixes.
 - 1) Testing agency shall be in accordance with ASTM E329 and ASTM C1077.
 - 2) Testing laboratory shall have been inspected and passed within previous two years by Cement and Concrete Reference Laboratory (CCRL) of NIST for: testing concrete aggregates, and for preparing and testing concrete trial batches with or without admixtures. Testing laboratory shall provide documentation indicating how deficiencies, if any, in most recent CCRL inspection report were corrected.
 - 3) Selection of testing laboratory is subject to Owner's acceptance.
 - 4) Submit written description of proposed concrete testing laboratory giving qualifications of personnel, laboratory facilities, and equipment, and other information requested by Engineer.
2. Batch Plant: NRMCA Program for Certification of Ready-Mixed Concrete Production Facilities or approved equivalent program.
3. Mix Designer: Person responsible for developing concrete mixture proportions certified as NRMCA Concrete Technologist Level 2 or DOT certified mix designer in jurisdiction of the Work. Requirement may be waived if individual is Contractor's Licensed Design Engineer.
4. Flatwork Finisher: Unless otherwise permitted, at least one person on finishing crew shall be certified as an ACI Flatwork Finisher, or equivalent.
5. Water Reducing Admixture Manufacturer:
 - a. Water-reducing admixtures shall be manufactured under strict quality control in facilities operated under a quality assurance program. Submit copy of manufacturer's quality assurance handbook to document program existence.
 - b. Manufacturer shall maintain a concrete testing laboratory approved by CCRL at NIST.

- c. Manufacturer shall be capable of providing services of qualified field service representatives at the Site.
- B. Laboratory Trial Batch:
 - 1. Each concrete mix design specified shall be verified by laboratory trial batch, unless indicated otherwise.
 - 2. For classes of concrete that require air-entrainment, test the trial batch at highest percentage of air allowed for that class of concrete.
 - 3. Perform the following testing on each trial batch:
 - a. Aggregate gradation for fine and coarse aggregates.
 - b. Fly ash testing to verify meeting specified properties, unless fly ash Supplier submits certification by an independent testing laboratory.
 - c. Slump.
 - d. Air content.
 - e. Compressive strength based on three cylinders each tested at seven days and at 28 days.
 - f. Shrinkage test in accordance with this Section, for Class “A” concrete and Class “AF” concrete.
 - 4. Submit for each trial batch the following information:
 - a. Project identification name and number (if applicable).
 - b. Date of test report.
 - c. Complete identification of aggregate source of supply.
 - d. Tests of aggregates for compliance with the Contract Documents.
 - e. Scale weight of each aggregate.
 - f. Absorbed water in each aggregate.
 - g. Brand, type, and composition of cementitious materials.
 - h. Brand, type, and amount of each admixture.
 - i. Amounts of water used in trial mixes.
 - j. Proportions of each material per cubic yard.
 - k. Gross weight and yield per cubic yard of trial mixtures.
 - l. Measured slump.
 - m. Measured air content.
 - n. Compressive strength developed at seven days and 28 days, from not less than three test cylinders cast for each seven day and 28 day test, and for each design mix.
 - o. Shrinkage test results where required and as specified in this Section. Report results and averages for original length and at zero, seven, 14, 21, and 28 days of drying.
- C. Shrinkage Test:
 - 1. Perform drying shrinkage tests for trial batch as specified in this Section.

2. Drying shrinkage specimens shall be four-inch by four-inch by 11-inch prisms with effective gage length of ten inches; fabricated, cured, dried, and measured in accordance with ASTM C157 modified as follows: remove specimens from molds at an age of 23 hours, plus-or-minus one hour, after trial batching; shall be placed immediately in water at 70 degrees F plus-or-minus three degrees F for at least 30 minutes; and shall be measured within 30 minutes thereafter to determine original length and then submerged in saturated lime water at 73 degrees F plus-or-minus three degrees F. Measurement to determine expansion expressed as percentage of original length shall be made at age of seven days. Length at age of seven days shall be base length for drying shrinkage calculations (zero days drying age). Immediately afterward store specimens in humidity-controlled room maintained at 73 degrees F plus-or-minus three degrees F, and 50 percent (plus-or-minus four percent) relative humidity for remainder of test. Obtain measurements to determine shrinkage expressed as percentage of base length and report measurements separately for seven, 14, 21, and 28 days of drying after seven days of moist curing.
3. Determine drying shrinkage deformation of each specimen as the difference between base length (at zero days drying age) and length after drying at each test age. Determine average drying shrinkage deformation of specimens to nearest 0.0001-inch at each test age. If drying shrinkage of a specimen departs from average of that test age by more than 0.0004-inch, results obtained from that specimen shall be disregarded. Report results of shrinkage test to nearest 0.001 percent of shrinkage. Compression test specimens shall be taken in each case from same concrete used for preparing drying shrinkage specimens. Tests shall be considered part of normal compression tests for the Work. Allowable shrinkage limitations shall be as specified in Part 2 of this Section.

D. Component Supply and Compatibility:

1. Provide a certificate of compatibility for all admixture materials.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:

1. Mix Design:
 - a. List of concrete materials and proportions for the proposed concrete mix designs. Include data sheets, test results, certifications, and mill reports to qualify the materials proposed for use in the mix designs. Do not start laboratory trial batch testing until this submittal is approved by Engineer.
 - b. Laboratory Trial Batch Reports: Submit laboratory test reports for concrete cylinders, materials, and mix design tests.
 - c. Test results per ASTM C33 confirming meets limit on deleterious material in fine aggregate.
 - d. Test results per ASTM C1260, ASTM C1293, and ASTM C1567 to determine potential for alkali-silica reactivity.
 - e. Certificate of compatibility of combined admixtures.
 - f. Certification of mix designer.
2. Concrete Supply:
 - a. Ready-mixed Concrete: Submit the following information.
 - 1) NRMCA plant certification.
 - 2) Physical capacity of mixing plant.
 - 3) Trucking facilities available.
 - 4) Estimated average amount of the specified concrete that can be produced and delivered to the Site during a normal, eight-hour day, excluding output to other customers.

3. Product Data:
 - a. Manufacturers' specifications with application and installation instructions for proprietary materials and items, including admixtures and bonding agents.
 4. Samples:
 - a. Submit Samples of materials as specified and as requested by Engineer. Include with each Sample names of product and Supplier, and description.
 - b. Colored Cement Pigment Color Samples: Submit complete selection of manufacturer's standard and custom colors for final selection by Engineer.
 5. Thermal Control Plan:
 - a. Submit plan for controlling internal temperature and temperature gradients within specified limits.
 6. Curing and Protection Plans:
 - a. Submit detailed plan for curing and protection of concrete placed and cured in cold weather.
 - b. Submit detailed plan for curing and protection of concrete placed and cured in ambient temperatures over 80 degrees F.
- B. Informational Submittals: Submit the following:
1. Certifications:
 - a. Notarized certification of conformance to reference standards used in this Section, when required by Engineer.
 - b. Flatwork finisher certification.
 2. Delivery Tickets: Copies of all delivery tickets for each load of concrete delivered to or mixed at the Site submitted prior to unloading. Each delivery tickets shall contain the information in accordance with ASTM C94 requirements of sections 14.2.1 through 14.2.10 along with project identification name and number (if any), date, mix type, mix time, quantity and amount of water initially withheld and introduced on site.
 3. Minutes of the Concrete Coordination Conference and other subsequent structure specific concrete construction conferences.

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Transportation, Delivery, and Handling:
1. Materials used for concrete shall be clean and free from foreign matter during transportation and handling, and kept separate until measured and placed into concrete mixer.
 2. Implement suitable measures during hauling, piling, and handling to ensure that segregation of coarse and fine aggregate particles does not occur and grading is not affected.
- B. Storage:
1. For storage, provide bins or platforms with hard, clean surfaces.

PART 2 – PRODUCTS

2.1 GENERAL

- A. Not used.

2.2 CEMENTITIOUS MATERIALS

A. Cement:

1. Portland cement shall be Type II(MH) ASTM C150. Type I or Type II may be used in lieu of Type II (MH) when approved by Engineer.
2. Portland cement shall be produced by one manufacturer. Alternate cement sources may be used provided that mix design has been approved and acceptable trial batch verifying performance has been made.
3. Do not use cement that has deteriorated because of improper storage or handling.

B. Fly Ash:

1. Fly ash, when used, shall conform to the requirements of ASTM C618 Class F, except as follows:
 - a. The loss on ignition shall be a maximum of four percent.
 - b. The maximum percent of sulfur trioxide (SO₃) shall be 4.0.
2. Fly ash shall be considered to be a cementitious material.
3. Laboratory trial batches shall be tested to determine compliance with strength requirements, times of setting, slump, slump loss, and shrinkage characteristics.

C. Slag Cement:

1. Slag Cement, when used, shall conform to ASTM C989, Grade 120.
2. Slag cement is considered a cementitious material.
3. Perform laboratory tests on trial batches to determine compliance with strength requirements, times of setting, slump, slump loss, and shrinkage characteristics.

D. Silica Fume:

1. Silica fume shall be dry compacted or slurry form and shall conform to ASTM C1240. Silica fume is considered a cementitious material. Application rate, when specified, shall be seven percent by weight of cement, unless indicated otherwise.

- E. For all classes of concrete, when Type II (MH) Cement is used, fly ash or slag cement may be used within the following percentages by weight. When Type II Cement is used, fly ash or slag cement shall be used within the following percentages by weight. When Type I Cement is used, in lieu of Type II (MH) Cement, fly ash or slag cement shall be used such that total tricalcium aluminate content (C3A) of the resulting cementitious material is not greater than eight percent.

1. When fly ash is used, material shall have minimum of 20 percent and maximum of 25 percent of total weight of cementitious material.
2. When slag cement is used, material shall have minimum of 40 percent and maximum of 50 percent of total weight of cementitious material.

2.3 AGGREGATES

A. General:

1. Aggregates shall conform to ASTM C33, Class Designation 4S, and as specified in this Section.
2. Do not use aggregates containing soluble salts or other substances, such as iron sulfides, pyrite, marcasite, ochre, or other materials, that can cause stains on exposed concrete surfaces.
3. Aggregates shall be tested to determine potential for alkali-silica reactivity.

B. Fine Aggregate:

1. Provide clean, sharp, natural sand free of loam, clay, lumps, and other deleterious substances.
2. Dune sand, bank run sand, and manufactured sand are unacceptable.

C. Coarse Aggregate:

1. Provide clean, uncoated, processed aggregate containing no clay, mud, loam, or foreign matter, as follows:
 - a. Crushed stone, processed from natural rock or stone.
 - b. Washed gravel, either natural or crushed. Slag, pit gravel, and bank run gravel are unacceptable.

2.4 WATER

- A. Water used in producing and curing concrete shall be clean and free of injurious quantities of oils, acids, alkalis, organic materials, and other substances that may be deleterious to concrete and steel.

2.5 CONCRETE ADMIXTURES

- A. Provide admixtures in accordance with product manufacturer's published instructions. Admixtures shall be compatible with each other. Admixtures shall not contain thiocyanates, shall not contain more than 0.05 percent chloride ion, and shall be non-toxic in the concrete mix after 30 days. Do not use admixtures that have not been incorporated and tested in the accepted mixes, unless otherwise approved by Engineer.
- B. Air Entraining Admixtures: ASTM C260.
 1. Air entraining admixture shall be vinsol resin or vinsol rosin-based.
- C. Water-Reducing Admixture: ASTM C494, Type A or D.
 1. Proportion Class "A", Class "AF", Class "AS", and Class "B" concrete with non-air entraining, water-reducing, aqueous solution of modified organic polymer.
- D. High Range Water-Reducing Admixture (HRWR): ASTM C494, Type F or G.
 1. Use high range water-reducing admixture in the concrete classifications so specified or indicated. Use of HRWR admixture is allowed at Contractor's option in all other classifications of concrete. Specific admixture formulation shall be as recommended by admixture manufacturer for Project conditions.

E. Plasticizing Admixtures: ASTM C1017, Type I or Type II

1. Use plasticizing admixture as an alternate to high range water-reducing admixture. Specific admixture formulation shall be as recommended by admixture manufacturer for Project conditions.

F. Set Control Admixtures: In accordance with ASTM C494. Use the following as required:

1. Type B, Retarding.
2. Type C, Accelerating.
3. Type D, Water reducing and Retarding.
4. Type E, Water reducing and Accelerating.
5. Type G, Water-reducing, high range, and retarding admixtures.

G. Calcium Chloride: Do not use calcium chloride.

H. Shrinkage Reducing Admixture:

1. Shrinkage reducing admixture may be used in mix design when necessary to conform to specified shrinkage limitations, provided that specified strength requirements are complied with and there is no reduction in sulfate resistance in the concrete and no increase in concrete permeability.

I. Corrosion-Inhibiting Admixtures:

1. Corrosion-inhibiting admixture shall be calcium nitrite solution containing minimum of 30 percent calcium nitrite. Admixture shall be added at dosage rate of five gallons per cubic yard of concrete.
2. Product and Manufacturer: Provide one of the following:
 - a. DCI or DCI-S, by Grace Construction Products.
 - b. Rheocrete CNI, by Master Builders, Inc.
 - c. Eucon CIA, by Euclid Chemical Company.
 - d. Or equal.
3. Adjust quantity of mix water to account for water portion of calcium nitrite solution.
4. Provide retarding admixtures as required, if set time is accelerated.

J. Colored Cement Pigments:

1. Provide the following, where shown or indicated: Commercial iron oxide, manganese dioxide, ultramarine blue, chromium oxide, or carbon black compounded for use in concrete.
2. Product and Manufacturer: Provide one of the following:
 - a. Truetone Mortar Colors by Frank D Davis Company, subsidiary of Rockwood Industries, Inc.
 - b. Sonobrite by Sonneborn Building Products, division of Rexnord Chemical Products, Inc.
 - c. Or equal.
3. Do not exceed pigment-to-cement ratios, by weight, of one-to-35 for carbon black, and one-to-seven for other pigments.
4. Engineer will select colors from manufacturer's full range of standard colors.

2.6 PROPORTIONING AND DESIGN OF MIXES

A. Prepare concrete design mixes in accordance with Table 03300-A:

TABLE 03300-A
CONCRETE DESIGN MIX CRITERIA

Concrete Class	Coarse Aggregate ⁽¹⁾		Minimum Cementitious ⁽⁵⁾ (lbs/cu yd)	Max. W/CM ⁽⁴⁾	Slump ⁽²⁾	Air ⁽⁶⁾ (%)	Min. Comp Strength ⁽³⁾ (psi)
	Size A	Size B					
Class "A"	No. 57	No. 8	535	0.42	4" max.	6 +/- 1.5	4,500
Class "AF"	No. 467	No. 8	517	0.42	4" max.	5 +/- 1.5	4,500
Class "AS"	No. 57	No. 8	535	0.42	4" max.	-	4,500
Class "B"	No. 57 or No. 67		517	0.50	4" max.	6 +/- 1.5	3,000
Class "C"	N. 57 or No. 67		564	0.40	4" max.	3 Max.	5,000
Class "D"	Any ASTM C33		← No requirements →				2,000

Notes Applicable to Table 03300-A:

- Coarse aggregate size numbers refer to ASTM C33. Where Size A and B are designated in Table 03300-A, it is intended that the smaller Size B aggregate is to be added, replacing a portion of the coarse or fine aggregate, in the minimum amount necessary to make a workable and pumpable mix with sand content not exceeding 41 percent of total aggregate.
- Slumps indicated are prior to addition of high range water reducing admixture or plasticizing admixture.
- Mix designs shall be made for all but Class "D", which does not require trial batch, so that the compressive strength achieved for laboratory trial batches will not be less than 125 percent of specified design strength.
- Quantity of water to be used in the determination of water-cementitious materials (W/CM) ratio shall include free water on aggregates in excess of SSD and water portion of admixtures.
- Minimum cementitious content shall be adjusted in accordance with the requirements of Table 5.2.2.1 of ACI 350.5 and Table 4.2.2.1 of ACI 301 if smaller maximum coarse aggregate size is used.
- Required air content listed shall be adjusted in accordance with the requirements of Table 5.2.2.4 of ACI 350.5 and Table 4.2.2.7.b.1 of ACI 301 for severe exposure if a different maximum coarse aggregate size is used.

- B. Lightweight Concrete: Not used.
- C. Adjustment to Concrete Mixes: Mix design adjustments may be requested by Contractor when characteristics of materials, Site conditions, weather, test results, or other circumstances warrant; at no additional cost to Owner and as approved by Engineer. Before using adjusted concrete mixes, laboratory test data and strength results shall be submitted to and approved by Engineer.
- D. Admixtures:
 - 1. Use air-entraining admixture in concrete, unless otherwise shown or indicated. Add air-entraining admixture at admixture manufacturer's prescribed rate to produce concrete at point of placement having air content within prescribed limits.
 - 2. Use water-reducing or high-range water-reducing admixtures in all Class "A" and Class "AF" concrete.
 - 3. Use amounts of admixtures recommended by admixture manufacturer for climatic conditions prevailing at the Site at time of placing. Adjust quantities and types of admixtures as required to maintain quality.
- E. Slump Limits with High-Range Water Reducer:
 - 1. Slump shall not exceed four inches prior to adding high-range water reducer and shall not exceed eight inches, measured at point of placement, after adding high-range water reducer.
- F. Shrinkage Limitation:
 - 1. Concrete shrinkage for specimens cast in laboratory from trial batch with total water of 30.2 gallons per cubic yard or less, as measured at 21-day drying age and at 28-day drying age shall not exceed 0.039 percent and 0.045 percent, respectively. For trial batch with total water of 32.7 gallons per cubic yard or greater respective limits shall not exceed 0.035 percent and 0.040 percent. Limits in between shall be linear interpolated. Use mix design for construction that complies with trial batch shrinkage requirements. Shrinkage limitations apply to Class "A" concrete and Class "AF" concrete.
 - 2. Trial Batch Does Not Comply with Shrinkage Limitation:
 - a. If trial batch results do not comply with shrinkage limitation specified in the Contract Documents, redesign the mix to reduce shrinkage.
 - b. After mix has been repeatedly redesigned and Engineer is satisfied that all reasonable means to provide concrete mix that complies with shrinkage requirement have been exercised; and mix design still fails to comply with shrinkage limitation in the Contract Documents, Engineer reserves the right to accept the higher-shrinkage mix, provided that the quantity of shrinkage reinforcing in structures is increased.
 - c. "Reasonable means" will be construed as reducing the total water content to a maximum of 27 gallons per cubic yard, having the large aggregate blended so that eight percent to 18 percent of combined aggregate is retained on each sieve, using an alternate aggregate source, and a combination of these means.
 - d. Basis for shrinkage reinforcing increase will be proportional to amount that shrinkage value is over the specified shrinkage limitation and will be determined by Engineer. The cost of providing additional shrinkage reinforcement will be paid by the Owner.
- G. Color: Provide colored concrete where shown and indicated. Incorporate pigments into concrete mix according to pigment manufacturer's written instructions. Match color of Sample approved by Engineer.

2.7 BONDING AGENT

- A. Epoxy Bonding Agent:
 - 1. Provide a two-component epoxy-resin bonding agent
 - 2. Product and Manufacturer: Provide one of the following:
 - a. Sikadur 32 Hi-Mod LPL, by Sika Corporation.
 - b. Eucopoxy LPL, by the Euclid Chemical Company.
 - c. Resi-Bond J-58, by Dayton Superior.
 - d. Or equal.
- B. Epoxy-Cement Bonding Agent:
 - 1. Provide three component epoxy resin-cement blend formulated as bonding agent.
 - 2. Product and Manufacturer: Provide one of the following:
 - a. Sika Armatec 110 EpoCem, as manufactured by Sika Corporation.
 - b. Duralprep A.C., as manufactured by the Euclid Chemical Company.
 - c. Emaco P24, as manufactured by MBT/ChemRex.
 - d. Or equal.

2.8 CONCRETE CURING MATERIALS

- A. Absorptive Cover: Burlap cloth made from jute or kenaf, weighing approximately 10 ounces per square yard and complying with AASHTO M 182, Class 3.
- B. Curing Mats: Shall be heavy carpets or cotton mats, quilted at four inches on centers, and weighing minimum of 12 ounces per square yard when dry.
- C. Moisture-Retaining Cover: Provide one of the following, complying with ASTM C171:
 - 1. Waterproof paper.
 - 2. Polyethylene film.
 - 3. White burlap polyethylene sheet.
- D. Liquid Curing Compound: ASTM C309 Type 1-D (water retention requirements):
 - 1. Provide fugitive dye.
 - 2. Curing compound shall be applied by roller or power sprayer.

2.9 FINISHING AIDS

- A. Evaporation Retardant:
 - 1. Product and Manufacturer: Provide one of the following:
 - a. Confilm, by Master Builders.
 - b. Eucobar, by Euclid Chemical Company.
 - c. SikaFilm, by Sika Corporation.
 - d. Or equal.

2.10 CRACK INJECTION MATERIALS

- A. Structural Crack Repair System:
 - 1. Epoxy for Injection: Low-viscosity, high-modulus moisture insensitive type.
 - 2. Products and Manufacturers: Provide one of the following:
 - a. Sikadur 35, Hi-Mod L.V. and Sikadur 31, Hi-Mod Gel, by Sika Corporation.
 - b. Eucopoxy Injection Resin, by Euclid Chemical Company.
 - c. Or equal.
- B. Non-structural Crack Repair System:
 - 1. Hydrophobic Polyurethane Chemical Grout:
 - a. Provide hydrophobic polyurethane that forms a flexible gasket.
 - b. Products and Manufacturers: Provide one of the following:
 - 1) SikaFix HH LV, by Sika Chemical Company.
 - 2) Hydro Active Flex SLV, by De Neef Construction Chemicals, Inc.
 - 3) Or equal.
 - c. Shrinkage limit shall not exceed 4.0 percent in accordance with ASTM D1042.
 - d. Minimum elongation of 250 percent in accordance with ASTM D3574.
 - e. Minimum tensile strength of 150 psi in accordance with ASTM D3574.
 - 2. Hydrophilic Acrylate-Ester Resin:
 - a. Hydrophilic crack repair system shall be acrylate-ester resin that forms a flexible gasket and increase in volume a minimum of 50 percent when in contact with water.
 - b. Products and Manufacturers: Provide one of the following:
 - 1) Duroseal Multigel 850, manufactured by BBZ USA, Inc.
 - 2) Superflex AR, by De Neef Construction Chemicals, Inc.
 - 2) Or equal.

2.11 CONCRETE REPAIR MATERIALS

- A. Concrete repair mortar shall be pre-packaged, polymer-modified cementitious repair mortar with the following minimum properties:
 - 1. Compressive Strength at One Day: 2,000 psi (ASTM C109).
 - 2. Compressive Strength at 28 Days: 6,000 psi (ASTM C109).
 - 3. Bond Strength at 28 Days: 1,800 psi (ASTM C882 modified).
- B. Products and Manufacturers: Provide one of the following:
 - 1. Five Star Structural Concrete, by Five Star Products, Inc. Use formulation recommended by manufacturer for the specific application conditions.
 - 2. SikaTop 122 Plus, SikaTop 123 Plus, SikaTop 111 Plus, or Sikacem 133, by Sika Corporation. Use formulation from among those listed in this paragraph recommended by manufacturer for specific application conditions.
 - 3. Emaco S88-CA or S66-CR, by Master Builders Inc. Use formulation from among those listed in this paragraph recommended by manufacturer for specific application conditions.
 - 4. Verticoat, Verticoat Supreme, or Euco SR-VO, by Euclid Chemical Company. Use formulation from among those listed in this paragraph recommended by manufacturer for specific application conditions.
 - 5. Or equal.

- C. Cement Mortar: Shall consist of mix of one part cement to 1.5 parts sand with sufficient water to form trowelable consistency. Minimum compressive strength at 28 days shall be 4,000 psi. Where required to match the color of adjacent concrete surfaces, blend white portland cement with standard portland cement so that, when dry, patching mortar matches the color of surrounding concrete.

2.12 CHEMICAL HARDENER

- A. Provide clear chemical hardener of fluosilicate family.
- B. Product and Manufacturer: Provide one of the following:
 - 1. Lapidolith, by Sonneborn ChemRex Inc.
 - 2. Hornolith, by A.C. Horn, Inc.
 - 3. Or equal.

2.13 SHAKE-ON METALLIC HARDENER

- A. Provide metallic hardener formulated, processed, and packaged under stringent quality control at metallic hardener manufacturer-owned and -controlled factory. Hardener shall be a mixture of specially-processed and -graded aggregate, selected portland cement, and plasticizing agents.
- B. Product and Manufacturer: Provide one of the following:
 - 1. Euco-Plate H.D., by Euclid Chemical Company.
 - 2. Masterplate 200, by Master Builders, Inc.
 - 3. Or equal.

2.14 VAPOR RETARDER

- A. Vapor Retarder:
 - 1. Vapor retarder membrane shall comply with the following.
 - a. Water Vapor Transmission Rate, ASTM E96: 0.04 perms or lower.
 - b. Water Vapor Retarder, ASTM E1745: Meets or exceeds Class C.
 - c. Thickness of Retarder (plastic), ACI 302 1R: Not less than 10 mils.
 - 2. Products and Manufacturers: Provide one of the following:
 - a. Stego Wrap 10-mil Vapor Retarder, by Stego Industries LLC.
 - b. Griffolyn 10-mil, by Reef Industries.
 - c. Moistop Ultra, by Fortifiber Industries.
 - d. Or equal.
- B. Accessories:
 - 1. Provide accessories by same manufacturer as vapor retarder.
 - 2. Seam Tape:
 - a. Tape shall have water vapor transmission rate (ASTM E96) of 0.3 perms or lower.
 - b. Products and Manufacturers: Provide one of the following:
 - 1) Stego Tape by Stego Industries LLC.
 - 2) Griffolyn Fab Tape by Reef Industries.
 - 3) Moistop Tape by Fortifiber Industries.
 - 4) Or equal.
 - 3. Vapor Proofing Mastic:
 - a. Mastic shall have a water vapor transmission rate ASTM E96, 0.3 perms or lower.

4. Pipe Boots:
 - a. Construct pipe boots from vapor barrier material, pressure sensitive tape, mastic, or a combination thereof, in accordance with manufacturer's recommendations.

2.15 SOURCE QUALITY CONTROL

- A. Concrete materials may require testing, as directed by Engineer, at any time during the Work if concrete quality is in question. Provide access to material stockpiles and facilities at all times. Tests shall be done at no expense to Owner.

PART 3 – EXECUTION

3.1 INSPECTION

- A. Examine the substrate and conditions under which the Work will be performed and notify Engineer in writing of unsatisfactory conditions. Do not proceed with the Work until unsatisfactory conditions have been corrected.

3.2 CONCRETE MIXING

- A. General:
 1. Concrete may be produced at batch plants or by the ready-mixed process. Batch plants shall comply with recommendations of ACI 301 and have sufficient capacity to produce concrete of qualities required and in quantities required to comply with the accepted Progress Schedule. All plant facilities are subject to acceptance of Engineer.
 2. Mixing:
 - a. Mix concrete with a rotating type batch machine, except where hand mixing of very small quantities is approved by Engineer.
 - b. Remove hardened accumulations of cement and concrete from drum and blades to ensure proper mixing action.
 - c. Replace mixer blades upon loss of ten percent of mixer blades' original height.
- B. Site Mixing:
 1. When Site mixing of concrete is approved by Engineer mix all materials for concrete in a drum-type batch mixer.
 - a. For mixers of one cubic yard or smaller capacity, continue mixing at least 1.5 minutes but not more than five minutes after all ingredients are in the mixer, before any part of batch is released.
 - b. For mixers of capacity larger than one cubic yard, increase minimum 1.5 minutes of mixing time by 15 seconds for each additional cubic yard or fraction thereof.
 2. Do not exceed mixer manufacturer's published rating of the mixer, or mixer nameplate capacity, for total volume of materials used per batch.
 3. Equip mixer with automatic controls for proportioning materials and proper, measured quantities.
 4. Do not exceed 45 minutes total elapsed time between intermingling of damp aggregates and cement to discharge of completed mix.
- C. Ready-Mix Concrete:
 1. Comply with ASTM C94 and the Contract Documents.
 - a. Plant Equipment and Facilities: Conform to requirements of NRMCA certification.

- b. Mix concrete in revolving-type truck mixers that are in good condition and produce thoroughly-mixed concrete conforming to the Contract Documents.
 - c. Do not exceed rated capacity of mixer.
 - d. Mix concrete for minimum of two minutes after arrival at the Site, or as recommended by mixer manufacturer.
 - e. Do not allow drum to mix while in transit.
 - f. Mix at proper speed until concrete is discharged from mixer.
 - g. Maintain adequate facilities at the Site for continuous delivery of concrete at required rates.
 - h. Provide access to mixing plant for Engineer upon request.
 - 2. When silica fume is used in dry compacted form, comply with the following mix requirements and ensure full dispersion:
 - a. For all types of mixing equipment, increase mix times by 40 percent over minimum mix time required to achieve mix uniformity defined in ASTM C94.
 - b. For truck-mixed and central-mixed concrete, maximum allowable batch size shall be 80 percent of maximum in accordance with ASTM C94.
- D. Maintain equipment in proper operating condition, with drums cleaned before charging each batch. Schedule rates of delivery to prevent delay of placing concrete after mixing, or holding dry-mixed materials too long in mixer before the adding water and admixtures.

3.3 TRANSPORTING CONCRETE

- A. Transport and place concrete not more than 90 minutes after water has been added to the dry ingredients.
- B. Avoid spilling and separation of concrete mixture during transportation.
- C. Do not place concrete in which the ingredients have separated.
- D. Do not retemper partially set concrete.
- E. Use suitable equipment for transporting concrete from mixer to forms.

3.4 PREPARATION FOR CONCRETING

- A. Submit to Engineer laboratory trial batch test results for proposed mixes at least 15 days prior to start of Work. Do not begin concrete production until associated laboratory trial batch test result submittal has been approved by Engineer.
- B. Notify Engineer a minimum of 24 hours in advance of placing concrete to allow for inspection of form work, joints, waterstops, reinforcement, embedded items, and vapor retarders. The section to be placed shall be fully prepared for concrete placement at the time of notice. Confirm inspection status with Engineer a minimum of 4 hours prior to concrete placement. Do not begin placing concrete until Work is in conformance with the Contract Documents.
- C. Subgrade surfaces shall be thoroughly wetted by sprinkling, prior to the placing of concrete, and these surfaces shall be kept moist by frequent sprinkling up to the time of placing concrete thereon. The surface shall be free from standing water, mud, and debris at the time of placing concrete.

- D. Reinforcing steel and embedded items shall be completely cleaned of mortar, loose rust, form release compounds, dirt, or other substances which would interfere with proper bonding with concrete. Protective coatings on embedded aluminum items shall continuously cover the surface to be in contact with concrete. Defects in the coating shall be repaired.
- E. Do not place concrete until flow of water entering space to be filled with concrete has been properly stopped or has been diverted by pipes, or other means, and carried out of the forms, clear of the Work. Do not deposit concrete underwater, and do not allow water to rise on concrete surfaces until concrete has attained its initial set. Do not allow water to flow over concrete surface in manner and or velocity that will injure concrete surface finish. Provide temporary pumping or other dewatering operations for removing water as required.
- F. Installation of Vapor Retarder:
 - 1. Provide vapor retarder under slabs-on-grade and outside walls to receive resilient floor finishes, carpet, ceramic and slate tile, chemical resistant coatings, and where shown or indicated on the Drawings.
 - 2. Install in accordance with manufacturer's instructions, ASTM E1643, and the following:
 - a. Unroll vapor retarder with longest dimension parallel with direction of the pour.
 - b. Lap vapor retarder over footings and seal to foundation walls.
 - c. Overlap vapor retarder joints by six inches and seal with vapor retarder manufacturer's tape.
 - d. Seal penetrations, including pipes, in accordance with vapor retarder manufacturer's instructions.
 - e. Penetration of vapor retarder is not allowed except for reinforcing steel and permanent utilities.
 - f. Repair damaged areas of vapor retarder by providing, for each damaged area, patch of vapor retarder material and overlapping damaged area with the patch by six inches on each side, and securely and continuously taping all four sides of patch to undamaged vapor retarder.

3.5 CONCRETE PLACEMENT

- A. General:
 - 1. Place concrete continuously, so that no concrete will be placed on concrete that has hardened sufficiently to cause formation of seams or planes of weakness within the section.
 - 2. Deposit concrete as nearly as practical in its final location to avoid segregation due to rehandling or flowing. Do not subject concrete to action that may cause segregation.
 - 3. Screed concrete that is to receive other construction to proper level to avoid excessive skimming or grouting.
 - 4. Do not use concrete that becomes non-plastic and unworkable, or does not conform to required quality limits, or that has been contaminated by foreign materials. Do not use retempered concrete. Remove rejected concrete from the Site and dispose of it in conformance with Laws and Regulations.
 - 5. Do not place concrete until forms, bracing, reinforcing, and embedded items are each in final position and secure.
 - 6. Do not place footings in freezing weather unless adequate precautions are taken against frost action.
 - 7. Do not place footings, piers or pile caps on frozen soil.
 - 8. Unless otherwise instructed, place concrete only when Engineer is present.
 - 9. Allow minimum of three days between adjoining concrete placements. At expansion joints, allow minimum of one day between adjoining concrete placements.

B. Bonding for Next Concrete Pour:

1. Prepare for bonding of fresh concrete to concrete that has set but is not fully cured, as follows:
 - a. Thoroughly wet the surface, but allow no free-standing water.
 - b. For horizontal surfaces place a six-inch layer of Construction Joint Grout, as specified in Section 03600, Grouting, over the hardened concrete surface.
 - c. Place fresh concrete before the grout has attained its initial set.
2. Accomplish bonding of fresh concrete to fully cured, hardened, existing concrete by using a bonding agent as specified in Section 2.7-BONDING AGENT of this specification.

C. Concrete Conveying:

1. Handle concrete from point of delivery at the Site, transfer to concrete conveying equipment, and transfer to locations of final deposit as rapidly as practical by methods that prevent segregation and loss of concrete mix materials.
2. Provide mechanical equipment for conveying concrete to ensure continuous flow of concrete at delivery end of conveyor. Provide runways for wheeled concrete conveying equipment from concrete delivery point to locations of final deposit. Keep interior surfaces of conveying equipment, including chutes, free of hardened concrete, debris, water, snow, ice, and other deleterious materials.
3. Do not use chutes for distributing concrete, unless accepted by Engineer.
4. Pumping concrete is allowed, however do not use aluminum pipe for conveying concrete.

D. Placing Concrete into Forms:

1. Deposit concrete in forms in horizontal layers not deeper than 18 inches each and in manner that avoids inclined construction joints. Where placement consists of several layers, place concrete at such rate that concrete being integrated with fresh concrete while still plastic.
2. Do not allow concrete to free-fall within the form from height exceeding four feet. Where high-range water reducer is used to extend slump to at least six inches, maximum allowable free-fall of concrete is six feet. Use “elephant trunks” to prevent free-fall and excessive splashing of concrete on forms and reinforcing. Discontinue free-falls in excess of four feet if there is evidence of segregation.
3. Remove temporary spreaders in forms when concrete placing has reached elevation of such spreaders.
4. Consolidate concrete placed in forms by mechanical vibrating equipment supplemented by hand-spading, rodding, or tamping. Use equipment and procedures for consolidating concrete in accordance with requirements of ACI 301. Vibration of forms and reinforcing is not allowed unless otherwise accepted by Engineer.
5. Where height of concrete placement in walls exceeds 14 feet, provide temporary windows in formwork to facilitate vibration. Properly close temporary windows when height of concrete approaches windows. Determine location, size, and spacing of temporary windows to suit equipment used.
6. Do not use vibrators to transport concrete inside of forms. Insert and withdraw vibrators vertically at uniformly-spaced locations not farther than the visible effectiveness of the vibrator. Place vibrators to rapidly penetrate the layer of concrete and at least six inches into the preceding layer. Do not insert vibrators into lower layers of concrete that have begun to set. At each insertion, limit the duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcing and other embedded items without causing segregation of concrete mix.
7. Do not place concrete in beam and slab forms until concrete previously placed in columns and walls is no longer plastic.

8. Prevent voids in the concrete. Force concrete under pipes, sleeves, openings, and inserts from one side until visible from the other side.
- E. Placing Concrete Slabs:
1. Deposit and consolidate concrete slabs in continuous operation, within limits of construction joints, until placing of a slab panel or section is completed.
 2. Consolidate concrete during placing operations using mechanical vibrating equipment, so that concrete is thoroughly worked around reinforcing and other embedded items and into corners.
 3. Consolidate concrete placed in beams and girders of supported slabs, and against bulkheads of slabs on ground, as specified in this Article for formed concrete structures.
 4. Bring slab surfaces to correct elevation and level. Smooth the surface, leaving surface free of humps or hollows. Do not sprinkle water on surface while concrete is plastic. Do not disturb slab surfaces prior to commencing concrete finishing.
 5. Where slabs are placed in conditions of high temperature or wind that could lead to formation of plastic shrinkage cracks, provide evaporation retardant applied in accordance with retardant manufacturer's recommendations.
- F. Quality of Concrete Work:
1. Concrete shall be solid, compact, and smooth, and free of laitance, cracks, and cold joints.
 2. Concrete for liquid-retaining structures, and concrete in contact with earth, water, or exposed directly to the elements shall be watertight.
 3. Cut out and properly replace to extent directed by Engineer, or repair to satisfaction of Engineer, defects as defined in 3.12. Thin patches or plastering are unacceptable.
 4. Leaks through concrete that exhibit flowing water, and cracks, holes, or other defective concrete in areas of potential leakage, shall be repaired and made watertight.
 5. Repair, removal, and replacement of defective concrete as directed by Engineer shall be at no additional cost to Owner.
- G. Cold Weather Placing:
1. Protect concrete Work from physical damage or reduced strength that could be caused by frost, freezing, or low temperatures, in compliance with ACI 306.1 and the Contract Documents.
 2. When air temperature has fallen to or may be expected to fall below 40 degrees F, provide adequate means to maintain temperature in area where concrete is being placed between 50 degrees F and 70 degrees F for at least seven days after placing. Provide temporary housings or coverings including tarpaulins or plastic film. Maintain temporary heating and protection as necessary so that ambient temperature does not fall more than 30 degrees F in the 24 hours following the seven-day period. Avoid rapid dry-out of concrete due to overheating, and avoid thermal shock due to sudden cooling or heating.
 3. When air temperature has fallen to or is expected to fall below 40 degrees F, uniformly heat water and aggregates before mixing for concrete as required to obtain concrete mixture temperature not less than 55 degrees F and not more than 85 degrees F at point of placement.
 4. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials. Before placing concrete, verify that forms, reinforcing, and adjacent concrete surfaces are entirely free of frost, snow, and ice.

5. Do not use salt or other materials containing antifreeze agents. Do not use chemical accelerators or set-control admixtures unless approved by Engineer and tested in mix design proposed for use.

H. Hot Weather Placing:

1. When hot weather conditions exist that would impair the quality and strength of concrete, place concrete in compliance with ACI 305.1 and the Contract Documents.
2. When ambient air temperature is at or above 90 degrees F and rising, cool ingredients before mixing concrete to maintain concrete temperature at time of placement below 80 degrees F. When ambient air temperature is at or above 90 degrees F and falling, cool the ingredients before mixing concrete to maintain concrete temperature at time of placement below 85 degrees F. In no case shall the concrete temperature at time of placement exceed 90 degrees F.
3. Mixing water may be chilled, or chopped ice may be used to control concrete temperature provided the water equivalent of ice is calculated in total amount of mixing water. If required, reduce the time from addition of mix water to placement, or use set-retarding admixture.
4. Cover reinforcing materials with water-soaked burlap if ambient air temperature becomes too hot, so that reinforcing material temperature does not exceed ambient air temperature immediately before embedment of reinforcing in concrete.
5. Wet forms thoroughly before placing concrete.
6. Do not place concrete at temperature that causes difficulty from loss of slump, flash set, or cold joints.
7. Obtain Engineer's approval of substitute methods and materials proposed for use.

3.6 FINISHING OF FORMED SURFACES

A. Standard Form Finish:

1. Standard form finish shall be basically smooth and even, but is allowed to have texture imparted by the form material used. Repair defects in accordance with the Contract Documents.
2. Use standard form finish for the following:
 - a. Exterior vertical surfaces from foundation up to one foot below grade.
 - b. Vertical surfaces not exposed to view.
 - c. Other areas shown or indicated.

B. Smooth Form Finish:

1. Produce smooth form finish by selecting form materials that will impart smooth, hard, uniform texture. Arrange panels in orderly and symmetrical manner with minimum of seams. Repair and patch defective areas in accordance with the Contract Documents.
2. Use smooth form finish for the following:
 - a. Exterior surfaces exposed to view.
 - b. Surfaces to be covered with coating material. Coating material may be applied directly to concrete or may be a covering bonded to concrete such as waterproofing, dampproofing, painting, or other similar system.
 - c. Interior vertical surfaces of liquid-containers.
 - d. Interior and exterior exposed beams and undersides of slabs.
 - e. Surfaces to receive abrasive blasted finish.
 - f. Surfaces to receive smooth rubbed or grout cleaned finish.
 - g. Other areas shown or indicated.

D. Grout Cleaned Finish:

1. Provide grout cleaned finish to concrete surfaces that have received smooth form finish and where defects have been repaired, as follows:
 - a. Combine one part portland cement to 1.5 parts fine sand by volume, and mix with water to consistency of thick paint. Blend standard portland cement and white portland cement, in proportions determined by trial patches, so that final color of dry grout will closely match adjacent concrete surfaces.
 - b. Thoroughly wet concrete surface and apply grout uniformly by brushing or spraying immediately to wetted surfaces. Scrub surface with cork float or stone to coat surface and fill surface holes. Remove excess grout by scraping, followed by rubbing with clean burlap to remove visible grout film. Keep grout damp during setting period by using fog spray on surface for at least 36 hours after final rubbing. Complete each area the same day the area is started, with limits of each area being natural breaks in the finished surface.
2. Use grout cleaned finish for the following:
 - a. Interior exposed walls and other vertical surfaces.
 - b. Exterior exposed walls and other vertical surfaces down to one foot below grade.
 - c. Interior and exterior horizontal surfaces.
 - d. Interior exposed vertical surfaces of liquid-containing structures down to one foot below normal operating liquid level.
 - e. Other areas shown.

E. Abrasive Blasted Finish:

1. Provide abrasive blasted finish where shown or indicated.
2. Where abrasive blasted finish is required, apply finish to smooth formed finish after end of curing period, with defects repaired, to match approved finish provided on mock-up or Sample panel, as applicable.
3. Heavy Abrasive Blasted Finish: Abrasive blast to uniformly expose coarse aggregate.
4. Light Abrasive Blasted Finish: Abrasive blast to uniformly expose fine aggregate.

F. Related Unformed Surfaces:

1. At tops of walls, horizontal offsets, and similar unformed surfaces occurring adjacent to formed surfaces, strike off smooth and finish with texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise shown or indicated.

3.7 SLAB FINISHES

A. Float Finish:

1. After placing concrete slabs, do not work the surface further until ready for floating. Begin floating when surface water has disappeared or when concrete has stiffened sufficiently. Check and level the surface plane to tolerance not exceeding 1/4-inch in ten feet when tested with a ten-foot straightedge placed on surface at not less than two different angles. Cut down high spots and fill low spots. Uniformly slope surfaces to drains. Immediately after leveling, refloat surface to uniform, smooth, granular texture.
2. Use float finish for the following:
 - a. Interior exposed horizontal surfaces of liquid-containing structures, except those to receive grout topping.
 - b. Exterior below-grade horizontal surfaces.
 - c. Surfaces to receive additional finishes, except as shown or indicated.

- B. Trowel Finish:
 - 1. After floating, begin first trowel finish operation using power-driven trowel. Begin final troweling when surface produces a ringing sound as trowel is moved over the surface.
 - 2. Consolidate concrete surface by the final hand troweling operation. Finish shall be free of trowel marks, uniform in texture and appearance, and with surface plane tolerance not exceeding 1/8-inch in ten feet when tested with a ten foot straight edge. Grind smooth surface defects that would otherwise project through applied floor covering system.
 - 3. Use trowel finish for the following:
 - a. Interior exposed slabs, unless otherwise shown or indicated.
 - b. Slabs that receive one of the following: resilient flooring, carpeting, or ceramic tile.
- C. Non-Slip Broom Finish:
 - 1. Immediately after float finishing, slightly roughen concrete surface by brooming in direction perpendicular to main traffic route. Use fine fiber-bristle broom, unless otherwise directed by Engineer. Coordinate required final finish with Engineer before applying finish.
 - 2. Use non-slip broom finish for the following:
 - a. Exterior exposed horizontal surfaces subject to lightweight foot traffic.
 - b. Interior and exterior concrete steps and ramps.
- D. Special Finish, Troweled Polyester Composition:
 - 1. For floors receiving troweled polyester composition finish, the following apply:
 - a. Provide wood float finish.
 - b. Elevation shall be uniform within 1/4-inch tolerance in ten feet.
 - c. Use approved curing and hardening compound or proper moist curing procedures.
 - d. Cure slabs for 21 days minimum prior to topping.
 - e. Protect slabs against oil and greases. Remove from slab surface dripping, flaking, and loose substances and other bonded foreign particles that might prevent adhesion of composition.
 - f. Patch and repair other floor imperfections in accordance to finish manufacturer's recommendations.
- E. Shake-On Metallic Finish:
 - 1. For each slab shown or indicated to receive shake-on metallic finish, provide application of shake-on metallic hardener at rate of two pounds per square foot. First shake shall comprise two-thirds of specified quantity of hardener. Provide first application after initial floating operation, unless climatic conditions dictate earlier application. Shake-on metallic hardener shall be floated in the second application. Surface shall be floated again after second application to properly bond hardener to base concrete slab. Surface shall then be troweled at least twice to smooth, dense finish.
 - 2. Furnish field service upon five days notice by the hardener manufacturer to assist Contractor in obtaining maximum benefits of product under prevailing conditions at the Site. Hardener manufacturer's representative shall attend concrete coordination conference required in Article 1.3 of this Section.
 - 3. Use shake-on metallic hardener finish with Class "C" concrete for slabs shown or indicated on the Drawings as receiving this finish.
 - 4. Protect slabs against oil and greases. Remove from slab surface dripping, flaking, or loose substances and other bonded foreign particles that might prevent adhesion of finish.
 - 5. Patch and repair other floor imperfections in accordance with hardener manufacturer's recommendations.

F. Scratched Finish:

1. After providing float finish, roughen concrete surface with rake before concrete's final set. Amplitude of surface shall be minimum of 1/4-inch.
2. Provide scratched finish for the following:
 - a. Horizontal surfaces that will receive grout topping or concrete equipment pad.
 - b. Surfaces so indicated on the Drawings or elsewhere in the Contract Documents.

3.8 CONCRETE CURING AND PROTECTION

A. General:

1. Protect freshly placed concrete from premature drying, excessive cold or hot temperatures, and maintain without drying at relatively constant temperature for period necessary for hydration of cement and proper hardening of concrete.
2. Start curing after placing and finishing concrete, as soon as free moisture has disappeared from concrete surface. Keep surface continuously moist during entire curing period. Cure for a minimum of 10 days and in accordance with requirements of ACI 301 and ACI 308.1. For concrete sections over 30-inches thick, the curing period shall be for a minimum of 14 days. Avoid rapid drying at end of final curing period.
3. For curing, use water that is free of impurities that could etch or discolor exposed concrete surfaces.
4. Confine water for curing to area being cured.

B. Curing Methods: Curing methods are specified below. Curing methods to be used on each type of concrete surface are specified elsewhere in this Article.

1. Water Curing. Cure by one of the following methods:
 - a. Keep concrete surface continuously wet.
 - b. Ponding or immersion.
 - c. Continuous water-fog spray.
 - d. Covering concrete surface with curing mats, thoroughly saturating mats with water, and keeping mats continuously wet with sprinklers or porous hoses. Place curing mats to cover concrete surfaces and edges with four-inch horizontal lap over adjacent mats; provide eight-inch lap over adjacent mats at vertical surfaces. If necessary, weigh down curing cover to maintain contact with concrete surface.
2. Form Curing. Cure by one of the following methods:
 - a. Forms shall be maintained and loosened during curing period.
 - b. Immediately after forms are loosened or removed, continue with the required curing method as applicable, for remainder of curing period.
 - c. Where wood forms are kept in place, apply water to keep forms wet.
3. Moisture Retaining Cover Curing. Cure as follows:
 - a. Cover concrete surfaces with the required moisture retaining cover for curing concrete, placed in widest practical width with sides and ends lapped at least three inches and sealed using waterproof tape or adhesive. Immediately repair holes or tears during curing period using cover material and waterproof tape.

4. Liquid Compound Curing. Cure as follows:
 - a. Unless otherwise approved by Engineer, provide water curing or form curing. Request to use liquid curing compound will be considered by Engineer on case-by-case basis. Construction joints, formed surfaces prior to receiving specified form finish, and concrete to receive surface treatment where surface treatment will be bonded to concrete surface (such as, but not limited to grout fill, hardener, coatings, lining, water repellent, painting, resilient flooring, terrazzo flooring, ceramic tile, quarry tile, chemical resistant coatings, or other applications) shall be water-cured or form-cured.
 - b. In liquid-retaining structures, provide water curing or form curing, unless other curing method is approved by Engineer. Requests to use liquid curing compound will be considered by Engineer on case-by-case basis. Request shall provide valid construction reason or safety reason for using liquid compound curing including reason why other curing methods are not viable.
 - c. Apply curing compounds immediately after final finishing or after terminating water curing. Apply curing compound in continuous operation by power spray equipment in accordance with curing compound manufacturer's directions. If areas are subjected to rainfall within three hours after completing curing compound application, area shall be recoated. Maintain coating continuity and repair areas damaged during curing period.
 - d. When liquid curing compound is used, apply first coat of liquid curing compound at compound manufacturer's recommended coverage rate, and subsequently apply second coat at identical rate, thus providing twice the curing compound manufacturer's recommended coverage.
 - e. At end of curing period, remove liquid curing compound where required.
- C. Formed Surfaces: Use the following curing methods:
 1. Walls That Will Retain Liquid or That are Under Ground Surface:
 - a. If forms are wood, form curing is allowed for entire curing period. If forms are steel, form curing is allowed for maximum of three days after which forms shall be removed so that concrete is free of the forms for remainder of the curing process.
 - b. Immediately after the forms are loosened or removed, continue with water curing for remainder of curing period.
 - c. When wall surface will not receive surface treatment and when allowed by Engineer, use of liquid curing compound is allowed. Before using liquid compound curing, use water curing or form curing for at least the first three days of curing.
 2. Formed Slab Underside and Beam Surfaces Where Will Retain Liquid:
 - a. Form curing is allowed for the full curing period.
 - b. Immediately after forms are loosened or removed, continue with water curing for remainder of curing period.
 - c. When slab surface will not receive surface treatment and when allowed by Engineer, use of liquid curing compound is allowed.
 3. Vertical Joint Surfaces and Surfaces to Receive Surface Treatment:
 - a. Form curing is allowed for entire curing period.
 - b. Immediately after forms are loosened or removed, continue with water curing for remainder of curing period.
 4. Cure other formed surfaces using an appropriate curing method specified in the Contract Documents.

- D. Unformed Surfaces: Treat with one of the following curing methods:
 - 1. Slabs and Mats That Will Retain Liquid or are Below Ground Surface:
 - a. Water curing.
 - b. Moisture-retaining cover curing when allowed by Engineer.
 - c. When slab or mat surface will not receive surface treatment and when allowed by Engineer, use of liquid curing compound is allowed. Before using liquid compound curing, use water curing or form curing for at least the first three days of curing.
 - 2. Construction Joint Surfaces and Slab and Mat Surfaces to Receive Surface Treatment.
 - a. Water curing.
 - b. Moisture-retaining cover curing.
 - 3. Cure other formed surfaces using an appropriate curing method specified in the Contract Documents.
- E. Temperature of Concrete During Curing:
 - 1. When ambient temperature is 40 degrees F or less, continuously maintain concrete temperature between 50 degrees F and 70 degrees F throughout curing period. When necessary, before concrete placing provide for temporary heating, covering, insulation, or housing as required to continuously maintain specified temperatures and moisture conditions throughout concrete curing period. Provide cold weather protection in accordance with requirements of ACI 306.1.
 - 2. When the ambient temperature is 80 degrees F and above, or during other climatic conditions that would cause too-rapid drying of concrete, before starting concrete placing, provide wind breaks and shading as required, and fog spraying, wet sprinkling, or moisture retaining coverings as required. Continuously protect concrete throughout concrete curing period. Provide hot weather protection in accordance with requirements of ACI 305.1, unless otherwise specified.
 - 3. Maintain concrete temperature as uniformly as possible, and protect from rapid ambient temperature changes. Avoid concrete temperature changes that exceed five degrees F in one hour and 50 degrees F in 24-hour period.
- F. Protection:
 - 1. During curing period, protect concrete from damaging mechanical disturbances including load stresses, heavy shock, excessive vibration, and damage by rain and flowing water. Protect finished concrete surfaces from damage by subsequent construction operations.

3.9 CONCRETE INSTALLATION TOLERANCES

- A. Installation Tolerances:
 - 1. Concrete placement tolerances, unless otherwise specified in the Contract Documents, shall be in accordance with ACI 117.
 - 2. Notify Engineer in writing when concrete placement does not conform with required tolerances, as soon as the condition is known to Contractor.
 - 3. When concrete installation does not conform to required tolerances, do not repair or correct by grinding unless specified in the Contract Documents or approved by Engineer in writing.
 - 4. Verification Measurements:
 - a. If surfaces where tolerances are in question, obtain measurements to verify conformance with tolerances in manner acceptable to Engineer.
 - b. If surfaces tolerances are in question, cost of obtaining measurements shall be at no additional cost to the Owner.

- c. Before obtaining measurements, obtain Engineer's acceptance of method proposed for obtaining measurements.
 - d. After obtaining measurements, submit measurements to Engineer.
5. Submit with verification measurements submittal proposed method to rectify out-of-tolerance concrete. Do not start repair Work without obtaining Engineer's approval.

3.10 FIELD QUALITY CONTROL

A. Field Testing Services:

1. Owner will employ testing laboratory to perform field quality control testing for concrete. Engineer will direct the testing requirements.
2. Testing laboratory will make standard compression test cylinders and entrained air tests as specified in this Article, under observation of Engineer or Resident Project Representative.
3. Testing laboratory will provide all labor, material, and equipment required for sampling and testing concrete, including: scale, glass tray, cones, rods, molds, air tester, thermometer, and other incidentals required.
4. Contractor shall provide all curing and necessary cylinder storage facilities in accordance with ASTM C31.

B. Quality Control Testing During Construction:

1. Perform sampling and testing for field quality control during placement of concrete, as follows:
 - a. Sampling Fresh Concrete: ASTM C172.
 - b. Slump: ASTM C143; one test for each concrete load at point of discharge.
 - c. Concrete Temperature: ASTM C1064; one for every two concrete loads at point of discharge, and when a change in the concrete is observed. Test each load when time from batching to placement exceeds 75 minutes.
 - d. Air Content: ASTM C231; one for every two concrete load at point of discharge, and when a change in the concrete is observed.
 - e. Unit Weight: ASTM C138; one for every two concrete loads at point of discharge, and when a change in the concrete is observed.
 - f. Compression Test Specimens:
 - 1) In accordance with ASTM C31; make one set of compression cylinders for each 50 cubic yards of concrete, or fraction thereof, of each mix design placed each day. Each set shall be four standard cylinders, unless otherwise directed by Engineer.
 - 2) Cast, store, and cure specimens in accordance with ASTM C31.
 - 3) Test and record the following when cylinders are cast: slump, concrete temperature, air content, and unit weight.
 - g. Compressive Strength Tests:
 - 1) In accordance with ASTM C39; one specimen tested at seven days, and two specimens tested at 28 days. Test fourth cylinder if needed to verify test results. If 4-inch by 8-inch cylinders are used, three specimens shall be tested at 28 days.
 - 2) Adjust mix design if test results are unsatisfactory and resubmit for approval.
 - 3) Concrete that does not comply with strength requirements will be considered as defective Work.
 - h. Water/Cementitious Materials Ratio: Perform one test from each sample from which compression test specimens are taken, in accordance with AASHTO TP23.
 - i. Within 24 hours of completion of test, testing laboratory will submit certified copy of test results to Contractor and Engineer.

C. Evaluation of Field Quality Control Tests:

1. Do not use concrete delivered to final point of placement having slump, concrete temperature, total air content or unit weight outside specified values.
2. Water/Cementitious Materials Ratio:
 - a. When water content testing indicates water/cementitious materials ratio to exceed specified requirements by greater than 0.02, remaining batches required to complete concrete placement shall have water content decreased in the mix and water reducing admixture dosage increased as required to bring subsequently-batched concrete within specified water/cementitious materials ratio.
 - b. Perform additional testing to verify compliance with specified water/cementitious materials ratio.
 - c. Do not resume concrete production for further concrete placement until Contractor has identified cause of excess water in the mix and revised batching procedures, or adjusted the mix design (and obtained Engineer's associated approval) to bring water/cementitious materials ratio into conformance with the Contract Documents.
3. Compressive Strength:
 - a. Compressive strength tests for laboratory-cured cylinders will be acceptable if the averages of all sets of three consecutive compressive strength tests results equal or exceed specified 28-day design compressive strength of the associated type or class of concrete, and no individual strength test falls below required compressive strength by more than 500 psi.
 - b. Questionable Field Conditions During Concrete Placement:
 - 1) Where questionable field conditions exist during concrete placement or immediately thereafter, strength tests of specimens cured under field conditions will be required by Engineer to check adequacy of curing and protecting of concrete placed. Specimens shall be molded at the same time and from the same samples as laboratory-cured specimens.
 - 2) Provide improved means and procedures for protecting concrete when 28-day compressive strength of field-cured cylinders is less than 85 percent of companion laboratory cured cylinders.
 - 3) When laboratory-cured cylinder strengths are appreciably higher than minimum required compressive strength, field-cured cylinder strengths need not exceed minimum required compressive strength by greater than 500 psi even though the 85 percent criterion may not be met.
 - 4) If individual tests of laboratory-cured specimens produce strengths more than 500 psi below the required minimum compressive strength, or if tests of field-cured cylinders indicate deficiencies in protection and curing, provide additional measures to ensure that load-bearing capacity of the structure is not jeopardized or impaired. If likelihood of low-strength concrete is confirmed and evaluations indicate load-bearing capacity may have been reduced, perform tests of cores from the concrete in question at Contractor's expense.
 - c. If compressive strength tests fail to indicate compliance with minimum requirements of the Contract Documents, concrete represented by such tests will be considered defective.

D. Testing Concrete Structure for Strength:

1. When there is evidence that strength of in-place concrete does not comply with the Contract Documents, Contractor shall employ the services of concrete testing laboratory to obtain cores from hardened concrete for compressive strength determination. Cores and tests shall comply with ASTM C42 and the following:

- a. Obtain at least three representative cores from each concrete member or suspect area of concrete at locations directed by Engineer.
 - b. Strength of concrete for each series of cores will be acceptable if average compressive strength is at least 85 percent of specified compressive strength and no single core is less than 75 percent of required 28-day required concrete compressive strength.
 - c. Testing laboratory shall submit test results to Engineer on same day that tests are completed. Include in test reports Project name and number (if any), date of sampling and testing, Contractor name, name of concrete testing laboratory, exact location of test core in the Work, type or class of concrete represented by core sample, nominal maximum size aggregate, design compressive strength, compression breaking strength, and type of break (corrected for length-diameter ratio), direction of applied load to core with respect to horizontal plane of concrete as placed, and moisture condition of the core at time of testing.
2. Fill core holes solid with non-shrink grout in accordance with Section 03600, Grouting, and finish to match adjacent concrete surfaces.
 3. If results of core tests are unacceptable or if it is impractical to obtain cores, perform static load test and evaluations complying with ACI 318 and ACI 350, as directed by Engineer.

E. Concrete Tolerance Verification Measurements: Refer to Article 3.9 of this Section.

F. Supplier's Services:

1. Water-Reducing Admixture Manufacturer: Furnish services of qualified concrete technician employed by admixture manufacturer to assist in proportioning concrete for optimum use of admixture. Concrete technician shall advise on proper addition of admixture to concrete and on adjustment of concrete mix proportions to meet changing conditions at the Site.

3.11 MISCELLANEOUS CONCRETE ITEMS

A. Temporary Openings:

1. Openings in concrete walls and slabs required for passage of Work are allowed only upon approval of Engineer.
2. Temporary openings made in concrete shall be provided with waterstop in below-ground or liquid-retaining members and structures. Reinforcement going through and around the opening shall be made continuous to provide continuity and shall be approved by the Engineer.
3. Temporary openings that remain in concrete structures shall be filled with the same class of concrete as the adjoining construction, after the Work causing need for temporary opening is complete, unless otherwise shown or directed by Engineer. Mix, place, and cure concrete as specified in this Section to blend with in-place construction. Provide miscellaneous concrete filling shown or required to complete the Work.

B. Bases or Pads for Piping, Panels, and Equipment:

1. Unless specifically shown or indicated otherwise, provide concrete bases or pads for equipment, floor-mounted panels, and floor-mounted supports for piping and similar construction. Provide all concrete pad and base Work not specifically included under other Sections.

2. Dimensions and Elevations:
 - a. Coordinate and construct bases and pads to dimensions shown or indicated, or as required to comply with equipment, panel, or piping manufacturer's requirements and elevations indicated on the Drawing.
 - b. Unless otherwise shown or indicated, place concrete bases for equipment up to one-inch below the equipment manufacturer's base or mounting plate.
 - c. Where specific dimensions or elevations are not shown or indicated, bases and pads shall be six inches thick and extend three inches outside dimensions of the equipment, panel, or supports.
3. Finish: Bases and pads outside of areas to receive non-shrink grout shall have smooth trowel finish, unless special finish such as terrazzo, ceramic tile, quarry tile, or heavy-duty concrete topping is required. In such cases, provide appropriate concrete finish. Surfaces of bases and pads to receive non-shrink grout shall have broom finish.

3.12 REPAIR OF CONCRETE PLACED UNDER THIS CONTRACT

A. Repair of Formed Surfaces:

1. Repair the following defects in all formed finishes:
 - a. Spalls, air bubbles, rock pockets, form depressions, and other defects that are more than 1/4-inch in depth.
 - b. Holes from tie rods and other form tie systems.
 - c. Fins, offsets, and other projections that extend more than 1/4-inch beyond designated concrete member surface.
 - d. Structural cracks, as defined by Engineer.
 - e. Non-structural cracks greater than 0.010-inch wide as defined by Engineer. In liquid-retaining structures, elevated slabs subject to the elements or washdowns, below-grade members, and cracks that evidence leakage. Where it is not possible to verify whether a crack is leaking, repair the crack.
2. Repair the following defects in smooth-finish surfaces, in addition to those listed above in this Section:
 - a. Spalls, air bubbles, rock pockets, form depressions, and other defects that extend to more than 1/2-inch in width in any direction, no matter how deep.
 - b. Spalls, air bubbles, rock pockets, form depressions, and other defects of any size that exceed three in number in a 12-inch by 12-inch area, or 12 in number in a three-foot by three-foot area.
 - c. Fins, offsets, and other projections shall be completely removed and smoothed.
 - d. Scratches and gouges in concrete surface.
 - e. Texture and color irregularities. In liquid-retaining surfaces, texture and color irregularities need not be repaired when greater than 12 inches below minimum normal operating liquid surface elevation, except where such defects are indicative of reduced durability.
3. Where smooth rubbed or grout cleaned finish is specified, minor surface defects repairable by the finishing process need not be repaired prior to finish application, when approved by Engineer.

B. Method of Repair of Formed Surfaces:

1. Immediately after removing forms, repair and patch defective areas with cement mortar or concrete repair mortar as directed by Engineer. Make repairs made to liquid-retaining structures and below-grade surfaces with repair mortar only. Repair form tie holes in liquid-retaining or below-grade surfaces with non-shrink grout in accordance with Section 03600, Grouting.

2. Honeycombs, Rock Pockets, and Holes Left by Tie Rods and Bolts:
 - a. Cut out honeycomb, rock pockets, voids, and holes left by tie rods and bolts, down to solid concrete but, in no case, to depth less than one-inch for cement mortar and 1/2-inch for repair mortar. Make edges of cuts perpendicular to concrete surface.
 - b. Before placing cement mortar, thoroughly clean and brush-coat area to be patched with specified bonding agent.
 - c. When using concrete repair mortar, use of bonding agent is optional; prepare the surface and place mortar in accordance with mortar manufacturer's recommendations.
 - d. Repairs at exposed-to-view surfaces shall match the color of surrounding concrete, except color matching is not required for interior surfaces of liquid-retaining surfaces up to one foot below typical minimum liquid level. Impart texture to repaired surfaces to match texture of existing adjacent surfaces. Provide test areas at inconspicuous locations to verify mixture, texture, and color match before proceeding with patching.
 - e. Compact mortar in place and strike off slightly higher than the surrounding surface.
 3. Structural Cracks: Pressure-grout structural cracks using injectable epoxy installed using pressurized system. Apply in accordance with epoxy manufacturer's directions and recommendations.
 4. Non-structural Cracks: Shall be pressure-grouted using hydrophobic or hydrophilic resin. Install in accordance with resin manufacturer's directions and recommendations.
 5. Determination of the crack type shall be made by the Engineer.
 6. Holes Through Concrete:
 - a. Using plunger-type gun or other suitable device, fill holes extending through concrete from least-exposed face, using flush stop held at exposed face; completely fill the hole with specified repair material.
 - b. At below-grade and liquid-containing members, fill holes with concrete repair mortar and use color-matched cement mortar for outer two inches at exposed-to-view surfaces.
 7. Where powerwashing or scrubbing is not adequate, abrasive blast exposed- to-view surfaces that require removal of stains, grout accumulations, sealing compounds, and other substances marring the surfaces. Use sand finer than No. 30 and air pressure from 15 to 25 psi.
- C. Repair of Unformed Surfaces:
1. Test unformed surfaces, such as monolithic slabs, for smoothness and to verify surface plane to specified tolerances for each surface and finish. Correct low and high areas in accordance with this Section.
 2. Test unformed surfaces sloped to drain for trueness of slope, in addition to smoothness, using template having the required slope. Correct high and low areas in accordance with this Section.
 3. Repair finish of unformed surfaces containing defects that adversely affect concrete durability. Surface defects include crazing, cracks in excess of 0.01-inch wide, spalling, popouts, honeycombs, rock pockets, and other objectionable conditions.
 4. Repair structural cracks in all structures and non-structural cracks in liquid-retaining structures. In liquid-retaining structures, where dry face of concrete member can be observed, repair all cracks evidencing any rate of water flow through crack. Where dry face of member cannot be observed, repair all cracks.

D. Methods of Repair of Unformed Surfaces:

1. Correct high areas in unformed surfaces by grinding, after concrete has cured sufficiently so that repairs can be made without damage to adjacent areas.
2. Correct low areas in unformed surfaces, during or immediately after completion of surface finishing, by cutting out low areas and replacing with fresh concrete. Finish repaired areas to blend into adjacent concrete. Where repairs are required and concrete has already set, sawcut around perimeter of area to be repaired to depth of 1/2-inch and remove concrete so that minimum thickness of repair is 1/2-inch. Apply specified concrete repair mortar in accordance with repair mortar manufacturer's directions and recommendations.
3. Repair defective areas, except random cracks and single holes not exceeding one-inch diameter, by cutting out and replacing with fresh concrete. Remove defective areas to sound concrete with clean, square cuts, and expose reinforcing steel with at least 3/4-inch clearance all around. Minimum thickness of repair shall be 1.5 inches. Dampen concrete surfaces in contact with patching concrete and brush with specified bonding agent. Place patching concrete while bonding agent is tacky. Mix patching concrete of same materials and proportions to provide concrete of same classification as original, adjacent concrete. Place, compact, and finish as required to blend with adjacent finished concrete. Cure in the same manner as adjacent concrete.
4. Repair isolated, random, non-structural cracks (in members that are not below grade or liquid-retaining), and single holes not greater than one-inch diameter, by dry-pack method. Groove top of cracks, and cut out holes to sound concrete, and clean repair area of dust, dirt, and loose particles. Dampen all cleaned concrete surfaces and brush with the specified bonding agent. Place dry-pack before cement grout takes its initial set. Mix dry-pack, consisting of one part portland cement to 2.5 parts fine aggregate passing No. 16 mesh sieve, using only enough water as required for handling and placing. Compact dry-pack mixture in place and finish to match adjacent concrete. Keep patched areas continuously moist for at least 72 hours.
5. Structural cracks shall be pressure-grouted using injectable epoxy. Apply in accordance with epoxy manufacturer's directions and recommendations.
6. Non-structural cracks in below-grade and liquid-retaining structures shall be pressure-grouted using hydrophilic resin. Apply in accordance with resin manufacturer's directions and recommendations.
7. Determination of crack type will be by Engineer.
8. Ensure that surface is acceptable for flooring material to be installed in accordance with flooring manufacturer's recommendations.

E. Other Methods of Repair:

1. Repair methods not specified in this Section may be used when approved by Engineer.

++ END OF SECTION ++

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SECTION 03600
GROUT

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Furnish all labor, materials, equipment and incidentals required and install grout complete as shown on the Drawings and as specified herein.

1.02 SUBMITTALS

- A. Submit, in accordance with Section 01300, shop drawings and product data showing materials of construction and details of surface preparation, mixing and installation for:
 - 1. Commercially manufactured non-shrink cementitious grout and self-leveling cementitious underlayment grout. Include catalog cuts, technical data, storage requirements, product life, working time after mixing, temperature considerations, conformity to the specified ASTM standards, and Material Safety Data Sheet.
 - 2. Commercially manufactured non-shrink epoxy grout. Include catalog cuts, technical data, storage requirements, product life, working time after mixing, temperature considerations, conformity to the specified ASTM standards, and Material Safety Data Sheet.
 - 3. Cement grout. Include the type and brand of cement, the gradation of fine aggregate, product data on any proposed admixtures and the proposed grout mix.
- B. Samples
 - 1. Submit samples of commercially manufactured grout products.
 - 2. Submit samples of aggregates proposed for use in grout mixes.
- C. Laboratory Test Reports
- D. Certifications
 - 1. Certify that commercially manufactured grout products and admixtures for cement grout and concrete grout are made for use in contact with potable water 30 days after installation (non-toxic and free of taste and odor).
 - 2. Certify that the Contractor is not associated with the independent testing laboratory, nor does the Contractor or its officers have a beneficial interest in the laboratory.
- E. Qualifications
 - 1. Submit documentation that grout manufacturers have a minimum of 10 years' experience in the production and use of the grouts proposed.
 - 2. Independent Testing Laboratory
 - a. Name and address

- b. Names and positions of principal officers and the name, position, and qualifications of the responsible registered professional engineer in charge.
- c. Listing of technical services to be provided. Indicate external technical services to be provided by other organizations.
- d. Names and qualifications of the supervising laboratory technicians.
- e. Statement of conformance provided by evaluation authority defined in ASTM C1077. Provide report prepared by evaluation authority when requested by the Engineer.
- f. Submit as required above for other organizations that will provide external technical services.

1.03 REFERENCE STANDARDS

A. ASTM International

- 1. ASTM C33 - Standard Specification for Concrete Aggregates
- 2. ASTM C150 - Standard Specification for Portland Cement
- 3. ASTM C531 - Standard Test Method for Linear Shrinkage and Coefficient of Thermal Expansion of Chemical-Resistant Mortars, Grouts and Monolithic Surfacing and Polymer Concretes
- 4. ASTM C827 - Standard Test Method for Change in Height at Early Ages of Cylindrical Specimens of Cementitious Mixtures
- 5. ASTM C1077 - Standard Practice for Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation
- 6. ASTM C1107 - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Non-shrink)
- 7. ASTM D695 - Standard Test Method for Compressive Properties of Rigid Plastics.
- 8. ASTM E329 - Standard specification for agencies engaged in the testing and/or inspection of materials used in construction

- B. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.04 QUALITY ASSURANCE

A. Qualifications

- 1. Grout manufacturers shall have a minimum of 10 years experience in the production and use of the type of grout proposed.
- 2. Independent testing laboratory shall meet the requirements of ASTM E329 and ASTM C1077 and be acceptable to the Engineer. Laboratories affiliated with the Contractor or in which the Contractor or officers of the Contractor's organization have beneficial interest are not acceptable.

B. Pre-installation Meeting

1. At least ten working days before grouting, hold a pre-installation meeting to review the requirements for surface preparation, mixing, placing and curing procedures for each product proposed for use. Notify all parties involved with grouting, including the Engineer, of the meeting at least ten working days prior to its scheduled date.

C. Services of Manufacturer's Representative

1. Provide services of a field technician of the non-shrink grout manufacturer [and of the self-leveling cementitious underlayment grout manufacturer who has performed at least five projects of similar size and complexity during the last five years, to attend the pre-installation meeting, to be present for the initial installation of each type of non-shrink grout and self-leveling cementitious underlayment grout], and to correct installation problems.

D. Field Testing

1. All field testing and inspection services will be provided by the Owner. Assist in the sampling of materials, and cooperate by allowing free access to the work and permitting the use of ladders, scaffolding, and such incidental equipment as may be required. Methods of testing will comply with the applicable ASTM Standards.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials to the jobsite in original, unopened packages, clearly labeled with the manufacturer's name, product identification, batch numbers and printed instructions.
- B. Store materials in full compliance with the manufacturer's recommendations. Limit total storage time from date of manufacture to date of installation to six months or the manufacturer's recommended storage time, whichever is less.
- C. Remove immediately from the site material which becomes damp, contains lumps, or is hardened and replace with acceptable material at no additional cost to the Owner.
- D. Deliver non-shrink cementitious grout [and self-leveling cementitious underlayment grout] as a pre-portioned blend in prepackaged mixes requiring only the addition of water.
- E. Deliver non-shrink epoxy grout as a pre-proportioned, prepackaged, three component system requiring only mixing as directed by the manufacturer.

1.06 DEFINITIONS

- A. Non-shrink Grout: A commercially manufactured product that does not shrink in either the plastic or hardened state, is dimensionally stable in the hardened state and bonds to a clean base plate.
- B. Self-Leveling Cementitious Underlayment Grout: A commercially manufactured portland cement based, non-shrinking, self-leveling underlayment.

PART 2 PRODUCTS

2.01 GENERAL

- A. The use of a manufacturer's name and product or catalog number is for the purpose of establishing the standard of quality desired.
- B. Like materials shall be the products of one manufacturer or supplier in order to provide standardization of appearance.

2.02 MATERIALS

A. Non-shrink Cementitious Grout

- 1. Non-shrink cementitious grouts: Conform to ASTM C1107. Grouts shall be portland cement based, contain a pre-proportioned blend of selected aggregates and shrinkage compensating agents and require only the addition of water. Non-shrink cementitious grouts shall not contain expansive cement or metallic particles. The grouts shall exhibit no shrinkage when tested in conformity with ASTM C827.
 - a. General purpose non-shrink cementitious grout: Conform to the standards stated above. SikaGrout 212 by Sika Corp.; Set Grout by BASF Building Systems; NS Grout by The Euclid Chemical Co.; Five Star Grout by Five Star Products, Inc., or equal.
 - b. Flowable (Precision) non-shrink cementitious grout: Conform to the standards stated above. Masterflow 928 by BASF Building Systems; Hi-Flow Grout by The Euclid Chemical Co.; SikaGrout 212 by Sika Corp.; Five Star Grout by Five Star Products, Inc., or equal.

B. Non-shrink Epoxy Grout

- 1. Non-shrink epoxy grout: Grout shall be pre-proportioned, prepackaged, three component, 100 percent solids system consisting of epoxy resin, hardener and blended aggregate. It shall have a compressive strength of 10,000 psi in 7 days when tested in conformity with ASTM [C579] [D695] and have a maximum coefficient of thermal expansion of 30×10^{-6} in/in/degrees F when tested in conformity with ASTM C531. Masterflow 648 CP by BASF Building Systems; Five Star HP Epoxy Grout by Five Stars Products, Inc; Sikadur 42 Grout-Pak by Sika Corp.; E3-G Epoxy Grout by the Euclid Chemical Co. or equal.

C. Cement Grout

- 1. A mixture of one part portland cement conforming to ASTM C150, Type I, II, or III and one to two parts sand conforming to ASTM C33 with sufficient water to place the grout. The water content shall be sufficient to impart workability to the grout but not to the degree that it will allow the grout to flow.

- D. Add synthetic reinforcing fibers as specified in Section [03 20 00] [03200] to the concrete grout mix at the rate of 1.5 lbs. of fibers per cubic yard of grout. Add fibers from the manufacturer's pre-measured bags and according to the manufacturer's recommendations to ensure complete dispersion of the fiber bundles as single monofilaments within the concrete grout.

E. Self-Leveling Cementitious Underlayment Grout

1. Grout shall be portland cement based, non-shrinking, self-leveling underlayment, factory prepared and packaged. Underlayment Self-Leveling by BASF Building Systems, LeveLayer by Dayton Superior, Flo-Top by the Euclid Chemical Company, or equal providing a one day compressive strength of 1200 psi minimum and a 28 day value of 3000 psi minimum.
2. Provide polymer emulsion, system primer for substrate preparation, Primer 800 by BASF Building Systems, Level Primer J42 by Dayton Superior, Tammsweld by the Euclid Chemical Company, or equal for the specific product proposed.
3. Provide clean, dry and sound pea gravel, 1/4-in maximum and 1/8-in minimum size and conforming to ASTM C33 (Provide 1/8-in maximum size, clean, dry and sound sand conforming to ASTM C33 for the equal specific products).

F. Water

1. Potable water free of oil, acid, alkali, salts, chlorides (except those attributable to drinking water), organic matter, or other deleterious substances.

PART 3 EXECUTION

3.01 PREPARATION

- A. Place grout where indicated or specified over [existing concrete and] cured concrete which has attained its specified design strength unless otherwise approved by the Engineer.
- B. Concrete surfaces to receive grout shall be clean and sound; free of ice, frost, dirt, dust, grease, oil, form release agent, laitance and paints and free of all loose material or foreign matter which may affect the bond or performance of the grout.
- C. Roughen concrete surfaces by chipping, sandblasting, or other dry mechanical means to bond the grout to the concrete. Remove loose or broken concrete. Irregular voids or projecting coarse aggregate need not be removed if they are sound, free of laitance and firmly embedded into the parent concrete.
 1. Air compressors used to clean surfaces in contact with grout shall be the oilless type or equipped with an oil trap in the airline to prevent oil from being blown onto the surface.
- D. Remove all loose rust, oil or other deleterious substances which may affect the bond or performance of the grout from metal embedments or bottom of baseplates prior to the installation of the grout.
- E. Wash concrete surfaces clean and then keep moist for at least 24 hours prior to the placement of non-shrink cementitious or cement grout. Saturation may be achieved by covering the concrete with saturated burlap bags, use of a soaker hose. Upon completion of the 24-hour period, remove visible water from the surface prior to grouting.

- F. Non-shrink epoxy grouts do not require saturation of the concrete substrate. Do not wet concrete surfaces to receive non-shrink epoxy grout. Surfaces in contact with epoxy grout shall be completely dry before grouting.
- G. Provide forms for grout. Line or coat forms with release agents recommended by the grout manufacturer. Provide forms anchored in place and shored to resist the forces imposed by the grout and its placement.
 - 1. Forms for all grout other than concrete grout shall be designed to allow the formation of a hydraulic head and shall have chamfer strips built into forms.
- H. Level and align the structural or equipment bearing plates in accordance with the structural requirements or the recommendations of the equipment manufacturer, as applicable.
- I. Support equipment during alignment and installation of grout by shims, wedges, blocks or other approved means. The shims, wedges and blocking devices shall be prevented from bonding to the grout by bond breaking coatings and removed after grouting unless otherwise approved by the Engineer. Grout voids created by the removal of shims, wedges and blocks.

3.02 INSTALLATION - GENERAL

- A. Mix, apply and cure products in strict compliance with the manufacturer's recommendations and these specifications.
- B. Provide staffing and equipment available for rapid and continuous mixing and placing. Keep all necessary tools and materials ready and close at hand.
- C. Maintain temperatures of the base plate, supporting concrete, and grout between 40 and 90 degrees F during grouting and for at least 24 hours after placement, until grout compressive strength reaches 1000 psi or as recommended by the grout manufacturer, whichever is longer. Do not allow differential heating or cooling of baseplates and grout during the curing period.
- D. Take special precautions for hot weather or cold weather grouting as recommended by the manufacturer when ambient temperatures and/or the temperature of the materials in contact with the grout are outside of the 40 to 90 degrees F range.
- E. Install grout to preserve the isolation between the elements on either side of the joint where grout is placed in the vicinity of an expansion or partial contraction joint.
- F. Reflect all existing underlying expansion, partial contraction and construction joints through the grout.

3.03 INSTALLATION - NON-SHRINK CEMENTITIOUS GROUTS AND CEMENT GROUTS

- A. Mix in accordance with manufacturer's recommendations. Do not add cement, sand, pea gravel or admixtures without prior approval by the Engineer.

- B. Do not mix by hand. Mix in a mortar mixer with moving blades. Pre-wet the mixer and empty excess water. Add pre-measured amount of water for mixing, followed by the grout. Begin with the minimum amount of water recommended by the manufacturer and then add the minimum additional water required to obtain workability. Do not exceed the manufacturer's maximum recommended water content.
- C. Placements greater than 3-in in depth shall include the addition of clean, washed pea gravel to the grout mix when approved by the manufacturer. Comply with the manufacturer's recommendations for the size and amount of aggregate to be added.
- D. Provide forms as specified in Paragraph 3.01G. Place grout into the designated areas and prevent segregation and entrapment of air. Do not vibrate grout to release air or to consolidate the material. Fill all spaces and provide full contact between the grout and adjoining surfaces. Provide grout holes and vent holes as necessary.
- E. Place grout rapidly and continuously to avoid cold joints. Do not place grout in layers. Do not add additional water to the mix (retemper) after initial stiffening.
- F. Just before the grout reaches its final set, cut back the grout to the substrate at a 45 degree angle from the lower edge of bearing plate unless otherwise ordered and approved by the Engineer. Finish this surface with a wood float or brush finish.
- G. Begin curing immediately after form removal, cutback, and finishing. Keep grout moist and within its recommended placement temperature range for at least 24 hours after placement, until grout compressive strength reaches 1000 psi or as recommended by the manufacturer, whichever is longer. Saturate the grout surface by use of saturated burlap bags, soaker hoses or ponding. Provide sunshades. If drying winds inhibit the ability of a given curing method to keep grout moist, erect wind breaks until wind is no longer a problem or curing is finished.

3.04 INSTALLATION – NON-SHRINK EPOXY GROUTS

- A. Mix in accordance with manufacturer's recommendations. Mix full batches only, to maintain proper proportions of resin, hardener and aggregate. Do not vary the ratio of components or add solvent to change the consistency of the grout mix. Do not overmix. Do not entrain air bubbles by mixing too quickly.
- B. Monitor ambient weather conditions and contact the grout manufacturer for special placement procedures to be used for temperatures below 60 or above 90 degrees F.
- C. Place grout rapidly and continuously to avoid cold joints. Place grout in lifts in accordance with manufacturer's recommendations.
- D. Provide forms as specified in Paragraph 3.01G. Place grout into the designated areas and prevent entrapment of air. Fill all spaces and provide full contact between the grout and adjoining surfaces. Provide grout holes and vent holes as necessary.
- E. Minimize "shoulder" length (extension of grout horizontally beyond base plate). In no case shall the shoulder length of the grout be greater than the grout thickness.
- F. Finish grout by puddling to cover all aggregate and provide a smooth finish. Break bubbles and smooth the top surface of the grout in conformity with the manufacturer's recommendations.

- G. Epoxy grouts are self-curing and do not require the application of water. Maintain the formed grout within its recommended placement temperature range for at least 24 hours after placement, until grout compressive strength reaches 1000 psi or as recommended by the manufacturer, whichever is longer.
- H. Provide grout control joints as indicated on the Drawings.

3.05 INSTALLATION – SELF-LEVELING CEMENTITIOUS UNDERLAYMENT GROUT

- A. Perform work generally as follows but conform to installation procedures as submitted and approved.
- B. Prime the prepared substrate with the system primer and remove all puddles. Allow to dry completely.
- C. Mix underlayment grout with water and the approved aggregate only and in the approved proportions to be flowable and self-leveling.
- D. Install in one lift for all locations and allow to level. Completely fill the required areas allowing no voids in the grout thickness. Slope to floor drains as required.
- E. Cure in conformance with manufacturer's instructions. Do not allow conditions which would permit premature drying.
- F. Protect the grouted areas as approved until finish material is applied under Division 09.

3.06 SCHEDULE

- A. The following list indicates where the particular types of grout are to be used:
 - 1. General purpose non-shrink cementitious grout: Use at all locations where non-shrink grout is indicated on the Drawings, except for base plates greater in area than 3-ft wide by 3-ft long.
 - 2. Flowable (precision) non-shrink cementitious grout: Use under all base plates greater in area than 3-ft wide by 3-ft long. Use at all locations indicated on the Drawings to receive flowable (precision) non-shrink grout. Flowable (precision), non-shrink, cementitious grout may be substituted for general purpose non-shrink cementitious grout.
 - 3. Non-shrink epoxy grout: Use at all locations specifically indicated on the Drawings to receive non-shrink epoxy grout.
 - 4. Cement grout: Use where indicated on the Drawings.
 - 5. Self-leveling cementitious underlayment grout: Use over existing slab as shown and required to provide substrate for tile work.

END OF SECTION

SECTION 03930
CONCRETE REPAIR AND REHABILITATION

PART 1 – GENERAL

1.1 DESCRIPTION

- A. Scope:
 - 1. CONTRACTOR shall provide labor, materials, equipment, and incidentals as shown, specified, and required to repair or rehabilitate, as required, existing concrete shown or indicated in the Contract Documents as being repaired or rehabilitated.
 - 2. CONTRACTOR shall repair damage to new concrete construction as specified in this Section except for repair Work specified in Section 03300, Cast-in-Place Concrete.
- B. Coordination:
 - 1. Review installation procedures under this and other Sections and coordinate the Work that must be installed with or before repair and rehabilitation of concrete.
- C. Related Sections:
 - 1. Section 03300, Cast-in-Place Concrete.
 - 2. Section 03600, Grouting.

1.2 REFERENCES

- A. Standards referenced in this Section are:
 - 1. ASTM C109/C109M, Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or [50-mm] Cube Specimens).
 - 2. ASTM C882/C882M, Test Method for Bond Strength of Epoxy-Resin Systems Used with Concrete by Slant Shear.
 - 3. ASTM D1042, Test Method for Linear Dimensional Changes of Plastics Under Accelerated Service Conditions.
 - 4. ASTM D3574, Test Methods for Flexible Cellular Materials – Slab, Bonded, and Molded Urethane Foams.
 - 5. ASTM G109, Test Method for Determining the Effects of Chemical Admixtures on the Corrosion of Embedded Steel Reinforcement in Concrete Exposed to Chloride Environments.

1.3 SUBMITTALS

- A. Action Submittals: Submit the following:
 - 1. Product Data: Information on products proposed for use, including manufacturer's brochures, technical data, specifications, and other applicable data.
- B. Informational Submittals: Submit the following:
 - 1. Certificates: Certificates documenting that repair materials that will be in contact with potable water or water that will be treated to become potable are listed in NSF/ANSI 61.
 - 2. Manufacturer's Instructions: Manufacturer's recommended procedures for installing materials proposed for use.
 - 3. Site Quality Control Submittals: Results of specified Site quality control testing.

4. Special Procedure Submittals: When requested by ENGINEER, submit information on methods for supporting during demolition and repair Work existing structures, pipes, and other existing facilities affected by the Work.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Delivery and Handling of Materials:
 1. Conform to Section 01600, Delivery, Storage and Handling.
 2. Clearly mark on containers manufacturer's name and label, name or title of material, manufacturer's stock number, and date of manufacture.
 3. Handle materials carefully to prevent inclusion of foreign matter.
 4. Do not open containers or mix components until necessary preparatory Work has been completed and application Work is to start immediately.
- B. Storage of Materials:
 1. Conform to Section 01600, Delivery, Storage and Handling, and this Section.
 2. Store only approved materials at the Site.

PART 2 – PRODUCTS

2.1 SYSTEM REQUIRMENTS

- A. Repair and rehabilitation materials that can or will come into contact with potable water or that will be treated to become potable shall be listed in ANSI/NSF 61.

2.2 REPAIR MORTAR

- A. Product Description: Repair mortar shall be prepackaged, cement-based product specifically formulated for repairing concrete surface defects and suitable for use in moist and submerged conditions.
- B. Products and Manufacturers: Provide one of the following:
 1. Five Star Structural Concrete, by Five Star Products, Inc. Use formulation recommended by manufacturer for the specific application conditions.
 2. SikaTop 122 Plus, SikaTop 123 Plus, SikaTop 111 Plus, or Sikacem 133, by Sika Corporation. Use formulation from among those listed in this paragraph recommended by manufacturer for specific application conditions.
 3. Emaco S88-CI or S66-CI, by Master Builders Inc. Use formulation from among those listed in this paragraph recommended by manufacturer for specific application conditions.
 4. DuralTop Gel, DuralTop Flowable Mortar, Verticoat, Verticoat Supreme, or Euco SR-VO, by Euclid Chemical Company. Use formulation from among those listed in this paragraph recommended by manufacturer for specific application conditions.
 5. Or equal.

C. Materials:

1. Provide a two-component, polymer-modified, Portland cement, fast-setting, trowel-grade mortar. Repair mortar shall be enhanced with penetrating corrosion inhibitor, and shall have the following properties:

Physical Property	Value	ASTM Standard
Minimum Compressive Strength at One Day	2,000 psi	C109
Minimum Compressive Strength at 28 Days	6,000 psi	C109
Minimum Bond Strength at 28 Days	1,800 psi	C882*

* Modified for use with repair mortars.

2. Where the least dimension of the placement in width or thickness exceeds four inches, extend repair mortar by adding aggregate as recommended by repair mortar manufacturer.

2.3 CRACK INJECTION MATERIALS

A. Structural Crack Repair System:

1. Epoxy for injection shall be low-viscosity, high-modulus moisture insensitive type.
2. Products and Manufacturers: Provide one of the following:
 - a. Sikadur 35, Hi-Mod L.V. and Sikadur 31, Hi-Mod Gel, by Sika Corporation.
 - b. Eucopoxy Injection Resin, by Euclid Chemical Company.
 - c. Or equal.

B. Non-structural Crack Repair System:

1. Hydrophilic Polyurethane Chemical Resin:
 - a. Products and Manufacturers: Provide one of the following:
 - 1) Prime Flex 900 XLV, manufactured by Prime Resins, Inc.
 - 2) Or equal.

PART 3 – EXECUTION

3.1 INSPECTION

- A. Examine areas and conditions under which the repair Work is to be installed and notify ENGINEER in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Preparation:

1. Initial Surface Preparation: Remove by chipping, abrasive blasting, or hydro blasting laitance, foreign material, and unsound concrete from entire area to be repaired. Further roughen surface as specified in this Section. Where non-shrink grout or repair mortar is used, perform additional surface preparation, if any, recommended by product manufacturer.
2. Wetting Procedure: Where repair concrete, shotcrete, or cement grout is used, and bonding agent is not required, or where repair mortar or non-shrink grout manufacturer recommends wet or saturated surface, perform the following:

- a. Continuously apply water for at least four hours to surface being repaired. Where large surface areas are to be repaired, use fog-spray nozzles, mounted on stands, in sufficient number so that entire surface to be repaired is contacted by fog spray cloud.
 - b. Prevent concrete from drying until after repair is completed. Re-wet surfaces not yet repaired using water sprays at least a daily; should more than four days elapse without re-wetting surfaces not yet repaired, repeat the original saturating procedure.
 - c. Remove standing water in areas to be repaired before placing repair material. Provide means to remove excess water from structure.
3. Preparation for Epoxy Bonding Agent: Where repair material manufacturer recommends use of epoxy-bonding agent, conform to recommendations of both repair material manufacturer and bonding agent manufacturer.

3.3 INSTALLATION, GENERAL

- A. Construction Tolerances: Shall be as specified in Section 03300, Cast-in-Place Concrete, except as specified in this Section and elsewhere in the Contract Documents.
- B. Care shall be taken to fully consolidate repair material, completely filling portions of space to be filled.
- C. Bring surface being repaired into alignment with adjacent surfaces, providing uniform, even surface. Surface repaired shall match adjacent existing surfaces in texture and shall receive coatings or surface treatments, if any, provided for the existing surface adjacent to repaired surface.
- D. Curing:
 1. Curing of repair mortar and non-shrink grout shall be in accordance with manufacturer's recommendations, except that minimum cure period shall be three days.
 2. Curing of other materials shall be in accordance with requirements of Section 03300, Cast-in-Place Concrete.

3.4 REPAIR OF SURFACE DEFECTS

- A. Surface defects are depressions in a concrete surface that do not extend all the way through the concrete. Surface defects can result from removal of an embedded item, removal of an intersecting concrete member, physical damage, or unrepaired rock pockets created during original placement. For spalls that result from corroded reinforcing steel or other embedment refer to Article 3.7 of this Section.
- B. Preparation: Perform the following in addition to requirements of Article 3.2 of this Section:
 1. Remove by chipping loose, damaged concrete to sound material.
 2. Where existing reinforcing is exposed, remove concrete to minimum of one-inch around exposed bars. If existing bars are cut through, cracked, or cross sectional area is reduced by more than 25 percent from original, immediately notify ENGINEER.
 3. Score-cut perimeter of area to be repaired to minimum depth of 1/2-inch and maximum depth that will not cut existing reinforcing steel. Chip out existing concrete to the score line so that minimum thickness of repair mortar will be 1/2-inch.

- C. Repair Material:
 - 1. Completely fill the surface defect with specified repair material, in accordance with material manufacturer's instructions and the Contract Documents.
 - 2. Perform, with repair mortar, repairs of surface defects in concrete normally in contact with water or soil, and interior surfaces of structures that contain water.
 - 3. Repair of other surface defects may be by applying repair mortar, repair concrete, shotcrete, or cement grout, as appropriate.

3.5 PATCHING OF HOLES IN CONCRETE

- A. For holes larger than 12-inch diameter or equivalent area of hole, refer to the Drawings for reinforcing details.
- B. Fill openings less than four inches in their least dimension with Class III non-shrink epoxy grout in accordance with Section 03600, Grouting.
- C. Openings greater than four inches and less than 16 inches in their least dimension shall be coated with an epoxy bonding agent prior to filling with Class I non-shrink grout in accordance with Section 03600, Grouting.
- D. Openings greater than 16 inches in their least dimension shall be coated with an epoxy bonding agent prior to filling with Class A concrete in accordance with Section 03300, Cast-in-Place Concrete.

3.6 REPAIR OF LINED HOLES

- A. This Article applies to openings with embedded material over or a portion of inside surface of hole. Where indicated on the Drawings, remove embedded materials and repair the hole in accordance with Article 3.5 of this Section, as modified in this Article 3.6.
- B. Where embedded material is allowed to remain, remove embedded material to at least two inches into the hole, as measured from the plane surface of concrete wall or slab, as applicable. Embedded material left in place shall be roughened or abraded for proper bonding to repair material. Completely remove substances that interfere with proper bonding.
- C. Completely remove embedded items not securely and permanently anchored into concrete.
- D. Completely remove embedded items larger than 12 inches in their smallest dimension. In lieu of removing the embedded item, where reinforcing is required as shown or indicated in the Contract Documents, weld reinforcing to embedded item to remain, provided embedded item to remain is composed of metal to which reinforcing steel can be welded.

3.7 REPAIR OF DETERIORATED CONCRETE

- A. This Article pertains to deteriorated concrete which has been damaged due to corrosion of reinforcing steel, physical damage due to abrasion, or damage due to chemical attack. Use repair mortar, as specified in this Article, for repairing deteriorated concrete. Where repaired surface will be subsequently covered with plastic liner material, coordinate finishing with requirements for installing plastic liner material.

- B. Surface Preparation: In addition to requirements of Article 3.2 of this Section, perform the following surface preparation:
1. Remove loose, broken, softened, and acid-contaminated concrete by abrasive blasting and chipping to sound, uncontaminated concrete.
 2. Upon completion of removal of deteriorated concrete, notify ENGINEER in writing. Allow two weeks for ENGINEER to evaluate the surface, perform testing for acid contamination if required, determine if additional concrete shall be removed, and to develop special repair details (if any) required. Should ENGINEER determine that additional concrete be removed to reach sound, uncontaminated concrete, allow another two-week period for further evaluation and testing following the additional removal.
 3. Surface preparation shall conform to recommendations of repair mortar manufacturer.
 4. Repair and rehabilitate isolated areas of exposed reinforcing bars in accordance with Article 3.4 and Article of 3.9 of this Section. If extensive areas of reinforcing steel are uncovered after removal of deteriorated concrete, ENGINEER will determine the repair methods required.
- C. Repair Mortar Placing:
1. Conform to manufacturer's recommended procedures for mixing and placing repair mortar.
 2. After initial mixing of repair mortar, addition of water is not allowed.
 3. Minimum Thickness:
 - a. Install repair mortar to not less than minimum thickness recommended by manufacturer, and not less than 1/2-inch.
 - b. Where removal of deteriorated concrete results in repair thickness of less than minimum required thickness to return to original concrete surface in isolated areas totaling less than ten percent of total repair surface area, remove additional concrete to obtain at least the required minimum thickness.
 - c. Where surface area with repair thickness less than minimum required thickness exceeds ten percent of total repair area, notify ENGINEER.
 - d. Provide repair mortar so that minimum cover over existing reinforcing steel is two inches. Do not place repair mortar creating locally raised areas.
 - e. Where transitioning to or from wall surfaces not requiring repair, do not feather-out repair mortar at transition. Instead, form the transition by saw cutting a score line to not less than minimum required repair mortar depth and chip out concrete to the saw cut line. Do not cut or otherwise damage reinforcing steel.
 4. Place repair mortar to an even, uniform plane to restore concrete member to its original surface. Out-of-plane tolerance shall be such that the gap between 12-inch long straight edge and repair mortar surface does not exceed 1/8-inch, and gap between a four-foot long straight edge and repair mortar surface shall not exceed 1/4-inch. Tolerances specified in this paragraph apply to straight edges placed in orientation at location.
- D. Finishing:
1. Provide smooth, steel trowel finish to repair mortar.
 2. When completed, there shall be no sharp edges. Provide exterior corners, such as at penetrations, one-inch radius. Interior corners shall be square, except corners to receive plastic lining which shall be made with two-inch fillet in repair mortar.

3.08 CRACK INJECTION

- A. Examine areas under which injection Work will be installed and locate cracks that require injection. Identify and inject cracks greater than 0.010-inch wide in structures that retain or contain water, wastewater, or similar liquid.
- B. Install injection material in accordance with crack injection manufacturer's requirements.
- C. After injecting and curing, verify that injected material penetrated the crack adequately and that there is no visible leakage through the crack. After injecting, if crack continues to leak, re-inject crack at no additional cost to OWNER until structure is watertight.
- D. If proper penetration of crack cannot be achieved, submit to ENGINEER a proposed alternate approach for modifying the specified injection procedure to properly seal the crack. In new concrete and in concrete cracked as a result of CONTRACTOR's operations, perform modifications to crack injection procedure and fully repair the crack without additional cost to OWNER or extension of the Contract Times.

3.09 SITE QUALITY CONTROL

- A. OWNER will employ and pay for services of testing laboratory for Site quality control testing. ENGINEER will direct the number of tests and specimens required. CONTRACTOR shall make standard compression test specimens as specified in this Section under the observation of ENGINEER. CONTRACTOR shall provide:
 - 1. Necessary assistance required by ENGINEER.
 - 2. All labor, material, and equipment required, including rods, molds, thermometer, curing in heated storage box, and other incidentals required, subject to approval by ENGINEER.
 - 3. All necessary storage, curing, and transportation required for testing.
 - 4. CONTRACTOR will be charged for cost of additional testing and investigation, if any, for Work performed that is not in accordance with the Contract Documents or is otherwise defective.
- B. Site Tests of Cement-based Grouts and Repair Mortar:
 - 1. Obtain compression test specimens during construction from first placement of each type of mortar or grout, and at intervals thereafter as selected by ENGINEER, to verify compliance with the Contract Documents.
 - 2. Compression tests and fabrication of specimens for repair mortar and non-shrink grout will be performed in accordance with ASTM C109. Set of three specimens will be made for each test. Tests will be made at seven days, 28 days, and additional time periods as deemed appropriate by ENGINEER.
 - 3. Material, already placed, failing to conform to the Contract Documents, is defective.
- C. Repair Concrete: Repair concrete shall be tested as required in Section 03300, Cast-in-Place Concrete.

++ END OF SECTION ++

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SECTION 07210 FIRESTOPPING

PART 1 – GENERAL

1.1 DESCRIPTION

- A. Scope:
 - 1. Contractor shall provide all labor, materials, tools, equipment, and incidentals as shown, specified, and required to furnish and install building firestopping.
 - 2. Extent of each type of building firestopping is shown and indicated in the Contract Documents.
- B. Coordination:
 - 1. Review installation procedures under this and other Sections and coordinate installation of items that must be installed with or before building insulation Work.

1.2 REFERENCES

- A. Standards referenced in this Section are:
 - 1. UL 1479, Fire Tests of Through-Penetration Firestops.

1.3 QUALITY ASSURANCE

- A. Qualifications:
 - 1. Manufacturers:
 - a. Manufacturer shall provide complete technical services including preparation and review of Shop Drawings and submittals, installation methods, and proposed detailing for the Work.
 - 2. Installer: Engage single installer for each type of building firestopping. Each installer shall be skilled, trained, and have record of successful experience in applying and installing each product, and possess successful record of performing work in accordance with recommendations and requirements of manufacturer or that can submit written evidence of being acceptable to manufacturer for providing the required Work. Installers shall employ only tradesmen with specific skill and successful experience in each type of Work required. Submit to Engineer name and qualifications of each installer with the following information for at least three successful, completed projects per installer:
 - a. Names and telephone numbers of owner and architect or engineer responsible for each project.
 - b. Approximate contract cost of the building firestopping system installed.
 - c. Quantity (area) of building insulation installed.
- B. Regulatory Requirements: Comply with code interpretations by authorities having jurisdiction at the Site.

1.4 SUBMITTALS

- A. Action Submittals: Submit the following:
 - 1. Shop Drawings:
 - a. Complete selection of fire stop manufacturer's recommended systems for each condition and kind of penetration encountered in the Work. Coordinate with equipment manufacturers for required number and kind of penetrations through fire-rated construction. Provide schedule of penetrations and fire stop system to be included for each condition and kind of penetration encountered.
 - 2. Product Data:
 - a. Material specifications and general recommendations from firestopping manufacturer for each type of firestop product. Include manufacturer's data substantiating that materials comply with Contract Documents.
 - b. Test Reports: Copies of reports of tests on materials being furnished or previously-manufactured, identical materials verifying compliance with physical properties and environmental features specified in the Contract Documents. When requested by Engineer, submit qualifications and summary of experience of testing agencies in performing tests similar to those required.
- B. Informational Submittals: Submit the following:
 - 1. Manufacturer's Instructions: Manufacturer's installation instructions. Indicate by copy of transmittal form that installer has received copy of manufacturer's installation instructions.
 - 2. Site Quality Control Submittals: Submit results of specified Site quality control tests.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Delivery and Handling of Materials:
 - 1. Do not deliver firestop materials to the Site before the time of installation.
 - 2. Deliver materials in sufficient quantities to allow uninterrupted continuity of the Work.
 - 3. Handle materials carefully to avoid damage and breakage.
 - 4. Handle materials in manner that prevents inclusion of foreign materials.
- B. Storage of Materials:
 - 1. Store materials in dry, enclosed area, off ground and away from possible contact with water, ice, and snow.
 - 2. Prevent damage to materials during storage, including minimizing the time materials are stored at the Site before being incorporated into the Work. Store only sufficient quantity of building firestopping materials at the Site required for continuous advancement of the Work without causing delay.

1.6 SITE CONDITIONS

A. Environmental Conditions:

1. Complete the installation and concealment of firestopping materials as rapidly as possible to avoid damage from adjacent construction operations and adverse weather conditions.
2. Install firestopping when weather and temperature conditions comply with firestopping manufacturers' written recommendations.
3. Install firestopping when damaging environmental condition are not forecasted for the time when exposed systems materials components would be exposed to potential damage from the elements.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Fire-Stop Sealants and Other Fire-Stop System Components: Provide the following:

1. Complete selection of fire-stop manufacturer's recommended silicone rubber fire-stop systems. Provide complete systems complying with UL 1479 with two- or three-hour fire rating. Provide equal fire protection as provided by fire-rating of construction penetrated.
2. Provide multiple component systems coordinated to meet actual conditions encountered in the Work and as recommended by fire-stop manufacturer. In addition to providing fire resistance, fire-stop systems shall also be gas and watertight.
3. Products and Manufacturers: Provide one of the following:
 - a. 3M Fire Stop Systems by 3M, Inc.
 - b. Fire Stop Systems by USG Interiors, Inc.
 - c. Or equal.

PART 3 – EXECUTION

3.1 INSPECTION

- #### A.
- Contractor and installer shall examine substrate and conditions under which firestopping work will be performed and notify Engineer in writing of unsatisfactory conditions. Do not proceed with the work until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- #### A.
- Surfaces to receive firestopping shall be clean of all debris, dirt, and other contamination before installation begins.

3.3 INSTALLATION

A. General:

1. Comply with manufacturer's instructions for particular conditions of installation in each case. If printed instructions are not available or do not apply to site conditions, before proceeding with the work obtain from manufacturer and submit to Engineer specific installation recommendations from manufacturer.

C. Fire-Stop Systems:

1. Install fire-stop systems to present continuous fire-rated fire barrier in areas shown and at perimeter of all fire-rated partitions and poke-through floor and wall penetrations, to maintain continuity of fire-rated construction whether or not shown.
2. Install fire stop sealants and other fire stop system components in thicknesses recommended by manufacturer at all locations where poke-through penetrations occur, at all locations where other penetrations such as ducts, pipe, cables, cable trays, and conduit occur and at perimeter of all fire-rated walls.
3. Include all components of manufacturer's fire/smoke-stop systems for complete system responsibility installed in accordance with manufacturer's written recommendations and specifications.

D. Correcting Defective Work:

1. System components that are dislodged, damaged, expanded, broken, penetrated, or crushed by subsequent installation operations or damaged by detrimental weather shall be immediately replaced with undamaged material in compliance with the Contract Documents and properly protected as specified.
2. Only original installer shall repair or replace deteriorated or defective Work.

END OF SECTION

SECTION 09512
SPECIALTY CEILINGS

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. 2' x 2' extruded Polyvinyl Chloride (PVC) ceilings complete with suspension systems and related accessories, entire system to be 100% recyclable. Ceiling tile units, suspension system, grid system and wall moldings shall be furnished by a single manufacturer, for a complete ceiling system.
- B. It shall be the Contractor's responsibility to coordinate with all other trades. Contractor shall remove and replace ceiling panels as required. It shall be the Contractor's responsibility to furnish a finished ceiling with no broken, scarred, marked, or soiled ceiling panels following the total completion of the project.

1.02 RELATED SECTIONS

- A. Division 16 - Electrical.

1.03 REFERENCES

- A. Job conditions, preparatory work, and installation techniques shall be in accordance with Acoustical Materials Association Installation Recommendations.
- B. American Society for Testing and Materials (ASTM):
 - 1. ASTM C 635 - Specification for Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings.
 - 2. ASTM C 636 - Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels.
 - 3. ASTM E 84 Test Method for Surface Burning Characteristics of Building Materials.
 - 4. ASTM E 580 - Specification for Application of Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels in Areas Requiring Seismic Restraint.
 - 5. ASTM A – Test Resistance to mold, mildew and bacteria.

1.04 PROJECT REQUIREMENTS

- A. Ceiling system shall be:
 - 1. 100% waterproof
 - 2. Washable
 - 3. Will never rust, sag, bow or bend due to humidity
 - 4. Mold, bacteria, fungi and mildew resistant
 - 5. Resistant to cleaning agents, acids and other chemicals
 - 6. Impact and damage resistant, non-shedding

7. Insect resistant
8. Free of lead, asbestos and fiberglass
9. Will not rot, peel or flake
10. Flame retardant
11. USDA, FDA, CFIA and Health Department compliant
12. UV-resistant
13. 100% Recyclable
14. Will not show scratches
15. No yellowing or color change in corrosive environments
16. Factory cut for installation for lay-in suspension grids

1.05 SUBMITTALS

- A. Submit under provisions of Section 01300.
- B. Product Data: Provide data on metal grid system, components, acoustic tile units and accessories.
- C. Samples: Submit two 6" x 6" samples of each ceiling type, illustrating material and finish of acoustic units.
- D. Submit to the Engineer for approval scaled shop drawings showing layout of suspension system and tile, incorporating light fixtures, grilles and other items mounted through or on acoustical ceiling.

1.06 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing work of this Section with minimum 5 years documented experience.
- B. Regulatory Requirements: Surface Burning Characteristics in Accordance with ASTM E 84 for Class A finish for both flame spread and smoke density.

1.07 DELIVERY, STORAGE AND HANDLING

- A. Materials shall be delivered and stored under the provisions of 01600.
- B. All materials shall be delivered to the job in original unopened containers or bundles, labeled so as to allow easy identification.
- C. Follow manufacturer's instructions on storage of materials; do not store materials in damp or wet areas. Store panels flat on a flat, smooth surface.
- D. Prior to installation, store acoustical units for 24 hours minimum at same temperature and relative humidity as space where Work will be installed.

1.08 ENVIRONMENTAL CONDITIONS

- A. Maintain uniform temperature of minimum 60 degrees F and maximum 80 degrees F and maximum humidity of 75 percent prior to, during, and after ceiling system installation.
- B. Sequence work to ensure ceiling system is not installed until building is enclosed, sufficient heat is provided, dust generating activities have terminated, and overhead work is completed, tested, and approved.
- C. Install acoustic units after interior wet work is dry.
- D. Rigidly secure ceiling system including integral mechanical and electrical components with maximum deflection of L/360.

1.09 WARRANTY

- A. Provide manufacturer's standard 25 year limited system warranty to withstand relative humidity without sag, mold/mildew, bacteria or rust.

1.10 EXTRA MATERIALS

- A. Section 01700 – Contract Closeout.
- B. Provide minimum 10 percent of total acoustic unit area of each type of tile to Owner in unopened packages.

PART 2 - PRODUCTS

2.01 STANDARD OF QUALITY

- A. The following acoustic tile specification is based upon products as manufactured by New Ceiling Tiles, LLC, Spring, TX (800) 518-9835. Substitutions shall be considered during bidding as stipulated in section 013300.
- B. Provide PVC ceiling system including tile, grid suspension system and all accessories which shall be manufactured by one manufacturer.

2.02 PVC PANELS

- A. Type 24" x 24" PVC Genesis maintenance free ceiling tile.
- B. Owner shall choose from manufacturer's full line of styles and colors from the Smooth Pro, Printed Pro, Classic Pro & Stucco Pro, Stucco Teg and Contour Teg lines.
- C. Manufactured from extruded, white, virgin-grade, rigid, PVC vinyl with printed surface, 100% recyclable content.

2.03 SUSPENSION SYSTEM

- A. Type Genesis RP 15/16" PVC ceiling grid, Color: White
- B. Suspension system shall not be less in size and strength than required to support itself and shall be increased in size and strength as necessary to support the light fixtures, acoustical units and related items without deflecting more than 1/36" of the span when tested as a simple beam, ends free.
 - 1. Grid: intermediate duty, PVC exposed T; nominal 1 inch width; quick lock keyhole connections.
 - 2. Accessories: Stabilizer bars, hold down clips, and splices.
 - 3. Support System: Main runners, cross tees, edge moldings, spacer bars, variable placement tees, grid adapters, and components.
 - 4. Manufactured from extruded, white, virgin-grade, rigid PVC vinyl.

2.04 HANGERS

- A. Suspension wire attached to power actuated fasteners shall be 12 gauge galvanized pre-straightened wire to support a maximum of 16 sq. ft. of ceiling and 8 gauge galvanized pre-straightened wire to support a ceiling area exceeding 16 sq. ft. No hanger shall support more than 24 sq. ft. of ceiling.
- B. Types of power actuated fasteners shall be subject to the approval of the manufacturer for the type of ceiling installed.

2.05 ACCESSORIES

- A. Provide all accessories, as required or recommended by manufacturer for use/condition including, spacers, hold downs, and wall moldings.
- B. Sealant for Perimeter Moldings: Manufactured by Bostik, TPI, 3M, Dow Corning or equal.
 - 1. Sealants:
 - a. Acrylic latex sealant (Interior): ASTM C920, paintable grade; single component, solvent curing, non-staining, non-bleeding, non-sagging.
 - b. Polyurethane sealant (Exterior): ASTM C92C, multi-component, chemical curing, non-staining, non-bleeding, non-sagging.
 - c. Caulking compounds shall be non-staining. Selection based upon manufacturer's recommendations for type of surface material and submitted to the Architect/Engineer for approval.
 - d. Butyl: One part butyl non-sagging, FSTT-5-1657.
 - e. One Part Silicone: ASTM C920, Type 5, Grade HS, Class 75, vertical surfaces.
 - f. Backing material shall be inserted into joint to the proper depth to allow for the proper balance of joint and sealant dimensions. Avoid excessive longitudinal stretching of rods during installation.
 - 2. Sealant Accessories:
 - a. Primer: Non-staining type, recommended by sealant manufacturer to suit

- application.
- b. Joint cleaner: Non-corrosive and non-staining type, as recommended by sealant manufacturer; compatible with joint forming materials.
- c. Joint backing: Round, closed cell polyethylene foam rod, oversized 50% larger than joint width; as recommended by sealant manufacturer; and compatible with sealant.
- d. Bond breaker: Pressure sensitive tape recommended by sealant manufacturer to suit application.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that layout of hangers will not interfere with other work.
- C. By beginning Work, Contractor accepts conditions and assumes responsibility for correcting unsuitable conditions encountered at no additional cost to the Owner.

3.02 INSTALLATION - GRID

- A. Install ceiling system per manufacturer's instructions and to support ceiling and applied fixture loads. Provide hanger wire at all four corners of each light fixture.
- B. Install ceiling tile in accordance with tile layouts shown on Contract Drawings and approved shop drawings.
- C. Contractor to coordinate work closely with electrical and mechanical trades in order to establish and maintain clearances with a minimum of conflict.
- D. Refer to Acoustical Materials Bulletin LXXII (1962) for installation and materials standards.
- E. Install after major above ceiling work is complete. Coordinate the location of hangers with other work.
- F. Hanger spacing to fall not more than 4'-0" o.c., not more than 2' 0" from ends, and not more than 4'-0" o.c. between ends of main runners and as required to support other work resting in or on ceiling. All four corners of all light fixtures must be supported with hanger wire.
- G. Where conditions prevent the regular spacing of hangers, reinforce the nearest affected hangers and related carrying channels to span the extra distance.
- H. Do not support components on main runners or cross runners if weight causes total dead load to exceed deflection capability.
- I. Do not eccentrically load system, or produce rotation of runners.
- J. Perimeter Molding:

1. Install edge molding at intersection of ceiling and vertical surfaces into bed of acoustic sealant at walls.
2. Use longest practical lengths.
3. Form corners in accordance with manufacturer's installation instructions.
4. Provide at junction with other interruptions.
5. To be same material and style as grid system.
6. To be manufactured by the same manufacturer as grid system.

- K. Wall moldings shall be provided at the perimeter of all rooms and shall be securely fastened to walls or as indicated. Finish channel corner plates shall be used at all exterior corners.

3.03 INSTALLATION – PANEL UNITS

- A. Install panel units in accordance with manufacturer's instructions.
- B. Fit units in place, free from damaged edges or other defects detrimental to appearance and function.
- C. Lay directional patterned units one way. Fit border trim neatly against abutting surfaces.
- D. Install units after ceiling grid work is complete.
- E. Install units level, in uniform plane, and free from twist, warp, and dents.
- F. Cutting PVC Units:
1. Use utility knife and straight edge; score the finish side of the panel. Bend panel at the score mark and snap apart.
 2. To cut to fit irregular grid and perimeter edge trim, measure distance between t-bar centers, or between the t-bar center and closest edge of wall molding.
 3. Cut with a table or skill saw. Use hole saw to cut penetrations for conduits, recessed light fixtures and other components.
 4. To cut to fit irregular grid and perimeter edge trim.
- G. Reach over the installed panel and snap hold-down clips over grid members.

3.04 CLEANING

- A. Remove all debris from space above ceiling. Vacuum or brush grid and panels to remove dust.
- B. Clean grid and panels of all dirt, finger/hand prints, smudges, etc. with moist cloth and mild soap or other household cleaner. Avoid solvents or lacquer thinner. Spray detergent onto clean rag and wipe. Ceiling system can be power washed.
- C. Tile and trim shall be clean and without blemish at time of acceptance.
- D. At the completion of the finished ceiling work, remove all rubbish from the building, leaving floors broom clean. Excess material, scaffolding, tools and other equipment shall be removed from the building and job site.

- E. Protect ceiling system from subsequent construction activity.

3.05 CONSTRUCTION TOLERANCES

- A. Section 01660 - Quality Control: Tolerances.
- B. Maximum Variation from Flat and Level Surface: 1/8 inch in 10 feet.
- C. Local kinks or bends shall not be made in hanger wires as a means of leveling main runners. Wire hanger loops shall be tightly wrapped and sharply bent to prevent any vertical movement or rotation of the member within the loops.
- D. Maximum Variation from Plumb of Grid Members Caused by Eccentric Loads: 2 degrees.

END OF SECTION

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SECTION 09901
SURFACE PREPARATION AND SHOP PRIME PAINTING

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Furnish all labor, materials, equipment and incidentals required for the surface preparation and application of shop primers on ferrous metals, excluding stainless steels, as specified herein.

1.02 RELATED WORK

- A. Finish painting is included in Section 09902.

1.03 SUBMITTALS

- A. Submit, in accordance with Section 01300, shop drawings, manufacturer's specifications and data on the proposed primers and detailed surface preparation, application procedures and dry mil thicknesses.
- B. Submit representative physical samples of the proposed primers, if required by the Engineer.

1.04 REFERENCE STANDARDS

- A. The Society for Protective Coatings (SSPC)
 - 1. SSPC-SP 6/NACE No. 3 - Joint Surface Preparation Standard SSPC-SP 6/NACE No. 3: Commercial Blast Cleaning
 - 2. SSPC-SP 10/NACE No. 2 - Joint Surface Preparation Standard SSPC-SP 10/NACE No. 2: Near-White Blast Cleaning.
- B. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Submerged Surfaces - Shop primer for ferrous metals which will be in contact with water being treated, either submerged or which are subject to splash action or which are specified to be considered submerged service shall be shop primed with the following:
 - 1. Shop Prime Coat: (Zinc Micaceous Iron Oxide Polyurethane Aromatic Shop Primer)
 - a. TNEMEC: Series 1 Omnithane
 - b. Carboline: Carboguard 561
 - c. Sherwin-Williams Company (The): Corothane I Zinc Primer 1K Mio-Zinc.
 - d. PPG PMC Durathane MCZ 97-679 Series or PPG PMC Amerlock 400.
 - e. Or equal.

- B. Non-Submerged Surfaces: Shop primer for ferrous metals which will not be in contact with water being treated, not submerged and not subject to splash action shall be shop primed with the following:
 - 1. Shop Prime Coat: (Zinc Micaceous Iron Oxide Polyurethane Aromatic Shop Primer)
 - a. TNEMEC: Series 1 Omnithane
 - b. Carboline: Carboguard 561
 - c. Sherwin-Williams Company (The): Corothane I Zinc Primer 1K Mio-Zinc.
 - d. PPG PMC Durathane MCZ 97-679 Series or PPG PMC Amercoat 68HS
 - e. Or equal.
- C. Submerged Surfaces:
 - 1. Shop Prime Coat for Ductile Iron Pipe: (Epoxy, Polyamidoamine Shop Primer)
 - a. TNEMEC: Series N140 Pota-Pox-Plus
 - b. Carboline: Carboguard 561
 - c. Sherwin-Williams Company (The): Macropoxy 846 NSF Winter Grade Epoxy Mill White
 - d. PPG PMC Aquapon HB Potable Water Epoxy Coating 95-132 Series or PPG PMC Amerlock 2 Epoxy.
 - e. Or equal.
 - 2. Shop Prime Coat for Ferrous Metal Surfaces: (Zinc Micaceous Iron Oxide Polyurethane Aromatic Shop Primer)
 - a. TNEMEC: Series 1 Omnithane
 - b. Carboline: Carboguard 561
 - c. Sherwin-Williams Company (The): Corothane I Zinc Primer 1K Mio-Zinc.
 - d. PPG PMC Durathane MCZ 97-679 Series
 - e. Or equal.
- D. Non-Primed Surfaces - Gears, bearings surfaces and other similar surfaces obviously not to be painted shall be given a heavy shop coat of grease or other suitable rust-resistant coating. This coating shall be maintained as necessary to prevent corrosion during all periods of storage and erection and shall be satisfactory to the Engineer up to the time of the final acceptance test.
- E. Compatibility of Coating Systems - Shop priming shall be done with primers that are guaranteed by the manufacturer to be compatible with their corresponding primers and finish coats specified in Section 09902 for use in the field and which are recommended for use together.

PART 3 EXECUTION

3.01 APPLICATION

A. Surface Preparation and Priming

- 1. Non-submerged components scheduled for priming, as defined above, shall be blast cleaned in accordance with SSPC-SP 6/NACE No. 3, immediately prior to priming. Submerged components scheduled for priming, as defined above, shall be blast cleaned in accordance with SSPC-SP 10/NACE No. 2, immediately prior to priming. Consult manufacturer regarding required surface profiles.

2. Surfaces shall be dry and free of dust, oil, grease and other foreign material before priming.
3. Shop prime in accordance with approved manufacturer's recommendations.

B. Non-Primed Surfaces

1. Apply approved coating per manufacturer's recommendations.

3.02 FABRICATED ITEMS

- A. All items to be shop primed shall be blast cleaned as specified for applicable service prior to priming. If, in the opinion of the Engineer, any prime coating that has been improperly applied or if material contrary to this Section has been used, that coating shall be removed by abrasive blasting to white metal and reprimed in accordance with this Section.
- B. All shop prime coats shall be of the correct materials and applied in accordance with this Section. Remove any prime coats not in accordance with this Section by blast cleaning and apply the specified prime coat at no additional cost to the Owner.
- C. Shop primed surfaces shall be cleaned thoroughly and damaged or bare spots prepared as approved and retouched with the specified primer before the application of successive paint coats in the field.
- D. Shop finish coats, if proposed and allowed, shall be equal in appearance and protection quality to a field applied finish coat. If, in the opinion of the Engineer, a shop finish coat system does not give the appearance and protection quality of other work of similar nature, prepare the surfaces and apply the coat or coats of paint as directed by the Engineer to accomplish the desired appearance and protection quality. Submit to the Engineer substantial evidence that the standard finish is compatible with the specified finish coat.
- E. Properly protect the shop prime and finish coats against damage from weather or any other cause.
- F. Wherever fabricated equipment is required to be blast cleaned, protect all motors, drives, bearings, gears, etc, from the entry of grit. Equipment found to contain grit shall be promptly and thoroughly cleaned.

END OF SECTION

NO TEXT ON THIS PAGE

SECTION 09902
PAINTING

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Furnish all labor, materials, equipment and incidentals required and install all painting complete as shown on the Drawings and as specified herein.
- B. It is the intent of this Section to provide requirements for touchup painting required as a result of demolition being performed under this contract and painting of new material being installed, such as electrical conduit. This shall include touchup painting of exposed walls, exposed structural and miscellaneous steel; chemical tanks and systems; mechanical and electrical equipment; sluice gates, operators and posts; conveying systems, pipe, fittings and valves; electrical conduit and appurtenances; new CMU walls; exposed interior ducts; all as specified in the attached painting schedules and all other work obviously required to be painted unless otherwise specified. Minor items not mentioned in the schedule of work shall be included in the work of this Section where they come within the general intent of this Section as stated herein.
- C. Aluminized steel, above roof level, for stacks - Paint with silicone aluminum as specified. Other aluminum-paint only where noted (as is specified). Paint items so noted in Paragraph 1.01B and in accordance with the Painting Schedule. Provide vinyl film letters and numbers for markings as specified. Items noted in other Specification Sections as having factory finish and other factory finished items are obviously not field painted. The Contractor is responsible for having damaged factory finish painted items repaired or, if so ordered, for replacing items. The various Sections are responsible, as stated in each, for preparation and field touch-up of abrasions, welds and damaged primed areas of primed or galvanized components after erection.
- D. The following items will not be painted:
 - 1. Concrete except where specified above and scheduled to be painted and seamless flooring.
 - 2. Stainless steel louvers, doors and frames.
 - 3. Finish hardware.
 - 4. Non-ferrous metals and stainless steel, unless specifically noted otherwise.
 - 5. Factory pre-finished architectural components.
 - 6. Packing glands and other adjustable parts and name plates of mechanical equipment.
 - 7. Parts of buildings not exposed to sight, unless specifically noted otherwise.
 - 8. Maintenance equipment
 - 9. Plumbing fixtures.
 - 10. Mechanical, HVAC, Plumbing and Electrical equipment which has been finished painted in the factory as specified in Divisions 11, 13 and 15.

1.02 RELATED WORK

- A. Shop priming and surface preparation of equipment and piping (except copper piping) are specified in Section 09901 and included in the respective Section with the item to be primed.

1.03 SUBMITTALS

- A. Submit the following in accordance with Section 01300.
- B. Product Data: For each type of product indicated.
- C. Samples: Submit the following for each type of coating system and in each color and gloss of finish coat indicated.
 - 1. Color cards for initial color selections.
 - 2. Three sets of 8-in by 8-in samples, on 1/4-in hardboard, of all colors required for all types of paint. Resubmit until approved.
- D. Product List: For each product indicated. Cross-reference products to coating system and locations of application areas. Use same designations indicated on Drawings and in schedules.
- E. LEED Submittals:
 - 1. Product Data for Credit EQ 4.2: For coatings, including printed statement of VOC content and chemical components.

1.04 REFERENCE STANDARDS

- A. Steel Structures Painting Council (SSPC)
 - 1. SSPC SP-1 - Surface Preparation Specification No. 1 Solvent Cleaning.
 - 2. SSPC SP-2 - Surface Preparation Specification No. 2 Hand Tool Cleaning.
- B. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.
 - 1. Maintain containers in clean condition, free of foreign materials and residue.
 - 2. Remove rags and waste from storage areas daily.

1.06 PROJECT CONDITIONS

- A. Apply coatings only when temperature of surfaces to be coated and surrounding air temperatures are between 50 and 95 deg F.

- B. Do not apply coatings in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Provide products by one of the following:
 - 1. Tnemec, Inc.(TN);
 - 2. The Sherwin Williams Company (SW)
 - 3. PPG Architectural Finishes, Inc. (PPG)
 - 4. PPG Architectural Finishes, Inc. Ameron (AME)
 - 5. Or equal.

2.02 MATERIALS

- A. Material Compatibility:
 - 1. Provide materials for use within each coating system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
 - 2. Provide products of same manufacturer for each coat in a coating system.
- B. All painting materials shall be delivered to the work site in unbroken packages, bearing the manufacturer's brand and name. They shall be used without adulteration and mixed, thinned and applied in strict accordance with manufacturer's directions for the applicable materials and surface and with the Engineer's approval before using.
- C. Shop priming shall be done with primers that are guaranteed by the manufacturer to be compatible with the finish paints to be used. Refer to Section 09901 for special primers.
- D. Work areas will be designated by the Engineer for storage and mixing of all painting materials. Materials shall be in full compliance with the requirements of pertinent codes and fire regulations. Proper containers outside of the buildings shall be provided and used for painting wastes and no plumbing fixture shall be used for this purpose.
- E. Colors: Match existing paint or as approved by the Owner.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of work.

1. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
 - a. Concrete: 12 percent.
 - b. Masonry (Clay and CMU): 12 percent.
 - c. Wood: 15 percent.
 - d. Gypsum Board: 12 percent.
2. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
3. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.
4. Coating application indicates acceptance of surfaces and conditions.

3.02 PREPARATION

- A. All surfaces to be painted shall be prepared as specified herein and shall be dry and clean before painting. Special care shall be given to thoroughly clean interior concrete and CMU surfaces to receive polyamide cured epoxy paint of all marks before application of finish.
- B. All metal welds, blisters, etc, shall be ground and sanded smooth. All pits and dents shall be filled and all imperfections shall be corrected so as to provide a smooth surface for painting. All rust, loose scale, oil, tar and asphalt bearing coatings, grease and dirt shall be removed by use of approved solvents, wire brushing, grinding or sanding.
- C. Concrete surfaces shall have been finished as specified in Division 3. Report unsatisfactory surfaces to the Engineer. Concrete shall be left for one month minimum before painting and shall be free of dust, oil, curing compounds and other foreign matter.
- D. Concrete masonry unit surfaces shall be smooth and cleaned of all dust, loose mortar and other foreign matter.
- E. All PVC pipe and other plastic matrix surfaces to be painted shall be sanded to an approved profile and cleaned of residue before painting.
- F. All PVC pipe and other plastic matrix surfaces to be painted shall be lightly sanded and cleaned of residue before painting.
- G. Galvanized, aluminum, and copper surfaces shall have all oxidation and foreign material removed before painting by SSPC SP-1, using an approved V.O.C. compliant method. Galvanized and, when ordered, the other metal surfaces specified above shall be hand tool cleaned to SSPC SP-2 standards to provide a uniform 1 mil surface profile.
- H. Existing Surfaces to be Repainted
 1. Existing masonry, steel and other previously field painted surfaces so noted or as provided in Paragraph 1.01B shall be repainted.

2. Preparation shall be in general as specified above for new surfaces except that all loose paint shall be removed and all edges of existing paint shall be feathered to ensure a smooth surface.
3. Paint removal, capture of its residue, and its disposal shall be handled in accordance with all laws and regulations concerning disposal of hazardous materials.
4. Primer (spot) and paint used for a particular surface shall, in general, be as scheduled for that type of new surface. Provide a CDM Smith approved organic zinc-rich (min. 83% zinc in dried film) primer as specified. Confirm with the paint manufacturer that the paint proposed for a particular repaint condition will be compatible with the existing painted surface. Perform adhesion and compatibility tests on existing substrates as ordered and required. Repainted areas shall be covered by the same guaranty specified for remainder of Project.

3.03 WORKMANSHIP

A. General

1. At the request of the Engineer, sample areas of the finished work prepared in strict accordance with this Section shall be furnished and all painting shall be equal in quality to the approved sample areas. Finished areas shall be adequate for the purpose of determining the quality of workmanship. Experimentation with factory or paint manufacturer's warehouse mixed colors shall be furnished to the satisfaction of the Engineer where standard chart colors are not satisfactory.
2. Protection of furniture and other movable objects, equipment, fittings and accessories shall be provided throughout the painting operation. Canopies of lighting fixtures shall be loosened and removed from contact with surface, covered and protected and reset upon completion. Remove all electric plates, surface hardware, etc, before painting, protect and replace when completed. Mask all machinery name plates and all machined parts not receiving a paint finish. Dripped or spattered paint shall be promptly removed. Lay drop cloths in all areas where painting is being done to adequately protect flooring and other work from all damage during the operation and until the finished job is accepted.
3. On metal surfaces apply each coat of paint at the rate specified by the manufacturer to achieve the minimum dry mil thickness required. If material has thickened or must be diluted for application by spray gun, the coating shall be built up to the same film thickness achieved with undiluted material. One gallon of paint as originally furnished by the manufacturer shall not cover a greater area when applied by spray gun than when applied unthinned by brush. Deficiencies in film thickness shall be corrected by the application of an additional coat(s). On masonry, application rates will vary according to surface texture; however, in no case shall the manufacturer's stated coverage rate be exceeded. On porous surfaces, it shall be the painter's responsibility to achieve a protective and decorative finish either by decreasing the coverage rate or by applying additional coats of paint.

B. Field Priming

1. Steel members, metal castings, mechanical and electrical equipment and other metals which are shop primed before delivery at the site will not require a prime coat on the job. All piping and other bare metals to be painted shall receive one coat of primer before exposure to the weather, and this prime coat shall be the first coat as specified in the painting schedule. Surface preparation of bare metal shall be the responsibility of the Contractor.
2. Equipment which is specified to receive a baked-on enamel finish or other factory finish shall not be field painted unless the finish has been damaged in transit or during installation. Surfaces that have been shop painted and have been damaged, or where the shop coat or coats of paint have deteriorated, shall be properly cleaned and retouched before any successive painting is done on them in the field. All such field painting shall match as nearly as possible the original finish. Preparation and painting shall be provided by the Contractor.
3. Equipment shipped with a protective shop painting coat or coats shall be touched up to the satisfaction of the Engineer with primers as recommended by the manufacturer of the finish paint. Preparation and painting shall be provided by the Contractor.

C. Field Painting

1. All painting at the site shall be under the strict inspection of the Engineer. Only skilled painters and, where dictated by special conditions or systems and so ordered, specialist painters shall be used on the work.
2. All paint shall be at room temperature before applying, and no painting shall be done when the temperature is below 60 degrees F, in dust-laden air, when rain or snow is falling, or until all traces of moisture have completely disappeared from the surface to be painted.
3. Successive coats of paint shall be different shades (from paint manufacturer's stock or shop mixed paint) of the required colors so as to make each coat easily distinguishable from each other with the final undercoat the approximate shade of the finished coat to ensure no show-through as approved.
4. Finish surfaces shall not show brush marks or other irregularities. Undercoats shall be thoroughly and uniformly sanded with the type paper appropriate for the undercoats to remove defects and provide a smooth even surface. Top and bottom edges of doors shall be painted.
5. Painting shall be continuous and shall be accomplished in an orderly manner so as to facilitate inspection. Materials subject to weather shall be primed coated as quickly as possible. Surfaces of exposed members that will be inaccessible after erection shall be cleaned and painted before erection.
6. All painting shall be performed by approved methods with number of coats modified as required to obtain the total dry film thickness specified. Spray painting shall be performed specifically by methods submitted and as approved by the Engineer.

7. All surfaces to be painted as well as the atmosphere in which painting is to be done shall be kept warm and dry by heating and ventilation, if necessary, until each coat of paint has hardened. Any defective paint shall be scraped off and repainted in accordance with the Engineer's directions.
8. Before final acceptance of the work, all damaged surfaces of paint shall be cleaned and repainted as directed by the Engineer.
9. Only the aluminum work noted on the Drawings or in the Painting Schedule shall be field painted.

3.04 FIELD QUALITY CONTROL

- A. Owner reserves the right to invoke the following procedure at any time and as often as Owner deems necessary during the period when coatings are being applied:
 1. Owner will engage the services of a qualified testing agency to sample coating material being used. Samples of material delivered to Project site will be taken, identified, sealed, and certified in presence of Contractor.
 2. Testing agency will perform tests for compliance with specified requirements.
 3. Owner may direct Contractor to stop applying coatings if test results show materials being used do not comply with specified requirements. Contractor shall remove noncomplying coating materials from Project site, pay for testing, and recoat surfaces coated with rejected materials. Contractor will be required to remove rejected materials from previously coated surfaces if, on recoating with complying materials, the two coatings are incompatible.

3.05 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing coating application, clean spattered surfaces. Remove spattered coatings by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from coating operation. Correct damage by cleaning, repairing, replacing, and recoating, as approved by Engineer, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced coated surfaces.

3.06 PAINTING SCHEDULE

- A. All colors will be selected by the Engineer.
- B. The following types of paints by PPG Protective & Marine Coatings, (PPG PMC); Tnemec Co. (TN) and The Sherwin Williams Company (SW) have been used as a basis for the paint schedule:

1. Epoxy:
 - a. TN: Hi-build Epoxoline II (Series N69)
 - b. SW: Macropoxy 646
 - c. PPG PMC: Pitt-Guard 97-145 Series Epoxy Mastic
 - d. AME: Amerlock 2/400 Series Epoxy
 - e. Or equal.
 2. Waterborne Cementitious Acrylic:
 - a. TN: Envirofil (No. 130-6602 off-white color).
 - b. SW: Cement-Plex 875
 - c. PPG: Cementitious Waterproofing Block Filler 95-217 Series
 - d. AME: Amerlock 400 BF Epoxy Block Filler
 - e. Or equal.
 3. High-Build Acrylic Polyurethane Enamel:
 - a. TN: Endura-Shield III - semi-gloss (Series V73)
 - b. SW: Acrolon 218 HS
 - c. PPG: Pitthane HB Semigloss Urethane 95-8800 Series
 - d. AME: Amercoat 450H SG Polyurethane
 - e. Or equal.
 4. High Heat Silicone Aluminum (to 600 degrees F)
 - a. TN: Silicone Aluminum (No. 39-661)
 - b. SW: Kem Hi-Temp No.850
 - c. PPG: Speedhide 6-220 Series Silicone Aluminum Coating
 - d. AME: Amercoat 878 Silicone Aluminum Coating
 - e. Or equal.
 5. Tie Coat, Low VOC, Epoxy:
 - a. TN: FC Typoxy (Series V27)
 - b. SW: Macropoxy HS
 - c. PPG: Pitt-Guard Epoxy Mastic 95-245 Series
 - d. AME: Amercoat 385 Multi-purpose Epoxy
 - e. Or equal.
 6. Acrylic Latex Emulsion, Eggshell Finish:
 - a. TN: Tneme-Cryl (Series 6)
 - b. SW: DTM Primer Finish
 - c. PPG: Pitt-tech Plus 90-1110 Series Satin DTM Acrylic
 - d. AME: Amercoat 220 Waterborne Acrylic
 - e. Or equal.
 7. Vinyl Acrylic Surface Sealer:
 - a. TN: PVA Sealer (No. 51-792) -.
 - b. SW: Prep-Rite 200 Primer
 - c. PPG: Speedhide 6-2 Vinyl Acrylic Drywall Primer
 - d. AME: Amercoat 148 Acrylic Primer
 - e. Or equal.
- C. The following surfaces shall have the types of paint scheduled below applied at the dry film thickness (DFT) in mils per coat noted:

1. Exterior non submerged ferrous metals (except first coat-hollow metal-pressed metal work).
 - a. First Coat: On properly prepared unprimed metal or for touch-up
 - 1) TN: No. N69 (white in color) (3.0-4.0 DFT)
 - 2) SW: Macropoxy 646 (5.0-10.0 DFT)
 - 3) PPG: Pitt-Guard 97-145 Series Epoxy Mastic
 - 4) AME: Amerlock 2/400 Series Epoxy
 - 5) Or equal.
 - b. Second Coat:
 - 1) TN: Series N69 (4.0 DFT)
 - 2) SW: Acrolon 218 HS (3.0-6.0 DFT)
 - 3) PPG: Pitt-Guard 97-145 Series Epoxy Mastic
 - 4) AME: Amerlock 2/400 Series Epoxy
 - 5) Or equal.
 - c. Third Coat:
 - 1) TN: Series V73 (3.0 DFT)
 - 2) SW: Acrolon 218 HS (3.0-6.0 DFT)
 - 3) PPG: Pitthane HB Semigloss Urethane 95-8800 Series
 - 4) AME: Amercoat 450H SG Polyurethane
 - 5) Or equal.
2. Interior non-submerged concrete scheduled for painting.
 - a. First and Second Coats:
 - 1) TN: Series N69 (4.0-5.0 DFT)
 - 2) SW: Macropoxy 646 (5.0-10.0 DFT)
 - 3) PPG: Pitt-Guard 97-145 Series Epoxy Mastic
 - 4) AME: Amerlock 2/400 Series Epoxy
 - 5) Or equal.
3. Interior concrete masonry units
 - a. First Coat:
 - 1) TN: No. 130-6602 (80 sq ft/gal minimum scrub-in to fill voids as approved)
 - 2) SW: Cement-Plex 875 (50-100 s.f./gl.)
 - 3) PPG: Cementitious Waterproofing Block Filler 95-217 Series
 - 4) AME: Amerlock 400 BF Epoxy Block Filler
 - 5) Or equal.
 - b. Second and Third Coats:
 - 1) TN: Series N69 (5.0 DFT)
 - 2) SW: Macropoxy 646 (5.0-10.0 DFT)
 - 3) PPG: Pitt-Guard 97-145 Series Epoxy Mastic
 - 4) AME: Amerlock 2/400 Series Epoxy
 - 5) Or equal.
4. Interior non-submerged ferrous metals (except first coat of previously painted metal work), on properly prepared unprimed metal or for touch-up.
 - a. First Coat:
 - 1) TN: No. N69 (white in color) (3.0-4.0 DFT)
 - 2) SW: Macropoxy 646 (5.0-10.0 DFT)
 - 3) PPG: Pitt-Guard 97-145 Series Epoxy Mastic
 - 4) AME: Amerlock 2/400 Series Epoxy
 - 5) Or equal.

- b. Second and Third Coats:
 - 1) TN: Series N69 (3.0-4.0 DFT)
 - 2) SW: Macropoxy 646 (5.0-10.0 DFT)
 - 3) PPG: Pitt-Guard 97-145 Series Epoxy Mastic
 - 4) PPG: Amerlock 2/400 Series Epoxy
 - 5) Or equal.
- 5. Submerged ferrous metals and ferrous metals subject to submersion or splashing. Surface shall be lightly sanded or abraded before application of first field coat.
 - a. First and Second Coats:
 - 1) TN: Series N69 (6.0 DFT)
 - 2) SW: Macropoxy 646 (5.0-10.0 DFT)
 - 3) PPG: Pitt-Guard 97-145 Series Epoxy Mastic
 - 4) PPG: Amerlock 2/400 Series Epoxy
 - 5) Or equal.
- 6. Plastic piping and, where scheduled to be painted, plastic components
 - a. First and Second Coats:
 - 1) TN: Series N69 (3.0 DFT)
 - 2) SW: Macropoxy 646 (5.0-10.0 DFT)
 - 3) PPG: Pitt-Guard 97-145 Series Epoxy Mastic
 - 4) AME: Amerlock 2/400 Series Epoxy
 - 5) Or equal.
- 7. Previously painted existing concrete/CMU scheduled for painting:
 - a. First Coat:
 - 1) TN: Series 113 (3.0-4.0 DFT)
 - 2) SW: Epo-Plex Multi-Mil (4.0-6.0 DFT)
 - 3) PPG: Aquapon WB Epoxy 98-1 Series
 - 4) AME: Amercoat 335 WB Epoxy
 - 5) Or equal.
 - b. Second Coat:
 - 1) TN: Series 297 (2.0-2.5 DFT)
 - 2) SW: Epo-Plex Multi-Mil (4.0-6.0 DFT)
 - 3) PPG: Aquapon WB Epoxy 98-1 Series
 - 4) AME: Amercoat 335 WB Epoxy
 - 5) Or equal.
- 8. Existing precast concrete plank ceilings scheduled to be painted.
 - a. First and Second Coats:
 - 1) TN: Series 113 (3.0-4.0 DFT)
 - 2) SW: Epo-Plex Multi-Mil (4.0-6.0 DFT)
 - 3) PPG: Aquapon WB Epoxy 98-1 Series
 - 4) AME: Amercoat 335 WB Epoxy
 - 5) Or equal.
- 9. Pipe insulation: (Plastic or metal sheathed insulation-paint as scheduled for appropriate substrate)
 - a. First Coat:
 - 1) TN: No. 51-792 (Vinyl-Acrylic Sealer - 1.0 DFT)
 - 2) SW: Prep-Rite 200 (1.1 DFT), Macropoxy 646 (5.0-10.0 DFT)

- 3) PPG: Speedhide 6-2 Vinyl Acrylic Drywall Primer
 - 4) AME: Amercoat 148 Acrylic Primer
 - 5) Or equal.
 - b. Second and Third Coats:
 - 1) TN: Series N69 (3.0 DFT)
 - 2) SW: Prep-Rite 200 (1.1 DFT), Macropoxy 646 (5.0-10.0 DFT)
 - 3) PPG: Pitt-Guard 97-145 Series Epoxy Mastic
 - 4) AME: Amerlock 2/400 Series Epoxy
 - 5) Or equal.
10. Aluminum designated to be painted. (Mechanically abrade surfaces to a uniform profile of 1 to 2 mils and clean completely.)
 - a. First and Second Coats: (Interior)
 - 1) TN: Series N69 (3.0 DFT)
 - 2) SW: Macropoxy 646 (5.0-10.0 DFT)
 - 3) PPG: Pitt-Guard 97-145 Series Epoxy Mastic
 - 4) AME: Amerlock 2/400 Series Epoxy
 - 5) Or equal.
 - b. First Coat: (Exterior)
 - 1) TN: Series N69 (4.0 DFT), 1 coat Series V73 (3.0 DFT)
 - 2) SW: Macropoxy 646 (5.0-10.0 DFT), Acrolon 218 HS (3.0-6.0 DFT)
 - 3) PPG: Pitt-Guard 97-145 Series Epoxy Mastic
 - 4) AME: Amerlock 2/400 Series Epoxy
 - 5) Or equal.
11. Copper piping
 - a. First and Second Coats:
 - 1) TN: Series N69 (3.0 DFT)
 - 2) SW: Macropoxy 646 (5.0-10.0 DFT)
 - 3) PPG: Pitt-Guard 97-145 Series Epoxy Mastic
 - 4) AME: Amerlock 2/400 Series Epoxy
 - 5) Or equal.
12. Hot ferrous metal surfaces
 - a. First and Second Coats:
 - 1) TN: Series 39-661 (1.5 DFT)
 - 2) SW: Kem Hi-Temp 850 (Primer 1.1 DFT / Topcoat 1.0-1.2 DFT)
 - 3) PPG: Speedhide 6-220 Series Silicone Aluminum Coating
 - 4) AME: Amercoat 878 Silicone Aluminum Coating
 - 5) Or equal.
13. Previously painted metal surfaces - First coat on substrates prepared as approved and replacing first coat of above-specified systems. Complete painting with remainder of specified system for each type of substrate.
 - a. First Coat:
 - 1) TN: FC Typoxy Series V27 (5 DFT)
 - 2) SW: Macropoxy HS (3.0-6.0 DFT)
 - 3) PPG: Pitt-Guard 97-145 Series Epoxy Mastic
 - 4) AME: Amerlock 2/400 Series Epoxy
 - 5) Or equal.

14. Exterior galvanized steel surfaces. (Mechanically abrade surfaces to a uniform profile of 1 to 2 mils and clean completely.)
 - a. First Coat:
 - 1) TN: Series V27 (3.0 to 4.0 DFT)
 - 2) SW: Macropoxy 646 (5.0-10.0 DFT)
 - 3) PPG: Pitt-Guard Epoxy Mastic 95-245 Series
 - 4) AME: Amercoat 385 Multi-purpose Epoxy
 - 5) Or equal.
 - b. Second Coat:
 - 1) TN: Series V73 (2.5 to 3.5 DFT)
 - 2) SW: Acrolon 218 HS (3.0-6.0 DFT)
 - 3) PPG: Pitthane HB Semigloss Urethane 95-8800 Series
 - 4) AME: Amercoat 450H SG Polyurethane
 - 5) Or equal.
15. Gypsum work
 - a. First Coat:
 - 1) TN: No. 51-792 (1.0 DFT)
 - 2) SW: PrepRite 200 Primer (1.1 DFT)
 - 3) PPG: Speedhide 6-2 Vinyl Acrylic Drywall Primer
 - 4) AME: Amercoat 148 Acrylic Primer
 - 5) Or equal.
 - b. Second and Third Coats:
 - 1) TN: Series 6 (3.0 DFT)
 - 2) SW: DTM Primer-Finish (2.5-5.0 DFT)
 - 3) PPG: Pitt-tech Plus 90-1110 Series Satin DTM Acrylic
 - 4) AME: Amercoat 220 Waterborne Acrylic
 - 5) Or equal.

END OF SECTION

SECTION 13300
INSTRUMENTATION AND CONTROLS – GENERAL PROVISIONS

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. The Contractor shall procure the services of a Process Control System Supplier (PCSS) to furnish and install all materials, equipment, labor and services, required to achieve a fully integrated and operational system as specified herein, in the Specification Sections listed below, and in related drawings, except for those services and materials specifically noted.

1.	Section No	Title
	13302	Testing
	13303	Training
	13305	Control Descriptions
	13306	Application Engineering Services
	13310	Computer System Hardware
	13311	PLC Hardware and Software
	13315	HMI System Software
	13316	Additional SCADA System Software
	13320	Control and Data Network Equipment
	13321	Fiber Optic Cabling and Equipment
	13330	Control Panels and Panel Mounted Equipment
	13335	Uninterruptible Power Supply (1 Phase)
	13340	Instruments
	13341	Flow Devices
	13342	Level Devices
	13343	Pressure Devices
	13344	Temperature Devices
	13345	Analytical Devices

- B. Items specifically excluded from the PCSS scope of the PCSS include the following:

CEDAR CREEK WPCP:

1. Hardware for SCADA servers are not required. A fault tolerant server has been provided under a previous project. The existing server has been provided with two copies of Windows Server Virtual machines which have been designated for use as the primary and secondary plant SCADA servers under this project.

GLEN COVE WWTP:

2. PLC programming of the Belt Filter Press CP-1 and associated local BFP control panels are provided under a separate contract.

3. PLC programming associated with the general starting, stopping, and interlocking operation of the APG Neuros blower and Turblex blower. However, configuration and PLC programming shall be provided to establish data transfer to the Master Aeration Control Panel (MACP) and HMI system for controlling the blowers in automatic and manual modes as described in the Control Descriptions, Section 13305.
 4. PLC's and PLC programming associated with the UV System Control Center (SCC) and Hydraulic Systems Center (HSC) shall be provided by the UV System Control Vendor.
 5. PLC programming and HMI development for the Influent pumps, Influent screens, and primary sludge pumps (plunger pumps).
- C. Requirements that the PCSS is responsible for at both the Cedar Creek WPCP and Glen Cove WWTP shall include, but not be limited to the following:
1. Auxiliary and accessory devices necessary for system operation or performance, such as transducers, relays, signal amplifiers, intrinsic safety barriers, signal isolators, software, and drivers to interface with existing equipment or equipment provided by others under other Sections of these specifications, shall be included whether they are shown on the Drawings or not.
 2. All equipment and installations shall satisfy applicable Federal, State and local codes.
 3. Use the equipment, instrument, and loop numbering scheme shown on the Drawings and specifications in the development of the submittals. Do not deviate from or modify the numbering scheme without the Engineer's approval.
- D. Equipment and services the PCSS shall be responsible for at the Cedar Creek WPCP shall include, but not be limited to the following:
1. Furnish and configure a fault-tolerant plant fiber optic network as required by Sections 13320 and 13321.
 2. Furnish GE Cimplicity HMI SCADA software licenses for installation on the SCADA servers and workstations as specified herein.
 3. Furnish, install, and configure a combustible gas detection system in the digester area as indicated on the drawings and per the instrument list included at the end of this specification.
 4. Provide overall installation and configuration of instrumentation, programmable logic controllers (PLCs), PLC enclosures, SCADA computer equipment, networking equipment, and other control system equipment as specified herein.
 5. Provide all PLC programming, including development of control programs, runtime and flow totalization calculations, peer-to-peer communication, alarming, and other functions as specified herein.

6. Provide all Human Machine Interface (HMI) configuration for the Cimplicity HMI software and for the operator interface terminals, including database configuration, graphic screens, alarming, security, and historical archiving, and other functions as specified herein.
7. The following substations shall be tied into the SCADA system for monitoring. Perform PLC and HMI programming to monitor the signals as required by Section 13305.
 - a. Substation T4 shall be tied into PLC-PST1 in the Grit Building via hardwired signals for monitoring of switch open/closed status.
 - b. Substation T-7 shall be tied into FOCE-DWTR in the Dewatering Building via a 3-pair fiber cable. Furnish and install at Substation T-7 a new network enclosure that contains a new fiber optic patch panel and fiber optic Ethernet switch as shown on the drawings and specified herein. CAT6 cable between the electrical devices and the new network enclosure shall be by others under a separate contract.
 - c. Substation T-8 shall be tied into the managed Ethernet switch in T-7 via a 3-pair fiber optic cable. Furnish and Install at Substation T-8 a new network enclosure that contains a new fiber optic patch panel and fiber optic Ethernet switch as shown on the drawings and specified herein. CAT6 cable between the electrical devices and the new network enclosure shall be by others under a separate contract.
 - d. The Main Switchgear shall be tied into the SCADA network via Ethernet radio (See Specification 13320). One Ethernet radio and associated antenna shall be mounted outside the switchgear housing and one Ethernet radio and associated antenna shall be mounted outside of Building U. Power for the radios shall be via power over Ethernet (PoE). Furnish and Install at Substation T1/T2 a new network enclosure that contains a new Ethernet switch as shown on the drawings and specified herein. CAT6 cable between the electrical devices and the new network enclosure shall be by others under a separate contract.
 - e. MCC-P10/P11 shall be tied into the Ethernet switch in FOCE-EQUP in Building B via CAT6 cable.
 - f. Substation T1/T2 shall be tied into the Ethernet switch in FOCE-EQUP in Building B via a 3-pair fiber optic cable. Furnish and Install at Substation T1/T2 a new network enclosure that contains a new fiber optic patch panel and fiber optic Ethernet switch as shown on the drawings and specified herein. CAT6 cable between the electrical devices and the new network enclosure shall be by others under a separate contract.
8. Perform PLC and HMI programming to monitor the County's Protected and Domestic Water flowmeters. The PLCs that shall be programmed for tie-in of these meters are as follows:
 - a. In the fire pump building, "Fire Pump Flow" shall be tied into the new PLC-FPB.
 - b. In the basement of Building B, "Seal Water Flow to the Raw Sewage Pumps" shall be tied into the existing Protected Waster Pump Control Panel". A spare analog input point shall be used for this signal.
 - c. In the basement of Building L, "Building L Protected Water Flow" shall be tied into the outfall PLC in the Outfall Pump Control Panel furnished under the Effluent Screens Project. A spare analog input point shall be used for this signal.
 - d. In Building U, "Building U Protected Water Flow" shall be tied into the existing Biofilter Control Panel PLC in Building U. A spare analog input point shall be used for this signal.
 - e. In Building S, "Building S Protected Water Flow" shall be tied into the PLC in the Main Control Panel in the Dewatering Control Room. A spare analog input point shall be used for this signal.

- f. In Building S, “Building S Domestic Water Flow” shall be tied into PLC-Polymer in the Polymer Room. A spare analog input point shall be used for this signal.
 - g. In Building J Basement, “Building J Protected Water Flow” shall be tied into PLC-GBT in the Gravity Belt Thickener Control Room in Building H. A spare analog input point shall be used for this signal.
 - h. In the tunnel between buildings J and K, “Building J/K Protected Water Flow” shall be tied into PLC-GBT in the Gravity Belt Thickener Control Room in Building H. A spare analog input point shall be used for this signal.
 - i. In the tunnel between buildings J and K, “Building J/K Domestic Water Flow” shall be tied into PLC-GBT in the Gravity Belt Thickener Control Room in Building H. A spare analog input point shall be used for this signal.
 - j. In the North Digester Area, in the tunnel between buildings J and F, “Building F/J Protected Water Flow” shall be tied into the new PLC-PST1 in Building F.
9. Perform programming to monitor the 8 existing digester gas flowmeters from the SCADA system. Refer to Sections 13305 and 13306 and the electrical drawings.
10. Furnish and install a new combustible gas monitoring system in the Building J digester area, including 22 combustible gas sensors gas monitoring controllers as required by the specification. This system shall replace the existing combustible gas monitoring system in Building J. The existing horns and strobe lights in Building J that are triggered by alarms from the existing combustible gas monitoring system shall be tied into the new combustible gas monitoring system such that the high combustible gas alarms from the new system trigger the existing strobe lights and horns. Sensors installed on the basement level shall be monitored by a single gas monitoring controller, while sensors installed on the first floor shall be monitored by a separate gas monitoring controller. Perform programming to monitor the new gas detectors from the SCADA system.
11. Furnish, install, and configure new instrumentation for measurement of the digester cover levels on the 9 digesters as indicated on the drawings and per the instrument list included at the end of this specification. Perform programming to monitor the digester cover levels from the SCADA system.
12. Demolish the existing 9 digester cover level position indicators/transmitters as required by the drawings and as specified herein.
13. Install conduit, CAT6 cable, and signal wire to the existing digester gas dryer system control panel. Also run wire. Provide programming to monitor the gas dryer system from the SCADA system.
14. Install conduit, CAT6 cable, and fiber optic cable as required to interface with the new plant switchgear equipment (furnished under separate contracts). Provide programming to interface with the switchgear equipment from the SCADA system.
15. Install electrical systems as required including conduit, wire, fiber optic cable, fiber optic cable enclosures, junction boxes, wire terminations, etc.
16. Refer to Article 7 of the General Conditions for additional requirements.
17. Merge the existing Cimplicity server databases into the new Cimplicity SCADA servers VM-1 and VM-2 (see I-2).

18. Merge all Cimplicity graphics such that, at the conclusion of this project, all Cimplicity nodes (including all new and all existing workstations) shall have the same graphic displays. At the coordination meetings, the Owner and Engineer will inform the PCSS which workstations shall have limited functionality (e.g. the workstations in the administration building control room shall be capable of monitoring the engine generators, but only the workstations in the engine control room shall be capable of performing control functions for the engine generators.)
19. Provide all materials, equipment, labor, and services required, to achieve a fully integrated and operational system. The PCSS shall design and coordinate the instrument and process control system for proper operation with related equipment and materials furnished by others under other sections of these Specifications and with related existing equipment. Should any coordination issues arise with the PCSS, the General Contractor shall be ultimately responsible to facilitate proper coordination between the PCSS and other manufacturers supplied equipment.
20. Provide CAT6 and fiber optic patch cables to connect networked devices as indicated on the drawings. Cabling shall be routed through patch panels, where provided.
21. The PCSS shall perform the following in the Cedar Creek Administration Building (Building A) First Floor Computer Room as specified and as indicated on Drawing I-2:
 - a. Configuration of the following existing equipment as indicated on the SCADA System Architecture drawing and as specified.
 - 1) Configuration of the existing Layer 3 Ethernet switches (UWLISCADACCES01 and UWLISCADACCES02) such that the fiber connections added under this project are configured to automatically failover in the event of a break in the fiber optic backbone.
 - 2) Configuration of the following virtual machines on the existing fault tolerant server:
 - a) VM-1 Plant SCADA HMI Primary Server (UWLISCADACCSV02)
 - b) VM-2 Plant SCADA HMI Secondary Server (UWLISCADACCSV03)
 - b. Furnish, install, and configure the following new equipment and software as indicated on the SCADA System Architecture drawing and as specified.
 - 1) One (1) Fiber Optic patch panel (FOPP-ADMIN) as specified in Section 13320, installed in the existing server rack.
 - 2) HMI software for use on virtual machines indicated above. See specification 13315 for software requirements.
22. The PCSS shall perform the following in the Cedar Creek Administration Building (Building A) Control Room as specified and as indicated on Drawing I-2:
 - a. Furnish, install, and configure the following new equipment as indicated on the SCADA System Architecture drawing and as specified.
 - 1) Two (2) workstation computers (UWLISCADACCWS05 and UWLISCADACCWS06) with associated monitors as indicated on the SCADA System Architecture and as specified in Section 13310.
 - 2) Furnish and install uninterruptible power supply (UPS-ACR), as specified in Section 13335. This UPS shall power SCADA workstations and monitors located in the control room.
 - 3) Provide a control console and desk chairs as required by Section 13310, to accommodate the two workstations.

23. The PCSS shall perform the following in the Administration Building (Building A) Basement as specified and as indicated on Drawing I-2:
 - a. Furnish, install, and configure the following new equipment as indicated on the SCADA System Architecture drawing and as specified.
 - 1) RIO-HVAC-A and associated enclosure. Refer to Section 13311 for PLC requirements and Section 13330 for panel requirements. The RIO shall be tied into the existing Ethernet switch in the server rack via CAT6.
24. The PCSS shall perform the following in the Grit Building (Building F) Control Room as specified and as indicated on Drawing I-3:
 - a. Furnish, install, and configure the following new equipment as indicated on the SCADA System Architecture drawing and as specified.
 - 1) One (1) Fiber Optic Communication Enclosure (FOCE-GRIT) as specified in Section 13320, which shall house the following equipment:
 - a) One (1) Fiber Optic Ethernet Switch (FOES-GRIT) as specified in Section 13320, for use as part of the fault tolerant fiber optic backbone.
 - b) One (1) CAT6 patch panel (CPP-GRIT), as specified in Section 13320.
 - c) One (1) Fiber Optic patch panel (FOPP-GRIT), as specified in Section 13320.
 - d) One uninterruptible power supply (UPS-GRIT-1) as specified in Section 13335, used to power devices mounted in the FOCE-GRIT. The UPS shall be tied into the Ethernet switch for monitoring by the SCADA system.
 - 2) PLC-PST-1 and associated enclosure. Refer to Section 13311 for PLC requirements and Section 13330 for panel requirements.
 - 3) Operator interface terminal (OIT- PST-1) on the door of the new PLC-PST-1 enclosure, as specified in Section 13311.
 - 4) Managed Ethernet switch (MES-PST-1), as specified in Section 13320. The Ethernet switch shall be tied into the new Fiber Optic Communication Enclosure via CAT6.
 - 5) One uninterruptible power supply (UPS-PST-1) as specified in Section 13335, used to power control panel components. The UPS shall be tied into the Ethernet switch for monitoring by the SCADA system.
25. The PCSS shall perform the following in the Digester Building (Building J) Control Room as specified and as indicated on Drawing I-3:
 - a. Relocate the existing air conditioning unit to make room for the new PLC-DIG control panel.
 - b. Furnish, install, and configure the following new equipment as indicated on the SCADA System Architecture drawing and as specified.
 - 1) One (1) Fiber Optic Communication Enclosure (FOCE-DIG) as specified in Section 13320, which shall house the following equipment:
 - a) One (1) Fiber Optic Ethernet Switch (FOES-DIG) as specified in Section 13320, for use as part of the fault tolerant fiber optic backbone.
 - b) One (1) CAT6 patch panel (CPP-DIG), as specified in Section 13320.
 - c) One (1) Fiber Optic patch panel (FOPP-DIG), as specified in Section 13320.
 - d) One uninterruptible power supply (UPS-DIG-1) as specified in Section 13335, used to power devices mounted in the FOCE-DIG. The UPS shall be tied into the Ethernet switch for monitoring by the SCADA system.
 - 2) PLC-DIG and associated enclosure. Refer to Section 13311 for PLC requirements and Section 13330 for panel requirements.

- 3) Local I/O racks as necessary to accommodate the required I/O points. Refer to Section 13311 for I/O rack requirements. Communication between PLC-DIG and the local I/O racks shall be via the Digester RIO VLAN (refer to Section 13320).
 - 4) Operator interface terminal (OIT-DIG) on the door of the new PLC-DIG enclosure, as specified in Section 13311.
 - 5) Managed Ethernet switch (MES-DIG), as specified in Section 13320, for use with the SCADA network.
 - 6) Unmanaged Ethernet switch (ES-DIG-RIO), as specified in Section 13320, used for segmenting the RIO network from the main SCADA network.
 - 7) One uninterruptible power supply (UPS-DIG) as specified in Section 13335, used to power control panel components. The UPS shall be tied into the Ethernet switch for monitoring by the SCADA system.
 - 8) RIO-HVAC-J and associated enclosure. Refer to Section 13311 for PLC requirements and Section 13330 for panel requirements. The RIO shall be tied into the existing Ethernet switch in FOCE-DIG via CAT6.
26. The PCSS shall perform the following in the Digester Building (Building J) Control Room as specified and as indicated on Drawing I-3:
- a. Furnish, install, and configure the following new equipment as indicated on the SCADA System Architecture drawing and
27. The PCSS shall perform the following in the Sludge Dewatering Building (Building S) Control Room as specified and as indicated on Drawing I-3:
- a. Furnish, install, and configure the following new equipment as indicated on the SCADA System Architecture drawing and as specified.
 - 1) One (1) Fiber Optic Communication Enclosure (FOCE-DWTR) as specified in Section 13320, which shall house the following equipment:
 - a) One (1) Fiber Optic Ethernet Switch (FOES-DWTR) as specified in Section 13320, for use as part of the fault tolerant fiber optic backbone.
 - b) One (1) CAT6 patch panel (CPP-DWTR), as specified in Section 13320.
 - c) One (1) Fiber Optic patch panel (FOPP-DWTR), as specified in Section 13320.
 - d) One uninterruptible power supply (UPS-DWTR) as specified in Section 13335, used to power devices mounted in the FOCE-DWTR. The UPS shall be tied into the Ethernet switch for monitoring by the SCADA system.
 - b. Configuration of the following existing equipment as indicated on the SCADA System Architecture drawing and as specified.
 - 1) The existing dewatering area Cimplicity servers in the Dewatering Building Control Room, shown on the system architecture drawing I-3, shall be reconfigured as client workstations. The existing server functionality shall be merged with the new VM-1 and VM-2 SCADA servers indicated on drawing I-2.
 - 2) The industrial workstation touchscreen existing on the door of the PLC-Polymer enclosure shall be reconfigured to communicate with the new Cimplicity servers (VM-1 and VM-2) indicated on drawing I-2.
 - 3) All graphic displays associated with the dewatering system (including belt filter presses, centrifuges, and polymer system, associated pumps, etc.) shall be copied to all Cimplicity nodes at the plant and configured for viewing.

28. The PCSS shall perform the following in the Primary Settling Building (Building G/GG) Control Room as specified and as indicated on Drawing I-3:
 - a. Furnish, install, and configure the following new equipment as indicated on the SCADA System Architecture drawing and as specified.
 - 1) One (1) Fiber Optic Communication Enclosure (FOCE-PST) as specified in Section 13320, which shall house the following equipment:
 - a) One (1) Fiber Optic Ethernet Switch (FOES-PST) as specified in Section 13320, for use as part of the fault tolerant fiber optic backbone. This switch shall also be configured to communicate with MES-ATCC-2 and MES-ATCC-4 over fiber optic cable as indicated on the drawings.
 - b) One (1) CAT6 patch panel (CPP-PST), as specified in Section 13320.
 - c) One (1) Fiber Optic patch panel (FOPP-PST), as specified in Section 13320.
 - d) One uninterruptible power supply (UPS-PST-3) as specified in Section 13335, used to power devices mounted in the FOCE-PST. The UPS shall be tied into the Ethernet switch for monitoring by the SCADA system.
 - 2) PLC-PST-2 and associated enclosure. Refer to Section 13311 for PLC requirements and Section 13330 for panel requirements.
 - 3) Operator interface terminal (OIT- PST-2) on the door of the new PLC-PST-2 enclosure, as specified in Section 13311.
 - 4) Managed Ethernet switch (MES-PST-2), as specified in Section 13320.
 - 5) One uninterruptible power supply (UPS-PST-2) as specified in Section 13335, used to power control panel components. The UPS shall be tied into the Ethernet switch for monitoring by the SCADA system.
29. The PCSS shall perform the following in the Sewer Maintenance Building (Building K) as specified and as indicated on Drawing I-3:
 - a. Furnish, install, and configure the following new equipment as indicated on the SCADA System Architecture drawing and as specified.
 - 1) One (1) Fiber Optic Communication Enclosure (FOCE-DEW) as specified in Section 13320, which shall house the following equipment:
 - a) One (1) CAT6 patch panel (CPP-DEW), as specified in Section 13320.
 - b) One (1) Fiber Optic patch panel (FOPP-DEW), as specified in Section 13320.
 - 2) RIO-HVAC-K and associated enclosure. Refer to Section 13311 for PLC requirements and Section 13330 for panel requirements. RIO-HVAC-K shall be furnished with a panel-mounted fiber optic Ethernet switch, which shall be tied into the FOES-DEW with a fiber optic patch cable.
30. The PCSS shall perform the following in the Sludge Thickening Building (Building H) DAF Control Room as specified and as indicated on Drawing I-3:
 - a. Furnish, install, and configure the following new equipment as indicated on the SCADA System Architecture drawing and as specified.
 - 1) One (1) Fiber Optic Communication Enclosure (FOCE-THK) as specified in Section 13320, which shall house the following equipment:
 - a) One (1) Fiber Optic Ethernet Switch (FOES-THK) as specified in Section 13320, for use as part of the fault tolerant fiber optic backbone.
 - b) One (1) CAT6 patch panel (CPP-THK), as specified in Section 13320.
 - c) One (1) Fiber Optic patch panel (FOPP-THK), as specified in Section 13320.

- d) One uninterruptible power supply (UPS-THK) as specified in Section 13335, used to power devices mounted in the FOCE-THK. The UPS shall be tied into the Ethernet switch for monitoring by the SCADA system.
 - 2) RIO-DIG-1 and associated enclosure. Refer to Section 13311 for RIO requirements and Section 13330 for panel requirements. RIO-DIG-3 shall be tied into the FOES-THK with a CAT6 cable. RIO-DIG-1 shall have hand switches and indicating lights to monitor and control the equipment associated with DAF Tank #7.
 - b. Configuration of the following existing equipment as indicated on the SCADA System Architecture drawing and as specified.
 - 1) The existing GBT area Cimplicity server shown on the system architecture shall be reconfigured as client workstations. The existing server functionality shall be merged with the new VM-1 and VM-2 SCADA servers indicated on drawing I-2.
31. The PCSS shall perform the following in the East Aeration Gallery as specified and as indicated on Drawing I-3:
- a. Furnish, install, and configure the following new equipment as indicated on the SCADA System Architecture drawing and as specified.
 - 1) PLC-ATCC-2 and associated enclosure. Refer to Section 13311 for PLC requirements and Section 13330 for panel requirements.
 - 2) One (1) Fiber Optic patch panel (FOPP-ATCC-2), as specified in Section 13320.
 - 3) Operator interface terminal (OIT-ATCC-2) on the door of the new PLC-ATCC-2 enclosure, as specified in Section 13311.
 - 4) Managed Ethernet switch (MES-ATCC-2), as specified in Section 13320. This switch shall include fiber optic ports as specified for communication with FOES-PST.
 - 5) One uninterruptible power supply (UPS-ATCC-2) as specified in Section 13335, used to power control panel components. The UPS shall be tied into the Ethernet switch for monitoring by the SCADA system.
 - 6) PLC-ATCC-4, which shall be mounted in the existing ATCC-4 enclosure. The existing panel-mounted controllers and interior components shall be removed and disposed of. A stainless-steel plate shall be installed on the face of the enclosure to cover the remaining holes. A new subpanel shall be furnished and installed within the enclosure for mounting of the new SCADA equipment as well as new wire troughs, terminal blocks, breakers, etc. Refer to Section 13311 for PLC requirements and Section 13330 for panel requirements.
 - 7) One (1) Fiber Optic patch panel (FOPP-ATCC-4), as specified in Section 13320.
 - 8) Operator interface terminal (OIT-ATCC-4) on the door of the new PLC-ATCC-4 enclosure, as specified in Section 13311.
 - 9) Managed Ethernet switch (MES-ATCC-4), as specified in Section 13320. This switch shall include fiber optic ports as specified for communication with FOES-PST.
 - 10) One uninterruptible power supply (UPS-ATCC-4) as specified in Section 13335, used to power control panel components. The UPS shall be tied into the Ethernet switch for monitoring by the SCADA system.

32. The PCSS shall perform the following in the Tertiary Treatment Building (Building R) First Floor Electrical Room as specified and as indicated on Drawing I-4:
- a. Furnish, install, and configure the following new equipment as indicated on the SCADA System Architecture drawing and as specified.
 - 1) One (1) Fiber Optic Communication Enclosure (FOCE-TERT) as specified in Section 13320, which shall house the following equipment:
 - a) One (1) Fiber Optic Ethernet Switch (FOES-TERT) as specified in Section 13320, for use as part of the fault tolerant fiber optic backbone.
 - b) One (1) CAT6 patch panel (CPP-TERT), as specified in Section 13320.
 - c) One (1) Fiber Optic patch panel (FOPP-TERT), as specified in Section 13320.
 - d) One uninterruptible power supply (UPS-TERT) as specified in Section 13335, used to power devices mounted in the FOCE-TERT. The UPS shall be tied into the Ethernet switch for monitoring by the SCADA system.
 - 2) RIO-HVAC-R and associated enclosure. Refer to Section 13311 for PLC requirements and Section 13330 for panel requirements. RIO-HVAC-R shall be tied into the FOCE-TERT with a CAT6 cable.
33. The PCSS shall perform the following in the Aeration Odor Control Building (Building T) Electrical Room as specified and as indicated on Drawing I-4:
- a. Furnish, install, and configure the following new equipment as indicated on the SCADA System Architecture drawing and as specified.
 - 1) One (1) Fiber Optic Communication Enclosure (FOCE-AOC) as specified in Section 13320, which shall house the following equipment:
 - a) One (1) CAT6 patch panel (CPP-AOC), as specified in Section 13320.
 - b) One (1) Fiber Optic patch panel (FOPP-AOC), as specified in Section 13320.
34. The PCSS shall perform the following in the Odor Control Building (Building U) as specified and as indicated on Drawing I-4:
- a. Furnish, install, and configure the following new equipment as indicated on the SCADA System Architecture drawing and as specified.
 - 1) One (1) Fiber Optic Communication Enclosure (FOCE-OC) as specified in Section 13320, which shall house the following equipment:
 - a) One (1) Fiber Optic Ethernet Switch (FOES-OC) as specified in Section 13320, for use as part of the fault tolerant fiber optic backbone.
 - b) One (1) CAT6 patch panel (CPP-OC), as specified in Section 13320.
 - c) One (1) Fiber Optic patch panel (FOPP-OC), as specified in Section 13320.
 - d) One uninterruptible power supply (UPS-OC) as specified in Section 13335, used to power devices mounted in the FOCE-OC. The UPS shall be tied into the Ethernet switch for monitoring by the SCADA system.
 - 2) The existing Biofilter Control Panel shall be tied into the new Fiber Optic Communication Enclosure via CAT6.
35. The PCSS shall perform the following in the RAS Pump Station North (Building V) as specified and as indicated on Drawing I-4:
- a. Furnish, install, and configure the following new equipment as indicated on the SCADA System Architecture drawing and as specified.
 - 1) One (1) Fiber Optic Communication Enclosure (FOCE-RASN) as specified in Section 13320, which shall be installed within the ATCC-3 enclosure and shall house the following equipment:

- a) One (1) Fiber Optic Ethernet Switch (FOES-RASN) as specified in Section 13320, for use as part of the fault tolerant fiber optic backbone.
 - b) One (1) CAT6 patch panel (CPP-RASN), as specified in Section 13320.
 - c) One (1) Fiber Optic patch panel (FOPP-RASN), as specified in Section 13320.
 - d) One uninterruptible power supply (UPS-RASN) as specified in Section 13335, used to power devices mounted in the FOCE-RASN. The UPS shall be tied into the Ethernet switch for monitoring by the SCADA system.
 - 2) PLC-ATCC-3 and associated enclosure. Refer to Section 13311 for PLC requirements and Section 13330 for panel requirements.
 - 3) Operator interface terminal (OIT-ATCC-3) on the door of the new PLC-ATCC-3 enclosure, as specified in Section 13311.
 - 4) Managed Ethernet switch (MES-ATCC-3), as specified in Section 13320.
36. The PCSS shall perform the following in the Effluent Pumping and Chlorination Building (Building L) as specified and as indicated on Drawing I-4:
- a. Furnish, install, and configure the following new equipment as indicated on the SCADA System Architecture drawing and as specified.
 - 1) One (1) Fiber Optic Communication Enclosure (FOCE-EFF) as specified in Section 13320, which shall house the following equipment:
 - a) One (1) Fiber Optic Ethernet Switch (FOES-EFF) as specified in Section 13320, for use as part of the fault tolerant fiber optic backbone.
 - b) One (1) CAT6 patch panel (CPP-EFF), as specified in Section 13320.
 - c) One (1) Fiber Optic patch panel (FOPP-EFF), as specified in Section 13320.
 - d) One uninterruptible power supply (UPS-EFF) as specified in Section 13335, used to power devices mounted in the FOCE-EFF. The UPS shall be tied into the Ethernet switch for monitoring by the SCADA system.
 - 2) The existing Ethernet switch in the network panel in the Electrical Control Room shall be tied into the new Fiber Optic Communication Enclosure via CAT6. The existing graphic displays programmed for the effluent chlorination and pumping building shall be merged with the new VM-1 and VM-2 SCADA servers indicated on drawing I-2 and the graphic displays shall be copied to all client nodes.
37. The PCSS shall perform the following in the West Aeration Gallery as specified and as indicated on Drawing I-4:
- a. Furnish, install, and configure the following new equipment as indicated on the SCADA System Architecture drawing and as specified.
 - 1) PLC-ATCC-1 and associated enclosure. Refer to Section 13311 for PLC requirements and Section 13330 for panel requirements.
 - 2) One (1) Fiber Optic patch panel (FOPP-ATCC-1), as specified in Section 13320.
 - 3) Operator interface terminal (OIT-ATCC-1) on the door of the new PLC-ATCC-1 enclosure, as specified in Section 13311.
 - 4) Managed Ethernet switch (FOES-ATCC-1), as specified in Section 13320. This switch shall include fiber optic ports as specified for communication with FOES-EFF.
 - 5) One uninterruptible power supply (UPS-ATCC-1) as specified in Section 13335, used to power control panel components. The UPS shall be tied into the Ethernet switch for monitoring by the SCADA system.

38. The PCSS shall perform the following in the RAS Pump Station South as specified and as indicated on Drawing I-4:
 - a. Furnish, install, and configure the following new equipment as indicated on the SCADA System Architecture drawing and as specified.
 - 1) One (1) Fiber Optic Communication Enclosure (FOCE-RASS) as specified in Section 13320, which shall house the following equipment:
 - a) One (1) CAT6 patch panel (CPP-RASS), as specified in Section 13320.
 - b) One (1) Fiber Optic patch panel (FOPP-RASS), as specified in Section 13320.
39. The PCSS shall perform the following in the Secondary Gas Compressor Building (Building W) as specified and as indicated on Drawing I-5:
 - a. Furnish, install, and configure the following new equipment as indicated on the SCADA System Architecture drawing and as specified.
 - 1) One (1) Fiber Optic Communication Enclosure (FOCE-CMPR) as specified in Section 13320, which shall house the following equipment:
 - a) One (1) CAT6 patch panel (CPP-CMPR), as specified in Section 13320.
 - b) One (1) Fiber Optic patch panel (FOPP-CMPR), as specified in Section 13320.
40. The PCSS shall perform the following in the Main Equipment Building (Building B) as specified and as indicated on Drawing I-5:
 - a. Furnish, install, and configure the following new equipment as indicated on the SCADA System Architecture drawing and as specified.
 - 1) One (1) Fiber Optic Communication Enclosure (FOCE-EQUP) as specified in Section 13320, which shall house the following equipment:
 - a) One (1) Fiber Optic Ethernet Switch (FOES-EQUP) as specified in Section 13320, for use as part of the fault tolerant fiber optic backbone.
 - b) One (1) CAT6 patch panel (CPP-EQUP), as specified in Section 13320.
 - c) One (1) Fiber Optic patch panel (FOPP-EQUP), as specified in Section 13320.
 - d) One uninterruptible power supply (UPS-EQUP) as specified in Section 13335, used to power devices mounted in the FOCE-EQUP. The UPS shall be tied into the Ethernet switch for monitoring by the SCADA system.
 - 2) PLC-HVAC-B and associated enclosure. Refer to Section 13311 for PLC requirements and Section 13330 for panel requirements.
 - 3) Managed Ethernet switch (MES-HVAC-B), as specified in Section 13320.
 - 4) One uninterruptible power supply (UPS-HVAC-B) as specified in Section 13335, used to power control panel components. The UPS shall be tied into the Ethernet switch for monitoring by the SCADA system.
 - 5) The existing Wonderware operator workstation shall be removed from service. Consult with the Owner as to whether the equipment should be turned over to the Owner or if it should be disposed of.
 - 6) One (1) new HMI client operator workstation as specified in 13310. Refer to Section 13315 for HMI software requirements. Re-create the graphic displays from the existing Wonderware workstation into the Cimplicity system.
 - 7) One uninterruptible power supply (UPS-BCR) as specified in Section 13335, used to power the operator workstation. The UPS shall be tied into the Ethernet switch in FOCE-EQUP for monitoring by the SCADA system.
 - 8) Field instrument wiring which is landed in the existing RTU-B to be demolished shall be rerouted the new PLC-HVAC-B Enclosure as shown on

- the System Architecture. The existing terminal blocks and wiring between the terminal blocks and RTU-B shall be removed from the enclosure.
- b. The existing Honeywell controller in the Absorption Chiller Management Panel shall be tied into the plant SCADA system via the Ethernet switch in FOCE-EQUIP.
41. The PCSS shall perform the following in the Warehouse Maintenance Building Electrical Shop (Building D) as specified and as indicated on Drawing I-5:
- a. Furnish, install, and configure the following new equipment as indicated on the SCADA System Architecture drawing and as specified.
- 1) One (1) Fiber Optic Communication Enclosure (FOCE-MANT) as specified in Section 13320, which shall house the following equipment:
- a) One (1) Fiber Optic Ethernet Switch (FOES-MANT) as specified in Section 13320, for use as part of the fault tolerant fiber optic backbone.
- b) One (1) CAT6 patch panel (CPP-MANT), as specified in Section 13320.
- c) One (1) Fiber Optic patch panel (FOPP-MANT), as specified in Section 13320.
- d) One uninterruptible power supply (UPS-MANT) as specified in Section 13335, used to power devices mounted in the FOCE-MANT. The UPS shall be tied into the Ethernet switch for monitoring by the SCADA system.
42. The PCSS shall perform the following in the Employee Building (Building C) as specified and as indicated on Drawing I-5:
- a. Furnish, install, and configure the following new equipment as indicated on the SCADA System Architecture drawing and as specified.
- 1) RIO-HVAC-C and associated enclosure. Refer to Section 13311 for PLC requirements and Section 13330 for panel requirements. The RIO shall be tied into the existing Ethernet switch in FOCE-EQUIP via CAT6.
- 2) The existing absorber control panel shall be tied into the new Fiber Optic Communication Enclosure in the Warehouse Maintenance Building (Building D) via CAT6. The existing absorber workstation in the boiler control room shall be r
43. The PCSS shall perform the following in the Fire Pump Building (Building FP) as specified and as indicated on Drawing I-5:
- a. Furnish, install, and configure the following new equipment as indicated on the SCADA System Architecture drawing and as specified.
- 1) PLC-FPB and associated enclosure. Refer to Section 13311 for PLC requirements and Section 13330 for panel requirements.
- 2) One (1) Fiber Optic Communication Enclosure (FOCE-FPB) as specified in Section 13320, which shall be mounted within the PLC-FPB enclosure and shall house the following equipment:
- a) One (1) Fiber Optic Ethernet Switch (FOES-FPB) as specified in Section 13320, for use as part of the fault tolerant fiber optic backbone.
- b) One (1) CAT6 patch panel (CPP-FPB), as specified in Section 13320.
- c) One (1) Fiber Optic patch panel (FOPP-FPB), as specified in Section 13320.
- d) One uninterruptible power supply (UPS-FPB) as specified in Section 13335, used to power PLC-FPB and all devices mounted in the FOCE-FPB. The UPS shall be tied into the Ethernet switch for monitoring by the SCADA system.

44. The PCSS shall perform the following in the Cold Storage Building (Building CS) as specified and as indicated on Drawing I-5:
 - a. Furnish, install, and configure the following new equipment as indicated on the SCADA System Architecture drawing and as specified.
 - 1) One (1) Fiber Optic Communication Enclosure (FOCE-CSB) as specified in Section 13320, which shall house the following equipment:
 - a) One (1) CAT6 patch panel (CPP-CSB), as specified in Section 13320.
 - b) One (1) Fiber Optic patch panel (FOPP-CSB), as specified in Section 13320.
 - c) One uninterruptible power supply (UPS-CSB) as specified in Section 13335, used to power devices mounted in the FOCE-CSB.
 45. The PCSS shall perform the following in the Generator Building (Building BB) Engine Control Room as specified and as indicated on Drawing I-6:
 - a. Furnish, install, and configure the following new equipment as indicated on the SCADA System Architecture drawing and as specified.
 - 1) PLC-ECR and associated enclosure. Refer to Section 13311 for PLC requirements and Section 13330 for panel requirements.
 - 2) Operator interface terminal (OIT-ECR) on the door of the new PLC-BLR enclosure, as specified in Section 13311.
 - 3) Managed Ethernet switch (MES-ECR), as specified in Section 13320. This Ethernet switch shall connect to the plant network via the existing Ethernet switch at the control desk in the Engine Control Room.
 - 4) One uninterruptible power supply (UPS-ECR) as specified in Section 13335, used to power control panel components. The UPS shall be tied into the Ethernet switch for monitoring by the SCADA system.
 - b. Configuration of the following existing equipment as indicated on the SCADA System Architecture drawing and as specified.
 - 1) The existing diesel engine Cimplicity servers shown on the system architecture shall remain as servers and continue to function as they currently function. The database points existing in these servers shall be duplicated in the new VM-1 and VM-2 SCADA servers indicated on drawing I-2 such that all Engine information is available in the new SCADA servers. The engine data shall continue to be historically collected to its current location, and it shall also be historically collected on the existing VM-6 Historian Server (see drawing I-2).
 - 2) The existing Ethernet switch located within the existing influent screen network enclosure (MES-ISCN Enclosure) shall be tied into the new MES-ECR in the PLC-ECR control panel. The PCSS shall establish communication with the existing Influent Screens PLC via FOES-ISCN. New Cimplicity HMI graphic displays and database points shall be added for monitoring of the influent screen system and adjusting operator setpoints. Refer to Section 13306.
- E. Equipment and services the PCSS shall be responsible for at the Glen Cover WWTP shall include, but not be limited to the following:
1. Furnish and configure a fault-tolerant plant fiber optic network as required by Sections 13320 and 13321.
 2. Furnish GE Cimplicity HMI SCADA and GE Historian software licenses for use on the SCADA servers and workstations as specified herein.

3. Furnish, install, and configure gas detection equipment in the Headworks Building Influent Pump Drywell and Screening Room first floor and basement as indicated on the Drawings and per the instrument list included at the end of this Section and as required by Section 13345.
4. Furnish, install, and configure a gas detection control panel in the Headworks Building Electrical room as indicated on the Drawings and as specified in Section 13345.
5. Furnish, install, and configure instrumentation related to the Aeration Tanks, as shown on the Drawings and per the instrument list included at the end of this Section and as required by Section 13345.
6. Provide overall installation and configuration of instrumentation, programmable logic controllers (PLCs), PLC enclosures, SCADA computer equipment, networking equipment, and other control system equipment as specified herein.
7. Provide all PLC programming, including development of control programs, runtime and flow totalization calculations, peer-to-peer communication, alarming, and other functions as specified herein and as required by Section 13306 and the Control Descriptions in Section 13305.
8. Provide all Human Machine Interface (HMI) configuration for the Cimplicity HMI software and for the operator interface terminals, including database configuration, graphic screens, alarming, security, and historical archiving, and other functions as specified herein and as required by Section 13306 and the Control Descriptions in Section 13305.
9. Provide CAT6 and fiber optic patch cables to connect networked devices as indicated on the Drawings. Cabling shall be routed through patch panels, where provided.
10. The PCSS shall perform the following in the Glen Cove Control Building, Office #2:
 - a. Furnish, install, and configure the following new equipment as indicated on the SCADA System Architecture and as specified.
 - 1) One (1) workstation computer (UWLISCADAGCWS01) with associated monitors and cabling as indicated on the SCADA System Architecture.
 - 2) Furnish and install uninterruptible power supply (UPS-WS-GC), as specified in Section 13335. This UPS shall power the SCADA workstations located in Office #2.
 - 3) Provide a control console and desk chair as required by Section 13310, to accommodate the workstation and UPS.
11. The PCSS shall perform the following in the Glen Cove Control Building, Office #2 IT Closet:
 - a. The existing wood framed room divider and door shall be relocated to make additional room for the new server rack. The existing room divider is not a structural component of the building. After the divider is relocated install new sheetrock and paint to match the room.
 - b. Remove the existing 19" server rack and turn over to the Operator's IT department.

- c. Furnish, install, and configure the following new equipment as indicated on the SCADA System Architecture and as specified.
- 1) 19" wide freestanding server rack as specified in Section 13320. The server rack shall reserve a minimum of 12 rack units for existing network equipment located in the Glen Cove IT Closet.
 - 2) One (1) fault tolerant server (UWLISCADAGCSV01) as specified in Section 13310. Virtual Machines shall be configured as follows:
 - a) Plant SCADA Primary HMI Server (UWLISCADAGCSV02)
 - b) Plant SCADA Secondary HMI Server (UWLISCADAGCSV03)
 - c) SCADA Historian (UWLISCADAGCSV04)
 - d) Domain Controller (UWLISCADAGCSV05)
 - e) Time Server (UWLISCADAGCSV06)
 - 3) HMI and Historian software shall be provided for use on virtual machines indicated above. See Section 13315 for software requirements.
 - 4) Keyboard/Video/Mouse (KVM) switch and associated wires to connect to servers located in the server rack.
 - 5) Layer 3 Ethernet switch (UWLISCADAGCES01) as specified in Section 13320.
 - 6) Network attached storage device (UWLISCADAGCNS01) shall be provided as specified in Section 13310. Device shall be used for storing all historical data and computer system backups.
 - 7) Furnish and install a 19" rack mountable uninterruptible power supply (UPS-SV-GC), as specified in Section 13335. The UPS shall power all devices located in the server rack.
 - 8) Furnish and install a CAT6 patch panel as required by Section 13310. The patch panel shall terminate all copper connection originating from outside of the server rack. CAT6 patch cables shall be used to connect the CAT6 patch panel to the Ethernet switch (UWLISCADAGCES01) as shown on the Drawings.
 - 9) Fiber Optic patch panel (FOPP-CTRL) as specified in Section 13320, installed in the existing server rack.
 - 10) VPN Firewall as specified in Section 13320, shall be installed in the server rack and configured with new VPN connections to the Cedar Creek and Bay Park plants as indicated on the drawings.
 - a) Using the Glen Cove VPN/Firewall (UWLISCADAGCFW01), establish a secure VPN tunnel between the Cedar Creek (UWLISCADACCFW01) and Bay Park (UWLISCADABPFW01) plants over the public Internet.
 - b) Seventeen (17) Glen Cove pump stations shall be monitored via the VPN connection to Cedar Creek, which is currently configured to poll data from the Glen Cove pump station PLCs. The existing Cimplicity application developed at the Cedar Creek WPCP shall be copied to the Glen Cove HMI workstations for monitoring. The Cedar Creek WPCP shall continue to poll the Glen Cove pump station PLCs.
 - c) The Cimplicity applications shall be copied to the Glen cove workstations for both the Cedar Creek and Bay Park plant and pump station monitoring. This shall allow for staff at the Glen Cove to monitor systems from the other plants, if authorized. Security shall be configured and follow the existing standards at the Cedar Creek and Bay Park sites.

12. The PCSS shall perform the following in the Glen Cove Control Building, Operations Manager's Office:
 - a. Furnish, install, and configure the following new equipment as indicated on the SCADA System Architecture and as specified.
 - 1) One (1) workstation computer (UWLISCADAGCWS02) with associated monitor and cabling as indicated on the SCADA System Architecture to be installed on the existing desk.
13. The PCSS shall perform the following in the Glen Cove Control Building, Maintenance Manager's Office:
 - a. Furnish, install, and configure the following new equipment as indicated on the SCADA System Architecture and as specified.
 - 1) One (1) workstation computer (UWLISCADAGCWS03) with associated monitor and cabling as indicated on the SCADA System Architecture to be installed on the existing desk.
14. The PCSS shall perform the following in the Glen Cove Control Building, Laboratory:
 - a. Furnish, install, and configure the following new equipment as indicated on the SCADA System Architecture and as specified.
 - 1) One (1) workstation computer (UWLISCADAGCWS04) with associated monitor and cabling as indicated on the SCADA System Architecture to be installed on the existing desk.
15. The PCSS shall perform the following in the Cedar Creek Water Pollution Control Plant:
 - a. Configuration of the existing VPN/Firewall (UWLISCADACCFW01) to establish a secure VPN tunnel to the Glen Cove VPN/Firewall (UWLISCADAGCFW01).
 - b. Any configuration necessary such that the Glen Cove WWTP can access the Glen Cove pump stations currently being monitored and controlled by the Cedar Creek Pump Station HMI servers.
16. The PCSS shall perform the following in the Bay Park Sewage Treatment Plant:
 - a. Configuration to the existing VPN/Firewall (UWLISCADABPFW01) to establish a secure VPN tunnel to the Glen Cove VPN/Firewall (UWLISCADAGCFW01).
17. The PCSS shall perform the following in the Glen Cove Control Building Blower Room:
 - a. Furnish, install, and configure the following new equipment as indicated on the SCADA System Architecture and as specified.
 - 1) PLC-MACP and associated enclosure. Refer to Section 13311 for PLC requirements and Section 13330 for enclosure requirements.
 - 2) Ethernet switch, as required by Section 13320.
 - 3) Panel mounted OIT, as required by Section 13311.
 - 4) UPS-MACP, as required by Section 13335. The UPS shall be capable of powering all panel equipment.
 - b. The existing APG Neuros Blower PLC shall be connected to the new plant Ethernet network via CAT6 between the existing Neuros Ethernet switch and the switch in the Master Aeration Control Panel. Any configuration to transmit data necessary for control (starting/stopping, remote control indication, flow or speed control, alarms, etc.) to the MACP shall be performed, if necessary. Refer to Appendix B of this Section for a full list of register addresses. Statuses not required for control by the MACP, but monitored by the APG Neuros blower OIT shall be replicated on the HMI system.

- c. The Turblex Blower PLC shall be furnished with a new CPU, capable of Ethernet communication with the new Master Aeration Control Panel via CAT6. Refer to Section 13311 for CPU requirements. The Turblex PLC program shall be configured as necessary to send signals required for blower control (starting/stopping, remote control indication, flow or speed control, alarms, etc.) to the MACP. All signals monitored on the existing Turblex Local Blower Panel OIT shall be replicated on the HMI system.
- 18. The PCSS shall perform the following in the Control Building Admin area:
 - a. Furnish, install, and configure the following new equipment as indicated on the SCADA System Architecture and as specified.
 - 1) RIO-ADMIN for installation into the existing graphic display panel located in the admin area near the front entrance of the control building. Refer to Section 13311 for RIO requirements.
 - 2) UPS-ADMIN, as required by Section 13335. The UPS shall be capable of powering the RIO-ADMIN.
 - b. Furnish, install, and configure one (1) analog 4-channel output module and one (1) relay 4-channel output module for use in the existing Omntec Monitoring Panel (model OEL8000IIP) to allow for monitoring of the fuel system from the Cimplicity HMI. Refer to process and instrumentation diagram (P&ID) and Section 13305 for signals required for monitoring by the SCADA System.
- 19. The PCSS shall perform the following in the Glen Cove Control Building Electrical Room hallway:
 - a. Furnish, install, and configure the following new equipment as indicated on the SCADA System Architecture and as specified.
 - 1) PLC-ELEC and associated enclosure. Refer to Section 13311 for PLC requirements and Section 13330 for enclosure requirements.
 - 2) Ethernet switch, as required by Section 13320.
 - 3) Panel mounted OIT, as required by Section 13311.
 - 4) UPS-ELEC, as required by Section 13335. The UPS shall be capable of powering all panel equipment.
- 20. The PCSS shall perform the following in the Glen Cove Control Building Electrical Room:
 - 1) One (1) Fiber Optic Communication Enclosure (FOCE-ELEC) as specified in Section 13320, which shall house the following equipment:
 - a) One (1) Fiber Optic Ethernet Switch (FOES-ELEC) as specified in Section 13320, for use as part of the fault tolerant fiber optic backbone.
 - b) One (1) Fiber Optic patch panel (FOPP-ELEC), as specified in Section 13320.
- 21. The PCSS shall perform the following in the Glen Cove Sodium Hypochlorite Building:
 - a. Furnish, install, and configure the following new equipment as indicated on the SCADA System Architecture and as specified.
 - 1) RIO-FINAL and associated enclosure. Refer to Section 13311 for RIO requirements and Section 13330 for enclosure requirements.
 - 2) Ethernet switch, as required by Section 13320.
 - 3) Panel mounted OIT, as required by Section 13311.
 - 4) UPS-FINAL, as required by Section 13335. The UPS shall be capable of powering all panel equipment.

- 5) One (1) Fiber Optic Communication Enclosure (FOCE-FINAL), as specified in Section 13320. It shall be mounted within the RIO-FINAL enclosure and shall contain the following equipment:
 - a) One (1) Fiber Optic Ethernet Switch (FOES-FINAL) as specified in Section 13320, for use as part of the fault tolerant fiber optic backbone.
 - b) One (1) Fiber Optic patch panel (FOPP-FINAL), as specified in Section 13320.
- 22. The PCSS shall perform the following in the Glen Cove Headworks building:
 - a. Furnish, install, and configure the following new equipment as indicated on the SCADA System Architecture and as specified.
 - 1) RIO-IPS and associated enclosure. Refer to Section 13311 for PLC requirements and Section 13330 for enclosure requirements.
 - 2) Ethernet switch, as required by Section 13320.
 - 3) Panel mounted OIT, as required by Section 13311.
 - 4) UPS-IPS, as required by Section 13335. The UPS shall be capable of powering all panel equipment.
 - 5) RS485 Modbus RTU to Modbus/TCP gateway required to establish communications with the existing outdoor switchgear equipment, as required by Section 13320.
 - 6) One (1) Fiber Optic Communication Enclosure (FOCE-HW) as specified in Section 13320. It shall be mounted within the RIO-FINAL enclosure and shall contain the following equipment:
 - a) One (1) Fiber Optic Ethernet Switch (FOES-HW) as specified in Section 13320, for use as part of the fault tolerant fiber optic backbone.
 - b) One (1) Fiber Optic patch panel (FOPP-HW), as specified in Section 13320.
- 23. The PCSS shall perform the following in the Glen Cove Sludge Thickening building:
 - a. Furnish, install, and configure the following new equipment as indicated on the SCADA System Architecture and as specified.
 - 1) One (1) Fiber Optic Communication Enclosure (FOCE-THK) as specified in Section 13320, which shall house the following equipment:
 - a) One (1) Fiber Optic Ethernet Switch (FOES-THK) as specified in Section 13320, for use as part of the fault tolerant fiber optic backbone.
 - b) One (1) Fiber Optic patch panel (FOPP-THK), as specified in Section 13320.
 - b. The existing Belt Filter Press PLC's shall be connected to the new plant Ethernet network via CAT6 between the existing CP-01 Control Panel Ethernet switch and the switch in the FOCE-THK. The HMI system shall be updated to include control and monitoring indicated on the BFP OITs.

1.02 RELATED WORK

- A. Instrumentation and Controls conduit systems are specified in Section 16131.
- B. Instrumentation signal cable, alarm and status wiring, and fiber optic cabling are specified in Section 16121.
- C. Relevant equipment Sections in Divisions 16.

1.03 SUBMITTALS

A. General Requirements:

1. Refer to Section 01300 for general submittal requirements.
2. Shop drawings shall demonstrate that the equipment and services to be furnished comply with the provisions of these specifications and shall provide a complete record of the equipment as manufactured and delivered.
3. Submittals shall be complete; giving equipment specifications, details of connections, wiring, ranges, installation requirements, and specific dimensions. Submittals consisting of only general sales literature shall not be acceptable.
4. Substitutions on functions or type of equipment specified shall not be acceptable unless specifically noted.
5. Separate submittals shall be made for each submittal listed below.

B. Qualifications submittal as required in the Quality Assurance section below.

C. Project Plan, Deviation List, and Schedule Submittal:

1. Submit, within 20 calendar days after Notice to Proceed, a Project plan. The Project Plan shall be submitted and approved before further submittals shall be accepted. The Project Plan shall, at a minimum, contain the following:
 - a. Overview of the proposed control system describing the understanding of the project work, a preliminary system architecture drawing, interfaces to other systems, schedule, startup, and coordination. A discussion of startup, replacement of existing equipment with new, switchover (Maintaining Plant Operations during system transition), approach to testing and training, and other tasks as required by these specifications shall be included as applicable.
 - b. Preliminary list of HMI software, PLC software, and PLC hardware, including version numbers, solely to determine compliance with the requirements of the Contract Documents prior to beginning development of system programming. Review and approval of software and hardware systems as part of this Project Plan stage shall not relieve the PCSS of meeting all the functional and performance requirements of the system as specified herein. Substitution of manufacturer or model of these systems after the submittal is approved is not allowed without Engineer approval.
 - c. Project personnel and organization including the PCSS project manager, project engineer, and lead project technicians. Include resumes of each these individuals and specify in writing their commitment to this project. These do not need to be submitted again if already submitted in the Qualification submittal.
 - d. Sample formats of the shop drawings to be submitted and in conformance with the requirements of the Specifications. At a minimum include samples of panel fabrication drawings, loop, and I/O wiring diagrams.
 - e. List of all graphics intended to be created for this project.
 - f. List of all PLC programs that will be created or modified for this project.
2. Exceptions to the Specifications or Drawings shall be clearly defined in a Deviation List. The Deviation List shall consist of a paragraph by paragraph review of the Specifications

indicating acceptance or any proposed deviations, the reason for exception, the exact nature of the exception and the proposed substitution so that an evaluation may be made by the Engineer. If no exceptions are taken to the specifications or drawings the PCSS shall make a statement as such. If there is no statement by the PCSS, then it is acknowledged that no exceptions are taken.

3. Project schedule shall be prepared in Gantt chart format clearly showing task linkages for all tasks and identifying critical path elements. PCSS schedule must be based on the General Contractor schedule and must meet all field installation, testing, and start-up milestones in that schedule. The project schedule shall illustrate I&C related major project milestones including the following:
 - a. Schedule for all subsequent project submittals. Include the time required for Contractor submittal preparation, Engineer's review time, and a minimum of two complete review cycles.
 - b. Proposed dates for all project coordination meetings.
 - c. Hardware purchasing, fabrication, and assembly (following approval of related submittals).
 - d. Software purchasing and configuration (following approval of related submittals).
 - e. Shipment of instrument and control system equipment.
 - f. Installation of instrument and control system equipment.
 - g. Testing: Schedule for all testing.
 - h. Schedule for system cutover, startup, and/or going on-line for each major system. At a minimum include the schedule for each process controller and HMI server/workstation provided under this Contract.
 - i. Schedule for all training including submittal and approval of O&M manuals, factory training, and site training.

D. Input/Output (I/O) List Submittal:

1. Submit, within 45 days after Notice to Proceed, a complete system Input/Output (I/O) address list for equipment connected to the control system under this Contract.
2. I/O list shall be based on the Drawings, the design I/O list, and requirements in the Specifications.
3. The I/O list shall be submitted in both a Microsoft Excel readable electronic file format and an 8-1/2 inch by 11-inch hard copy.
4. The I/O list shall reflect all active and spare I/O points. Add points to accommodate spare I/O as required in the specifications.
5. The I/O list shall be arranged such that each control panel has a dedicated worksheet. At a minimum, I/O worksheet shall include the following information:
 - a. TAG NUMBER(S): As indicated on the Drawings, the identifier assigned to a device that performs a function in the control system. As part of this information, the loop number of the tag shall be broken out to allow for sorting by loop.
 - b. DESCRIPTION: A description of the function of the device (text that includes signal source, control function, etc.) Include the text "Spare Points" for all I/O module points that are not connected to equipment.
 - c. PHYSICAL LOCATION: The Control Panel designation of where the I/O point is wired to.

- d. Physical POINT ADDRESS: Rack, Slot, and Point (or Channel) assignment for each I/O point.
 - e. I/O TYPE: use DO - Discrete Output, DI - Discrete Input, AO - Analog Output, AI - Analog Input, PI - Pulse Input, or PO - Pulse Output.
 - f. RANGE/STATE: The range in engineering units corresponding to an analog 4-20 mA signal, or, the state at which the value of the discrete points are "1."
 - g. ENGINEERING UNITS: The engineering units associated with the Analog I/O.
 - h. ALARM LIMITS: Include alarm limits based on the control descriptions and the Drawings.
 - i. P&ID - the P&ID or drawing where the I/O point appears on. Mark as "NA" (Not Applicable) if the I/O point is derived from a specification requirement and is not on the P&IDs.
 - j. LOGICAL POINT ADDRESS: I/O address of each point.
 6. The I/O list shall be sorted in order by:
 - a. Physical location.
 - b. I/O Type.
 - c. Loop Number.
 - d. Device Tag.
 7. Once the I/O list is approved, the PLC I/O addresses shall not be modified without approval by the Engineer.
 8. For I/O layout requirements, see the PLC Section 13311.
 9. Submit a master Networking list that lists all devices that shall be connected to the network. Include the following parameters on the network list at a minimum:
 - a. Device Description
 - b. Equipment Name ID
 - c. Device Location
 - d. IP Address
 - e. Subnet Mask
 - f. Gateway
 - g. IP Subnet (Network ID/Subnet bits)
 - h. VLAN Designation
 10. List the Networking device settings on each of the I/O lists for each control panel.
- E. Field Instruments Submittal:
1. Refer to the Instrument submittal requirements in Section 13340.
- F. Hardware and Software Packages Submittal:
1. Refer to the sections below for specific Hardware and Software Packages submittal requirements:
 - a. 13310 - Computer System Hardware.
 - b. 13311 - PLC Hardware and Software.
 - c. 13315 - HMI System Software.
 - d. 13316 - Additional SCADA System Software.
 - e. 13320 - Control and Data Network Equipment.

- f. 13330 - Control Panels and Panel Mounted Equipment.
 - g. 13335 - Uninterruptible Power Supply.
 - 2. For each hardware and software packages component specified in the sections above, submit a cover page that lists, at a minimum, date, specification number, product name, manufacturer, model number, Location(s), and power required. Preferred format for the cover page is ISA-TR20.00.01-2001 (updated in 2004-2006), general data sheet; however, other formats will be acceptable provided they contain all required information.
- G. Panel Layout Drawings and Wiring Diagrams Submittal:
- 1. Refer to the Control Panels section for submittal requirements.
- H. Testing Plan Submittals:
- 1. Refer to Section 13302 - Testing for specific testing submittal requirements.
- I. Training Plan Submittals:
- 1. Refer to Section 13303 for specific training requirements.
- J. Spares, Expendables, and Test Equipment Lists Submittal:
- 1. Submit a list of, and descriptive literature for, spares, expendables, and test equipment.
 - 2. Submit a list of, and descriptive literature for, additional spares, expendables, and test equipment recommended by the manufacturer.
 - 3. Submit unit and total costs for the additional spare items specified or recommended for each subsystem.
- K. Cutover Plan Submittal:
- 1. A minimum of two cutover plans will be required (one for Cedar Creek and one for Glen Cove).
 - 2. Prior to performing any site work, the contractor must receive approval of the cutover plan. The cutover plan shall include the following information as a minimum:
 - a. The cutover plan shall follow the requirements and restrictions set forth by Section 01310 Maintenance of Plant Operation.
 - b. Provide a sequence of construction and startup activities required for each building.
 - c. Provide a schedule for the work to be performed at each building. Include expected duration of time for each outage to occur and how the equipment will be run in manual mode if required during the switchover process.
 - d. The cutover plan will identify the steps required to keep the building operational during the switchover process if possible as well as recovery plan to bring the buildings equipment back online if equipment must be shut down.
 - e. The cutover plan shall identify any potential operational and safety issues that may be encountered and a plan for addressing these issues should they occur.
 - f. Credentials of personnel who will be performing site work.

- g. The cutover plan shall explain any assistance requested of the Owner or Operator during the cutover process.
- 3. After the cutover plan is submitted, a meeting shall be scheduled to review the submittal as explained under the Coordination Meetings section below.

L. Point to Point Interconnection Wiring Diagrams:

- 1. Provide detailed point-to-point interconnection wiring diagrams for all control panel inputs, outputs, network connections, interlocks, and power circuits, including those that utilize existing field wiring and cabling and those that use new wiring and cabling. All communication system wiring and cabling shall be included.
- 2. Submit samples of the point-to-point interconnection wiring (PTP) diagrams to the Engineer for approval at the beginning of the construction phase. The sample drawings shall indicate the drawing format, equipment and device labeling, and wire tagging methodology to be used for all diagrams. Once approved, the contractor shall proceed with developing the point-to-point interconnection diagrams.
- 3. Provide detailed PTP diagrams for all electrical and fiber optic connections, including control, signal, communication, and power connections and including those that utilize existing field wiring and cabling and those that use new wiring and cabling.
- 4. Example formats for PTP diagrams have been included in the appendices at the end of this section.
- 5. All PTP diagrams shall meet the following requirements:
 - a. PTP diagrams shall be produced in AutoCAD software, and the AutoCAD files shall be submitted to the Engineer/Owner with the final documentation.
 - b. Each point-to-point interconnection diagram shall be unique with diagram number, device numbers, equipment numbers, circuit origin, circuit destination, wire numbers, and location designations.
 - c. Locations of devices, such as, but not limited to: field, panels, auxiliary equipment, termination cabinets, local control panels, switchboard, motor control centers, automatic transfer switches and panel boards.
 - d. The diagram shall show all components of the circuit (analog, digital, and discrete), including all relays, switches, and starters which are being provided for proper operation
 - e. Include all intermediate terminations between field elements and panels (e.g. terminal junction boxes). Show locations for and interconnecting wiring between instruments, equipment, panels, terminal junction boxes, and PLCs.
 - f. At each termination point, include:
 - 1) Identifying numbers for equipment, including devices, panels, terminal boxes, junction boxes, motor control centers, switchboards and panel boards
 - 2) Circuit origin and destination.
 - 3) Wire numbers
 - 4) Terminal strip names and terminal numbers for electrical wires. If terminal numbers are not available for some existing equipment, then terminal numbers for those cases can be omitted from the drawing.
 - 5) Device names and port numbers for communication cables, such as fiber optic cable and CAT6 cable.

- g. Electrical power supply requirements designation voltage and other applicable requirements. Show all power back to termination on terminal block or panel board, including circuit breaker size, as applicable.
- h. Show all grounding points with cabinets and panels and identify the connection point of individual components.
- i. The diagrams shall be coordinated with the work to be performed under other Divisions, including Divisions 15 and 16.
- j. Paper and electronic (PDF) versions of all PTP connection diagrams shall be submitted to the owner and engineer.
- k. A consistent pattern (horizontal or vertical) shall be developed for presentation. The drawing shall be divided into section for relative location of devices.

M. Operations and Maintenance (O&M) Manuals:

- 1. Submit in accordance with Section 01730.
- 2. Furnish O&M manuals as specified herein.
- 3. The operations and maintenance manuals shall, at a minimum, contain the following information:
 - a. Table of Contents:
 - 1) A Table of Contents shall be provided for the entire manual with the specific contents of each volume clearly listed. The complete Table of Contents shall appear in each volume.
 - b. Instrument and Equipment Lists:
 - 1) The following lists shall be developed in Microsoft Excel format and provided not only as a hardcopy in O&M but also electronically on a CD/DVD.
 - 2) An instrument list for all devices supplied including tag number, description, specification section and paragraph number, manufacturer, model number, serial number, range, span, location, manufacturer phone number, local supplier name, local supplier phone number, completion year replacement cost, and any other pertinent data.
 - 3) An equipment list for all non-instrument devices supplied listing description, specification section and paragraph number, manufacturer, model number, serial number, location, manufacturer phone number, local supplier name, local supplier phone number, completion year replacement cost, and any other pertinent data.
 - c. Equipment Operations and Maintenance Information:
 - 1) ISA-TR20.00.01-2001(updated in 2004-2006) data sheets shall be provided for all field instruments. For non-field instrumentation devices, provide a cover page for each device, piece of equipment, and OEM software that lists date, specification number, product name, manufacturer, model number, Location(s), and power required. Preferred format for the cover page is ISA-TR20.00.01-2001(updated in 2004-2006), general data sheet; however, other formats will be acceptable provided they contain all required information.
 - 2) Vendor O&M documentation for each device, piece of equipment, or OEM software shall be either new documentation written specifically for this project, or modified standard vendor documentation. All standard vendor documentation furnished shall have all portions that apply clearly indicated with arrows or circles. All portions that do not apply shall be neatly lined out or

- crossed out. Groups of pages that do not apply at all to the specific model supplied shall be removed.
- 3) Provide the record documentation of the system audit as specified in Section 13302 - Testing.
 - 4) Include the calibration forms developed as specified in Section 13302 - Testing.
- d. As-Built Drawings:
- 1) Complete as-built drawings, including all drawings and diagrams specified in this section under the "Submittals" section. These drawings shall include all termination points on all equipment the system is connected to, including terminal points of equipment not supplied by the PCSS.
 - 2) As built documentation shall include information from submittals, as described in this Specification, updated to reflect the as-built system. Errors in or modifications to the system resulting from the Factory and/or Functional Acceptance Tests shall be incorporated in this documentation.
- e. Original Licensed Software:
- 1) Submit original software diskettes or CD-ROMs of all software provided under this Contract. Submit original paper based and electronic documentation for all software provided. Submit license agreement information including serial numbers, license agreements, User Registration Numbers and related information. All software provided under this Contract shall be licensed to the Owner at the time of purchase. Provide media in software sleeves within O&M manual.
- f. Electronic O&M Information:
- 1) In addition to the hard copy of O&M data, provide an electronic version of all equipment manuals and data sheets, along with any software back-up of configuration files, on CDROM or DVD. Electronic documents shall be supplied in Adobe Acrobat format.
 - 2) Provide electronic files for all custom-developed manuals including training manuals. Text shall be supplied in both Microsoft Office format and Adobe Acrobat format.
 - 3) Provide electronic files for all drawings produced. Drawings shall be in AutoCAD ".dwg" format and in Adobe Acrobat format. Drawings shall be provided using the AutoCAD eTransmit feature to bind external references, pen/line styles, fonts, and the drawing file into individual zip files.
 - 4) Each computer system hardware device shall be backed up onto CDROM or DVD after Substantial Completion and shall be turned over to the Owner.
 - 5) If specified in the training section, provide digital copies of all training videos. Videos shall be in a format that is readable by standard DVD players and by standard PC DVD drives. Format shall be a minimum of 800 by 600 pixels and shall include sound.
4. The cover and edge of each volume shall contain the information as specified in Section 01730.

1.04 COORDINATION MEETINGS

- A. Schedule the mandatory coordination meetings as described herein. The meetings shall be held at the Owner's designated location and shall include attendance by the Owner, the Engineer, the Contractor, and the PCSS's Project Engineer. Other Division 13 specifications may require additional meetings. Prepare and distribute an agenda for this meeting a minimum of one week

before the scheduled meeting date. Meeting shall be scheduled a minimum of one week before the requested meeting date.

1. A project kickoff coordination meeting shall be held within two weeks after submitting the Project Plan. The purpose of the meeting shall be to discuss the PCSS's Project Plan, to summarize the PCSS's understanding of the project; discuss any proposed substitutions or alternatives; schedule testing and delivery deadline dates; provide a forum to coordinate hardware and software related issues; and request any additional information required from the Owner. The meeting will last up to one business day.
2. A submittal review coordination meeting shall be held after the field instruments, Hardware and Software Packages Submittal, and Panel Layout Drawings and Wiring Diagrams Submittal have been reviewed by the Engineer and returned to the PCSS. The purpose of this meeting shall be to review comments made on the submittal packages; to refine scheduled deadline dates; and to coordinate equipment installation activities. The meeting will last up to one business day.
3. A meeting to review each cutover plan shall be held after the associated cutover plan is submitted. The meeting will last up to one business day.
4. Additional meetings specified in Section 13306.
5. Regular on-site meetings when the PCSS staff is at the plant.

1.05 REFERENCE STANDARDS

- A. Publications are referred to in the text by basic designation only. Where a date is given for reference standards, that edition shall be used. Where no date is given for reference standards, the latest edition in effect at the time of bid opening shall apply.
- B. International Society of Automation (ISA):
 1. ISA S5.2, Binary Logic Diagrams for Process Operations.
 2. ISA S5.3, Graphic Symbols for Distributed Control/Shared Display Instrumentation Logic and Computer Systems.
 3. ISA S5.4, Instrument Loop Diagrams.
 4. ISA S20, Specification Forms for Process Measurement and Control Instruments, Primary Elements and Control Valves.
 5. ISA RP60.3, Human Engineering for Control Centers.
 6. ISA RP60.6, Nameplates, Labels, and Tags for Control Centers.
 7. ISA-99, Industrial Automation and Control Systems Security.
- C. National Electrical Manufacturers Association (NEMA).

D. National Fire Protection Agency (NFPA):

1. NFPA 70, National Electrical Code (NEC).
2. NFPA 79, Industrial Control Equipment.

E. Underwriters Laboratories, Inc. (UL):

1. UL 508 - Industrial Control Equipment - for custom fabricated equipment.
2. A nationally recognized testing laboratory, as approved by the Authority having jurisdiction, may substitute for UL listing on commercial off the shelf products.

1.06 QUALITY ASSURANCE

A. The Process Control System Supplier (PCSS) shall be a "systems integrator" regularly engaged in the design and the installation of instrumentation systems and their associated subsystems as they are applied to the municipal water and wastewater industry. For the purposes of this Specification Section, a "systems integrator" shall be interpreted to mean an organization that complies with all of the following criteria:

1. Employs personnel on this project who have successfully completed ISA or manufacturers training courses on general process instrumentation and configuration and implementation of the specific programmable controllers, computers, and software proposed for this project. Key personnel shall have a minimum of 10 years of verifiable plant startup experience. Key personnel shall include, as a minimum, the lead field technician.
2. Has successfully completed work of similar or greater complexity on at least three previous projects within the last five years. Successful completion shall be defined as a finished project completed on time, without any outstanding claims or litigation involving the PCSS. Potential references shall be for projects where the PCSS's contract was of similar size to this project.
3. Has been actively engaged in the type of work specified in this Section for a minimum of five years.

B. The PCSS shall maintain a permanent, fully staffed and equipped service facility within 200 miles of the project site with full time employees capable of designing, fabricating, installing, calibrating, and testing the systems specified herein. At a minimum, the PCSS shall be capable of responding to on-site problems within 12 hours of notice. Provide an on-site response within 4 hours of notification starting at two months before scheduled startup to two months after startup completion.

C. PCSS shall hold a valid UL-508 certification for their panel fabrication facility.

D. Actual installation of the instrumentation system need not be performed by the PCSS's employees; however, the PCSS as a minimum shall be responsible for the technical supervision of the installation by providing on site supervision to the installers of the various components.

- E. The selected PCSS shall be one of the following:
1. E-Merge Systems, Inc. - Inderdeep Huja - Newark, DE - (804) 344-3511
 2. Allied Control Services, Inc. - West Point, PA - Paul Mamzic – (215) 699-2855
 3. Optimum Controls Corporation - Reading, PA – James Brunell - (610) 375-0990
 4. PCS Integrators - Fairfield, NJ 07004 - Stephen Mirsky – (973) 575-7464
 5. Aaron Associates - Waterbury, CT - Carmen Corvigno - (203) 753-1536.
 6. AdvanTech Corporation – Don Green - Fairfield, NJ - (973) 808-8550
 7. Automated Control Concepts Inc. - Neptune NJ - Arlene Weichert - (732) 922-6611
 8. or equal.
- F. Being listed in this specification does not relieve any potential PCSS from meeting the qualifications specified in this Section. Contractors interested in listing an equal to the above listed suppliers shall submit three copies of the PCSS' qualifications submittal for review and approval no later than 14 days prior to the bid date. The submittal shall include the following:
1. Qualifications Submittal:
 - a. Submit detailed information on staff and organization to show compliance with the Quality Assurance requirements of this Section. Failure to meet the minimum requirements shall be grounds for rejection as a PCSS. The Qualifications Submittal shall, as a minimum, contain the following:
 - 1) Notarized statement from the firm's financial institution demonstrating ability for the firm to meet the obligations necessary for the performance of the work.
 - 2) Copy of UL-508 certificate for panel fabrication facilities.
 - 3) Project references demonstrating experience required by the Quality Assurance paragraphs above.
 - 4) Documentation to demonstrate the ability to complete this project including: resumes of key staff, financial capacities, details on engineering, design, fabrication, and field service capacity, and location of staff responsible for responding to the site within four hours to resolve startup issues.
 - 5) The PCSS shall demonstrate experience and expertise in the configuration of fault tolerant virtualized server systems.
- G. Being listed in this specification does not relieve any potential PCSS from meeting the qualifications specified in this Section.

1.07 DELIVERY, STORAGE AND HANDLING

- A. Delivery, storage, and handling shall be in accordance with Section 01600.
- B. Shipping Precautions:
 - 1. After completion of shop assembly, factory test and approval of all equipment, cabinets, panels and consoles shall be packed in protective crates and enclosed in heavy duty (5 mil) polyethylene envelopes or secured sheeting to provide protection from damage, dust and moisture. Dehumidifiers shall be placed inside the polyethylene coverings. The equipment shall then be skid-mounted for final transport. Lifting rings shall be provided for moving without removing protective covering. Boxed weights shall be shown on shipping tags together with instructions for unloading, transporting, storing and handling at the job site.
 - 2. Manufacturer's special instructions for field handling, storage and installation required for protection, shall be securely attached to the packaging for each piece of equipment prior to shipment. The instructions shall be stored in resealable plastic bags or other means of protection.
 - 3. None of the HMI control and monitoring equipment shall be shipped to the site until the control room areas comply with specified ambient temperature and humidity. Have qualified personnel accept the equipment on delivery and supervise unloading within the control room areas.
 - 4. If any apparatus has been damaged, such damage shall be repaired at no additional cost to the Owner.

1.08 NOMENCLATURE AND IDENTIFICATION

- A. Field Instrument Tags:
 - 1. See Section 13340.
- B. Panel Nameplates:
 - 1. See Section 13330.

1.09 WARRANTY

- A. Provide warranty per Section 01740, Warranties and Bonds, and as specified herein.

1.10 MAINTENANCE CONTRACT

- A. A written proposal for a maintenance contract executed by the PCSS shall be provided to the Owner for on-site preventive maintenance services related to the Instrumentation and Control system. The cost of this maintenance contract shall not be included in the Contract Price.
- B. This proposal shall be provided within 30 days after final acceptance for the purpose of entering a contract for annual maintenance subsequent to the first year of maintenance. Standard per diem rates for providing breakdown service shall be set forth in the contract. Such rates shall be fair and reasonable and reflect the lowest rates offered to most favored customers. The fee quoted shall be firm for a minimum of 90 days from date of issue.

- C. This maintenance contract shall include all labor, parts, and emergency calls providing on-site response within 24 hours, to provide complete system maintenance for a period of one year after the date of Substantial Completion of the system for all equipment and software provided as part of the PCSS scope of work.
- D. Provide software updates throughout the maintenance contract period. Provide latest official released version for all software provided under this Contract. Owner shall have the latest software releases at the end of the maintenance contract period.
- E. The maintenance contract shall also include a minimum of 4 preventive maintenance visits by qualified service personnel of the Supplier who is familiar with the type of equipment provided for this project. Each preventive maintenance visit shall include routine adjustment, calibration, cleaning and lubrication of system equipment and verification of correct operation.
- F. Visits to the sites to correct deficiencies under warranty shall not be included in this preventive maintenance service contract.
- G. Emergency maintenance procedures or plant visits may coincide with a preventive maintenance visit, however, they shall not replace the work intended to be performed during a preventive maintenance visit. The Supplier shall have full responsibility for the system hardware preventive and corrective maintenance.
- H. During the one-year maintenance period, observation of maintenance operations by plant personnel and the instruction of said personnel in the details of the maintenance work being performed, shall be provided.

1.11 PROJECT/SITE REQUIREMENTS

- A. Environmental Requirements. Refer to Division 16 and the Electrical Drawings for specific environmental and hazardous area classifications.
- B. Elevation: Equipment shall be designed to operate at the project ground elevation.
- C. Temperature:
 - 1. Outdoor areas' equipment shall operate between -22 to 122 F degrees ambient.
 - 2. Equipment located in indoor locations shall operate between 50 to 95 F degrees ambient.
 - 3. Storage temperatures shall range from 32 to 122 F degrees ambient minimum.
 - 4. Additional cooling or heating shall be furnished if required by the equipment as specified herein.
- D. Relative Humidity. Air-conditioned area equipment shall operate between 20 to 95 percent relative, non-condensing humidity. All other equipment shall operate between 5 to 100 percent relative, condensing humidity.

PART 2 PRODUCTS

2.01 GENERAL

- A. All instrumentation and electronic equipment shall be of the manufacturer's latest design, utilizing printed circuitry and epoxy or equal coating to prevent contamination by dust, moisture and fungus. The field mounted equipment and system components shall be designed for installation in dusty, humid and slightly corrosive service conditions.
- B. All instruments shall be provided with mounting hardware and floor stands, wall brackets, or instrument racks unless otherwise noted. Fasteners for securing control panels and enclosures to walls and floors shall be either hot-dipped galvanized after fabrication or stainless steel. Provide stainless steel fasteners only in corrosive areas rated NEMA 4X on the Drawings or as defined under Section 16000. Provide minimum size anchor of 3/8-inch.
- C. All indicators shall be linear in process units, unless otherwise noted. All transmitters shall be provided with indicators in process units, accurate to two percent or better.
- D. All equipment, cabinets and devices furnished shall be heavy-duty type, designed for continuous industrial service. The system shall contain similar products of a single manufacturer, and shall consist of equipment models, which are currently in production. All equipment provided shall be of modular construction and shall be capable of field expansion.
- E. All electronic/digital equipment shall be provided with radio frequency interference protection.
- F. Electrical:
 - 1. Equipment shall operate on a 60 Hertz alternating current power source at a nominal 120 volts, plus or minus 10 percent, except where specifically noted. Regulators and power supplies required for compliance with the above shall be provided between power supply and interconnected instrument loop. Where equipment requires voltage regulation, constant voltage transformers shall be supplied.
 - 2. With the exception for field device network connected devices, all electronic instrumentation shall utilize linear transmission signals of isolated 4 to 20 mA DC (milliampere direct current) capable of driving a load up to 750 ohms, unless specified otherwise. However, signals between instruments within the same panel or cabinet may be 1-5 VDC (volts direct current).
 - 3. Outputs of equipment that are not of the standard signals as outlined, shall have the output immediately raised and/or converted to compatible standard signals for remote transmission. No zero-based signals will be allowed.
 - 4. All switches shall have double-pole, double-throw contacts rated at a minimum of 600 VA, unless noted otherwise.
 - 5. Switches and/or signals indicating an alarm, failure or upset condition shall be wired in a fail-safe manner. A fail-safe condition is an open circuit when in an alarm state.
 - 6. Materials and equipment shall be UL approved whenever such approved equipment and materials are available.

7. All equipment furnished shall be designed and constructed so that in the event of power interruption, the systems specified herein shall go through an orderly shutdown with no loss of memory and shall resume normal operation without manual resetting when power is restored, unless otherwise noted.

2.02 ELECTRICAL SURGE PROTECTION

- A. General - Surge protection shall be provided to protect the electronic instrumentation system from induced surges propagating along the signal and power supply lines from lightning, utility, or the plant electrical system. The protection systems shall be such that the protective level shall not interfere with normal operation but shall be lower than the instrument surge withstand level. Protection shall be maintenance free and self-restoring. Devices shall have a response time of less than 50 nanoseconds and be capable of handling a discharge surge current (at an 8x20 μ s impulse waveform) of at least 8 kA. Ground wires for all instrumentation device surge protectors shall be connected to a low resistance ground in accordance with Section 16660.
- B. Provide protection of all analog signal (4-20 mA) circuits where any part of the circuit is outside of the building envelope. Circuits shall be protected at both the transmitter and the control system end of the circuit. Protection devices located near the transmitter shall be mounted in a separate NEMA 4X stainless steel enclosure (plastic is not acceptable) or conduit mounted, and shall be Phoenix Contact PT Series, MTL Surge Technologies (Telematic) TP48, Citel TSP-10 series, or equal. Substitution of a single device to protect both 120 VAC and 4-20 mA wires to an instrument is acceptable. Protection devices in control panels shall be MTL Surge Technologies (Telematic) SD Series, Phoenix Contact PT Series, Citel DLA series, or equal.
- C. Provide protection of all 120 VAC power feeds into control panels, instruments, and control room equipment. Surge arresters shall be Transtector ACP-100BW Series, Phoenix Contact "Mains-PlugTrab", MCG Surge Protection 400 Series, Citel DS40 series, or equal.
- D. Non-Fiber Based Data Highway or Communications Circuits - Provide protection on all communication and data highway circuits that leave a building or are routed external to a building. Circuit protection shall be provided at both ends of the line. Surge protection devices shall be Phoenix Contact PlugTrab Series, Transtector FSP Series, MTL Surge Technologies (Telematic) NP Series, Citel DLA series or MJ8 series, or equal.
- E. RF Coaxial Cable - Provide protection on communication cables between radios and antennas, mounted either inside the panel, or in the wall of the enclosure in accordance with NEMA and UL standards. Surge protection devices shall be Citel P8AX series, Polyphaser, or equal.
- F. Inductive Loads - Provide coil surge suppression devices, such as varistors or interposing relays, on all process controller outputs or switches rated 120 VA or less that drive solenoid, coil, or motor loads.

2.03 SPARE PARTS

- A. All spare parts shall be wrapped in bubble wrap, sealed in a polyethylene bag complete with dehumidifier, then packed in cartons and labeled with indelible markings. Complete ordering information including manufacturer's contact information (address and phone number), part name, part number, part ordering information, and equipment name and number(s) for which the part is to be used shall be supplied with the required spare parts. The spare parts shall be delivered and stored in a location directed by the Owner or Engineer.

- B. Furnish one of each type of installed Surge protection devices.
- C. Other spare parts are specified in each section. An overview follows:
 - 1. Devices within Control Panels - See Section 13330.
 - 2. Computer Hardware and Software spare parts - See Section 13310.
 - 3. PLC spare parts - See Section 13311.
 - 4. Network and Communications System - See Section 13320.
 - 5. Instrument related Spare Parts - see the Instrument Sections 13340 through 13345.

PART 3 EXECUTION

3.01 GENERAL INSTALLATION

- A. Instrumentation and accessory equipment shall be installed in accordance with manufacturer instructions. The indicated locations of equipment, transmitters, alarms and similar devices indicated are approximate only. Exact locations of all devices shall be as approved by the Engineer during construction. Obtain in the field, all information relevant to the placing of process control equipment and in case of interference with other work, proceed as directed by the Engineer and furnish all labor and materials necessary to complete the work in an approved manner at no additional cost to the Owner.
- B. Provide brackets and hangers required for mounting of equipment.
- C. The shield on each process instrumentation cable shall be continuous from source to destination and be grounded at only one ground point for each shield.
- D. Investigate each space in the building through which equipment must pass to reach its final location. If necessary, ship material in sections sized to permit passing through restricted areas in the building. Provide on-site service to oversee the installation, the placing and location of system components, their connections to the process equipment panels, cabinets and devices, subject to the Engineer's approval. Certify that field wiring associated with the equipment is installed in accordance with best industry practice. Coordinate work under this Section with that of the electrical work specified under applicable sections of Division 16.
- E. Provide sunshades for equipment mounted outdoors in direct sunlight. Sunshades shall include standoffs to allow air circulation around the cabinet. Orient equipment outdoors to face to the North or as required to minimize the impact of glare and ultraviolet exposure on digital readouts.

3.02 TESTING

- A. Refer to Section 13302.

3.03 TRAINING

- A. Refer to Section 13303.

3.04 DIVISION 13 (PCSS) FIELD INSTRUMENT LIST

A. Each column of the field instrument list is defined as follows:

1. TAG: The identifier assigned to the field instrument.
2. QUANTITY: The quantity of instruments to be provided.
3. DESCRIPTION: A description of the instrument.
4. FUNCTION: The process being measured.
5. TYPE: The type of instrument to be provided. For example, if the instrument is a flowmeter, this will specify whether it is a magnetic flowmeter, propeller flowmeter, etc. Special criteria will also be included in this column, such as quantity of alarm contacts needed, etc.
6. SHEET: The P&ID or drawing where the I/O point appears on.
7. RANGE/SETTING: Required instrument range or switch setting.
8. SPEC: The Division 13 specification section number where the instrument details can be found.

B. Instruments shall be furnished per the requirements of the following field instrument list.

CEDAR CREEK WPCP:

TAG	QTY	DESCRIPTION	FUNCTION	TYPE	RANGE/ SETTING	SPEC SECTION
LE/LIT-DIG1	1	Level Indicator/Transmitter	Digester No. 1 Cover Level	Continuous Radar Level Monitor	0-30 ft	13342
LE/LIT-DIG2	1	Level Indicator/Transmitter	Digester No. 2 Cover Level	Continuous Radar Level Monitor	0-30 ft	13342
LE/LIT-DIG3	1	Level Indicator/Transmitter	Digester No. 3 Cover Level	Continuous Radar Level Monitor	0-30 ft	13342
LE/LIT-DIG4	1	Level Indicator/Transmitter	Digester No. 4 Cover Level	Continuous Radar Level Monitor	0-30 ft	13342
LE/LIT-DIG5	1	Level Indicator/Transmitter	Digester No. 5 Cover Level	Continuous Radar Level Monitor	0-30 ft	13342
LE/LIT-DIG6	1	Level Indicator/Transmitter	Digester No. 6 Cover Level	Continuous Radar Level Monitor	0-30 ft	13342
LE/LIT-DIG7	1	Level Indicator/Transmitter	Digester No. 7 Cover Level	Continuous Radar Level Monitor	0-30 ft	13342
LE/LIT-DIG8	1	Level Indicator/Transmitter	Digester No. 8 Cover Level	Continuous Radar Level Monitor	0-30 ft	13342
LE/LIT-DIG9	1	Level Indicator/Transmitter	Digester No. 9 Cover Level	Continuous Radar Level Monitor	0-30 ft	13342
AE/AIT-6600-1	1	Combustible Gas Detector/ Transmitter	Sludge Heater Room North	Continuous Infrared Sensor	0-100% LEL	13345

TAG	QTY	DESCRIPTION	FUNCTION	TYPE	RANGE/ SETTING	SPEC SECTION
			Combustible Gas Detection			
AE/AIT- 6600-2	1	Combustible Gas Detector/ Transmitter	Sludge Heater Room South Combustible Gas Detection	Continuous Infrared Sensor	0-100% LEL	13345
AE/AIT- 6600-3	1	Combustible Gas Detector/ Transmitter	Sludge Heater Room West Combustible Gas Detection	Continuous Infrared Sensor	0-100% LEL	13345
AE/AIT- 6600-4	1	Combustible Gas Detector/ Transmitter	Compressor Room East Combustible Gas Detection	Continuous Infrared Sensor	0-100% LEL	13345
AE/AIT- 6600-5	1	Combustible Gas Detector/ Transmitter	Compressor Room Center Combustible Gas Detection	Continuous Infrared Sensor	0-100% LEL	13345
AE/AIT- 6600-6	1	Combustible Gas Detector/ Transmitter	Compressor Room West Combustible Gas Detection	Continuous Infrared Sensor	0-100% LEL	13345
AE/AIT- 6600-7	1	Combustible Gas Detector/ Transmitter	Digester Basement West Combustible Gas Detection	Continuous Infrared Sensor	0-100% LEL	13345
AE/AIT- 6600-8	1	Combustible Gas Detector/ Transmitter	Digester Basement Combustible Gas Detection (near water pumps)	Continuous Infrared Sensor	0-100% LEL	13345
AE/AIT- 6600-9	1	Combustible Gas Detector/ Transmitter	Digester Basement Combustible Gas Detection (near circulation pumps)	Continuous Infrared Sensor	0-100% LEL	13345
AE/AIT- 6600-10	1	Combustible Gas Detector/ Transmitter	Digester Basement South Combustible Gas Detection	Continuous Infrared Sensor	0-100% LEL	13345
AE/AIT- 6600-11	1	Combustible Gas Detector/ Transmitter	Digester Basement Combustible Gas Detection (near transfer pumps)	Continuous Infrared Sensor	0-100% LEL	13345
AE/AIT- 6600-12	1	Combustible Gas Detector/ Transmitter	Digester Basement North Combustible Gas Detection	Continuous Infrared Sensor	0-100% LEL 0-100% LEL	13345
AE/AIT- 6600-13	1	Combustible Gas Detector/ Transmitter	Basement Between Digesters 5 and 6	Continuous Infrared Sensor	0-100% LEL	13345
AE/AIT- 6600-14	1	Combustible Gas Detector/ Transmitter	Basement Between Digesters 6 and 8	Continuous Infrared Sensor	0-100% LEL	13345
AE/AIT- 6600-15	1	Combustible Gas Detector/ Transmitter	Basement Between Digesters 7 and 8	Continuous Infrared Sensor	0-100% LEL	13345

TAG	QTY	DESCRIPTION	FUNCTION	TYPE	RANGE/ SETTING	SPEC SECTION
AE/AIT-6600-16	1	Combustible Gas Detector/ Transmitter	Basement Between Digesters 8 and 9	Continuous Infrared Sensor	0-100% LEL	13345
AE/AIT-6600-17	1	Combustible Gas Detector/ Transmitter	Basement Between Digesters 5 and 6	Continuous Infrared Sensor	0-100% LEL	13345
AE/AIT-6600-18	1	Combustible Gas Detector/ Transmitter	Basement Between Digesters 5 and 7	Continuous Infrared Sensor	0-100% LEL	13345
AE/AIT-6600-19	1	Combustible Gas Detector/ Transmitter	Basement Between Digesters 6 and 7	Continuous Infrared Sensor	0-100% LEL	13345
AE/AIT-6600-20	1	Combustible Gas Detector/ Transmitter	Basement Between Digesters 6 and 8	Continuous Infrared Sensor	0-100% LEL	13345
AE/AIT-6600-21	1	Combustible Gas Detector/ Transmitter	First Floor above Methane System 1	Continuous Infrared Sensor	0-100% LEL	13345
AE/AIT-6600-21	1	Combustible Gas Detector/ Transmitter	First Floor above Methane System 2	Continuous Infrared Sensor	0-100% LEL	13345

GLEN COVE WWTP:

TAG	QTY	DESCRIPTION	FUNCTION	TYPE	SHEET	RANGE/ SETTING	SPEC
AE/AIT-0100-A	1	Combustible Gas Sensor/Transmitter	Headworks Building Drywell Combustible Gas Detection	Infrared Combustible gas detector	I-5	0-100% LEL	13345
AE/AIT-0100-B	1	Hydrogen Sulfide Sensor/Transmitter	Headworks Building Drywell Hydrogen Sulfide Detection	Continuous diffusion H2S detector	I-5	0-100 ppm	13345
AE/AIT-0100-C	1	Oxygen Sensor/Transmitter	Headworks Building Drywell Oxygen Detection	Electrochemical Oxygen detector	I-5	0-25%	13345
AE/AIT-0100-D	1	Carbon Monoxide Sensor/Transmitter	Headworks Building Drywell Carbon Monoxide Detection	Metal Oxide Sensor	I-5	0-100 ppm	13345
AE/AIT-0501-A	1	Combustible Gas Sensor/Transmitter	Headworks Building Basement Screening and Wetwell Combustible Gas Detection	Infrared Combustible gas detector	I-5	0-100% LEL	13345
AE/AIT-0501-B	1	Hydrogen Sulfide Sensor/Transmitter	Headworks Building Basement Screening and Wetwell Hydrogen Sulfide Detection	Continuous diffusion H2S detector	I-5	0-100 ppm	13345
AE/AIT-0501-C	1	Oxygen Sensor/Transmitter	Headworks Building Basement Screening and Wetwell Oxygen Detection	Electrochemical Oxygen detector	I-5	0-25%	13345

TAG	QTY	DESCRIPTION	FUNCTION	TYPE	SHEET	RANGE/ SETTING	SPEC
AE/AIT-0501-D	1	Carbon Monoxide Sensor/Transmitter	Headworks Building Basement Screening and Wetwell Carbon Monoxide Detection	Metal Oxide Sensor	I-5	0-100 ppm	13345
AE/AIT-0502-A	1	Combustible Gas Sensor/Transmitter	Headworks Building First Floor Screening Room Combustible Gas Detection	Infrared Combustible gas detector	I-5	0-100% LEL	13345
AE/AIT-0502-B	1	Hydrogen Sulfide Sensor/Transmitter	Headworks Building First Floor Screening Room Hydrogen Sulfide Detection	Continuous diffusion H2S detector	I-5	0-100 ppm	13345
AE/AIT-0502-C	1	Oxygen Sensor/Transmitter	Headworks Building First Floor Screening Room Oxygen Detection	Electrochemical Oxygen detector	I-5	0-25%	13345
AE/AIT-0502-D	1	Carbon Monoxide Sensor/Transmitter	Headworks Building First Floor Screening Room Carbon Monoxide Detection	Metal Oxide Sensor	I-5	0-100 ppm	13345
FIT-2000	1	Flow Transmitter	Blower Common Header Discharge Flow	Differential Pressure for Flow	I-6	0-15,000 SCFM	13341
PIT-2010	1	Pressure Transmitter	Blower Common Header Discharge Pressure	Microprocessor based, intelligent type	I-6	0-25 PSI	13343
FIT-2100-1 thru 8	8	Flow Transmitter	Aeration Tank Inlet Air Flow	Differential Pressure for Flow	I-6	0-1,800 SCFM	13341
TIT-2110-1 thru 8	8	Temperature Sensor/Transmitter	Aeration Tank Inlet Air Temperature	RTD	I-6	0 to 200°F	13344
AE-2250-1A thru 8A	8	Dissolved Oxygen Sensor	Aeration Tank Dissolved Oxygen	Optical DO Sensor	I-2	0-20 ppm	13345
AE-2250-1B thru 8B	8	Dissolved Oxygen Sensor	Aeration Tank Dissolved Oxygen	Optical DO Sensor	I-2	0-20 ppm	13345
AIT-2250-1 thru 8	8	Dissolved Oxygen Transmitter	Aeration Tank Dissolved Oxygen	2-channel	I-2	0-20 ppm	13345
LSH-6210	1	High Level Switch	Sludge Pump Area Flood Alarm	Capacitance level switch	N/A	2" from floor	13342

END OF SECTION

APPENDIX 13300-A

EXAMPLE POINT-TO-POINT WIRING DIAGRAMS

Point-to-point drawings are included for reference only. Actual point-to-point drawings shall follow all requirements specified herein.

CEDAR CREEK WPCP APPENDICES:

APPENDIX 13300-B

CONTROL SYSTEM INPUT/OUTPUT (I/O) SCHEDULE

This I/O Schedule is included for reference only. The determination of the exact number and type of I/O points shall be the responsibility of the PCSS based on the Drawings, the Specifications, Process Control Loop Descriptions (Section 13305), auxiliary device requirements, and spare requirements.

This I/O schedule includes points terminating at new programmable logic controllers (PLCs) as well as existing PLCs. For the existing PLCs, the programs shall be modified under this project to accommodate the spare points, except where the point is labeled as "Future" in the remarks section.

Future I/O is also included in this I/O schedule. Future points listed shall be wired to terminal blocks in the enclosure so that the field wiring can be terminated in the future. When calculating spare I/O requirements, provide 20% of (used I/O + Future I/O).

GLEN COVE WWTP APPENDICES:

APPENDIX 13300-C

CONTROL SYSTEM INPUT/OUTPUT (I/O) SCHEDULE

This I/O Schedule is included for reference only. The determination of the exact number and type of I/O points shall be the responsibility of the PCSS based on the Drawings, the Specifications, Process Control Loop Descriptions (Section 13305), auxiliary device requirements, and spare requirements.

APPENDIX 13300-D

APG NEUROS BLOWER COMMUNICATION

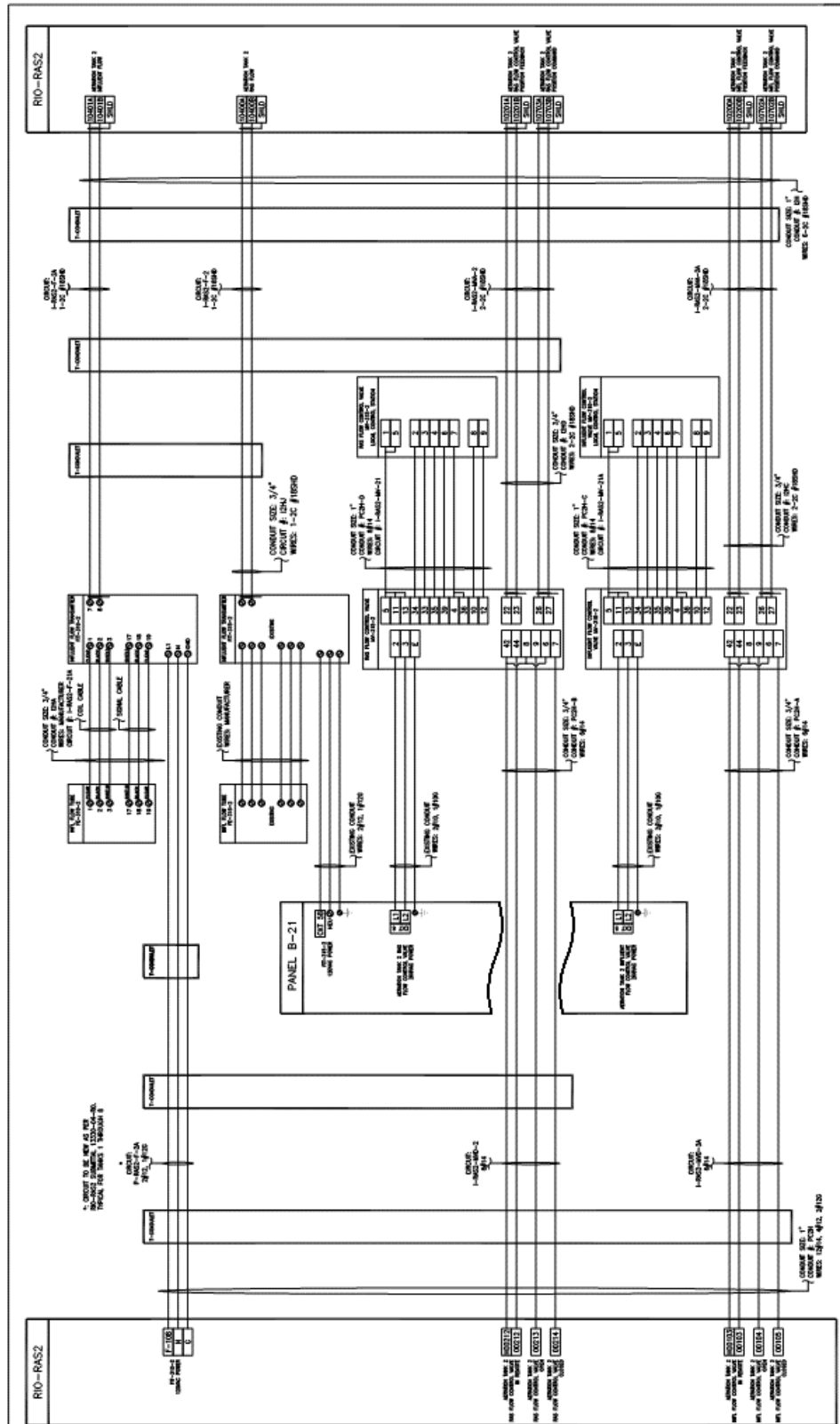
This appendix is an excerpt from the Neuros Blower Operations and Maintenance (O&M) manual and is included to assist in establishing communications necessary for control and monitoring by the PLC-MACP and the HMI system. This document is included for reference only. The determination of the exact number and type of I/O points shall be the responsibility of the PCSS based on the Drawings, the Specifications, Process Control Loop Descriptions (Section 13305), auxiliary device requirements, and spare requirements.

APPENDIX 13300-E
TURBLEX BLOWER OIT SCREENS

This appendix includes photos of the graphics displayed on the Turblex Local Blower OIT. The data displayed on this OIT shall be included in new HMI graphics. These screens shall also be used to create a preliminary I/O list.

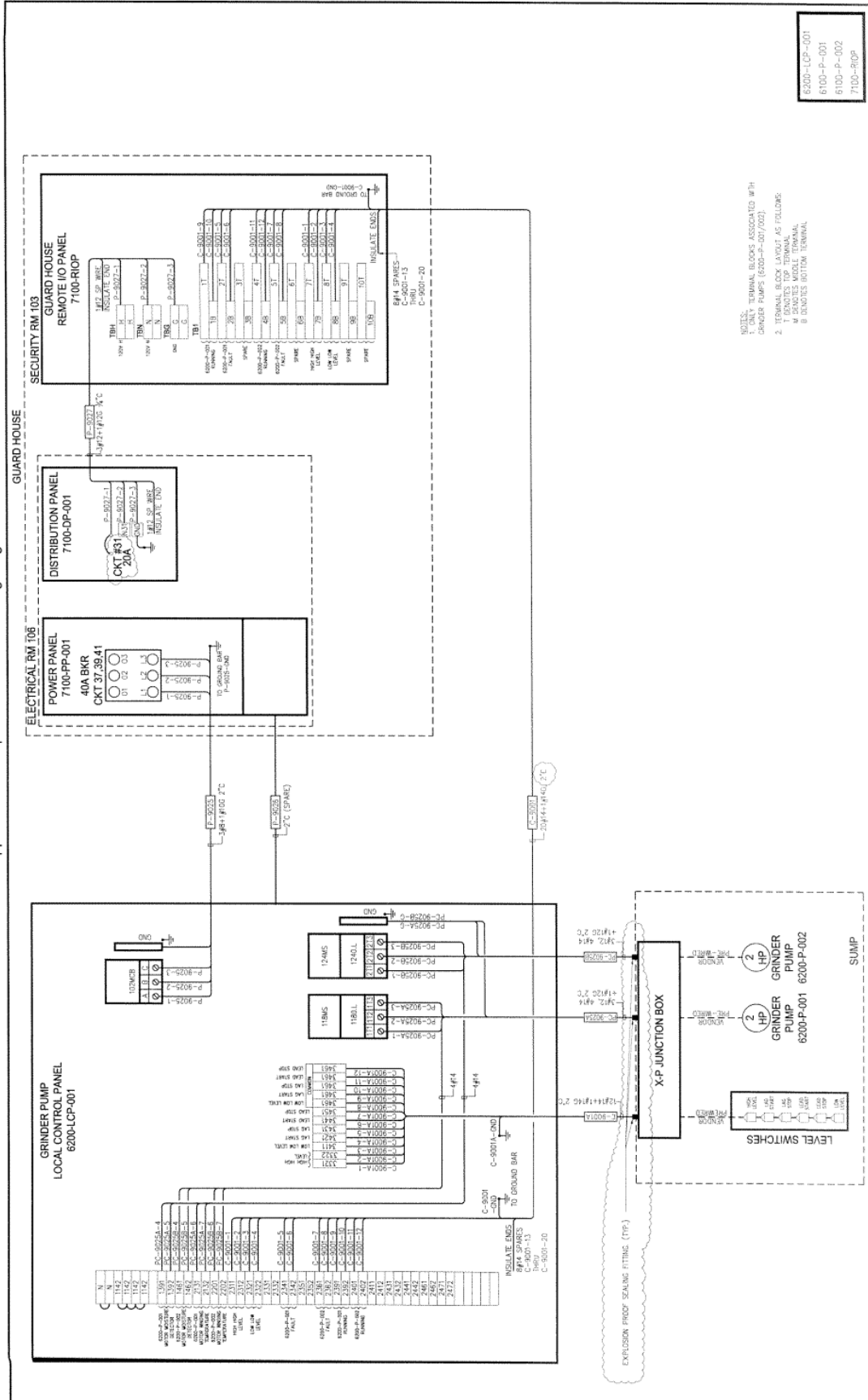
END OF SECTION

SECTION 13300 – APPENDIX A
EXAMPLE POINT-TO-POINT WIRING DIAGRAMS





13300 Appendix A - Sample Point-to-Point Wiring Diagrams



NO TEXT ON THIS PAGE

Cedar Creek Water Pollution Control Plant
SCADA System Improvements
Building A – RIO-HVAC-A Control Panel I/O List

No.	Tag Number	Description	DI	DO	AI	AO	Units	Range	Notes
1		RIO-HVAC-A Door Intrusion	1						
2	PIT-06104	A-AHU 1 Inlet Hot Water Pressure			1		PSI		
3	TE-06104	A-AHU 1 Inlet Hot Water Temp			1		°F		
4	PIT-06105	A-AHU 1 Inlet Cold Water PSI			1		PSI		
5	TE-06105	A-AHU 1 Inlet Cold Water Temp			1		°F		
6	TI-06102	A-AHU 1 Hot Deck Air Temp			1		°F		
7	TI-06103	A-AHU 1 Cold Deck Air Temp			1		°F		
8	AIT-06101	Laboratory Humidity			1		%		
9	TE-06101	Laboratory Temperature			1		°F		
10									
11									
12									
Total Number Of I/O			1	0	8	0			

Cedar Creek Water Pollution Control Plant
SCADA System Improvements
Building A – PLC-ADMIN Control Panel I/O List

No.	Tag Number	Description	DI	DO	AI	AO	Units	Range	Notes
1		PLC Reset Button	1						
2		PLC-ADMIN Enclosure Door Intrusion	1						
3		Audible Horn		1					
4		Strobe		1					
5									
6									
7									
		Total Number Of I/O	0	2	0	0			

Cedar Creek Water Pollution Control Plant
SCADA System Improvements
Building BB – Engine Control Room Control Panel (PLC-ECR) I/O List

No.	Tag Number	Description	DI	DO	AI	AO	Units	Range	Notes
1		Start Pump A-1	1						
2		Start Pump A-2	1						
3		Start Pump A-2	1						
4		Start Pump A-3	1						
5		Sewage Pump A-1 Warning	1						
6		Sewage Pump A-3 Warning	1						
7		Sewage Pump A-1 Malfunction	1						
8		Sewage Pump A-2 Malfunction	1						
9		Sewage Pump A-2 Malfunction	1						
10		Sewage Pump A-3 Malfunction	1						
11		Grit Building MCC panel Failure	1						
12		Influent Screening MCC Panel Failure	1						
13		Effluent Screening Building MCC panel Failure	1						
14		Aeration Tanks North MCC Panel Failure	1						
15		Aeration Tanks South MCC Panel Failure	1						
16		Sludge Thickening Building MMC Failure	1						
17		Blower No. 1 Motor Winding Temperature High	1						
18		Blower No. 2 Motor Winding Temperature High	1						
19		Blower No. 3 Motor Winding Temperature High	1						
20		Blower No. 4 Motor Winding Temperature High	1						
21		Blower No. 1 Malfunction	1						
22		Blower No. 2 Malfunction	1						
23		Blower No. 3 Malfunction	1						
24		Blower No. 4 Malfunction	1						
25		Blower No. 5 Malfunction	1						
26		Blower No. 6 Malfunction	1						
27		Blower No. 7 Malfunction	1						
28		Sec. Gas Compressor No. 1 Disch. Temperature High	1						
29		Sec. Gas Compressor No. 2 Disch. Temperature High	1						
30		Sec. Gas Compressor No. 1 Suction Pressure Low	1						
31		Sec. Gas Compressor No. 2 Suction Pressure Low	1						
32		Low Influent Flow	1						
33		Low Effluent Water Pressure	1						
34		Low Domestic Water Pressure	1						
35		Emergency Generator OFF	1						
36		Pump Station Malfunction	1						
37		Low Instrument Air Pressure "B" Building Components	1						
38		Domestic Water Level High	1						
39		Domestic Water Level Low	1						
40		Gas Leak M.E.B. Basement North	1						

Cedar Creek Water Pollution Control Plant
SCADA System Improvements
Building BB – Engine Control Room Control Panel (PLC-ECR) I/O List

No.	Tag Number	Description	DI	DO	AI	AO	Units	Range	Notes
41		Gas Leak M.E.B First Floor North	1						
42		Gas Leak M.E.B Basement South	1						
43		Gas Leak M.E.B First Floor South	1						
44		Gas Leak Compressor Building	1						
45		East Wet Well Level Abnormal	1						
46		West Wet Well Level Abnormal	1						
47		Boiler Room General Alarm	1						
48		Sewage Pump No. 1 Running	1						
49		Sewage Pump No.1 Remote	1						
50		Sewage Pump No. 2 Running	1						
51		Sewage Pump No.2 Remote	1						
52		Sewage Pump No. 3 Running	1						
53		Sewage Pump No.3 Remote	1						
54		Sewage Pump No. 4 Running	1						
55		Sewage Pump No.4 Remote	1						
56		Sewage Pump No. 5 Running	1						
57		Sewage Pump No.5 Remote	1						
58		Sewage Pump No. 6 Running	1						
59		Sewage Pump No.6 Remote	1						
60		Sewage Pump No. 7 Running	1						
61		Sewage Pump No.7 Remote	1						
62		Blower No. 1 Running	1						
63		Blower No.1 Remote	1						
64		Blower No. 2 Running	1						
65		Blower No.2 Remote	1						
66		Blower No. 3 Running	1						
67		Blower No.3 Remote	1						
68		Blower No. 4 Running	1						
69		Blower No.4 Remote	1						
70		Blower No. 5 Running	1						
71		Blower No.5 Remote	1						
72		Blower No. 6 Running	1						
73		Blower No.6 Remote	1						
74		Blower No. 7 Running	1						
75		Blower No.7 Remote	1						
76		Outfall Pump No. 1 Running	1						
77		Outfall Pump No. 2 Running	1						
78		Outfall Pump No. 3 Running	1						
79		Outfall Pump No. 4 Running	1						
80		Outfall Pump No. 5 Running	1						

Cedar Creek Water Pollution Control Plant
SCADA System Improvements
Building BB – Engine Control Room Control Panel (PLC-ECR) I/O List

No.	Tag Number	Description	DI	DO	AI	AO	Units	Range	Notes
81		Wet Well East Selected	1						
82		Wet Well West Selected	1						
83		PLC Reset Button	1						
84		PLC-ECR Enclosure Door Intrusion	1						
85		Sewage Pump No. 1 Start/ Stop		1					
86		Sewage Pump No. 2 Start/ Stop		1					
87		Sewage Pump No. 3 Start/ Stop		1					
88		Sewage Pump No. 4 Start/ Stop		1					
89		Sewage Pump No. 5 Start/ Stop		1					
90		Sewage Pump No. 6 Start/ Stop		1					
91		Sewage Pump No. 7 Start/ Stop		1					
92		Blower No. 1 Start/ Stop		1					
93		Blower No. 2 Start/ Stop		1					
94		Blower No. 3 Start/ Stop		1					
95		Blower No. 4 Start/ Stop		1					
96		Blower No. 5 Start/ Stop		1					
97		Blower No. 6 Start/ Stop		1					
98		Blower No. 7 Start/ Stop		1					
99		Audible Horn		1					
100		Strobe		1					
101		Sewage Pump No. 1 Speed			1		RPM		
102		Sewage Pump No. 2 Speed			1		RPM		
103		Sewage Pump No. 3 Speed			1		RPM		
104		East & West Wet Well Level			1				
105		Sewage Pump No. 6 Speed			1		RPM		
106		Sewage Pump No. 7 Speed			1		RPM		
107		Blower No.1 Vane Position			1				
108		Blower No.1 Vane Current			1		AMPS		
109		Blower No.2 Vane Position			1				
110		Blower No.2 Vane Current			1		AMPS		
111		Blower No.3 Vane Position			1				
112		Blower No.3 Vane Current			1		AMPS		
113		Blower No.4 Vane Position			1				
114		Blower No.4 Vane Current			1		AMPS		
115		Blower No.5 Vane Position			1				
116		Blower No.5 Vane Current			1		AMPS		
117		Blower No.6 Vane Position			1				
118		Blower No.6 Vane Current			1		AMPS		
119		Blower No.7 Vane Position			1				
120		Blower No.7 Vane Current			1		AMPS		

Cedar Creek Water Pollution Control Plant

SCADA System Improvements

Building BB – Engine Control Room Control Panel (PLC-ECR) I/O List

No.	Tag Number	Description	DI	DO	AI	AO	Units	Range	Notes
121		Domestic Water Flow #1			1				To Protected Water Panel
122		Domestic Water Flow #2			1				To Protected Water Panel
123		Domestic Water Flow #3			1				To Protected Water Panel
124		Domestic Water Flow #4			1				To Protected Water Panel
125		Seal Water Flow to the Raw Sewage Pumps			1				To Protected Water Panel
126		Sewage Pump No. 1 Speed Control				1			
127		Sewage Pump No. 2 Speed Control				1			
128		Sewage Pump No. 3 Speed Control				1			
129		Sewage Pump No. 6 Speed Control				1			
130		Sewage Pump No. 7 Speed Control				1			
		Total Number Of I/O	84	16	25	5			

Cedar Creek Water Pollution Control Plant
SCADA System Improvements
Building B – PLC-HVAC-B Control Panel I/O List

No.	Tag Number	Description	DI	DO	AI	AO	Units	Range	Notes
1		C-P5A ON	1						PLC-HVAC-B
2		C-P5B ON	1						PLC-HVAC-B
3		C-P5C ON	1						PLC-HVAC-B
4		Boiler Opacity Alarm	1						PLC-HVAC-B
5		Boiler High Flue Temp Alarm	1						PLC-HVAC-B
6		Blr Mstr Auto Lead/Lag Select	1						PLC-HVAC-B
7		Blr Mstr Boiler 1 Lead Select	1						PLC-HVAC-B
8		Blr Mstr Boiler 2 Lead Select	1						PLC-HVAC-B
9		Blr Mstr Boiler 3 Lead Select	1						PLC-HVAC-B
10		Blr Mstr Boiler 4 Lead Select	1						PLC-HVAC-B
11		Refrig. Leak Alarm	1						PLC-HVAC-B
12		Domestic HW Low Flow	1						PLC-HVAC-B
13		Chilled Water Low Flow	1						PLC-HVAC-B
14		Blr 1 High HW Discharge PSI	1						PLC-HVAC-B
15		Blr 1 Low HW Discharge PSI	1						PLC-HVAC-B
16		Blr #1 Common Alarm Output	1						PLC-HVAC-B
17		Blr 2 High HW Discharge PSI	1						PLC-HVAC-B
18		Blr 2 Low HW Discharge PSI	1						PLC-HVAC-B
19		Blr #2 Common Alarm Output	1						PLC-HVAC-B
20		Blr 3 High HW Discharge PSI	1						PLC-HVAC-B
21		Blr 3 Low HW Discharge PSI	1						PLC-HVAC-B
22		Blr #3 Common Alarm Output	1						PLC-HVAC-B
23		Blr 4 High HW Discharge PSI	1						PLC-HVAC-B
24		Blr 4 Low HW Discharge PSI	1						PLC-HVAC-B
25		Blr #4 Common Alarm Output	1						PLC-HVAC-B
26		Blr Mstr Boiler start	1						PLC-HVAC-B
27		Blr Mstr Boiler Stop	1						PLC-HVAC-B
28		Blr Mstr Common Alarm	1						PLC-HVAC-B
29		BMC Call for a Lead	1						PLC-HVAC-B
30		FOP-1A-ON	1						PLC-HVAC-B
31		FOP-1B-ON	1						PLC-HVAC-B
32		FOP-1C-ON	1						PLC-HVAC-B
33		C-P26 ON	1						PLC-HVAC-B
34		C-P27 ON	1						PLC-HVAC-B
35		C-P28 ON	1						PLC-HVAC-B
36		C-P29 ON	1						PLC-HVAC-B
37		C-P5 ON	1						PLC-HVAC-B
38		C-P6 ON	1						PLC-HVAC-B
39		C-P7 ON	1						PLC-HVAC-B
40		C-P8 ON	1						PLC-HVAC-B

Cedar Creek Water Pollution Control Plant
SCADA System Improvements
Building B – PLC-HVAC-B Control Panel I/O List

No.	Tag Number	Description	DI	DO	AI	AO	Units	Range	Notes
41		C-P1 ON	1						PLC-HVAC-B
42		C-P2 ON	1						PLC-HVAC-B
43		C-P3 ON	1						PLC-HVAC-B
44		C-P4 ON	1						PLC-HVAC-B
45		Blr #1 Call For Heat	1						PLC-HVAC-B
46		Blr #1 Safety Lockout	1						PLC-HVAC-B
47		Blr #1 Boiler Avail. Contact	1						PLC-HVAC-B
48		Blr #1 Fuel Valve Open	1						PLC-HVAC-B
49		Blr #1 Boiler in Hand	1						PLC-HVAC-B
50		Blr #1 Boiler in Auto	1						PLC-HVAC-B
51		Blr #1 High Gas Pressure	1						PLC-HVAC-B
52		Blr #1 Low Gas Pressure	1						PLC-HVAC-B
53		Blr #2 Call For Heat	1						PLC-HVAC-B
54		Blr #2 Safety Lockout	1						PLC-HVAC-B
55		Blr #2 Boiler Avail. Contact	1						PLC-HVAC-B
56		Blr #2 Fuel Valve Open	1						PLC-HVAC-B
57		Blr #2 Boiler in Hand	1						PLC-HVAC-B
58		Blr #2 Boiler in Auto	1						PLC-HVAC-B
59		Blr #2 High Gas Pressure	1						PLC-HVAC-B
60		Blr #2 Low Gas Pressure	1						PLC-HVAC-B
61		Blr #3 Call For Heat	1						PLC-HVAC-B
62		Blr #3 Safety Lockout	1						PLC-HVAC-B
63		Blr #3 Boiler Avail. Contact	1						PLC-HVAC-B
64		Blr #3 Fuel Valve Open	1						PLC-HVAC-B
65		Blr #3 Boiler in Hand	1						PLC-HVAC-B
66		Blr #3 Boiler in Auto	1						PLC-HVAC-B
67		Blr #3 High Gas Pressure	1						PLC-HVAC-B
68		Blr #3 Low Gas Pressure	1						PLC-HVAC-B
69		Blr #4 Call For Heat	1						PLC-HVAC-B
70		Blr #4 Safety Lockout	1						PLC-HVAC-B
71		Blr #4 Boiler Avail. Contact	1						PLC-HVAC-B
72		Blr #4 Fuel Valve Open	1						PLC-HVAC-B
73		Blr #4 Boiler in Hand	1						PLC-HVAC-B
74		Blr #4 Boiler in Auto	1						PLC-HVAC-B
75		Blr #4 High Gas Pressure	1						PLC-HVAC-B
76		Blr #4 Low Gas Pressure	1						PLC-HVAC-B
77		Chiller 1A On	1						PLC-HVAC-B
78		Chiller 1B On	1						PLC-HVAC-B
79	IL-06385	Steam Absorber #1 Running	1						RIO-HVAC-C
80	IL-06386	Steam Absorber #2 Running	1						RIO-HVAC-C

Cedar Creek Water Pollution Control Plant
SCADA System Improvements
Building B – PLC-HVAC-B Control Panel I/O List

No.	Tag Number	Description	DI	DO	AI	AO	Units	Range	Notes
81	IL-06387	Steam Absorber #3 Running	1						RIO-HVAC-C
82	FSL-06336	Domestic HW Low Flow Switch	1						RIO-HVAC-C
83	IL-06319	CHW Pump C-P19 On	1						MCC-P12 PANEL
84	IL-06320	CHW Pump C-P20 On	1						MCC-P12 PANEL
85	IL-06321	CHW Pump C-P21 On	1						MCC-P12 PANEL
86	IL-06322	CHW Pump C-P22 On	1						MCC-P12 PANEL
87	IL-06421	HW Pump J-P1 On	1						MCC-DS-1
88	IL-06422	HW Pump J-P2 On	1						MCC-DS-1
89	IL-06425	HW Pump #5 On	1						MCC-DS-1
90	IL-06427	HW Pump #1 On	1						MCC-DS-1
91	IL-06428	HW Pump #2 On	1						MCC-DS-1
92	IL-06423	HW Pump J-P3 On	1						MCC-DS-2
93	IL-06424	HW Pump J-P4 On	1						MCC-DS-2
94	IL-06426	HW Pump #6 On	1						MCC-DS-2
95	IL-06429	HW Pump #3 On	1						MCC-DS-2
96	IL-06430	HW Pump #4 On	1						MCC-DS-2
97		PLC-HVAC-B Enclosure Door Intrusion	1						
98	AIT-6260	Control Room Humidity			1		%		PLC-HVAC-B
99	TE-6260	Control Room Temp			1		°F		PLC-HVAC-B
100	FIT-06391	Absorber Total Waste Steam			1		kpph		RIO-HVAC-C
101	TE-06331	Chilled Water Supply Temp			1		°F		RIO-HVAC-C
102	FIT-06392	Primary Heat Exh. Waste Steam			1		kpph		RIO-HVAC-C
103	TE-06332	Chilled Water Return Temp			1		°F		RIO-HVAC-C
104	FIT-06330	Chiller Water Flow			1		GPM		RIO-HVAC-C
105	PIT-06341	F.O. Pump Discharge PSI			1		PSI		RIO-HVAC-C
106	TE-06336	Domestic HW Temp			1		°F		RIO-HVAC-C
107	LIT-06337	Engine/Boiler cond. Tank Level			1		Inches H2O		RIO-HVAC-C
108	PIT-06344	F.O. Tank Strainer Delta-P			1		PSI		RIO-HVAC-C
109	FIT-06251	Combined Fuel Oil Supply Flow			1		GPM		RIO-HVAC-C
110	FIT-06252	Combined Fuel Oil Return Flow			1		GPM		RIO-HVAC-C
111	PIT-06333	CW Makeup Water PSI			1		PSI		RIO-HVAC-C
112	TE-06372	Outdoor Temperature			1		°F		RIO-HVAC-C
113	PIT-06361	HHW Makeup Water PSI			1		PSI		RIO-HVAC-C
114	TE-06382	Screened Effluent Return Temp			1		°F		RIO-HVAC-C
115	LIT-06342	Fuel Oil Tank #19 Level			1		%		RIO-HVAC-C
116	LIT-06343	Fuel Oil Tank #20 Level			1		%		RIO-HVAC-C
117	FIT-06334	Dig. 1-4 Space Heating HW Flow			1		GPM		RIO-HVAC-C
118	FIT-06335	Dig. 5-9 Space Heating HW Flow			1		GPM		RIO-HVAC-C
119	FIT-06393	Secondary Heat Exch. Waste Steam			1		PSI		RIO-HVAC-C
120	TE-06381	Screen Effluent Supply Temp			1		°F		RIO-HVAC-C

Cedar Creek Water Pollution Control Plant
SCADA System Improvements
Building B – PLC-HVAC-B Control Panel I/O List

No.	Tag Number	Description	DI	DO	AI	AO	Units	Range	Notes
121	TE-06371	Hot Water Supply Temp.			1		°F		RIO-HVAC-C
122	PIT-06351	Pri Heat Exch. #1 Shell PSI			1		PSI		RIO-HVAC-C
123	PIT-06352	Pri Heat Exch. #2 Shell PSI			1		PSI		RIO-HVAC-C
124	PIT-06353	Pri Heat Exch. #3 Shell PSI			1		PSI		RIO-HVAC-C
125	PIT-06354	Pri Heat Exch. #4 Shell PSI			1		PSI		RIO-HVAC-C
126	PIT-06362	HHW Pri. Heat Exch. Inlet PSI			1		PSI		RIO-HVAC-C
127	TE-06362	HHW Pri. Heat Exch. Inlet Temp			1		°F		RIO-HVAC-C
128	PIT-06363	HHW Pri. Heat Exch. Outlet PSI			1		PSI		RIO-HVAC-C
129	TE-06363	HHW Pri. Heat Exch. Outlet Temp			1		°F		RIO-HVAC-C
130	PIT-06731	Chill Water Supply Pressure			1		PSI		RIO-HVAC-R
131	TE-06731	Chill Water Supply Temp.			1		°F		RIO-HVAC-R
132	PIT-06732	Hot Water Supply Pressure			1		PSI		RIO-HVAC-R
133	TE-06732	Hot Water Supply Temp.			1		°F		RIO-HVAC-R
134	AIT-06701	Laboratory Humidity			1		%		RIO-HVAC-R
135	TE-06701	Laboratory Temperature			1		°F		RIO-HVAC-R
136	TY-06711	R-AHU 1 Cold/Hot Deck Temp			1		°F		RIO-HVAC-R
137	TY-06721	R-AHU 2 Cold/Hot Deck Temp			1		°F		RIO-HVAC-R
138	TY-06771	R-AHU 7 Cold/Hot Deck Temp			1		°F		RIO-HVAC-R
139	PIT-06531	Chill Water Supply Pressure			1		PSI		RIO-HVAC-K
140	TE-06531	Chill Water Supply Temp.			1		°F		RIO-HVAC-K
141	PIT-06532	Hot Water Supply Pressure			1		PSI		RIO-HVAC-K
142	TE-06532	Hot Water Supply Temp.			1		°F		RIO-HVAC-K
143	TY-06511	R-AHU 1 Cold Deck Air Temp.			1		°F		RIO-HVAC-K
144	TY-06512	R-AHU 1 Hot Deck Air Temp.			1		°F		RIO-HVAC-K
145	TY-06521	R-AHU 2 Cold Deck Air Temp.			1		°F		RIO-HVAC-K
146	TY-06522	R-AHU 2 Hot Deck Air Temp.			1		°F		RIO-HVAC-K
147	TI-82100	Dig. 1-4 CP Digester #1 Temp			1		°F		RIO-HVAC-J
148	TI-82300	Dig. 1-4 CP Digester #3 Temp			1		°F		RIO-HVAC-J
149	TI-82400	Dig. 1-4 CP Digester #4 Temp			1		°F		RIO-HVAC-J
150	TI-81004	Dig. 5-9 CP Digester #5 Temp			1		°F		RIO-HVAC-J
151	TI-81031	Dig. 5-9 CP Digester #7 Temp			1		°F		RIO-HVAC-J
152	TI-81040	Dig. 5-9 CP Digester #8 Temp			1		°F		RIO-HVAC-J
153	FIT-06401	Heat Exchanger 1-3 Flow			1		GPM		RIO-HVAC-J
154	TE-06402	Heat Exchanger 1-3 Inlet Temp			1		°F		RIO-HVAC-J
155	TE-06403	Heat Exchanger 1-3 Outlet Temp			1		°F		RIO-HVAC-J
156	TE-06412	Heat Exchanger 4-6 Inlet Temp			1		°F		RIO-HVAC-J
157	TE-06413	Heat Exchanger 4-6 Outlet Temp			1		°F		RIO-HVAC-J
158	FIT-06411	Heat Exchanger 4-6 Flow			1		GPM		RIO-HVAC-J
159	PIT-06104	A-AHU 1 Inlet Hot Water Pressure			1		PSI		RIO-HVAC-A
160	TE-06104	A-AHU 1 Inlet Hot Water Temp			1		°F		RIO-HVAC-A

Cedar Creek Water Pollution Control Plant
SCADA System Improvements
Building B – PLC-HVAC-B Control Panel I/O List

No.	Tag Number	Description	DI	DO	AI	AO	Units	Range	Notes
161	PIT-06105	A-AHU 1 Inlet Cold Water PSI			1		PSI		RIO-HVAC-A
162	TE-06105	A-AHU 1 Inlet Cold Water Temp			1		°F		RIO-HVAC-A
163	TI-06102	A-AHU 1 Hot Deck Air Temp			1		°F		RIO-HVAC-A
164	TI-06103	A-AHU 1 Cold Deck Air Temp			1		°F		RIO-HVAC-A
165	AIT-06101	Laboratory Humidity			1		%		RIO-HVAC-A
166	TE-06101	Laboratory Temperature			1		°F		RIO-HVAC-A
		Total Number Of I/O	97	0	69	0			

Cedar Creek Water Pollution Control Plant
SCADA System Improvements

Building B Basement – Protected Water Pump PLC Control Panel I/O List (Add I/O to Existing PLC)

No.	Tag Number	Description	DI	DO	AI	AO	Units	Range	Notes
1		Seal Water Flow to Raw Sewage Pumps			1				
2									
3									
4									
5									
6									
7									
		Total Number Of I/O	0	0	1	0			

Cedar Creek Water Pollution Control Plant
SCADA System Improvements
Building C – RIO-HVAC-C Control Panel I/O List

No.	Tag Number	Description	DI	DO	AI	AO	Units	Range	Notes
1	FSL-06336	Domestic HW Low Flow Switch	1						
2		PLC-HVAC-C Enclosure Door Intrusion	1						
3	FIT-06391	Absorber Total Waste Steam			1		kp-ph		
4	TE-06331	Chilled Water Supply Temp			1		°F		
5	FIT-06392	Primary Heat Exh. Waste Steam			1		kp-ph		
6	TE-06332	Chilled Water Return Temp			1		°F		
7	FIT-06330	Chiller Water Flow			1		GPM		
8	PIT-06341	F.O. Pump Discharge PSI			1		PSI		
9	TE-06336	Domestic HW Temp			1		°F		
10	LIT-06337	Engine/Boiler cond. Tank Level			1		Inches H ₂ O		
11	PIT-06344	F.O. Tank Strainer Delta-P			1		PSI		
12	FIT-06251	Combined Fuel Oil Supply Flow			1		GPM		
13	FIT-06252	Combined Fuel Oil Return Flow			1		GPM		
14	PIT-06333	CW Makeup Water PSI			1		PSI		
15	TE-06372	Outdoor Temperature			1		°F		
16	PIT-06361	HHW Makeup Water PSI			1		PSI		
17	TE-06382	Screened Effluent Return Temp			1		°F		
18	LIT-06342	Fuel Oil Tank #19 Level			1		%		
19	LIT-06343	Fuel Oil Tank #20 Level			1		%		
20	FIT-06334	Dig. 1-4 Space Heating HW Flow			1		GPM		
21	FIT-06335	Dig. 5-9 Space Heating HW Flow			1		GPM		
22	FIT-06393	Secondary Heat Exch. Waste Steam			1		PSI		
23	TE-06381	Screen Effluent Supply Temp			1		°F		
24	TE-06371	Hot Water Supply Temp.			1		°F		
25	PIT-06351	Pri Heat Exch. #1 Shell PSI			1		PSI		
26	PIT-06352	Pri Heat Exch. #2 Shell PSI			1		PSI		
27	PIT-06353	Pri Heat Exch. #3 Shell PSI			1		PSI		
28	PIT-06354	Pri Heat Exch. #4 Shell PSI			1		PSI		
29	PIT-06362	HHW Pri. Heat Exch. Inlet PSI			1		PSI		
30	TE-06362	HHW Pri. Heat Exch. Inlet Temp			1		°F		
31	PIT-06363	HHW Pri. Heat Exch. Outlet PSI			1		PSI		
32	TE0-6363	HHW Pri. Heat Exch. Outlet Temp			1		°F		
33									
34									
35									
	Total Number Of I/O		2	0	30	0			

Cedar Creek Water Pollution Control Plant
SCADA System Improvements
Building FP – PLC-FPB Control Panel I/O List

No.	Tag Number	Description	DI	DO	AI	AO	Units	Range	Notes
1		PLC-FPB Enclosure Door Intrusion	1						
2		Fire Pump Flow			1				
3									
4									
5									
6									
7									
		Total Number Of I/O	1	0	1	0			

Cedar Creek Water Pollution Control Plant
SCADA System Improvements
Building F – PLC-PST-1 I/O List

No.	Tag Number	Description	DI	DO	AI	AO	Units	Range	Notes
1	IAH-30110	Primary Tank #1 Cross Collector Overload	1						
2	IL-30110	Primary Tank #1 Cross Collector Run Status	1						
3	ZA-30113	Primary Tank #1 Cross Collector Shear Pin	1						
4	IAH-30120	Primary Tank #1 Longitudinal Collect Overload	1						
5	IL-30120	Primary Tank #1 Longitudinal Collect Run Status	1						
6	ZA-30123	Primary Tank #1 Longitudinal Collect Shear Pin	1						
7	IAH-30130	Primary Tank #1 Scum Pipe Overload	1						
8	IL-30130	Primary Tank #1 Scum Pipe Run Status	1						
9	IL-30131	Primary Tank #1 Scum Pipe Auto Status	1						
10	IAH-30140	Primary Sludge Pump #1 Overload	1						
11	IL-30140	Primary Sludge Pump #1 Run Status	1						
12	IL-30141	Primary Sludge Pump #1 Auto Status	1						
13	PAH-30143	Primary Sludge Pump #1 Hi Discharge Press	1						
14	PAL-30146	Primary Sludge Pump #1 Seal Water Pressure Low	1						
15	IL-30150	Primary Sludge Pump #1 Discharge Valve Open	1						
16	IL-30151	Primary Sludge Pump #1 Discharge Valve Auto Status	1						
17	IAH-30210	Primary Tank #2 Cross Collector Overload	1						
18	IL-30210	Primary Tank #2 Cross Collector Run Status	1						
19	ZA-30213	Primary Tank #2 Cross Collector Shear Pin	1						
20	IAH-30220	Primary Tank #2 Longitudinal Collect Overload	1						
21	IL-30220	Primary Tank #2 Longitudinal Collect Run Status	1						
22	ZA-30223	Primary Tank #2 Longitudinal Collect Shear Pin	1						
23	IAH-30230	Primary Tank #2 Scum Pipe Overload	1						
24	IL-30230	Primary Tank #2 Scum Pipe Run Status	1						
25	IL-30231	Primary Tank #2 Scum Pipe Auto Status	1						
26	IAH-30240	Primary Sludge Pump #2 Overload	1						
27	IL-30240	Primary Sludge Pump #2 Run Status	1						
28	IL-30241	Primary Sludge Pump #2 Auto Status	1						
29	PAH-30243	Primary Sludge Pump #2 Hi Discharge Press	1						
30	FAL-30246	Primary Sludge Pump #2 Seal Water Pressure Low	1						
31	IL-30250	Primary Sludge Pump #2 Discharge Valve Open	1						
32	IL-30251	Primary Sludge Pump #2 Discharge Valve Auto Status	1						
33	IAH-30310	Primary Tank #3 Cross Collector Overload	1						
34	IL-30310	Primary Tank #3 Cross Collector Run Status	1						
35	ZA-30313	Primary Tank #3 Cross Collector Shear Pin	1						
36	IAH-30320	Primary Tank #3 Longitudinal Collect Overload	1						
37	IL-30320	Primary Tank #3 Longitudinal Collect Run Status	1						
38	ZA-30323	Primary Tank #3 Longitudinal Collect Shear Pin	1						
39	IAH-30330	Primary Tank #3 Scum Pipe Overload	1						
40	IL-30330	Primary Tank #3 Scum Pipe Run Status	1						

Cedar Creek Water Pollution Control Plant
SCADA System Improvements
Building F – PLC-PST-1 I/O List

No.	Tag Number	Description	DI	DO	AI	AO	Units	Range	Notes
41	IL-30331	Primary Tank #3 Scum Pipe Auto Status	1						
42	IAH-30340	Primary Sludge Pump #3 Overload	1						
43	IL-30340	Primary Sludge Pump #3 Run Status	1						
44	IL-30341	Primary Sludge Pump #3 Auto Status	1						
45	PAH-30343	Primary Sludge Pump #3 Hi Discharge Press	1						
46	FAL-30346	Primary Sludge Pump #3 Seal Water Pressure Low	1						
47	IL-30350	Primary Sludge Pump #3 Discharge Valve Open	1						
48	IL-30351	Primary Sludge Pump #3 Discharge Valve Auto Status	1						
49	IAH-30410	Primary Tank #4 Cross Collector Overload	1						
50	IL-30410	Primary Tank #4 Cross Collector Run Status	1						
51	ZA-30413	Primary Tank #4 Cross Collector Shear Pin	1						
52	IAH-30420	Primary Tank #4 Longitudinal Collect Overload	1						
53	IL-30420	Primary Tank #4 Longitudinal Collect Run Status	1						
54	ZA-30423	Primary Tank #4 Longitudinal Collect Shear Pin	1						
55	IAH-30430	Primary Tank #4 Scum Pipe Overload	1						
56	IL-30430	Primary Tank #4 Scum Pipe Run Status	1						
57	IL-30431	Primary Tank #4 Scum Pipe Auto Status	1						
58	IAH-30440	Primary Sludge Pump #4 Overload	1						
59	IL-30440	Primary Sludge Pump #4 Run Status	1						
60	IL-30441	Primary Sludge Pump #4 Auto Status	1						
61	PAH-30443	Primary Sludge Pump #4 Hi Discharge Press	1						
62	FAL-30446	Primary Sludge Pump #4 Seal Water Pressure Low	1						
63	IL-30450	Primary Sludge Pump #4 Discharge Valve Open	1						
64	IL-30451	Primary Sludge Pump #4 Discharge Valve Auto Status	1						
65	IAH-30510	Primary Tank #5 Cross Collector Overload	1						
66	IL-30510	Primary Tank #5 Cross Collector Run Status	1						
67	ZA-30513	Primary Tank #5 Cross Collector Shear Pin	1						
68	IAH-30520	Primary Tank #5 Longitudinal Collect Overload	1						
69	IL-30520	Primary Tank #5 Longitudinal Collect Run Status	1						
70	ZA-30523	Primary Tank #5 Longitudinal Collect Shear Pin	1						
71	IAH-30530	Primary Tank #5 Scum Pipe Overload	1						
72	IL-30530	Primary Tank #5 Scum Pipe Run Status	1						
73	IL-30531	Primary Tank #5 Scum Pipe Auto Status	1						
74	IAH-30540	Primary Sludge Pump #5 Overload	1						
75	IL-30540	Primary Sludge Pump #5 Run Status	1						
76	IL-30541	Primary Sludge Pump #5 Auto Status	1						
77	PAH-30543	Primary Sludge Pump #5 Hi Discharge Press	1						
78	FAL-30546	Primary Sludge Pump #5 Seal Water Pressure Low	1						
79	IL-30550	Primary Sludge Pump #5 Discharge Valve Open	1						
80	IL-30551	Primary Sludge Pump #5 Discharge Valve Auto Status	1						

Cedar Creek Water Pollution Control Plant
SCADA System Improvements
Building F – PLC-PST-1 I/O List

No.	Tag Number	Description	DI	DO	AI	AO	Units	Range	Notes
81	IAH-30610	Primary Tank #6 Cross Collector Overload	1						
82	IL-30610	Primary Tank #6 Cross Collector Run Status	1						
83	ZA-30613	Primary Tank #6 Cross Collector Shear Pin	1						
84	IAH-30620	Primary Tank #6 Longitudinal Collect Overload	1						
85	IL-30620	Primary Tank #6 Longitudinal Collect Run Status	1						
86	IAH-30623	Primary Tank #6 Longitudinal Collect Shear Pin	1						
87	IAH-30630	Primary Tank #6 Scum Pipe Overload	1						
88	IL-30630	Primary Tank #6 Scum Pipe Run Status	1						
89	IL-30631	Primary Tank #6 Scum Pipe Auto Status	1						
90	IAH-30640	Primary Sludge Pump #6 Overload	1						
91	IL-30640	Primary Sludge Pump #6 Run Status	1						
92	IL-30641	Primary Sludge Pump #6 Auto Status	1						
93	PAH-30643	Primary Sludge Pump #6 Hi Discharge Press	1						
94	FAL-30646	Primary Sludge Pump #6 Seal Water Pressure Low	1						
95	IL-30650	Primary Sludge Pump #6 Discharge Valve Open	1						
96	IL-30651	Primary Sludge Pump #6 Discharge Valve Auto Status	1						
97		Substation T4 Primary Switch 1 Open Status	1						
98		Substation T4 Primary Switch 1 Closed Status	1						
99		Substation T4 Primary Switch 2 Open Status	1						
100		Substation T4 Primary Switch 2 Closed Status	1						
101		Substation T4 Primary Switch 3 Open Status	1						
102		Substation T4 Primary Switch 3 Closed Status	1						
103		Substation T4 Primary Switch 4 Open Status	1						
104		Substation T4 Primary Switch 4 Closed Status	1						
105		PLC-PST-1 Enclosure Door Intrusion	1						
106	HS-30110	Primary Tank 1 Cross Collector Start/Stop Command		1					
107	HS-30120	Primary Tank 1 Longitudinal Collector Start/Stop Command		1					
108	KY-30130	Primary Tank 1 Scum Pipe Cycle Timer Output		1					
109	KY-30140	Primary Sludge Pump 1 Start		1					
110	ZA-30100	Cross & Long Collector Common Alarm		1					
111	PB-30153.1	Primary Sludge Pump 1 Speed Increase		1					
112	PB-30153.2	Primary Sludge Pump 1 Speed Decrease		1					
113	KY-30150	Primary Sludge Pump 1 Discharge Valve Open		1					
114	HS-30210	Primary Tank 2 Cross Collector Start/Stop Command		1					
115	HS-30220	Primary Tank 2 Longitudinal Collector Start/Stop Command		1					
116	KY-30230	Primary Tank 2 Scum Pipe Cycle Timer Output		1					
117	KY-30240	Primary Sludge Pump 2 Start		1					
118	ZA-30200	Cross & Long Collector Common Alarm		1					
119	PB-30253.1	Primary Sludge Pump 2 Speed Increase		1					
120	PB-30253.2	Primary Sludge Pump 2 Speed Decrease		1					

Cedar Creek Water Pollution Control Plant
SCADA System Improvements
Building F – PLC-PST-1 I/O List

No.	Tag Number	Description	DI	DO	AI	AO	Units	Range	Notes
121	KY-30250	Primary Sludge Pump 2 Discharge Valve Open		1					
122	HS-30310	Primary Tank 3 Cross Collector Start/Stop Command		1					
123	HS-30320	Primary Tank 3 Longitudinal Collector Start/Stop Command		1					
124	KY-30330	Primary Tank 3 Scum Pipe Cycle Timer Output		1					
125	KY-30340	Primary Sludge Pump 3 Start		1					
126	ZA-30300	Cross & Long Collector Common Alarm		1					
127	PB-30353.1	Primary Sludge Pump 3 Speed Increase		1					
128	PB-30353.2	Primary Sludge Pump 3 Speed Decrease		1					
129	KY-30350	Primary Sludge Pump 3 Discharge Valve Open		1					
130	HS-30410	Primary Tank 4 Cross Collector Start/Stop Command		1					
131	HS-30420	Primary Tank 4 Longitudinal Collector Start/Stop Command		1					
132	KY-30430	Primary Tank 4 Scum Pipe Cycle Timer Output		1					
133	KY-30440	Primary Sludge Pump 4 Start		1					
134	ZA-30400	Cross & Long Collector Common Alarm		1					
135	PB-30453.1	Primary Sludge Pump 4 Speed Increase		1					
136	PB-30453.2	Primary Sludge Pump 4 Speed Decrease		1					
137	KY-30450	Primary Sludge Pump 4 Discharge Valve Open		1					
138	HS-30510	Primary Tank 5 Cross Collector Start/Stop Command		1					
139	HS-30520	Primary Tank 5 Longitudinal Collector Start/Stop Command		1					
140	KY-30530	Primary Tank 5 Scum Pipe Cycle Timer Output		1					
141	KY-30540	Primary Sludge Pump 5 Start		1					
142	ZA-30500	Cross & Long Collector Common Alarm		1					
143	PB-30553.1	Primary Sludge Pump 5 Speed Increase		1					
144	PB-30553.2	Primary Sludge Pump 5 Speed Decrease		1					
145	KY-30550	Primary Sludge Pump 5 Discharge Valve Open		1					
146	HS-30610	Primary Tank 6 Cross Collector Start/Stop Command		1					
147	HS-30620	Primary Tank 6 Longitudinal Collector Start/Stop Command		1					
148	KY-30630	Primary Tank 6 Scum Pipe Cycle Timer Output		1					
149	KY-30640	Primary Sludge Pump 6 Start		1					
150	ZA-30600	Cross & Long Collector Common Alarm		1					
151	PB-30653.1	Primary Sludge Pump 6 Speed Increase		1					
152	PB-30653.2	Primary Sludge Pump 6 Speed Decrease		1					
153	KY-30650	Primary Sludge Pump 6 Discharge Valve Open		1					
154		Primary Sed Tank #1 Gas Detector Fault		1					Reserved for Future
155		Primary Sed Tank #2 Gas Detector Fault		1					Reserved for Future
156		Primary Sed Tank #3 Gas Detector Fault		1					Reserved for Future
157		Primary Sed Tank #4 Gas Detector Fault		1					Reserved for Future
158		Primary Sed Tank #5 Gas Detector Fault		1					Reserved for Future
159		Primary Sed Tank #6 Gas Detector Fault		1					Reserved for Future
160	FI-30701	Primary Sludge Flow to Digesters Tanks 1-6			1				

Cedar Creek Water Pollution Control Plant
SCADA System Improvements
Building F – PLC-PST-1 I/O List

No.	Tag Number	Description	DI	DO	AI	AO	Units	Range	Notes
161	LIT-1500-1	Primary Sed Tank 1 Sludge Blanket Level			1				
162	LIT-1500-2	Primary Sed Tank 2 Sludge Blanket Level			1				
163	LIT-1500-3	Primary Sed Tank 3 Sludge Blanket Level			1				
164	LIT-1500-4	Primary Sed Tank 4 Sludge Blanket Level			1				
165	LIT-1500-5	Primary Sed Tank 5 Sludge Blanket Level			1				
166	LIT-1500-6	Primary Sed Tank 6 Sludge Blanket Level			1				
167		Sodium Hypochlorite Storage Tank #1 - For Scrubber			1				Reserved for Future
168		Caustic Storage Tank #1 - For Scrubber			1				Reserved for Future
169		Primary Sed Tank #1 Combustable Gas Detector			1		%LEL		Reserved for Future
170		Primary Sed Tank #2 Combustable Gas Detector			1		%LEL		Reserved for Future
171		Primary Sed Tank #3 Combustable Gas Detector			1		%LEL		Reserved for Future
172		Primary Sed Tank #4 Combustable Gas Detector			1		%LEL		Reserved for Future
173		Primary Sed Tank #5 Combustable Gas Detector			1		%LEL		Reserved for Future
174		Primary Sed Tank #6 Combustable Gas Detector			1		%LEL		Reserved for Future
175		Primary Sludge Header Total Suspended Solids			1				Reserved for Future
176		Building F/J Protected Water Flow			1				Reserved for Future
		Total Number Of I/O	105	54	17	0			

Cedar Creek Water Pollution Control Plant
SCADA System Improvements
Building G/GG – PLC-PST-2 I/O List

No.	Tag Number	Description	DI	DO	AI	AO	Units	Range	Notes
1	IAH-31110	Primary Tank #7 Cross Collector Overload	1						
2	IL-31110	Primary Tank #7 Cross Collector Run Status	1						
3	ZA-31113	Primary Tank #7 Cross Collector Shear Pin	1						
4	IAH-31120	Primary Tank #7 Longitudinal Collect Overload	1						
5	ZA-31123	Primary Tank #7 Longitudinal Collect Shear Pin	1						
6	IAH-31130	Primary Tank #7 Scum Pipe Overload	1						
7	IL-31130	Primary Tank #7 Scum Pipe Run Status	1						
8	IL-31131	Primary Tank #7 Scum Pipe Auto Status	1						
9	IAH-31140	Primary Sludge Pump #7 Overload	1						
10	IL-31140	Primary Sludge Pump #7 Run Status	1						
11	IL-31141	Primary Sludge Pump #7 Auto Status	1						
12	PAH-31143	Primary Sludge Pump #7 Hi Discharge Press	1						
13	FAL-31146	Primary Sludge Pump #7 Seal Water Flow Low	1						
14	IL-31150	Primary Sludge Pump #7 Discharge Valve Open	1						
15	IL-31151	Primary Sludge Pump #7 Discharge Valve Auto Status	1						
16	IAH-31210	Primary Tank #8 Cross Collector Overload	1						
17	IL-31210	Primary Tank #8 Cross Collector Run Status	1						
18	ZA-31213	Primary Tank #8 Cross Collector Shear Pin	1						
19	IAH-31220	Primary Tank #8 Longitudinal Collect Overload	1						
20	IL-31220	Primary Tank #8 Longitudinal Collect Run Status	1						
21	ZA-31223	Primary Tank #8 Longitudinal Collect Shear Pin	1						
22	IAH-31230	Primary Tank #8 Scum Pipe Overload	1						
23	IL-31230	Primary Tank #8 Scum Pipe Run Status	1						
24	IL-31231	Primary Tank #8 Scum Pipe Auto Status	1						
25	IAH-31240	Primary Sludge Pump #8 Overload	1						
26	IL-31240	Primary Sludge Pump #8 Run Status	1						
27	IL-31241	Primary Sludge Pump #8 Auto Status	1						
28	PAH-31243	Primary Sludge Pump #8 Hi Discharge Press	1						
29	FAL-31246	Primary Sludge Pump #8 Seal Water Flow Low	1						
30	IL-31250	Primary Sludge Pump #8 Discharge Valve Open	1						
31	IL-31251	Primary Sludge Pump #8 Discharge Valve Auto Status	1						
32	IAH-31310	Primary Tank #9 Cross Collector Overload	1						
33	IL-31310	Primary Tank #9 Cross Collector Run Status	1						
34	ZA-31313	Primary Tank #9 Cross Collector Shear Pin	1						
35	IAH-31320	Primary Tank #9 Longitudinal Collect Overload	1						
36	IL-31320	Primary Tank #9 Longitudinal Collect Run Status	1						
37	ZA-31323	Primary Tank #9 Longitudinal Collect Shear Pin	1						
38	IAH-31330	Primary Tank #9 Scum Pipe Overload	1						
39	IL-31330	Primary Tank #9 Scum Pipe Run Status	1						
40	IL-31331	Primary Tank #9 Scum Pipe Auto Status	1						

Cedar Creek Water Pollution Control Plant
SCADA System Improvements
Building G/GG – PLC-PST-2 I/O List

No.	Tag Number	Description	DI	DO	AI	AO	Units	Range	Notes
41	IAH-31340	Primary Sludge Pump #9 Overload	1						
42	IL-31340	Primary Sludge Pump #9 Run Status	1						
43	IL-31341	Primary Sludge Pump #9 Auto Status	1						
44	PAH-31343	Primary Sludge Pump #9 Hi Discharge Press	1						
45	FAL-31346	Primary Sludge Pump #9 Seal Water Flow Low	1						
46	IL-31350	Primary Sludge Pump #9 Discharge Valve Open	1						
47	IL-31351	Primary Sludge Pump #9 Discharge Valve Auto Status	1						
48	IAH-31410	Primary Tank #10 Cross Collector Overload	1						
49	IL-31410	Primary Tank #10 Cross Collector Run Status	1						
50	ZA-31413	Primary Tank #10 Cross Collector Shear Pin	1						
51	IAH-31420	Primary Tank #10 Longitudinal Collect Overload	1						
52	IL-31420	Primary Tank #10 Longitudinal Collect Run Status	1						
53	ZA-31423	Primary Tank #10 Longitudinal Collect Shear Pin	1						
54	IAH-31430	Primary Tank #10 Scum Pipe Overload	1						
55	IL-31430	Primary Tank #10 Scum Pipe Run Status	1						
56	IL-31431	Primary Tank #10 Scum Pipe Auto Status	1						
57	IAH-31440	Primary Sludge Pump #10 Overload	1						
58	IL-31440	Primary Sludge Pump #10 Run Status	1						
59	IL-31441	Primary Sludge Pump #10 Auto Status	1						
60	PAH-31443	Primary Sludge Pump #10 Hi Discharge Press	1						
61	FAL-31446	Primary Sludge Pump #10 Seal Water Flow Low	1						
62	IL-31450	Primary Sludge Pump #10 Discharge Valve Open	1						
63	IL-31451	Primary Sludge Pump #10 Discharge Valve Auto Status	1						
64	IL-31450	Primary Sludge Pump #10 Discharge Valve Open	1						
65	IL-31451	Primary Sludge Pump #10 Discharge Valve Auto Status	1						
66		PLC-PST-2 Enclosure Door Intrusion	1						
67	HS-31110	Primary Tank 7 Cross Collector Start/Stop Command		1					
68	HS-31120	Primary Tank 7 Longitudinal Collector Start/Stop Command		1					
69	KY-31130	Primary Tank 7 Scum Pipe Cycle Timer Output		1					
70	KY-31140	Primary Sludge Pump 7 Start		1					
71	ZA-31100	Gross & Long Collector Common Alarm		1					
72	PB-31153.1	Primary Sludge Pump 7 Speed Increase		1					
73	PB-31153.2	Primary Sludge Pump 7 Speed Decrease		1					
74	KY-31150	Primary Sludge Pump 7 Discharge Valve Open		1					
75	HS-31210	Primary Tank 8 Cross Collector Start/Stop Command		1					
76	HS-31220	Primary Tank 8 Longitudinal Collector Start/Stop Command		1					
77	KY-31230	Primary Tank 8 Scum Pipe Cycle Timer Output		1					
78	KY-31240	Primary Sludge Pump 8 Start		1					
79	ZA-31200	Gross & Long Collector Common Alarm		1					
80	PB-31253.1	Primary Sludge Pump 8 Speed Increase		1					

Cedar Creek Water Pollution Control Plant
SCADA System Improvements
Building G/GG – PLC-PST-2 I/O List

No.	Tag Number	Description	DI	DO	AI	AO	Units	Range	Notes
81	PB-31253.2	Primary Sludge Pump 8 Speed Decrease		1					
82	KY-31250	Primary Sludge Pump 8 Discharge Valve Open		1					
83	HS-31310	Primary Tank 9 Cross Collector Start/Stop Command		1					
84	HS-31320	Primary Tank 9 Longitudinal Collector Start/Stop Command		1					
85	KY-31330	Primary Tank 9 Scum Pipe Cycle Timer Output		1					
86	KY-31340	Primary Sludge Pump 9 Start		1					
87	ZA-31310	Cross & Long Collector Common Alarm		1					
88	PB-31353.1	Primary Sludge Pump 9 Speed Increase		1					
89	PB-31353.2	Primary Sludge Pump 9 Speed Decrease		1					
90	KY-31350	Primary Sludge Pump 9 Discharge Valve Open		1					
91	HS-31410	Primary Tank 10 Cross Collector Start/Stop Command		1					
92	HS-31420	Primary Tank 10 Longitudinal Collector Start/Stop Command		1					
93	KY-31430	Primary Tank 10 Scum Pipe Cycle Timer Output		1					
94	KY-31440	Primary Sludge Pump 10 Start		1					
95	ZA-31400	Cross & Long Collector Common Alarm		1					
96	PB-31453.1	Primary Sludge Pump 10 Speed Increase		1					
97	PB-31453.2	Primary Sludge Pump 10 Speed Decrease		1					
98	KY-31450	Primary Sludge Pump 10 Discharge Valve Open		1					
99		Primary Sed Tank #7 Gas Detector Fault		1					Reserved for Future
100		Primary Sed Tank #8 Gas Detector Fault		1					Reserved for Future
101		Primary Sed Tank #9 Gas Detector Fault		1					Reserved for Future
102		Primary Sed Tank #10 Gas Detector Fault		1					Reserved for Future
103	FI-310308	Primary Sludge Flow to Digesters Tanks 7-10			1				
104	LIT-1500-7	Primary Sed Tank 7 Sludge Blanket Level			1				
105	LIT-1500-8	Primary Sed Tank 8 Sludge Blanket Level			1				
106	LIT-1500-9	Primary Sed Tank 9 Sludge Blanket Level			1				
107	LIT-1500-10	Primary Sed Tank 10 Sludge Blanket Level			1				
108		Sodium Hypochlorite Storage Tank #1 - North Primary			1				Reserved for Future
109		Caustic Storage Tank #1 - North Primary			1				Reserved for Future
110		Sodium Hypochlorite Storage Tank #1 - South Primary			1				Reserved for Future
111		Caustic Storage Tank #1 - South Primary			1				Reserved for Future
112		Primary Sed Tank #7 Combustible Gas Detector			1		%LEL		Reserved for Future
113		Primary Sed Tank #8 Combustible Gas Detector			1		%LEL		Reserved for Future
114		Primary Sed Tank #9 Combustible Gas Detector			1		%LEL		Reserved for Future
115		Primary Sed Tank #10 Combustible Gas Detector			1		%LEL		Reserved for Future
116		Primary Sludge Header Total Suspended Solids			1				Reserved for Future
		Total Number Of I/O	66	36	14	0			

Cedar Creek Water Pollution Control Plant
SCADA System Improvements
Building H – PLC-GBT Control Panel I/O List

No.	Tag Number	Description	DI	DO	AI	AO	Units	Range	Notes
1		Building J Protected Water Flow			1				
2		Building J/K Protected Water Flow			1				
3		Building J/K Domestic Water Flow			1				
4									
5									
6									
7									
8									
9									
10									
11									
		Total Number Of I/O	0	0	3	0			

Cedar Creek Water Pollution Control Plant
SCADA System Improvements
Building H – DAF Control Room RIO-DIG-1 I/O List

No.	Tag Number	Description	DI	DO	AI	AO	Units	Range	Notes
25		Thickened Sludge Well Level			1				
26		Subnatant Well Level			1				
27		Settled Solids Discharge Flow			1				
28		Thickened Sludge Header Discharge Flow			1				
29		Subnatant Header Discharge Flow			1				
30	AE-93009	Building H Basement Methane Gas Detection			1				
31	AE-93010	Building H Basement Methane Gas Detection			1				
32	AE-93011	Building H First Floor Methane Gas Detection			1				
33	AE-93012	Building H First Floor Methane Gas Detection			1				
34	AE-93013	Building H First Floor Methane Gas Detection			1				
35	AE-93009	Sensor AE-93009 Basement LEL Sensor Fault	1						Reserved for Future
36	AE-93010	Sensor AE-93010 Basement LEL Sensor Fault	1						Reserved for Future
37	AE-93011	Sensor AE-93011 First Floor LEL Sensor Fault	1						Reserved for Future
38	AE-93012	Sensor AE-93012 First Floor LEL Sensor Fault	1						Reserved for Future
39	AE-93013	Sensor AE-93013 First Floor LEL Sensor Fault	1						Reserved for Future
40		DAF Area H2S Indication #1			1				Reserved for Future
41		DAF Area H2S Indication #2			1				Reserved for Future
42		DAF Area H2S Indication #3			1				Reserved for Future
43		DAF Area H2S Indication #4			1				Reserved for Future
44		DAF Area H2S Sensor #1 Fault	1						Reserved for Future
45		DAF Area H2S Sensor #2 Fault	1						Reserved for Future
46		DAF Area H2S Sensor #3 Fault	1						Reserved for Future
47		DAF Area H2S Sensor #4 Fault	1						Reserved for Future
		Total Number Of I/O	9	0	14	0			

Cedar Creek Water Pollution Control Plant
SCADA System Improvements
Building J – Digester Control Panel (PLC-J) I/O List

No.	Tag Number	Description	DI	DO	AI	AO	Units	Range	Notes
1		Coalescing Duplex Filter Drain Line Moisture Sensor Fault	1						Via Capacitance Probe
13		Compressor # 10 Low Oil Flow	1						From PrimGasCmpr Panel
14		Compressor # 10 Low Oil Level	1						From PrimGasCmpr Panel
15		Compressor # 10 Remote Status	1						From PrimGasCmpr Panel
16		Compressor # 10 Run Status	1						From PrimGasCmpr Panel
17		Compressor # 6 Low Oil Flow	1						From PrimGasCmpr Panel
18		Compressor # 6 Low Oil Level	1						From PrimGasCmpr Panel
19		Compressor # 6 Remote Status	1						From PrimGasCmpr Panel
20		Compressor # 6 Run Status	1						From PrimGasCmpr Panel
21		Compressor # 7 Low Oil Flow	1						From PrimGasCmpr Panel
22		Compressor # 7 Low Oil Level	1						From PrimGasCmpr Panel
23		Compressor # 7 Remote Status	1						From PrimGasCmpr Panel
24		Compressor # 7 Run Status	1						From PrimGasCmpr Panel
25		Compressor # 8 Low Oil Flow	1						From PrimGasCmpr Panel
26		Compressor # 8 Low Oil Level	1						From PrimGasCmpr Panel
27		Compressor # 8 Remote Status	1						From PrimGasCmpr Panel
28		Compressor # 8 Run Status	1						From PrimGasCmpr Panel
29		Compressor # 9 Low Oil Flow	1						From PrimGasCmpr Panel
30		Compressor # 9 Low Oil Level	1						From PrimGasCmpr Panel
31		Compressor # 9 Remote Status	1						From PrimGasCmpr Panel
32		Compressor # 9 Run Status	1						From PrimGasCmpr Panel
33		Compressor 10 High Discharge Temperature	1						From PrimGasCmpr Panel
34		Compressor 10 Low Cooling Water Flow	1						From PrimGasCmpr Panel
35		Compressor 10 Malfunction	1						From PrimGasCmpr Panel
36		Compressor 6 High Discharge Temperature	1						From PrimGasCmpr Panel
37		Compressor 6 Low Cooling Water Flow	1						From PrimGasCmpr Panel
38		Compressor 6 Malfunction	1						From PrimGasCmpr Panel
39		Compressor 7 High Discharge Temperature	1						From PrimGasCmpr Panel
40		Compressor 7 Low Cooling Water Flow	1						From PrimGasCmpr Panel

Cedar Creek Water Pollution Control Plant
SCADA System Improvements
Building J – Digester Control Panel (PLC-J) I/O List

No.	Tag Number	Description	DI	DO	AI	AO	Units	Range	Notes
41		Compressor 7 Malfunction	1						From PrimGasCmpr Panel
42		Compressor 8 High Discharge Temperature	1						From PrimGasCmpr Panel
43		Compressor 8 Low Cooling Water Flow	1						From PrimGasCmpr Panel
44		Compressor 8 Malfunction	1						From PrimGasCmpr Panel
45		Compressor 9 High Discharge Temperature	1						From PrimGasCmpr Panel
46		Compressor 9 Low Cooling Water Flow	1						From PrimGasCmpr Panel
47		Compressor 9 Malfunction	1						From PrimGasCmpr Panel
48		Compressor Sequence Selection #1	1						From PrimGasCmpr Panel
49		Compressor Sequence Selection #2	1						From PrimGasCmpr Panel
50		Compressor Sequence Selection #3	1						From PrimGasCmpr Panel
51		Compressor Sequence Selection #4	1						From PrimGasCmpr Panel
52		Compressor Sequence Selection #5	1						From PrimGasCmpr Panel
53		Digested Sludge Pumps Header Pressure High	1						From Dig 5-9 Panel
54		Digested Sludge Pumps Header Pressure Low	1						From Dig 5-9 Panel
55		Digester Basement Gas Detected	1						From Dig 1-4 Panel
56		Digester No. 1 Foam Detected	1						Reserved for future
57		Digester No. 1 Sludge Level High	1						From Dig 1-4 Panel
58		Digester No. 2 Foam Detected	1						Reserved for future
59		Digester No. 2 Sludge Level High	1						From Dig 1-4 Panel
60		Digester No. 3 Foam Detected	1						Reserved for future
61		Digester No. 3 Sludge Level High	1						From Dig 1-4 Panel
62		Digester No. 4 Foam Detected	1						Reserved for future
63		Digester No. 4 Sludge Level High	1						From Dig 1-4 Panel
64		Digester No. 5 Foam Detected	1						Reserved for future
65		Digester No. 5 Sludge Level High	1						From Dig 5-9 Panel
66		Digester No. 5 Sludge Level Low	1						From Dig 5-9 Panel
67		Digester No. 5 Sludge Temperature High	1						From Dig 5-9 Panel
68		Digester No. 5 Sludge Temperature Low	1						From Dig 5-9 Panel
69		Digester No. 6 Foam Detected	1						Reserved for future
70		Digester No. 6 Sludge Level High	1						From Dig 5-9 Panel
71		Digester No. 6 Sludge Level Low	1						From Dig 5-9 Panel
72		Digester No. 6 Sludge Temperature High	1						From Dig 5-9 Panel
73		Digester No. 6 Sludge Temperature Low	1						From Dig 5-9 Panel
74		Digester No. 7 Foam Detected	1						Reserved for future
75		Digester No. 7 Sludge Level High	1						From Dig 5-9 Panel
76		Digester No. 7 Sludge Level Low	1						From Dig 5-9 Panel
77		Digester No. 7 Sludge Temperature High	1						From Dig 5-9 Panel
78		Digester No. 7 Sludge Temperature Low	1						From Dig 5-9 Panel
79		Digester No. 8 Foam Detected	1						Reserved for future
80		Digester No. 8 Sludge Level High	1						From Dig 5-9 Panel
81		Digester No. 8 Sludge Level Low	1						From Dig 5-9 Panel

Cedar Creek Water Pollution Control Plant
SCADA System Improvements
Building J – Digester Control Panel (PLC-J) I/O List

No.	Tag Number	Description	DI	DO	AI	AO	Units	Range	Notes
82		Digester No. 8 Sludge Temperature High	1						From Dig 5-9 Panel
83		Digester No. 8 Sludge Temperature Low	1						From Dig 5-9 Panel
84		Digester No. 9 Foam Detected	1						Reserved for future
85		Digester No. 9 Sludge Level High	1						From Dig 5-9 Panel
86		Digester No. 9 Sludge Level Low	1						From Dig 5-9 Panel
87		Digester No. 9 Sludge Temperature High	1						From Dig 5-9 Panel
88		Digester No. 9 Sludge Temperature Low	1						From Dig 5-9 Panel
89		Dryer Control Common Alarm	1						
90		Fire/ Smoke	1						From Dig 5-9 Panel
91		Fire/ Smoke Gas Detected	1						From Dig 1-4 Panel
92		Gas Compressor Room Gas Detected	1						From Dig 1-4 Panel
93		Gas Dryer Condensate Drain Line Moisture	1						Via Capacitance Probe
94		Gas Recirculation Compressor No. 10 Disch. Pressure High	1						From Dig 5-9 Panel
95		Gas Recirculation Compressor No. 10 Disch. Temperature High	1						From Dig 5-9 Panel
96		Gas Recirculation Compressor No. 10 Malfuction	1						From Dig 5-9 Panel
97		Gas Recirculation Compressor No. 10 Running	1						From Dig 5-9 Panel
98		Gas Recirculation Compressor No. 10 Suction Pressure Low	1						From Dig 5-9 Panel
99		Gas Recirculation Compressor No. 6 Disch. Pressure High	1						From Dig 5-9 Panel
100		Gas Recirculation Compressor No. 6 Disch. Temperature High	1						From Dig 5-9 Panel
101		Gas Recirculation Compressor No. 6 Malfuction	1						From Dig 5-9 Panel
102		Gas Recirculation Compressor No. 6 Running	1						From Dig 5-9 Panel
103		Gas Recirculation Compressor No. 6 Suction Pressure Low	1						From Dig 5-9 Panel
104		Gas Recirculation Compressor No. 7 Disch. Pressure High	1						From Dig 5-9 Panel
105		Gas Recirculation Compressor No. 7 Disch. Temperature High	1						From Dig 5-9 Panel
106		Gas Recirculation Compressor No. 7 Malfuction	1						From Dig 5-9 Panel
107		Gas Recirculation Compressor No. 7 Running	1						From Dig 5-9 Panel
108		Gas Recirculation Compressor No. 7 Suction Pressure Low	1						From Dig 5-9 Panel
109		Gas Recirculation Compressor No. 8 Disch. Pressure High	1						From Dig 5-9 Panel
110		Gas Recirculation Compressor No. 8 Disch. Temperature High	1						From Dig 5-9 Panel
111		Gas Recirculation Compressor No. 8 Malfuction	1						From Dig 5-9 Panel
112		Gas Recirculation Compressor No. 8 Running	1						From Dig 5-9 Panel
113		Gas Recirculation Compressor No. 8 Suction Pressure Low	1						From Dig 5-9 Panel
114		Gas Recirculation Compressor No. 9 Disch. Pressure High	1						From Dig 5-9 Panel
115		Gas Recirculation Compressor No. 9 Disch. Temperature High	1						From Dig 5-9 Panel
116		Gas Recirculation Compressor No. 9 Malfuction	1						From Dig 5-9 Panel
117		Gas Recirculation Compressor No. 9 Running	1						From Dig 5-9 Panel
118		Gas Recirculation Compressor No. 9 Suction Pressure Low	1						From Dig 5-9 Panel
119		Gas Recirculation Compressor No.1 Disch. Pressure High	1						From Dig 1-4 Panel
120		Gas Recirculation Compressor No.1 Disch. Temperature High	1						From Dig 1-4 Panel
121		Gas Recirculation Compressor No.1 Malfuction	1						From Dig 1-4 Panel
122		Gas Recirculation Compressor No.1 Running	1						From Dig 1-4 Panel

Cedar Creek Water Pollution Control Plant
SCADA System Improvements
Building J – Digester Control Panel (PLC-J) I/O List

No.	Tag Number	Description	DI	DO	AI	AO	Units	Range	Notes
123		Gas Recirculation Compressor No.1 Suction Pressure Low	1						From Dig 1-4 Panel
124		Gas Recirculation Compressor No.2 Disch. Pressure High	1						From Dig 1-4 Panel
125		Gas Recirculation Compressor No.2 Disch. Temperature High	1						From Dig 1-4 Panel
126		Gas Recirculation Compressor No.2 Malfuction	1						From Dig 1-4 Panel
127		Gas Recirculation Compressor No.2 Running	1						From Dig 1-4 Panel
128		Gas Recirculation Compressor No.2 Suction Pressure Low	1						From Dig 1-4 Panel
129		Gas Recirculation Compressor No.3 Disch. Pressure High	1						From Dig 1-4 Panel
130		Gas Recirculation Compressor No.3 Disch. Temperature High	1						From Dig 1-4 Panel
131		Gas Recirculation Compressor No.3 Malfuction	1						From Dig 1-4 Panel
132		Gas Recirculation Compressor No.3 Running	1						From Dig 1-4 Panel
133		Gas Recirculation Compressor No.3 Suction Pressure Low	1						From Dig 1-4 Panel
134		Gas Recirculation Compressor No.4 Disch. Pressure High	1						From Dig 1-4 Panel
135		Gas Recirculation Compressor No.4 Disch. Temperature High	1						From Dig 1-4 Panel
136		Gas Recirculation Compressor No.4 Malfuction	1						From Dig 1-4 Panel
137		Gas Recirculation Compressor No.4 Running	1						From Dig 1-4 Panel
138		Gas Recirculation Compressor No.4 Suction Pressure Low	1						From Dig 1-4 Panel
139		Gas Recirculation Compressor No.5 Disch. Pressure High	1						From Dig 1-4 Panel
140		Gas Recirculation Compressor No.5 Disch. Temperature High	1						From Dig 1-4 Panel
141		Gas Recirculation Compressor No.5 Malfuction	1						From Dig 1-4 Panel
142		Gas Recirculation Compressor No.5 Running	1						From Dig 1-4 Panel
143		Gas Recirculation Compressor No.5 Suction Pressure Low	1						From Dig 1-4 Panel
144		Heat Exchanger No. 4 Inside Tube Diff. Pressure High	1						From Dig 5-9 Panel
145		Heat Exchanger No. 4 Outside Tube Diff. Pressure High	1						From Dig 5-9 Panel
146		Heat Exchanger No. 5 Inside Tube Diff. Pressure High	1						From Dig 5-9 Panel
147		Heat Exchanger No. 5 Outside Tube Diff. Pressure High	1						From Dig 5-9 Panel
148		Heat Exchanger No. 6 Inside Tube Diff. Pressure High	1						From Dig 5-9 Panel
149		Heat Exchanger No. 6 Outside Tube Diff. Pressure High	1						From Dig 5-9 Panel
150		High Discharge Pressure	1						From PrimGasCmpr Panel
151		Instruement Air Flow	1						From Dig 1-4 Panel
152		Low Suction Pressure	1						From PrimGasCmpr Panel
153		Methane System #1 Gas Detection Sensor Fault	1						
154		Methane System #2 Gas Detection Sensor Fault	1						
155		Plant Air Flow	1						From Dig 1-4 Panel
156		PLC Reset Button	1						
157		PLC-DIG Enclosure Door Intrusion	1						
158		Primary Gas Compressor No. 1 Running	1						From Dig 1-4 Panel
159		Primary Gas Compressor No. 2 Running	1						From Dig 1-4 Panel
160		Primary Gas Compressor No. 3 Running	1						From Dig 1-4 Panel
161		Primary Gas Compressor No. 4 Running	1						From Dig 1-4 Panel
162		Primary Gas Compressor No.1 Disch. Temperature High	1						From Dig 1-4 Panel
163		Primary Gas Compressor No.1 Malfuction	1						From Dig 1-4 Panel

Cedar Creek Water Pollution Control Plant
SCADA System Improvements
Building J – Digester Control Panel (PLC-J) I/O List

No.	Tag Number	Description	DI	DO	AI	AO	Units	Range	Notes
164		Primary Gas Compressor No.2 Disch. Temperature High	1						From Dig 1-4 Panel
165		Primary Gas Compressor No.2 Malfuction	1						From Dig 1-4 Panel
166		Primary Gas Compressor No.3 Disch. Temperature High	1						From Dig 1-4 Panel
167		Primary Gas Compressor No.3 Malfuction	1						From Dig 1-4 Panel
168		Primary Gas Compressor No.4 Disch. Temperature High	1						From Dig 1-4 Panel
169		Primary Gas Compressor No.4 Malfuction	1						From Dig 1-4 Panel
170		Primary Gas Compressors Disch. Pressure High	1						From Dig 1-4 Panel
171		Primary Gas Compressors Suction Pressure High	1						From Dig 1-4 Panel
172		Primary Gas Compressors Suction Pressure Low	1						From Dig 1-4 Panel
173		Seal Water Booster Pump 1 Selector	1						From Dig 5-9 Panel
174		Seal Water Booster Pump 2 Selector	1						From Dig 5-9 Panel
175		Seal Water Booster Pump 3 Selector	1						From Dig 5-9 Panel
176	AE-93001	Sensor AE-93001 First Floor LEL Sensor Fault	1						From Dig 5-9 Panel
177	AE-93002	Sensor AE-93002 First Floor LEL Sensor Fault	1						From Dig 5-9 Panel
178	AE-93003	Sensor AE-93003 First Floor LEL Sensor Fault	1						From Dig 5-9 Panel
179	AE-93004	Sensor AE-93004 First Floor LEL Sensor Fault	1						From Dig 5-9 Panel
180	AE-93005	Sensor AE-93005 Basement LEL Sensor Fault	1						From Dig 5-9 Panel
181	AE-93006	Sensor AE-93006 Basement LEL Sensor Fault	1						From Dig 5-9 Panel
182	AE-93007	Sensor AE-93007 Basement LEL Sensor Fault	1						From Dig 5-9 Panel
183	AE-93008	Sensor AE-93008 Basement LEL Sensor Fault	1						From Dig 5-9 Panel
184		Sludge Circulation Pump No. 1 Running	1						From Dig 1-4 Panel
185		Sludge Circulation Pump No. 10 Disch. Pressure High	1						From Dig 5-9 Panel
186		Sludge Circulation Pump No. 10 Malfuction	1						From Dig 5-9 Panel
187		Sludge Circulation Pump No. 10 Remote	1						From Dig 5-9 Panel
188		Sludge Circulation Pump No. 10 Running	1						From Dig 5-9 Panel
189		Sludge Circulation Pump No. 11 Disch. Pressure High	1						From Dig 5-9 Panel
190		Sludge Circulation Pump No. 11 Malfuction	1						From Dig 5-9 Panel
191		Sludge Circulation Pump No. 11 Remote	1						From Dig 5-9 Panel
192		Sludge Circulation Pump No. 11 Running	1						From Dig 5-9 Panel
193		Sludge Circulation Pump No. 12 Disch. Pressure High	1						From Dig 5-9 Panel
194		Sludge Circulation Pump No. 12 Malfuction	1						From Dig 5-9 Panel
195		Sludge Circulation Pump No. 12 Remote	1						From Dig 5-9 Panel
196		Sludge Circulation Pump No. 12 Running	1						From Dig 5-9 Panel
197		Sludge Circulation Pump No. 13 Disch. Pressure High	1						From Dig 5-9 Panel
198		Sludge Circulation Pump No. 13 Malfuction	1						From Dig 5-9 Panel
199		Sludge Circulation Pump No. 13 Remote	1						From Dig 5-9 Panel
200		Sludge Circulation Pump No. 13 Running	1						From Dig 5-9 Panel
201		Sludge Circulation Pump No. 14 Disch. Pressure High	1						From Dig 5-9 Panel
202		Sludge Circulation Pump No. 14 Malfuction	1						From Dig 5-9 Panel
203		Sludge Circulation Pump No. 14 Remote	1						From Dig 5-9 Panel
204		Sludge Circulation Pump No. 14 Running	1						From Dig 5-9 Panel

Cedar Creek Water Pollution Control Plant
SCADA System Improvements
Building J – Digester Control Panel (PLC-J) I/O List

No.	Tag Number	Description	DI	DO	AI	AO	Units	Range	Notes
205		Sludge Circulation Pump No. 2 Running	1						From Dig 1-4 Panel
206		Sludge Circulation Pump No. 3 Running	1						From Dig 1-4 Panel
207		Sludge Circulation Pump No. 4 Running	1						From Dig 1-4 Panel
208		Sludge Circulation Pump No. 5 Running	1						From Dig 1-4 Panel
209		Sludge Circulation Pump No. 6 Running	1						From Dig 1-4 Panel
210		Sludge Circulation Pump No. 7 Disch. Pressure High	1						From Dig 5-9 Panel
211		Sludge Circulation Pump No. 7 Malfuction	1						From Dig 5-9 Panel
212		Sludge Circulation Pump No. 7 Remote	1						From Dig 5-9 Panel
213		Sludge Circulation Pump No. 7 Running	1						From Dig 5-9 Panel
214		Sludge Circulation Pump No. 8 Disch. Pressure High	1						From Dig 5-9 Panel
215		Sludge Circulation Pump No. 8 Malfuction	1						From Dig 5-9 Panel
216		Sludge Circulation Pump No. 8 Remote	1						From Dig 5-9 Panel
217		Sludge Circulation Pump No. 8 Running	1						From Dig 5-9 Panel
218		Sludge Circulation Pump No. 9 Disch. Pressure High	1						From Dig 5-9 Panel
219		Sludge Circulation Pump No. 9 Malfuction	1						From Dig 5-9 Panel
220		Sludge Circulation Pump No. 9 Remote	1						From Dig 5-9 Panel
221		Sludge Circulation Pump No. 9 Running	1						From Dig 5-9 Panel
222		Sludge Circulation Pump No.1 Disch. Pressure High	1						From Dig 1-4 Panel
223		Sludge Circulation Pump No.1 Overload	1						From Dig 1-4 Panel
224		Sludge Circulation Pump No.1 Seal Water Pressure Low	1						From Dig 1-4 Panel
225		Sludge Circulation Pump No.2 Disch. Pressure High	1						From Dig 1-4 Panel
226		Sludge Circulation Pump No.2 Overload	1						From Dig 1-4 Panel
227		Sludge Circulation Pump No.2 Seal Water Pressure Low	1						From Dig 1-4 Panel
228		Sludge Circulation Pump No.3 Disch. Pressure High	1						From Dig 1-4 Panel
229		Sludge Circulation Pump No.3 Overload	1						From Dig 1-4 Panel
230		Sludge Circulation Pump No.3 Seal Water Pressure Low	1						From Dig 1-4 Panel
231		Sludge Circulation Pump No.4 Disch. Pressure High	1						From Dig 1-4 Panel
232		Sludge Circulation Pump No.4 Overload	1						From Dig 1-4 Panel
233		Sludge Circulation Pump No.4 Seal Water Pressure Low	1						From Dig 1-4 Panel
234		Sludge Circulation Pump No.5 Overload	1						From Dig 1-4 Panel
235		Sludge Circulation Pump No.6 Overload	1						From Dig 1-4 Panel
236		Sludge Heater Room Gas Detected	1						From Dig 1-4 Panel
237		W.G. Burner No.1 Fail Safe Mode	1						From Dig 5-9 Panel
238		W.G. Burner No.1 Malfuction	1						From Dig 5-9 Panel
239		W.G. Burner No.2 Fail Safe Mode	1						From Dig 5-9 Panel
240		W.G. Burner No.2 Malfuction	1						From Dig 5-9 Panel
241		W.G. Burner No.3 Fail Safe Mode	1						From Dig 5-9 Panel
242		W.G. Burner No.3 Malfuction	1						From Dig 5-9 Panel
243		W.G. Burner No.4 Fail Safe Mode	1						From Dig 5-9 Panel
244		W.G. Burner No.4 Malfuction	1						From Dig 5-9 Panel
245		W.G. Burner No.5 Fail Safe Mode	1						From Dig 5-9 Panel

Cedar Creek Water Pollution Control Plant
SCADA System Improvements
Building J – Digester Control Panel (PLC-J) I/O List

No.	Tag Number	Description	DI	DO	AI	AO	Units	Range	Notes
246		W.G. Burner No.5 Malfuction	1						From Dig 5-9 Panel
247		W.G. Burner No.6 Fail Safe Mode	1						From Dig 5-9 Panel
248		W.G. Burner No.6 Malfuction	1						From Dig 5-9 Panel
249		Waste Gas Burner No. 1 Running	1						From Dig 5-9 Panel
250		Waste Gas Burner No. 2 Running	1						From Dig 5-9 Panel
251		Waste Gas Burner No. 3 Running	1						From Dig 5-9 Panel
252		Waste Gas Burner No. 4 Running	1						From Dig 5-9 Panel
253		Waste Gas Burner No. 5 Running	1						From Dig 5-9 Panel
254		Waste Gas Burner No. 6 Running	1						From Dig 5-9 Panel
255		Audible Horn		1					
256		Gas Recirculation Compressor No. 10 Start/ Stop		1					From Dig 5-9 Panel
257		Gas Recirculation Compressor No. 6 Start/ Stop		1					From Dig 5-9 Panel
258		Gas Recirculation Compressor No. 7 Start/ Stop		1					From Dig 5-9 Panel
259		Gas Recirculation Compressor No. 8 Start/ Stop		1					From Dig 5-9 Panel
260		Gas Recirculation Compressor No. 9 Start/ Stop		1					From Dig 5-9 Panel
261		Sludge Circulation Pump No. 10 Start/ Stop		1					From Dig 5-9 Panel
262		Sludge Circulation Pump No. 11 Start/ Stop		1					From Dig 5-9 Panel
263		Sludge Circulation Pump No. 12 Start/ Stop		1					From Dig 5-9 Panel
264		Sludge Circulation Pump No. 13 Start/ Stop		1					From Dig 5-9 Panel
265		Sludge Circulation Pump No. 14 Start/ Stop		1					From Dig 5-9 Panel
266		Sludge Circulation Pump No. 7 Start/ Stop		1					From Dig 5-9 Panel
267		Sludge Circulation Pump No. 8 Start/ Stop		1					From Dig 5-9 Panel
268		Sludge Circulation Pump No. 9 Start/ Stop		1					From Dig 5-9 Panel
269		Strobe		1					
270		Digester No. 6 Gas Discharge Flow			1				Reserved for Future
271	FI-84040	Digester No. 8 Gas System Inlet Flow			1		ACFM		From Dig 5-9 Panel
272		Digester No. 9 Gas Discharge Flow			1				Reserved for Future
295		Compressor # 10 Speed Indication			1				From PrimGasCmpr Panel
296		Compressor # 6 Speed Indication			1				From PrimGasCmpr Panel
297		Compressor # 7 Speed Indication			1				From PrimGasCmpr Panel
298		Compressor # 8 Speed Indication			1				From PrimGasCmpr Panel
299		Compressor # 9 Speed Indication			1				From PrimGasCmpr Panel
300	FIR-81180A	Digested Sludge Discharge Flow			1		GPM		From Dig 5-9 Panel
301		Digester No. 1 Cover Position			1				New radar sensor to replace existing position indicator
302		Digester No. 1 Discharge Total Suspended Solids			1				Reserved for future
303		Digester No. 1 Gas Discharge Flow			1				Reserved for future
304		Digester No. 1 Intake Total Suspended Solids			1				Reserved for future
305		Digester No. 1 Sludge Discharge Flow			1				Reserved for future
306		Digester No. 1 Sludge Inlet Flow			1				Reserved for future

Cedar Creek Water Pollution Control Plant
SCADA System Improvements
Building J – Digester Control Panel (PLC-J) I/O List

No.	Tag Number	Description	DI	DO	AI	AO	Units	Range	Notes
307		Digester No. 1 Temperature			1				Reserved for future
308		Digester No. 2 Cover Position			1				New radar sensor to replace existing position indicator
309		Digester No. 2 Discharge Total Suspended Solids			1				Reserved for future
310		Digester No. 2 Gas Discharge Flow			1				Reserved for future
311		Digester No. 2 Intake Total Suspended Solids			1				Reserved for future
312		Digester No. 2 Sludge Discharge Flow			1				Reserved for future
313		Digester No. 2 Sludge Inlet Flow			1				Reserved for future
314		Digester No. 2 Temperature			1				Reserved for future
315		Digester No. 3 Cover Position			1				New radar sensor to replace existing position indicator
316		Digester No. 3 Discharge Total Suspended Solids			1				Reserved for future
317		Digester No. 3 Gas Discharge Flow			1				Reserved for future
318		Digester No. 3 Intake Total Suspended Solids			1				Reserved for future
319		Digester No. 3 Sludge Discharge Flow			1				Reserved for future
320		Digester No. 3 Sludge Inlet Flow			1				Reserved for future
321		Digester No. 3 Temperature			1				Reserved for future
322		Digester No. 4 Cover Position			1				New radar sensor to replace existing position indicator
323		Digester No. 4 Discharge Total Suspended Solids			1				Reserved for future
324		Digester No. 4 Gas Discharge Flow			1				Reserved for future
325		Digester No. 4 Intake Total Suspended Solids			1				Reserved for future
326		Digester No. 4 Sludge Discharge Flow			1				Reserved for future
327		Digester No. 4 Sludge Inlet Flow			1				Reserved for future
328		Digester No. 4 Temperature			1				Reserved for future
329		Digester No. 5 Cover Position			1		Feet		New radar sensor to replace existing position indicator
330		Digester No. 5 Discharge Total Suspended Solids			1				Reserved for future
331	FI-84038	Digester No. 5 Gas Discharge Flow			1		ACFM		From Dig 5-9 Panel
332		Digester No. 5 Intake Total Suspended Solids			1				Reserved for future
333		Digester No. 5 Sludge Discharge Flow			1				Reserved for Future
334		Digester No. 5 Sludge Inlet Flow			1				Reserved for Future
335		Digester No. 5 Temperature			1				Reserved for future
336		Digester No. 5 Temperature			1		°F		From Dig 5-9 Panel
337		Digester No. 6 Cover Position			1		Feet		New radar sensor to replace existing position indicator
338		Digester No. 6 Discharge Total Suspended Solids			1				Reserved for future
339		Digester No. 6 Intake Total Suspended Solids			1				Reserved for future
340		Digester No. 6 Sludge Discharge Flow			1				Reserved for Future
341	FI-84061	Digester No. 6 Sludge Inlet Flow			1		ACFM		From Dig 5-9 Panel

Cedar Creek Water Pollution Control Plant
SCADA System Improvements
Building J – Digester Control Panel (PLC-J) I/O List

No.	Tag Number	Description	DI	DO	AI	AO	Units	Range	Notes
342		Digester No. 6 Temperature			1				Reserved for future
343		Digester No. 6 Temperature			1		°F		From Dig 5-9 Panel
344		Digester No. 7 Cover Position			1		Feet		New radar sensor to replace existing position indicator
345		Digester No. 7 Discharge Total Suspended Solids			1				Reserved for future
346	FI-84019	Digester No. 7 Gas Discharge Flow			1		ACFM		From Dig 5-9 Panel
347		Digester No. 7 Intake Total Suspended Solids			1				Reserved for future
348		Digester No. 7 Sludge Discharge Flow			1				Reserved for Future
349		Digester No. 7 Sludge Inlet Flow			1				Reserved for Future
350		Digester No. 7 Temperature			1				Reserved for future
351		Digester No. 7 Temperature			1		°F		From Dig 5-9 Panel
352		Digester No. 8 Cover Position			1		Feet		New radar sensor to replace existing position indicator
353		Digester No. 8 Discharge Total Suspended Solids			1				Reserved for future
354	FI-84058	Digester No. 8 Gas Discharge Flow			1		ACFM		From Dig 5-9 Panel
355		Digester No. 8 Intake Total Suspended Solids			1				Reserved for future
356		Digester No. 8 Sludge Discharge Flow			1				Reserved for Future
357		Digester No. 8 Sludge Inlet Flow			1				Reserved for Future
358		Digester No. 8 Temperature			1				Reserved for future
359		Digester No. 8 Temperature			1		°F		From Dig 5-9 Panel
360		Digester No. 9 Cover Position			1		Feet		From Dig 5-9 Panel
361		Digester No. 9 Discharge Total Suspended Solids			1				Reserved for future
362		Digester No. 9 Intake Total Suspended Solids			1				Reserved for future
363		Digester No. 9 Sludge Discharge Flow			1				Reserved for Future
364	FI-84063	Digester No. 9 Sludge Inlet Flow			1		ACFM		From Dig 5-9 Panel
365		Digester No. 9 Temperature			1				Reserved for future
366		Digester No. 9 Temperature			1		°F		From Dig 5-9 Panel
367	FI-84020	Digester No.5 Gas System Inlet Flow			1		ACFM		From Dig 5-9 Panel
368	FI-84000	Digester No.7 Gas System Inlet Flow			1		ACFM		From Dig 5-9 Panel
369	FIR-84065A	Digesters No. 5 Thru No.9 gas Discharge Flow			1		GPM		From Dig 5-9 Panel
370		Discharge Gas Flow			1				From Dig 1-4 Panel
371		Domestic Water Flow			1				
372		Dryer Differential Pressure Across Coalescing Filter 1			1				
373		Dryer Differential Pressure Across Coalescing Filter 2			1				
374		Dryer Differential Pressure Across Particulate Pre-Filter			1				
375		Flow Indication 84150			1				From PrimGasCmpr Panel
376		Methane System #1 Gas Detection			1				
377		Methane System #2 Gas Detection			1				
378		Pressure Indication 84130			1				From PrimGasCmpr Panel

Cedar Creek Water Pollution Control Plant
SCADA System Improvements
Building J – Digester Control Panel (PLC-J) I/O List

No.	Tag Number	Description	DI	DO	AI	AO	Units	Range	Notes
379		Compressor # 10 Speed Control				1			From PrimGasCmpr Panel
380		Compressor # 6 Speed Control				1			From PrimGasCmpr Panel
381		Compressor # 7 Speed Control				1			From PrimGasCmpr Panel
382		Compressor # 8 Speed Control				1			From PrimGasCmpr Panel
383		Compressor # 9 Speed Control				1			From PrimGasCmpr Panel
384		Pressure Control 84130				1			From PrimGasCmpr Panel
		Total Number Of I/O	243	15	87	6			

Building J – RIO-HVAC-J Control Panel I/O List

No.	Tag Number	Description	DI	DO	AI	AO	Units	Range	Notes
1	IL-06421	HW Pump J-P1 On	1						
2	IL-06422	HW Pump J-P2 On	1						
3	IL-06425	HW Pump #5 On	1						
4	IL-06427	HW Pump #1 On	1						
5	IL-06428	HW Pump #2 On	1						
6	IL-06423	HW Pump J-P3 On	1						
7	IL-06424	HW Pump J-P4 On	1						
8	IL-06426	HW Pump #6 On	1						
9	IL-06429	HW Pump #3 On	1						
10	IL-06430	HW Pump #4 On	1						
11		RIO-HVAC-J Enclosure Door Intrusion	1						
12	TI-82100	Dig. 1-4 CP Digester #1 Temp			1		°F		
13	TI-82300	Dig. 1-4 CP Digester #3 Temp			1		°F		
14	TI-82400	Dig. 1-4 CP Digester #4 Temp			1		°F		
15	TI-81004	Dig. 5-9 CP Digester #5 Temp			1		°F		
16	TI-81031	Dig. 5-9 CP Digester #7 Temp			1		°F		
17	TI-81040	Dig. 5-9 CP Digester #8 Temp			1		°F		
18	FIT-06401	Heat Exchanger 1-3 Flow			1		GPM		
19	TE-06402	Heat Exchanger 1-3 Inlet Temp			1		°F		
20	TE-06403	Heat Exchanger 1-3 Outlet Temp			1		°F		
21	TE-06412	Heat Exchanger 4-6 Inlet Temp			1		°F		
22	TE-06413	Heat Exchanger 4-6 Outlet Temp			1		°F		
23	FIT-06411	Heat Exchanger 4-6 Flow			1		GPM		
		Total Number Of I/O	11	0	12	0			

Cedar Creek Water Pollution Control Plant
SCADA System Improvements
Building K – RIO-HVAC-K Control Panel I/O List

No.	Tag Number	Description	DI	DO	AI	AO	Units	Range	Notes
1		RIO-HVAC-K Enclosure Door Intrusion	1						
2	PIT-06531	Chill Water Supply Pressure			1		PSI		
3	TE-06531	Chill Water Supply Temp.			1		°F		
4	PIT-06532	Hot Water Supply Pressure			1		PSI		
5	TE-06532	Hot Water Supply Temp.			1		°F		
6	TY-06511	R-AHU 1 Cold Deck Air Temp.			1		°F		
7	TY-06512	R-AHU 1 Hot Deck Air Temp.			1		°F		
8	TY-06521	R-AHU 2 Cold Deck Air Temp.			1		°F		
9	TY-06522	R-AHU 2 Hot Deck Air Temp.			1		°F		
10									
11									
12									
13									
14									
15									
16									
17									
18									
19									
20									
21									
22									
23									
24									
25									
26									
27									
28									
29									
		Total Number Of I/O	1	0	8	0			

Cedar Creek Water Pollution Control Plant

SCADA System Improvements

Building L – Outfall Pump Control Panel I/O List (Add I/O to Existing)

No.	Tag Number	Description	DI	DO	AI	AO	Units	Range	Notes
1		Building L Protected Water Flow			1				To Outfall Pump CP
2									
3									
4									
5									
6									
7									
		Total Number Of I/O	0	0	1	0			

Cedar Creek Water Pollution Control Plant
Area M – PLC-ATCC-1 Control Panel I/O List

No.	Tag Number	Description	DI	DO	AI	AO	Units	Range	Notes
1		RAS Pump No. 1 Running	1						
2		RAS Pump No. 1 Remote	1						
3		RAS Pump No. 2 Running	1						
4		RAS Pump No. 2 Remote	1						
5		RAS Pump No. 3 Running	1						
6		RAS Pump No. 3 Remote	1						
7		RAS Pump No. 4 Running	1						
8		RAS Pump No. 4 Remote	1						
9		RAS Pump No. 5 Running	1						
10		RAS Pump No. 5 Remote	1						
11		Valve 1 Open Status	1						
12		Valve 1 Closed Status	1						
13		Valve 2 Open Status	1						
14		Valve 2 Closed Status	1						
15		Valve 3 Open Status	1						
16		Valve 3 Closed Status	1						
17		Valve 4 Open Status	1						
18		Valve 4 Closed Status	1						
19		Valve 5 Open Status	1						
20		Valve 5 Closed Status	1						
21		Valve 6 Open Status	1						
22		Valve 6 Closed Status	1						
23		Final Sedimentation Tank No. 9 Drive Running	1						
24		Final Sedimentation Tank No. 9 High torque	1						
25		Final Sedimentation Tank No. 9 torque Overload	1						
26		Final Sedimentation Tank No. 10 Drive Running	1						
27		Final Sedimentation Tank No. 10 High torque	1						
28		Final Sedimentation Tank No. 10 torque Overload	1						
29		Final Sedimentation Tank No. 11 Drive Running	1						
30		Final Sedimentation Tank No. 11 High torque	1						
31		Final Sedimentation Tank No. 11 torque Overload	1						
32		Final Sedimentation Tank No. 12 Drive Running	1						
33		Final Sedimentation Tank No. 12 High torque	1						
34		Final Sedimentation Tank No. 12 torque Overload	1						
35		Final Sedimentation Tank No. 13 Drive Running	1						
36		Final Sedimentation Tank No. 13 High torque	1						
37		Final Sedimentation Tank No. 13 torque Overload	1						
38		Final Sedimentation Tank No. 14 Drive Running	1						
39		Final Sedimentation Tank No. 14 High torque	1						
40		Final Sedimentation Tank No. 14 torque Overload	1						

Cedar Creek Water Pollution Control Plant
Area M – PLC-ATCC-1 Control Panel I/O List

No.	Tag Number	Description	DI	DO	AI	AO	Units	Range	Notes
41		PLC-ATCC-1 Enclosure Door Intrusion	1						
42		RAS Pump No. 1 Start/ Stop		1					
43		RAS Pump No. 2 Start/ Stop		1					
44		RAS Pump No. 3 Start/ Stop		1					
45		RAS Pump No. 4 Start/ Stop		1					
46		RAS Pump No. 5 Start/ Stop		1					
47	FI-50091	RAS Flow from 9 Final Tank to Well			1		MGD		
48	FI-51091	Mixed Liquor Flow to Final Tank 9			1		MGD		
49	FI-50101	RAS Flow from 10 Final Tank to Well			1		MGD		
50	FI-51101A	Mixed Liquor Flow to Final Tank 10			1		MGD		
51	FI-50111	RAS Flow from 11 Final Tank to Well			1		MGD		
52	FI-51111	Mixed Liquor Flow to Final Tank 11			1		MGD		
53	FI-50121	RAS Flow from 12 Final Tank to Well			1		MGD		
54	FI-51121	Mixed Liquor Flow to Final Tank 12			1		MGD		
55	FI-50131	RAS Flow from 13 Final Tank to Well			1		MGD		
56	FI-51131	Mixed Liquor Flow to Final Tank 13			1		MGD		
57	FI-50141	RAS Flow from 14 Final Tank to Well			1		MGD		
58	FI-51141	Mixed Liquor Flow to Final Tank 14			1		MGD		
59	FI-51401	RAS Flow to Pass 4A			1		MGD		
60		RAS Flow to Pass 4A Flow Control Position Feedback			1		%		
61	FI-51403	RAS Flow to Pass 4C			1		MGD		
62		RAS Flow to Pass 4C Flow Control Position Feedback			1		%		
63	FI-51501	RAS Flow to Pass 5A			1		MGD		
64		RAS Flow to Pass 5A Flow Control Position Feedback			1		%		
65	FI-51503	RAS Flow to Pass 5C			1		MGD		
66		RAS Flow to Pass 5C Flow Control Position Feedback			1		%		
67	FI-51601	RAS Flow to Pass 6A			1		MGD		
68		RAS Flow to Pass 6A Flow Control Position Feedback			1		%		
69	FI-51603	RAS Flow to Pass 6C			1		MGD		
70		RAS Flow to Pass 6C Flow Control Position Feedback			1		%		
71	PI-61900	RAS Header Pressure and Flow			1		PSIC		
72	SI-51907	South #1 RAS Pump Speed			1		RPM		
73	SI-51908	South #2 RAS Pump Speed			1		RPM		
74	SI-51909	South #3 RAS Pump Speed			1		RPM		
75	SI-51910	South #4 RAS Pump Speed			1		RPM		
76	SI-51911	South #5 RAS Pump Speed			1		RPM		
77	ZI-50003	Effluent Channel Level			1		FEET		
78	LI-51030	RAS Wet Wet Well Level			1		FEET		
79	FIC-50091	RAS Flow from 9 Final Tank to Well Control				1			
80	FIC-51091	Mixed Liquor Flow to Final Tank 9 Control				1			

Cedar Creek Water Pollution Control Plant
Area M – PLC-ATCC-1 Control Panel I/O List

No.	Tag Number	Description	DI	DO	AI	AO	Units	Range	Notes
81	FIC-50101	RAS Flow from 10 Final Tank to Well				1			
82	FIC-51101A	Mixed Liquor Flow to Final Tank 10 Control				1			
83	FIC-50111	RAS Flow from 11 Final Tank to Well Control				1			
84	FIC-51111	Mixed Liquor Flow to Final Tank 11 Control				1			
85	FIC-50121	RAS Flow from 12 Final Tank to Well Control				1			
86	FIC-51121	Mixed Liquor Flow to Final Tank 12 Control				1			
87	FIC-50131	RAS Flow from 13 Final Tank to Well Control				1			
88	FIC-51131	Mixed Liquor Flow to Final Tank 13 Control				1			
89	FIC-50141	RAS Flow from 14 Final Tank to Well Control				1			
90	FIC-51141	Mixed Liquor Flow to Final Tank 14 Control				1			
91	FIC-51401	RAS Flow to Pass 4A Flow Control				1	%		
92	FIC-51403	RAS Flow to Pass 4C Flow Control				1	%		
93	FIC-51501	RAS Flow to Pass 5A Flow Control				1	%		
94	FIC-51503	RAS Flow to Pass 5C Flow Control				1	%		
95	FIC-51601	RAS Flow to Pass 6A Flow Control				1	%		
96	FIC-51603	RAS Flow to Pass 6C Flow Control				1	%		
97	PIC-61900	RAS Header Pressure and Flow Control				1			
98	SIC-51907	South #1 RAS Pump Speed Control				1			
99	SIC-51908	South #2 RAS Pump Speed Control				1			
100	SIC-51909	South #3 RAS Pump Speed Control				1			
101	SIC-51910	South #4 RAS Pump Speed Control				1			
102	SIC-51911	South #5 RAS Pump Speed Control				1			
103	ZIC-50003	Effluent Channel Level Control				1			
104	LIC-51030	RAS Wet Wet Well Level Control				1			
	Total Number Of I/O		41	5	32	26			

Cedar Creek Water Pollution Control Plant
SCADA System Improvements
Area M – PLC-ATCC-2 Control Panel I/O List

No.	Tag Number	Description	DI	DO	AI	AO	Units	Range	Notes
1		PLC-ATCC-2 Enclosure Door Intrusion	1						
2	FI-39401	Settled Sewage to 4A			1		MGD		
3		Settled Sewage to 4A Flow Control Position Feedback			1		%		
4	FI-39402	Settled Sewage to 4B			1		MGD		
5		Settled Sewage to 4B Flow Control Position Feedback			1		%		
6	FI-39403	Settled Sewage to 4C			1		MGD		
7		Settled Sewage to 4C Flow Control Position Feedback			1		%		
8	FI-39404	Settled Sewage to 4D			1		MGD		
9		Settled Sewage to 4D Flow Control Position Feedback			1		%		
10	FI-39501	Settled Sewage to 5A			1		MGD		
11		Settled Sewage to 5A Flow Control Position Feedback			1		%		
12	FI-39502	Settled Sewage to 5B			1		MGD		
13		Settled Sewage to 5B Flow Control Position Feedback			1		%		
14	FI-39503	Settled Sewage to 5C			1		MGD		
15		Settled Sewage to 5C Flow Control Position Feedback			1		%		
16	FI-39504	Settled Sewage to 5D			1		MGD		
17		Settled Sewage to 5D Flow Control Position Feedback			1		%		
18	FI-39601	Settled Sewage to 6A			1		MGD		
19		Settled Sewage to 6A Flow Control Position Feedback			1		%		
20	FI-39602	Settled Sewage to 6B			1		MGD		
21		Settled Sewage to 6B Flow Control Position Feedback			1		%		
22	FI-39603	Settled Sewage to 6C			1		MGD		
23		Settled Sewage to 6C Flow Control Position Feedback			1		%		
24	FI-39604	Settled Sewage to 6D			1		MGD		
25		Settled Sewage to 6D Flow Control Position Feedback			1		%		
26	FI-45401	D.O to Pass 4A			1		SCFM		
27	FI-45402	D.O to Pass 4B			1		SCFM		
28	FI-45403	D.O to Pass 4C			1		SCFM		
29	FI-45404	D.O to Pass 4D			1		SCFM		
30	FI-45410	Air to Pass 4A			1		SCFM		
31	FI-45420	Air to Pass 4B			1		SCFM		
32	FI-45430	Air to Pass 4C			1		SCFM		
33	FI-45440	Air to Pass 4D			1		SCFM		
34	FI-45501	D.O to Pass 5A			1		SCFM		
35	FI-45502	D.O to Pass 5B			1		SCFM		
36	FI-45503	D.O to Pass 5C			1		SCFM		
37	FI-45504	D.O to Pass 5D			1		SCFM		
38	FI-45510	Air to Pass 5A			1		SCFM		
39	FI-45520	Air to Pass 5B			1		SCFM		
40	FI-45530	Air to Pass 5C			1		SCFM		

Cedar Creek Water Pollution Control Plant
SCADA System Improvements
Area M – PLC-ATCC-2 Control Panel I/O List

No.	Tag Number	Description	DI	DO	AI	AO	Units	Range	Notes
41	FI-45540	Air to Pass 5D			1		SCFM		
42	FI-45601	D.O to Pass 6A			1		SCFM		
43	FI-45602	D.O to Pass 6B			1		SCFM		
44	FI-45603	D.O to Pass 6C			1		SCFM		
45	FI-45604	D.O to Pass 6D			1		SCFM		
46	FI-45610	Air to Pass 6A			1		SCFM		
47	FI-45620	Air to Pass 6B			1		SCFM		
48	FI-45630	Air to Pass 6C			1		SCFM		
49	FI-45640	Air to Pass 6D			1		SCFM		
50	FIC-39401	Settled Sewage to 4A Flow Control				1	%		
51	FIC-39402	Settled Sewage to 4B Flow Control				1	%		
52	FIC-39403	Settled Sewage to 4C Flow Control				1	%		
53	FIC-39404	Settled Sewage to 4D Flow Control				1	%		
54	FIC-39501	Settled Sewage to 5A Flow Control				1	%		
55	FIC-39502	Settled Sewage to 5B Flow Control				1	%		
56	FIC-39503	Settled Sewage to 5C Flow Control				1	%		
57	FIC-39504	Settled Sewage to 5D Flow Control				1	%		
58	FIC-39601	Settled Sewage to 6A Flow Control				1	%		
59	FIC-39602	Settled Sewage to 6B Flow Control				1	%		
60	FIC-39603	Settled Sewage to 6C Flow Control				1	%		
61	FIC-39604	Settled Sewage to 6D Flow Control				1	%		
62	FIC-45401	D.O to Pass 4A Control				1			
63	FIC-45402	D.O to Pass 4B Control				1			
64	FIC-45403	D.O to Pass 4 Control				1			
65	FIC-45404	D.O to Pass 4D Control				1			
66	FIC-45410	Air to Pass 4A Control				1			
67	FIC-45420	Air to Pass 4B Control				1			
68	FIC-45430	Air to Pass 4C Control				1			
69	FIC-45440	Air to Pass 4D Control				1			
70	FIC-45501	D.O to Pass 5A Control				1			
71	FIC-45502	D.O to Pass 5B Control				1			
72	FIC-45503	D.O to Pass 5 Control				1			
73	FIC-45504	D.O to Pass 5D Control				1			
74	FIC-45510	Air to Pass 5A Control				1			
75	FIC-45520	Air to Pass 5B Control				1			
76	FIC-45530	Air to Pass 5C Control				1			
77	FIC-45540	Air to Pass 5D Control				1			
78	FIC-45601	D.O to Pass 6A Control				1			
79	FIC-45602	D.O to Pass 6B Control				1			
80	FIC-45603	D.O to Pass 6 Control				1			

Cedar Creek Water Pollution Control Plant
SCADA System Improvements
Area M – PLC-ATCC-2 Control Panel I/O List

No.	Tag Number	Description	DI	DO	AI	AO	Units	Range	Notes
81	FIC-45604	D.O to Pass 6D Control				1			
82	FIC-45610	Air to Pass 6A Control				1			
83	FIC-45620	Air to Pass 6B Control				1			
84	FIC-45630	Air to Pass 6C Control				1			
85	FIC-45640	Air to Pass 6D Control				1			
		Total Number Of I/O	1	0	48	36			

Cedar Creek Water Pollution Control Plant
SCADA System Improvements
Building V – PLC-ATCC-3 Control Panel I/O List

No.	Tag Number	Description	DI	DO	AI	AO	Units	Range	Notes
1		Final Tank 1 Drive Running	1						
2		Final Tank 1 Drive High Torque	1						
3		Final Tank 1 Drive Torque Overload	1						
4		Final Tank 2 Drive Running	1						
5		Final Tank 2 Drive High Torque	1						
6		Final Tank 2 Drive Torque Overload	1						
7		Final Tank 3 Drive Running	1						
8		Final Tank 3 Drive High Torque	1						
9		Final Tank 3 Drive Torque Overload	1						
10		Final Tank 4 Drive Running	1						
11		Final Tank 4 Drive High Torque	1						
12		Final Tank 4 Drive Torque Overload	1						
13		Final Tank 5 Drive Running	1						
14		Final Tank 5 Drive High Torque	1						
15		Final Tank 5 Drive Torque Overload	1						
16		Final Tank 6 Drive Running	1						
17		Final Tank 6 Drive High Torque	1						
18		Final Tank 6 Drive Torque Overload	1						
19		Final Tank 1 Valve Opened	1						
20		Final Tank 1 Valve Closed	1						
21		Final Tank 2 Valve Opened	1						
22		Final Tank 2 Valve Closed	1						
23		Final Tank 3 Valve Opened	1						
24		Final Tank 3 Valve Closed	1						
25		Final Tank 4 Valve Opened	1						
26		Final Tank 4 Valve Closed	1						
27		Final Tank 5 Valve Opened	1						
28		Final Tank 5 Valve Closed	1						
29		Final Tank 6 Valve Opened	1						
30		Final Tank 6 Valve Closed	1						
31		WAS Pump 1 Running	1						
32		WAS Pump 1 Remote	1						
33		WAS Pump 2 Running	1						
34		WAS Pump 2 Remote	1						
35		WAS Pump 3 Running	1						
36		WAS Pump 3 Remote	1						
37		WAS Pump 4 Running	1						
38		WAS Pump 4 Remote	1						
39		RAS Pump 1 Running	1						
40		RAS Pump 1 Remote	1						

Cedar Creek Water Pollution Control Plant
SCADA System Improvements
Building V – PLC-ATCC-3 Control Panel I/O List

No.	Tag Number	Description	DI	DO	AI	AO	Units	Range	Notes
41		RAS Pump 2 Running	1						
42		RAS Pump 2 Remote	1						
43		RAS Pump 3 Running	1						
44		RAS Pump 3 Remote	1						
45		RAS Pump 4 Running	1						
46		RAS Pump 4 Remote	1						
47		RAS Pump 5 Running	1						
48		RAS Pump 5 Remote	1						
48		PLC-ATCC-3 Enclosure Door Intrusion	1						
49		WAS Pump 1 Start/ Stop		1					
50		WAS Pump 2 Start/ Stop		1					
51		WAS Pump 3 Start/ Stop		1					
52		WAS Pump 4 Start/ Stop		1					
53		RAS Pump 1 Start/ Stop		1					
54		RAS Pump 2 Start/ Stop		1					
55		RAS Pump 3 Start/ Stop		1					
56		RAS Pump 4 Start/ Stop		1					
57		RAS Pump 5 Start/ Stop		1					
58	FI-51011	RAS Flow From Final Tank 1			1		MGD		
59	FI-51021	RAS Flow From Final Tank 2			1		MGD		
60	FI-51031	RAS Flow From Final Tank 3			1		MGD		
61	FI-51041	RAS Flow From Final Tank 4			1		MGD		
62	FI-51051	RAS Flow From Final Tank 5			1		MGD		
63	FI-51061	RAS Flow From Final Tank 6			1		MGD		
64	FI-50011	Mixed Liquor Flow to Final Tank 1			1		MGD		
65	FI-50021	Mixed Liquor Flow to Final Tank 2			1		MGD		
66	FI-50031	Mixed Liquor Flow to Final Tank 3			1		MGD		
67	FI-50041	Mixed Liquor Flow to Final Tank 4			1		MGD		
68	FI-50051	Mixed Liquor Flow to Final Tank 5			1		MGD		
69	FI-50061	Mixed Liquor Flow to Final Tank 6			1		MGD		
70	FI-51101	RAS Flow to Aeration Tank 1 Pass A			1		MGD		
71		RAS Flow to Aeration Tank 1 Pass A Flow Control Position Feedback			1		%		
72	FI-51201	RAS Flow to Aeration Tank 2 Pass A			1		MGD		
73		RAS Flow to Aeration Tank 2 Pass A Flow Control Position Feedback			1		%		
74	FI-51301	RAS Flow to Aeration Tank 3 Pass A			1		MGD		
75		RAS Flow to Aeration Tank 3 Pass A Flow Control Position Feedback			1		%		
76	FI-51103	RAS Flow to Aeration Tank 1 Pass C			1		MGD		
77		RAS Flow to Aeration Tank 1 Pass C Flow Control Position Feedback			1		%		
78	FI-51203	RAS Flow to Aeration Tank 2 Pass C			1		MGD		
79		RAS Flow to Aeration Tank 2 Pass C Flow Control Position Feedback			1		%		

Cedar Creek Water Pollution Control Plant
SCADA System Improvements
Building V – PLC-ATCC-3 Control Panel I/O List

No.	Tag Number	Description	DI	DO	AI	AO	Units	Range	Notes
80	FI-51303	RAS Flow to Aeration Tank 3 Pass C			1		MGD		
81		RAS Flow to Aeration Tank 3 Pass C Flow Control Position Feedback			1		%		
82		WAS Flow Pump 1			1		GPM		
83		WAS Flow Pump 2			1		GPM		
84		WAS Flow Pump 3			1		GPM		
85		WAS Flow Pump 4			1		GPM		
86	LI-51007	North RAS Well Level A/B			1		FEET		
87	PI-51000	Total RAS Flow			1		MGD		
88	PI-51000	Total RAS Head Pressure			1		PSIG		
89	SI-51514	RAS Pump 1 Flow			1		RPM		
90	SI-51524	RAS Pump 2 Flow			1		RPM		
91	SI-51534	RAS Pump 3 Flow			1		RPM		
92	SI-51544	RAS Pump 4 Flow			1		RPM		
93	SI-51554	RAS Pump 5 Flow			1		RPM		
94	FIC-51011	RAS Flow From Final Tank 1 Flow Control				1	%		
95	FIC-51021	RAS Flow From Final Tank 2 Flow Control				1	%		
96	FIC-51031	RAS Flow From Final Tank 3 Flow Control				1	%		
97	FIC-51041	RAS Flow From Final Tank 4 Flow Control				1	%		
98	FIC-51051	RAS Flow From Final Tank 5 Flow Control				1	%		
99	FIC-51061	RAS Flow From Final Tank 6 Flow Control				1	%		
100	FIC-50011	Mixed Liquor Flow to Final Tank 1 Flow Control				1	%		
101	FIC-50021	Mixed Liquor Flow to Final Tank 2 Flow Control				1	%		
102	FIC-50031	Mixed Liquor Flow to Final Tank 3 Flow Control				1	%		
103	FIC-50041	Mixed Liquor Flow to Final Tank 4 Flow Control				1	%		
104	FIC-50051	Mixed Liquor Flow to Final Tank 5 Flow Control				1	%		
105	FIC-50061	Mixed Liquor Flow to Final Tank 6 Flow Control				1	%		
106	FIC-51101	RAS Flow to Aeration Tank 1 Pass A Flow Control				1	%		
107	FIC-51201	RAS Flow to Aeration Tank 2 Pass A Flow Control				1	%		
108	FIC-51301	RAS Flow to Aeration Tank 3 Pass A Flow Control				1	%		
109	FIC-51103	RAS Flow to Aeration Tank 1 Pass C Flow Control				1	%		
110	FIC-51203	RAS Flow to Aeration Tank 2 Pass C Flow Control				1	%		
111	FIC-51303	RAS Flow to Aeration Tank 3 Pass C Flow Control				1	%		
112		WAS Flow Pump 1 Control				1			
113		WAS Flow Pump 2 Control				1			
114		WAS Flow Pump 3 Control				1			
115		WAS Flow Pump 4 Control				1			
116	LIC-51007	North RAS Well Level Control				1			
117	PIC-51000	Total RAS Head Pressure Control				1			
118	SIC-51514	RAS Pump 1 Flow Control				1			
119	SIC-51524	RAS Pump 2 Flow Control				1			

Cedar Creek Water Pollution Control Plant
SCADA System Improvements
Building V – PLC-ATCC-3 Control Panel I/O List

No.	Tag Number	Description	DI	DO	AI	AO	Units	Range	Notes
120	SIC-51534	RAS Pump 3 Flow Control				1			
121	SIC-51544	RAS Pump 4 Flow Control				1			
122	SIC-51554	RAS Pump 5 Flow Control				1			
		Total Number Of I/O	49	9	36	29			

Cedar Creek Water Pollution Control Plant
SCADA System Improvements
Area M – PLC-ATCC-4 Control Panel I/O List

No.	Tag Number	Description	DI	DO	AI	AO	Units	Range	Notes
1		PLC-ATCC-4 Enclosure Door Intrusion	1				MGD		
2	FI-39100	Aeration Tank No. 1 RAS Flow / Settled Sewage Flow			1		MGD		
3		Settled Sewage to 1A			1		MGD		
4		Settled Sewage to 1A Flow Control Position Feedback			1		%		
5		Settled Sewage to 1B			1		MGD		
6		Settled Sewage to 1B Flow Control Position Feedback			1		%		
7		Settled Sewage to 1C			1		MGD		
8		Settled Sewage to 1C Flow Control Position Feedback			1		%		
9		Settled Sewage to 1D			1		MGD		
10		Settled Sewage to 1D Flow Control Position Feedback			1		%		
11	FI-39200	Aeration Tank No. 2 RAS Flow			1		MGD		
12		Settled Sewage to 2A			1		MGD		
13		Settled Sewage to 2A Flow Control Position Feedback			1		%		
14		Settled Sewage to 2B			1		MGD		
15		Settled Sewage to 2B Flow Control Position Feedback			1		%		
16		Settled Sewage to 2C			1		MGD		
17		Settled Sewage to 2C Flow Control Position Feedback			1		%		
18		Settled Sewage to 2D			1		MGD		
19		Settled Sewage to 2D Flow Control Position Feedback			1		%		
20	FI-39300	Aeration Tank No. 3 RAS Flow			1		MGD		
21		Settled Sewage to 3A			1		MGD		
22		Settled Sewage to 3A Flow Control Position Feedback			1		%		
23		Settled Sewage to 3B			1		MGD		
24		Settled Sewage to 3B Flow Control Position Feedback			1		%		
25		Settled Sewage to 3C			1		MGD		
26		Settled Sewage to 3C Flow Control Position Feedback			1		%		
27		Settled Sewage to 3D			1		MGD		
28		Settled Sewage to 3D Flow Control Position Feedback			1		%		
29	FI-45110	Aeration Tank No. 1 Pass A D.O.			1		SCFM		
30	FI-45120	Aeration Tank No. 1 Pass B D.O.			1		SCFM		
31	FI-45130	Aeration Tank No. 1 Pass C D.O.			1		SCFM		
32	FI-45140	Aeration Tank No. 1 Pass D D.O.			1		SCFM		
33	FI-45210	Aeration Tank No. 2 Pass A D.O.			1		SCFM		
34	FI-45220	Aeration Tank No. 2 Pass B D.O.			1		SCFM		
35	FI-45230	Aeration Tank No. 2 Pass C D.O.			1		SCFM		
36	FI-45240	Aeration Tank No. 2 Pass D D.O.			1		SCFM		
37	FI-45310	Aeration Tank No. 3 Pass A D.O.			1		SCFM		
38	FI-45320	Aeration Tank No. 3 Pass B D.O.			1		SCFM		
39	FI-45330	Aeration Tank No. 3 Pass C D.O.			1		SCFM		
40	FI-45340	Aeration Tank No. 3 Pass D D.O.			1		SCFM		

Cedar Creek Water Pollution Control Plant
SCADA System Improvements
Area M – PLC-ATCC-4 Control Panel I/O List

No.	Tag Number	Description	DI	DO	AI	AO	Units	Range	Notes
41	FI-12305	Plant Influent Flow			1		MGD		
42	FI-39200	Aeration Tank No. 2 Settled Sewage Flow			1		MGD		
43	FI-39300	Aeration Tank No. 3 Settled Sewage Flow			1		MGD		
44	FI-45110	Aeration Tank No. 1 Pass A Air Flow Valve Position Feedback			1		%		
45	FI-45120	Aeration Tank No. 1 Pass B Air Flow Valve Position Feedback			1		%		
46	FI-45130	Aeration Tank No. 1 Pass C Air Flow Valve Position Feedback			1		%		
47	FI-45140	Aeration Tank No. 1 Pass D Air Flow Valve Position Feedback			1		%		
48	FI-45210	Aeration Tank No. 2 Pass A Air Flow Valve Position Feedback			1		%		
49	FI-45220	Aeration Tank No. 2 Pass B Air Flow Valve Position Feedback			1		%		
50	FI-45230	Aeration Tank No. 2 Pass C Air Flow Valve Position Feedback			1		%		
51	FI-45240	Aeration Tank No. 2 Pass D Air Flow Valve Position Feedback			1		%		
52	FI-45310	Aeration Tank No. 3 Pass A Air Flow Valve Position Feedback			1		%		
53	FI-45320	Aeration Tank No. 3 Pass B Air Flow Valve Position Feedback			1		%		
54	FI-45330	Aeration Tank No. 3 Pass C Air Flow Valve Position Feedback			1		%		
55	FI-45340	Aeration Tank No. 3 Pass D Air Flow Valve Position Feedback			1		%		
56	FI-12305	Plant Total Settled Sewage Flow			1		MGD		
57		Settled Sewage to 1A Flow Control				1	%		
58		Settled Sewage to 1B Flow Control				1	%		
59		Settled Sewage to 1C Flow Control				1	%		
60		Settled Sewage to 1D Flow Control				1	%		
61		Settled Sewage to 2A Flow Control				1	%		
62		Settled Sewage to 2B Flow Control				1	%		
63		Settled Sewage to 2C Flow Control				1	%		
64		Settled Sewage to 2D Flow Control				1	%		
65		Settled Sewage to 3A Flow Control				1	%		
66		Settled Sewage to 3B Flow Control				1	%		
67		Settled Sewage to 3C Flow Control				1	%		
68		Settled Sewage to 3D Flow Control				1	%		
69	FIC-45110	Aeration Tank No. 1 Pass A Air Flow Valve Position Control				1	%		
70	FIC-45120	Aeration Tank No. 1 Pass B Air Flow Valve Position Control				1	%		
71	FIC-45130	Aeration Tank No. 1 Pass C Air Flow Valve Position Control				1	%		
72	FIC-45140	Aeration Tank No. 1 Pass D Air Flow Valve Position Control				1	%		
73	FIC-45210	Aeration Tank No. 2 Pass A Air Flow Valve Position Control				1	%		
74	FIC-45220	Aeration Tank No. 2 Pass B Air Flow Valve Position Control				1	%		
75	FIC-45230	Aeration Tank No. 2 Pass C Air Flow Valve Position Control				1	%		
76	FIC-45240	Aeration Tank No. 2 Pass D Air Flow Valve Position Control				1	%		
77	FIC-45310	Aeration Tank No. 3 Pass A Air Flow Valve Position Control				1	%		
78	FIC-45320	Aeration Tank No. 3 Pass B Air Flow Valve Position Control				1	%		
79	FIC-45330	Aeration Tank No. 3 Pass C Air Flow Valve Position Control				1	%		
80	FIC-45340	Aeration Tank No. 3 Pass D Air Flow Valve Position Control				1	%		

Cedar Creek Water Pollution Control Plant
SCADA System Improvements
Area M – PLC-ATCC-4 Control Panel I/O List

No.	Tag Number	Description	DI	DO	AI	AO	Units	Range	Notes
		Total Number Of I/O	1	0	55	24			

Cedar Creek Water Pollution Control Plant
SCADA System Improvements
Building R – RIO-HVAC-R Control Panel I/O List

No.	Tag Number	Description	DI	DO	AI	AO	Units	Range	Notes
10		PLC-HVAC-R Enclosure Door Intrusion	1						
1	PIT-06731	Chill Water Supply Pressure			1		PSI		
2	TE-06731	Chill Water Supply Temp.			1		°F		
3	PIT-06732	Hot Water Supply Pressure			1		PSI		
4	TE-06732	Hot Water Supply Temp.			1		°F		
5	AIT-06701	Laboratory Humidity			1		%		
6	TE-06701	Laboratory Temperature			1		°F		
7	TY-06711	R-AHU 1 Cold/Hot Deck Temp			1		°F		
8	TY-06721	R-AHU 2 Cold/Hot Deck Temp			1		°F		
9	TY-06771	R-AHU 7 Cold/Hot Deck Temp			1		°F		
11									
12									
13									
		Total Number Of I/O	1	0	9	0			

Cedar Creek Water Pollution Control Plant

SCADA System Improvements

Building S – Dewatering Main Control Panel I/O List (Add I/O to Existing PLC)

No.	Tag Number	Description	DI	DO	AI	AO	Units	Range	Notes
1		Building S Protected Water Flow			1				To BFP MCP
2									
3									
4									
5									
6									
7									
8									
		Total Number Of I/O	0	0	1	0			

Cedar Creek Water Pollution Control Plant

SCADA System Improvements

Building S – Dewatering Polymer Control Panel I/O List (Add I/O to Existing PLC)

No.	Tag Number	Description	DI	DO	AI	AO	Units	Range	Notes
4		Building S Domestic Water Flow			1				To PLC-Polymer
5									
6									
		Total Number Of I/O	0	0	1	0			

Cedar Creek Water Pollution Control Plant

SCADA System Improvements

Building U – Biofilter Control Panel I/O List (Add I/O to Existing PLC)

No.	Tag Number	Description	DI	DO	AI	AO	Units	Range	Notes
2		Building U Protected Water Flow			1				To Biofilter CP
3									
4									
5									
6									
		Total Number Of I/O	0	0	1	0			

Glen Cove Waste Water Treatment Plant
SCADA System Improvements
Headworks Building – RIO-IPS Control Panel I/O List

No.	Tag Number	Description	DI	DO	AI	AO	Units	Range	Notes
1		Aeration Tank No. 1 Mixer 1 Run Status	1						
2		Aeration Tank No. 1 Mixer 2 Run Status	1						
3		Aeration Tank No. 1 Mixer 3 Run Status	1						
4		Aeration Tank No. 1 Mixer 4 Run Status	1						
5		Aeration Tank No. 1 Mixer 5 Run Status	1						
6		Aeration Tank No. 3 Mixer 1 Run Status	1						
7		Aeration Tank No. 3 Mixer 2 Run Status	1						
8		Aeration Tank No. 3 Mixer 3 Run Status	1						
9		Aeration Tank No. 3 Mixer 4 Run Status	1						
10		Aeration Tank No. 3 Mixer 5 Run Status	1						
11		Aeration Tank No. 5 Mixer 1 Run Status	1						
12		Aeration Tank No. 5 Mixer 2 Run Status	1						
13		Aeration Tank No. 5 Mixer 3 Run Status	1						
14		Aeration Tank No. 5 Mixer 4 Run Status	1						
15		Aeration Tank No. 5 Mixer 5 Run Status	1						
16		Aeration Tank No. 7 Mixer 1 Run Status	1						
17		Aeration Tank No. 7 Mixer 2 Run Status	1						
18		Aeration Tank No. 7 Mixer 3 Run Status	1						
19		Aeration Tank No. 7 Mixer 4 Run Status	1						
20		Aeration Tank No. 7 Mixer 5 Run Status	1						
21		Primary Settling Tank 1 Run Status	1						
22		Primary Settling Tank 1 Shutdown Alarm (Torque)	1						
23		Primary Settling Tank 1 Sludge Level (Reserved for Future)	1		1				
24		Primary Settling Tank 2 Run Status	1						
25		Primary Settling Tank 2 Shutdown Alarm (Torque)	1						
26		Primary Settling Tank 2 Sludge Level (Reserved for Future)	1		1				
27		Primary Settling Tank 3 Run Status	1						
28		Primary Settling Tank 3 Shutdown Alarm (Torque)	1						
29		Primary Settling Tank 3 Sludge Level (Reserved for Future)	1		1				
30		Primary Settling Tank 4 Run Status	1						
31		Primary Settling Tank 4 Shutdown Alarm (Torque)	1						
32		Primary Settling Tank 4 Sludge Level (Reserved for Future)	1		1				
33		Grit Screw Run Status	1						
34		Grit Screw Auto Status	1						
35		Grit Screw Alarm	1						
36		Grit Screw Start Command		1					
37		Waste Activated Sludge (WAS) Flow			1				

Glen Cove Waste Water Treatment Plant
SCADA System Improvements
Headworks Building – RIO-IPS Control Panel I/O List

No.	Tag Number	Description	DI	DO	AI	AO	Units	Range	Notes
38		WAS Flow Control Valve Position				1			
39		WAS Flow Control Valve Position Feedback			1				
		Total Number Of I/O	31	1	6	1			

Glen Cove Waste Water Treatment Plant
SCADA System Improvements
Control Building – PLC-ELEC Control Panel I/O List

No.	Tag Number	Description	DI	DO	AI	AO	Units	Range	Notes
1		Nitrate Return Pump No. 1 Run Status	1						
2		Nitrate Return Pump No. 1 Remote Status (Ready)	1						
3		Nitrate Return Pump No. 1 Fault	1						
4		Nitrate Return Pump No. 1 Speed Feedback			1				
5		Nitrate Return Pump No. 1 Speed Control				1			
6		Nitrate Return Pump No. 1 Run Command		1					
7		Nitrate Return Pump No. 2 Run Status	1						
8		Nitrate Return Pump No. 2 Remote Status (Ready)	1						
9		Nitrate Return Pump No. 2 Fault	1						
10		Nitrate Return Pump No. 2 Speed Feedback			1				
11		Nitrate Return Pump No. 2 Speed Control				1			
12		Nitrate Return Pump No. 2 Run Command		1					
13		Nitrate Return Pump No. 3 Run Status	1						
14		Nitrate Return Pump No. 3 Remote Status (Ready)	1						
15		Nitrate Return Pump No. 3 Fault	1						
16		Nitrate Return Pump No. 3 Speed Feedback			1				
17		Nitrate Return Pump No. 3 Speed Control				1			
18		Nitrate Return Pump No. 3 Run Command		1					
19		RAS Low Rate Pump No. 1 Run Status	1						
20		RAS Low Rate Pump No. 1 Remote Status (Ready)	1						
21		RAS Low Rate Pump No. 1 Fault	1						
22		RAS Low Rate Pump No. 1 Bypass Mode	1						
23		RAS Low Rate Pump No. 1 Speed Feedback			1				
24		RAS Low Rate Pump No. 1 Speed Control				1			
25		RAS Low Rate Pump No. 1 Run Command		1					
26		RAS Low Rate Pump No. 2 Run Status	1						
27		RAS Low Rate Pump No. 2 Remote Status (Ready)	1						
28		RAS Low Rate Pump No. 2 Fault	1						
29		RAS Low Rate Pump No. 2 Bypass Mode	1						
30		RAS Low Rate Pump No. 2 Speed Feedback			1				
31		RAS Low Rate Pump No. 2 Speed Control				1			
32		RAS Low Rate Pump No. 2 Run Command		1					
33		RAS Low Rate Pump No. 3 Run Status	1						
34		RAS Low Rate Pump No. 3 Remote Status (Ready)	1						

Glen Cove Waste Water Treatment Plant
SCADA System Improvements
Control Building – PLC-ELEC Control Panel I/O List

No.	Tag Number	Description	DI	DO	AI	AO	Units	Range	Notes
35		RAS Low Rate Pump No. 3 Fault	1						
36		RAS Low Rate Pump No. 3 Bypass Mode	1						
37		RAS Low Rate Pump No. 3 Speed Feedback			1				
38		RAS Low Rate Pump No. 3 Speed Control				1			
39		RAS Low Rate Pump No. 3 Run Command		1					
40		RAS High Rate Pump No. 1 Run Status	1						
41		RAS High Rate Pump No. 1 Remote Status (Ready)	1						
42		RAS High Rate Pump No. 1 Fault	1						
43		RAS High Rate Pump No. 1 Bypass Mode	1						
44		RAS High Rate Pump No. 1 Speed Feedback			1				
45		RAS High Rate Pump No. 1 Speed Control				1			
46		RAS High Rate Pump No. 1 Run Command		1					
47		RAS High Rate Pump No. 2 Run Status	1						
48		RAS High Rate Pump No. 2 Remote Status (Ready)	1						
49		RAS High Rate Pump No. 2 Fault	1						
50		RAS High Rate Pump No. 2 Bypass Mode	1						
51		RAS High Rate Pump No. 2 Speed Feedback			1				
52		RAS High Rate Pump No. 2 Speed Control				1			
53		RAS High Rate Pump No. 2 Run Command		1					
54		RAS High Rate Pump No. 3 Run Status	1						
55		RAS High Rate Pump No. 3 Remote Status (Ready)	1						
56		RAS High Rate Pump No. 3 Fault	1						
57		RAS High Rate Pump No. 3 Bypass Mode	1						
58		RAS High Rate Pump No. 3 Speed Feedback			1				
59		RAS High Rate Pump No. 3 Speed Control				1			
60		RAS High Rate Pump No. 3 Run Command		1					
61		RAS High Rate Flow			1				
62		RAS Low Rate Flow			1				
63		Aeration Tank Spray Water Pump No. 1 Run Status	1						
64		Aeration Tank Spray Water Pump No. 2 Run Status	1						
65		Seal Water Pump No. 1 Running	1						
66		Seal Water Pump No. 2 Running	1						
67		Screw Pump VFD Mode	1						
68		Screw Pump Manual Mode	1						
69		Screw Pump Running	1						
70		Grease Pump Running	1						
		Total Number Of I/O	41	9	11	9			

Glen Cove Waste Water Treatment Plant

No.	Tag Number	Description	DI	DO	AI	AO	Units	Range	Notes
1		Final Settling Tank 1 Run Status	1						
2		Final Settling Tank 1 Alarm	1						
3		Final Settling Tank 1 Scum Pump Run Status	1						
4		Final Settling Tank 1 Shutdown Alarm	1						
5		Final Settling Tank 2 Run Status	1						
6		Final Settling Tank 2 Alarm	1						
7		Final Settling Tank 2 Scum Pump Run Status	1						
8		Final Settling Tank 2 Shutdown Alarm	1						
9		Final Settling Tank 3 Run Status	1						
10		Final Settling Tank 3 Alarm	1						
11		Final Settling Tank 3 Scum Pump Run Status	1						
12		Final Settling Tank 3 Shutdown Alarm	1						
13		Final Settling Tank 4 Run Status	1						
14		Final Settling Tank 4 Alarm	1						
15		Final Settling Tank 4 Scum Pump Run Status	1						
16		Final Settling Tank 4 Shutdown Alarm	1						
17		Emergency Generator Run Status	1						
		Total Number Of I/O	17	0	0	0			

Glen Cove Waste Water Treatment Plant
SCADA System Improvements
Control Building – RIO-Admin Control Panel I/O List

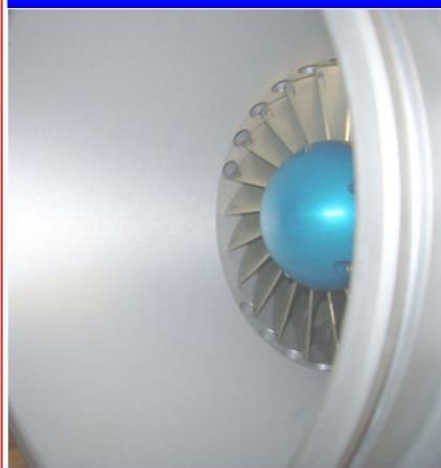
No.	Tag Number	Description	DI	DO	AI	AO	Units	Range	Notes
1		Fuel Storage Tank Level			1				
2		Fuel Storage Tank Leak Alarm	1						
3		Fuel Day Tank #2 Level			1				
4		Fuel Day Tank #3 Level			1				
5		Waste Activated Sludge (WAS) Flow			1				
6		WAS Flow Control Valve Position				1			
7		WAS Flow Control Valve Position Feedback			1				
8		Alarm Dialer Input #1	1						
9		Alarm Dialer Input #2	1						
10		Alarm Dialer Input #3	1						
11		Alarm Dialer Input #4	1						
12		Alarm Dialer Input #5	1						
13		Alarm Dialer Input #6	1						
14		Alarm Dialer Input #7	1						
15		Alarm Dialer Input #8	1						
16		Alarm Dialer Input #9	1						
17		Alarm Dialer Input #10	1						
18		Alarm Dialer Input #11	1						
19		Alarm Dialer Input #12	1						
20		Alarm Dialer Input #13	1						
21		Alarm Dialer Input #14	1						
22		Alarm Dialer Input #15	1						
23		Alarm Dialer Input #16	1						
24		Alarm Dialer Input #17	1						
25		Alarm Dialer Input #18	1						
26		Alarm Dialer Input #19	1						
27		Alarm Dialer Input #20	1						
		Total Number Of I/O	21	0	5	1			

SECTION 13300 – APPENDIX D APG NEUROS BLOWER COMMUNICATIONS

This appendix is an excerpt from the APG Neuros Blower Operations and Maintenance (O&M) manual and is included to assist in establishing communications necessary for control and monitoring by the PLC-MACP and the HMI system. This document is included for reference only. The determination of the exact number and type of I/O points shall be the responsibility of the PCSS based on the Drawings, the Specifications, Process Control Loop Descriptions (Section 13305), auxiliary device requirements, and spare requirements.



Remote Communication CompactLogix



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Review Date: January-30-2015

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1. Remote Communication

The default communications configuration for the control panel PLC (programmable logic controller) is, as follows:

Item	IP Address
PLC IP Address	192.168.0.10
Touch Screen IP Address	192.168.0.30
Subnet Mask	255.255.255.0
Gateway	192.168.0.1

Contact APG-Neuros for information on reconfiguring the IP addresses if it is required.



Remote Communication

2. Communication Address Map

COMMUNICATION ADDRESS MAP

Note: All data is being passed through the gateway is converted to single integer (16bit) values.

Tag Name	Description	Metric Units	English Units	Variable Type	Compact Logix Address	Access	Metric Units Range	English Units Range
Ps	Filter Pressure Drop	Bar	PSI	Real	MCP_Float_Data[0]	Read Only	0-.05	0-0.725
Pd	Discharge Pressure	kgf/cm ²	PSI	Real	MCP_Float_Data[1]	Read Only	0-1.5	0-21.3
Xm	Rotor Vibration	µm	mil	Real	MCP_Float_Data[2]	Read Only	0-200	0-7.87
Ox	Dissolved Oxygen	mg/l	PPM	Real	MCP_Float_Data[3]	Read Only	0-10	0-10
N1	Motor Speed	RPM	RPM	Real	MCP_Float_Data[4]	Read Only	0-50,000	0-50,000
Wm	Motor Power	KW	KW	Real	MCP_Float_Data[5]	Read Only	0-350	0-350
Ts	Suction Temperature	°C	°F	Real	MCP_Float_Data[6]	Read Only	-50-300	-58-572
Td	Discharge Temperature	°C	°F	Real	MCP_Float_Data[7]	Read Only	-50-300	-58-572
Tb	Bearing Temperature	°C	°F	Real	MCP_Float_Data[8]	Read Only	-50-300	-58-572
Tm	Motor Temperature	°C	°F	Real	MCP_Float_Data[9]	Read Only	-50-300	-58-572
Q	Normalized Suction Flow Rate	Nm ³ /min	SCFM	Real	MCP_Float_Data[10]	Read Only	0-285	0-10000
Hours_t	Total Run Hours	Hours	Hours	Real	MCP_Float_Data[11]	Read Only	0-2,000,000,000	
Hours_c	Current Run Hours	Hours	Hours	Real	MCP_Float_Data[12]	Read Only	0-3276.7	0-3276.7
Ref Cmd	Ref Speed Command	%	%	Real	MCP_Float_Data[13]	Read Only	0-100	0-100
Nc_Max	Speed at Current Suction Temperature	RPM	RPM	Real	MCP_Float_Data[14]	Read Only	0-50,000	0-50,000
Pi_Max	Filter Drop Pressure Limit	kPa	PSI	Real	MCP_Float_Data[15]	Read Only	0-.05	0-0.725
Xm_Max	Rotor Vibration Limit	µm	mil	Real	MCP_Float_Data[16]	Read Only	0-200	0-7.87
Pd_Max	Discharge Pressure Limit	kgf/cm ²	PSI	Real	MCP_Float_Data[17]	Read Only	0-1.5	0-21.3
Ti_Max	Suction Temperature Limit	°C	°F	Real	MCP_Float_Data[18]	Read Only	-50-300	-58-572
Td_Max	Discharge Temperature Limit	°C	°F	Real	MCP_Float_Data[19]	Read Only	-50-300	-58-572
Tb_Max	Bearing Temperature Limit	°C	°F	Real	MCP_Float_Data[20]	Read Only	-50-300	-58-572
Tm_Max	Motor Temperature Limit	°C	°F	Real	MCP_Float_Data[21]	Read Only	-50-300	-58-572
NM_Max	Motor Speed Limit	RPM	RPM	Real	MCP_Float_Data[22]	Read Only	0-50,000	0-50,000
Wm_Max	Motor Power Limit	KW	KW	Real	MCP_Float_Data[23]	Read Only	0-350	0-350
Ns	Minimum Blower Speed	%	%	Real	MCP_Float_Data[24]	Read Only	0-100	0-100
Q	Suction Flow	m ³ /min	CFM	Real	MCP_Float_Data[25]	Read Only	0-285	0-10000
KWH	Total KWH Usage	KWH	KWH	Real	MCP_Float_Data[26]	Read Only	0-2,000,000,000	
					MCP_Float_Data[27]			
					MCP_Float_Data[28]			
Target	Target Command	%	%	Real	MCP_Float_Data[29]	MCP_CMD		70-100



Remote Communication

Status	Blower Status Word (See Below)		Double Integer	MCP_Integer_Data[0]	Read Only		
Site	Remote Mode (See Below)		Double Integer	MCP_Integer_Data[1]	Read Only		
Mode	Control Mode (See Below)		Double Integer	MCP_Integer_Data[2]	Read Only		
Surge	Surge Mode (See Below)		Double Integer	MCP_Integer_Data[3]	Read Only		
Heart	Health Word (Constantly incrementing #)		Double Integer	MCP_Integer_Data[4]	Read Only		0-10000
Fault	Fault Code (See Fault Code List)		Double Integer	MCP_Integer_Data[5]	Read Only		0-10000
	Blower Warning Code		Double Integer	MCP_Integer_Data[6]	Read Only		
	Blower Status Bits (See Below)		Double Integer	MCP_Integer_Data[7]	Read Only		
MCP_Heart	Heart Beat from MCP/ Scada		Double Integer	MCP_Integer_Data[8]	Write Only		0-65535
Cmd	Control Bits		Double Integer	MCP_Integer_Data[9]	Write Only		
Start	Remote Blower Start (See Description)		Binary	MCP_Integer_Data[9].0	Write Only		1 = Run 0 = Stop
Stop	Remote Blower Stop (See Description)		Binary	MCP_Integer_Data[9].1			1 = Stop
Target	Target Command	%	%	Float	MCP_CMD	Write Only	70-100
Blower Status Word		Control Mode Word		Surge Mode Word			
Value	Meaning	Value	Meaning	Value	Meaning		
0	Ready	0	Constant Speed Control	0	No Surge control		
1	Starting	1	Constant Pressure Control	1	Boundary Surge control		
2	Running	2	Constant Flow Control	2	Surge Stop		
3	Stopping	3	DO Control	3	BOV Open		
4	Faulted						
5	Reset						
6	Checking						
Remote Mode Word		CMD Control Word					
Value	Meaning	Value	Meaning				
0	Local	2	Wire Control Selected in System Set up				
1	TCP/IP	0	Stop				
2	Remote Hardwired Start Stop and analog speed reference	1	Run				
3	Remote Hardwired Start Stop With Touch screen speed control	3	Wire Control Selected in System Set up				
		1	Run				
		2	Stop				
Blower Status Bits							
Bit	Description	0 Value	1 Value				
0	BOV Close Command	Open	Close	This is only the indication of what the valve is being told to do, not what it is actually doing.			
1	Discharge Valve Open Indication	Not Open	Fully Open				
2	Discharge Valve Close Indication	Not Closed	Fully Closed	In travel means that the valve is currently not fully open or fully closed.			
3	Discharge Valve Travel Indication	Not in Travel	In Travel				
4	Discharge Valve Fail	Valve Ok	Failed				
5	Discharge Valve in Remote	Not in Remote	Remote				
6	E-Stop Button Status	Ok	E-Stop On				
7							
8							
9							
10							
11							



3. Description of Principal Control Parameters

The following section describes the principal parameters.

3.1 Status

Status indicates the blower operating status as defined in the following table.

Setting	Status
0	Ready
1	Starting
2	Running
3	Stopping
4	Faulted
5	Reset
6	Checking

3.2 Mode (Control Mode)

Control Mode indicates the selected blower control mode.

Setting	Control Mode	Description
0	Const Speed	Constant Speed Control
1	Const Pressure	Constant Pressure Control
2	Const Flow	Constant Flow Control
3	DO	DO Control Mode

3.3 Site (Remote Method)

Remote method indicates the selected operating type.

Setting	Remote Mode	Description
0	Local	Local Control
1	TCP/IP	TCP/IP Control
2	Remote	Remote Control via terminal operation
3	TS & Rem S/S	Start/Stop via terminals with touch screen speed control



3.4 Surge (Protection Method)

Protection method defines the selected option for surge protection.

Setting	Type	Description
0	None	No surge protection. This is for factory testing purposes only.
1	Boundary	Surge protection activated but blower stops on abrupt surge. (Continues operation in the boundary of the surge limit.
2	Surge Stop	Blower stops when a surge occurs and trips a protection function.
3	BOV Open	No surge protection and BOV (blow-off valve) is open.

3.5 Fault Code

See the Advanced Troubleshooting document for a comprehensive listing of fault codes, inspection procedures and corrective actions.

3.6 Heart

Heart is a changeable word to define the health status. This can be used to ensure communications are active.

3.7 Target

Target is an operation setpoint percentage of the following control modes: constant speed, constant pressure, constant flow and DO (dissolved oxygen). The setpoint represents a percentage of speed (RPM), pressure (PSI), flow (SCFM) or dissolved oxygen (PPM).

3.8 MCP_Heart

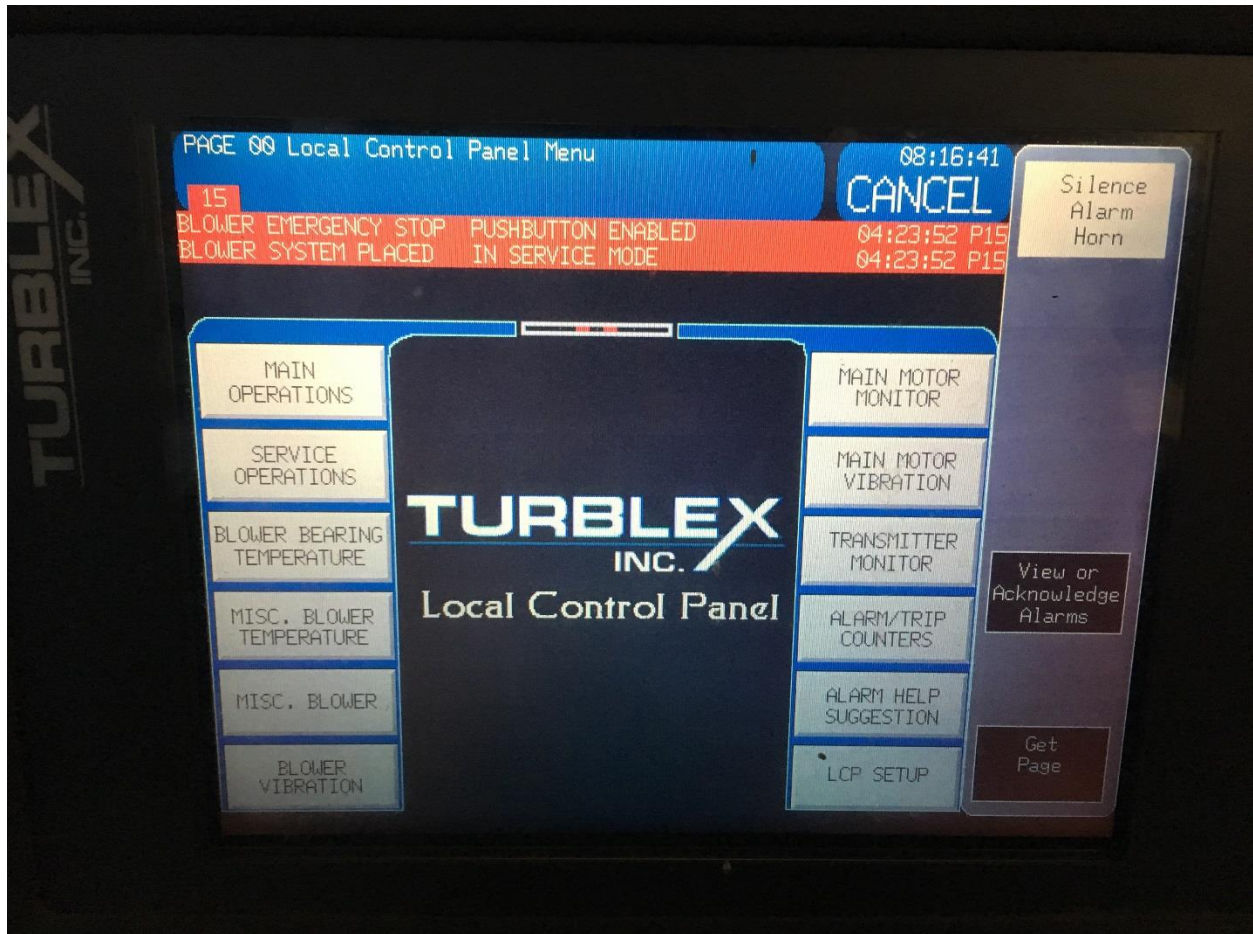
The parameter defines the Heartbeat signal from the MCP (Master Control Panel) or SCADA system. When enabled, the blower will turn off if the signal has not changed for more than 5 seconds.

3.9 Start/Stop

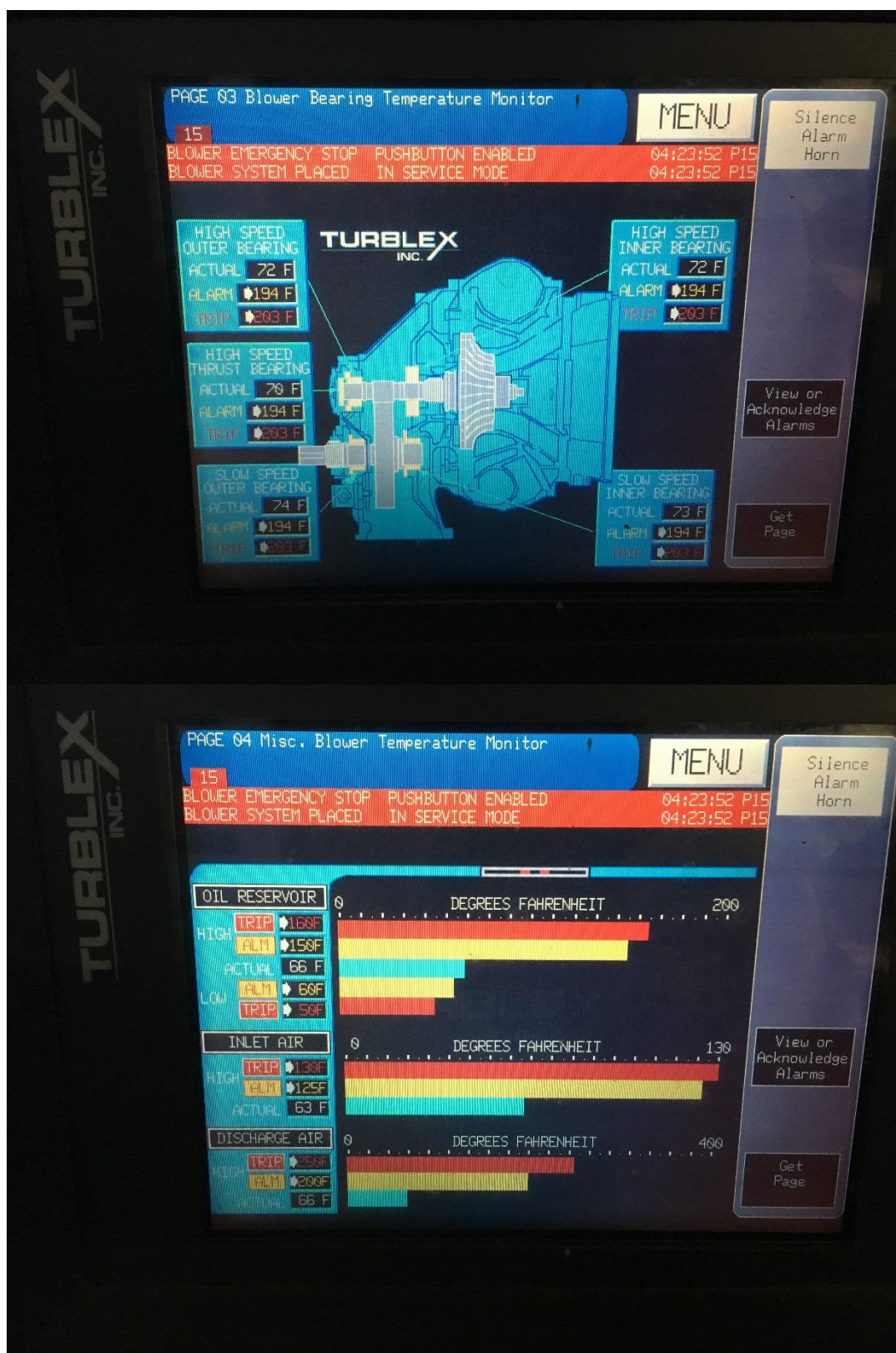
- A. For 3-wire control, write a '1' to the word to START the blower;
- B. For 3-wire control, write a '2' to the word to STOP the blower;
- C. For 2-wire control, the '1' must be maintained until the unit is to stop. Then, 0 must be written.

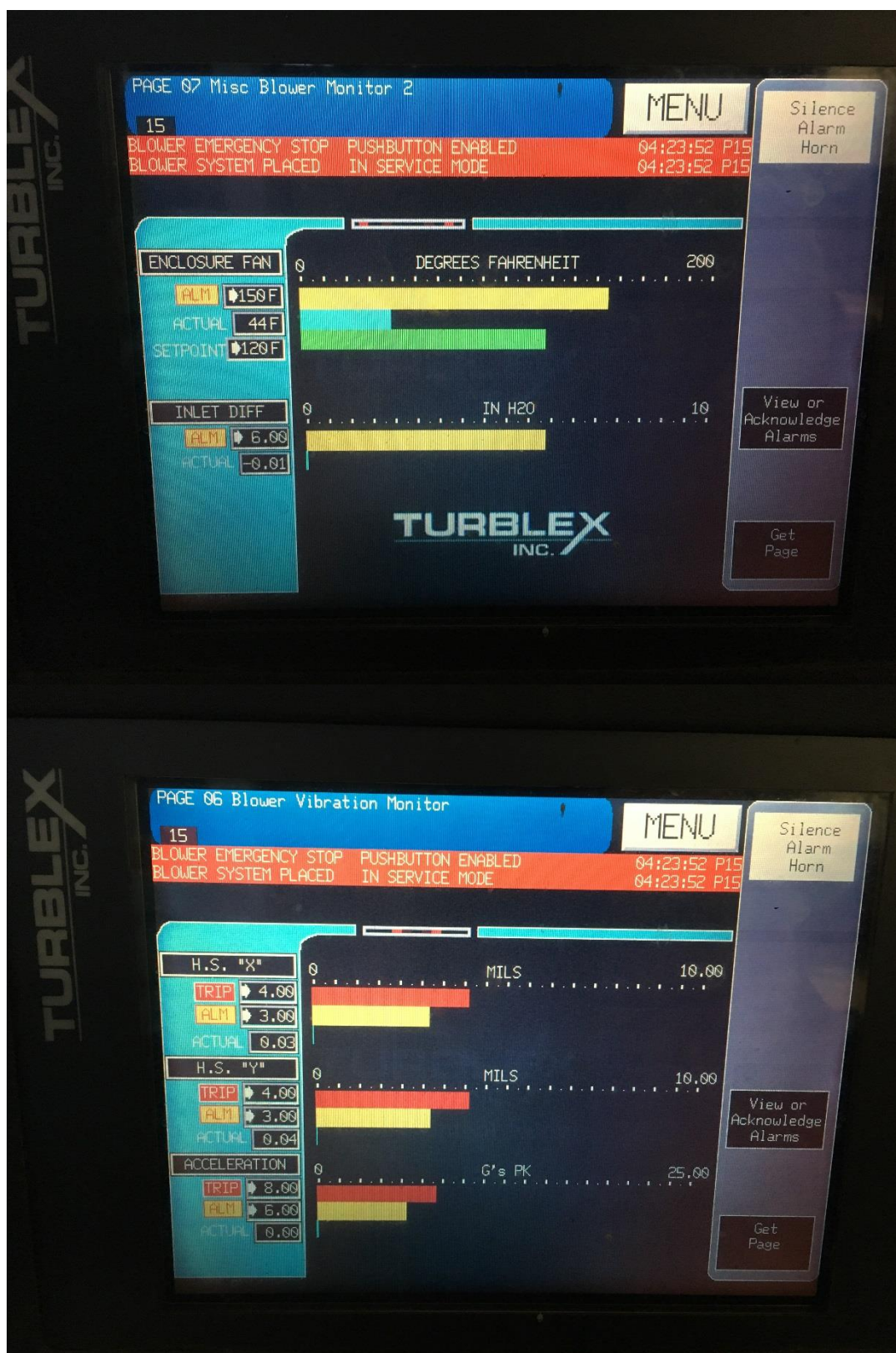
SECTION 13300 – APPENDIX E TURBLEX BLOWER OIT SCREENS

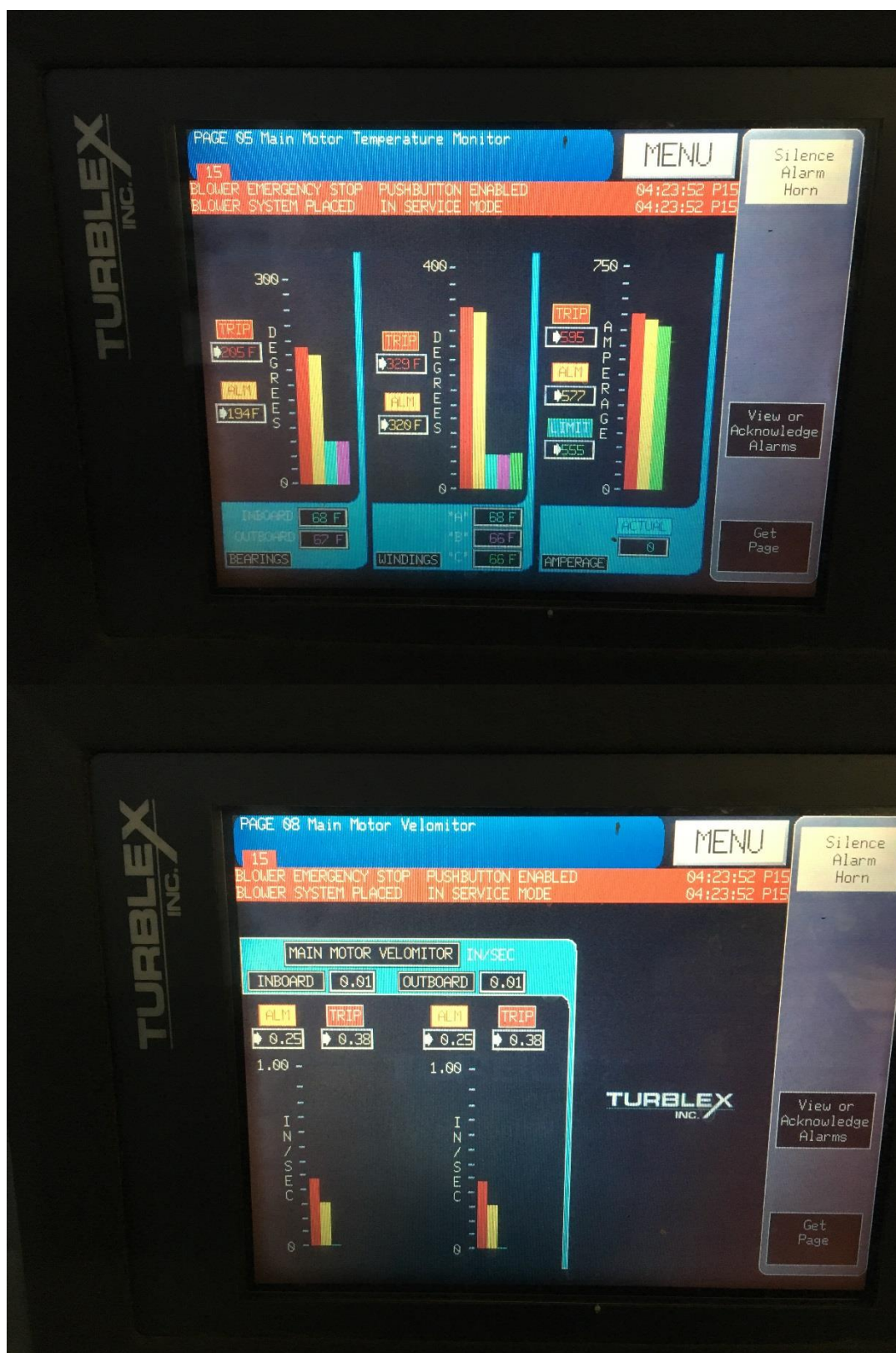
This appendix includes photos of the graphics displayed on the Turblex Local Blower OIT. The data displayed on this OIT shall be included in new HMI graphics. These screens shall also be used to create a preliminary I/O list.

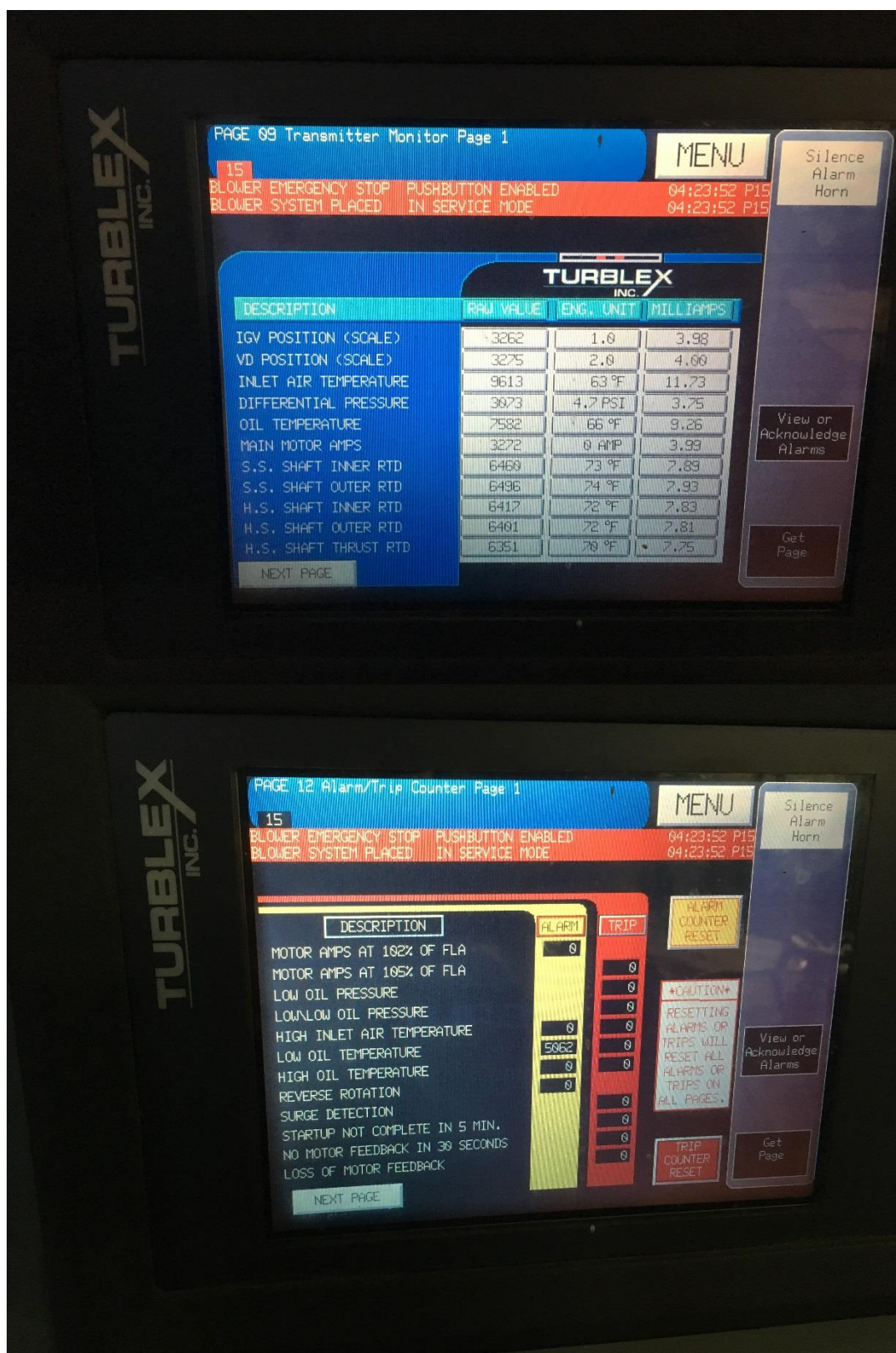


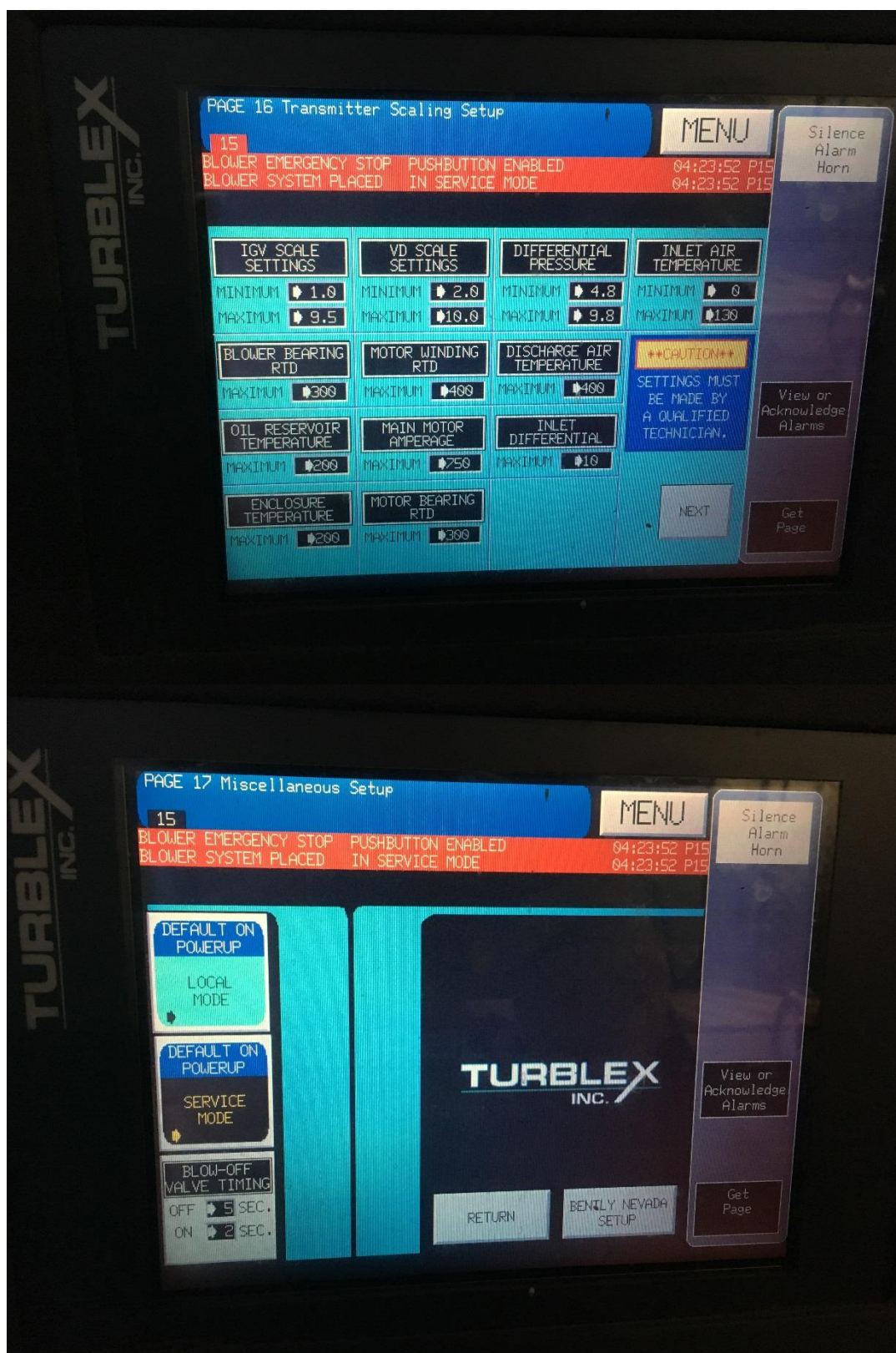












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SECTION 13302 TESTING

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Furnish all labor, materials, equipment and incidentals required to complete the testing of all devices and systems furnished and installed as detailed on Drawings, and as specified herein.
- B. Refer to Section 13300 for other general requirements.

1.02 RELATED WORK

- A. Refer to Section 13300.
- B. Refer to Section 01465 - Equipment Testing and Startup.
- C. Refer to Section 13321 for testing of fiber optic cable.

1.03 SUBMITTALS

- A. Refer to Section 13300.
- B. Testing Submittals - Submit, in one submittal, the following testing related documents:
 - 1. Status signoff forms:
 - a. Develop and submit project specific I/O Status and Automatic Control Strategy signoff forms to be used during factory and field testing to organize and track each loop's inspection, adjustment, calibration, configuration, and testing status and sign off. Include sign-off forms for each testing phase showing all loops.
 - 1) Example forms are shown in the Appendices.
 - 2) Separate forms for factory and field testing can be used, or they can be combined, at the discretion of the PCSS.
 - 3) Submit testing forms prior to start of testing.
 - 2. Testing Procedures:
 - a. Submit detailed procedures proposed to be followed for each of the tests specified herein. The test procedures shall serve as the basis for the execution of the required tests to demonstrate that the system meets and functions as specified.
 - b. Documents shall be structured in an orderly and easy to follow manner to facilitate an efficient and comprehensive test.
 - c. Test procedures shall indicate all pre-testing setup requirements, all required test equipment, and simulation techniques to be used.
 - d. Test procedures shall be structured in a cause and effect manner where the inputs are indicated, and the outputs are recorded.
 - e. Test procedures shall include the demonstration and validation under normal operating conditions and under various failure scenarios as specified in Contract Documents.
 - f. Testing may not start until all Testing Submittals have been approved.

C. Test Documentation:

1. Upon completion of each required test, document the test by submitting a copy of the signed off Testing Status forms. Testing shall not be considered complete until the signed-off forms have been submitted and approved. Submittal of other test documentation, including "highlighted" wiring diagrams with field technician notes are not acceptable substitutes for the formal test documentation.

D. Refer to Section 13321 for fiber optic cable testing submittal requirements.

1.04 MAINTENANCE

A. Refer to Section 13300.

1.05 COST OF TRAVEL

- A. Scheduled tests will only be attended once by Engineer /Owner. If test is not successful, all subsequent tests will be performed at Contractor's expense. Reimburse Owner for all costs, including labor and expenses, invoiced by Engineer and incurred by Owner for subsequent retests.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 TESTING - GENERAL

- A. Refer to Section 13300.
- B. Results of all testing shall be tracked on a project specific status sign off form or similar document. PCSS shall be responsible for maintaining the sheet. Appendix of this Section has an example template for this sheet.
- C. Tests the PCSS is required to perform are as follows:
1. Factory Testing:
 - a. Unwitnessed Factory Test (UFT).
 - b. Witnessed Factory Test (WFT).
 2. Field Testing:
 - a. Operational Readiness Test (ORT).
 - b. Functional Demonstration Test (FDT).
 - c. Startup Acceptance Test (SAT).
- D. Wherever possible, perform tests using actual process variables, equipment, and data. Where it is not practical to test with real process variables, equipment, and data, provide all special testing materials and equipment required for a suitable means of simulation.
- E. PCSS shall coordinate all required testing with Contractor, affected Subcontractors, Engineer, and Owner.

- F. No equipment shall be shipped to jobsite until Engineer or Owner has received all Factory Testing results and approved the system as ready for shipment.
- G. Engineer reserves the right to test or re-test any functions.
- H. Correction of Deficiencies:
 - 1. Deficiencies in workmanship and/or items not meeting specified testing requirements shall be corrected to meet specification requirements at no additional cost to Owner.
 - 2. Testing, as specified herein, shall be repeated after correction of deficiencies is made until specified requirements are met. This work shall be performed at no additional cost to Owner.

3.02 FACTORY TESTING - UNWITNESSED FACTORY TEST (UFT)

- A. Purpose of UFT is for PCSS to check system prior to Engineer and/or Owner attending factory testing. This type of testing should be part of any quality firm's internal QA/QC procedures.
- B. Temporary network connections will be required to confirm the network configuration. Temporary wiring of primary elements, final control elements, and field-mounted transmitters is not required.
- C. Hardware to be tested shall include all control system devices shown on System Architecture drawings and provided by PCSS.
- D. Tests to be performed shall include, but not be limited to, the following. Each of these tests shall be specifically addressed in Test Procedure submittal.
 - 1. All panels and enclosures being provided shall undergo a thorough inspection to verify integrity of cabinet enclosures, frame structures, paint work and finish, etc. Review panel drawings to ensure they accurately reflect panel layout and wiring.
 - 2. Perform a system audit to verify all components have been staged for test and have been documented properly with correct model numbers, serial numbers, etc. Following documentation of audit shall be provided at factory test and submitted as part of O&M Manual Documentation:
 - a. For each workstation and server, list of all software installed (including the operating system), with software revision number, software improvement modules or patches installed, license number and owner registration information, warranty period, vendor and local distributor names and contacts.
 - b. For each microprocessor-based component connected to control communication backbone in system (PLCs, managed switches, protocol converters, communication cards on final field devices, radios, etc.), list firmware revision, vendor and local distributor information, and system, warranty information, configuration parameters (e.g., communication settings, fail position settings, etc.)
 - 3. Panel wire pull tests shall be performed to ensure all wiring has been connected with appropriate torque to prevent wires from coming loose.

4. UPS shall be tested to verify UPS switch power correctly while keeping all UPS powered loads online. Testing of UPS to determine if they have been sized correctly to maintain specified run time shall be performed during field testing.
5. A 100 percent I/O point checkout shall be performed to verify proper operation of input/output points from panel terminations to HMI and OIT nodes. At a minimum, I/O checkout shall consist of four steps.
 - a. Discrete input signals shall be jumpered at field terminal blocks in control panels to verify proper status in HMI and OIT nodes.
 - b. Analog input signals shall be connected to a signal generator at field terminal blocks in control panels to verify proper status in HMI and OIT nodes and signals shall be verified at zero percent, 50 percent, and 100 percent of full scale.
 - c. Discrete output signals shall be tested by switching equipment to manual control at HMI and OIT nodes and turning the output on or other means to turn the output on. Then verify the output is on by connecting a digital multimeter to measure continuity at terminations, thus verifying command from PLC has properly executed contact closure.
 - d. Analog output signals shall be tested by switching the equipment to manual control at HMI and OIT nodes and turning output on or other means to turn the output on. Then verify output by utilizing a digital multimeter to measure current or voltage generated at termination points.
6. All control strategies shall be verified using simulation or other means to verify logic performs as expected. Verify faults and logical failure conditions for control strategies such as instrument failures, equipment failures, loss of communication between HMI Server and PLC, loss of peer-to-peer communication, out of range testing (over and under scale) for analog inputs, and all other strategies specified in control strategy document.
7. For each hardware enclosure, inspection shall include, but not be limited to, cabinet enclosures, frame structure, paint work and finish, dimensions, and hardware operability (i.e., fans, door hinges, keylocks, etc.).
8. For each subpanel, inspection shall include, but not be limited to, I/O subsystem physical layout, power supply sizing and mounting, cable routing, wire runs across hinges properly installed, fans and blowers unobstructed and mounted to maximize air flow, power conditioning correctly installed, and overall layout and installation of components meets manufacturer's recommendations and standard industry accepted practices.
9. All other control panel circuitry.
10. Following systems tests shall be performed:
 - a. Demonstrate ability to share data between operator workstations and servers.
 - b. Demonstrate ability of each workstation to create reports.
 - c. Demonstrate ability for each workstation to read and write designated files from servers and other workstations on the network.
 - d. Demonstrate operability of all back-up and mass storage equipment.
 - e. Demonstrate communication failure and recovering self-healing ring testing.
 - f. Demonstrate total power failure and recovery. UPS shall be removed for this test.
 - g. Demonstrate failover capabilities of the redundant HMI servers.
 - h. Demonstrate failover capabilities of the redundant PLCs.

- E. Upon successful completion of UFT, PCSS shall submit a record copy of test results as specified in PART 1. As part of this test results submittal, notify Engineer and Owner in writing that system is ready for WFT. No other notice of Factory test will be accepted. Engineer and/or Owner shall schedule a test date within 30 days of receipt of this submittal.

3.03 FACTORY TESTING - WITNESSED FACTORY TEST (WFT)

- A. Purpose of WFT is to allow Engineer or Owner representatives to witness functionality, performance, and stability of entire hardware and software system as a complete integrated system. WFT shall be run by PCSS and conducted at PCSS's facility.
- B. Required Documents for Test:
 - 1. Clean set of approved panel drawings and wiring diagrams.
 - 2. Set of Contract Documents - all drawings and specifications.
 - 3. All design change related documentation.
 - 4. Master copy of the PCSS developed factory testing signoff forms.
 - 5. Testing procedures.
- C. System shall operate continuously throughout WFT without failure, except where initiated per established test procedures. Any unanticipated failures may, at Owner or Engineer's option, result in overall WFT being deemed unsuccessful. All deficiencies identified during these tests shall be corrected and re-tested prior to completing WFT or shipment of panels to jobsite as determined by Owner/Engineer.
- D. Tests to be performed during the WFT shall include, but not be limited to, the following:
 - 1. A repeat of all tests specified in the UFT.
- E. Daily schedule during these tests shall be as follows:
 - 1. Morning meeting to review the day's test schedule.
 - 2. Scheduled tests and sign-offs.
 - 3. End of day meeting to review day's test results and to review or revise next day's test schedule.
 - 4. Unstructured testing period by witnesses.
- F. Upon successful completion of WFT, PCSS shall submit a record copy of test results as specified in PART 1.

3.04 FIELD TESTING - OPERATIONAL READINESS TEST (ORT)

- A. Purpose of ORT is to check that process equipment, instrument installation, instrument calibration, instrument configuration, field wiring, control panels, and all other related system components are ready to monitor and control the processes. This test will determine if equipment is ready for operation.
- B. This test shall take place prior to FDT and startup. Prior to starting this test, relevant process equipment shall be installed and mechanically tested, instruments installed, control panels installed, and field wiring complete.
- C. Required Documents for Test:
 - 1. Master copy of the PCSS developed field testing signoff forms.
 - 2. Testing procedures.
 - 3. Calibration forms.
- D. These inspections, calibrations, and tests do not require witnessing. However, Engineer may review and spot-check testing process periodically. Any deficiencies found shall be corrected by PCSS prior to commencement of Functional Demonstration Test.
- E. PCSS shall maintain Sign-off forms and Calibration forms at job site and make them available to Engineer/Owner at any time.
- F. Following tests shall be performed as part of ORT:
 - 1. Instrument calibration, configuration, and set-up.
 - 2. Input/Output (I/O) Testing to HMI and OITs.
 - 3. Testing of control strategies.
- G. Instrument calibration, configuration, and set-up:
 - 1. Calibrate, configure, and set-up all components and instruments to perform specified functions.
 - 2. Calibration form:
 - a. For any component or instrument requiring dip switch settings, calibration, or custom configuration, maintain a calibration form in field documenting this information. These forms shall provide a summary of the actual settings used in the field to allow an Instrument technician to replace the device entirely and configure it to function as it did before.
 - b. This information shall be added to Instrument data sheet, shall be added to a copy of manufacturer's standard "Configuration Sheet", or a separate form shall be created.
 - 1) If a separate form, the form shall list Project Name, Loop Number, ISA Tag Number, I/O Module Address, Manufacturer, Model Number/Serial Number, Output Range and Calibrated Value.
 - c. Some examples of required information are:

- 1) For Discrete Devices: Actual trip points and reset points.
- 2) For Instruments: Any configuration or calibration settings entered into instrument
- 3) For Controllers: Mode settings (PID).
- 4) For I/O Modules: Dip switch settings, module configuration (if not documented in native programming documentation).
- d. Maintain a copy of these forms in field during testing, and make them available for inspection at any time.
- e. For any device that allows a software back-up of configuration files to a laptop, make configuration files available to Engineer/Owner for inspection. Submit as part of Final System Documentation as specified in Section 13300.

H. I/O Testing:

1. Purpose of I/O testing is to check that process equipment, instrument installation, calibration, configuration, field wiring, and control panels are set-up correctly to monitor and control the processes. This test is commonly referred to as a "loop test" or an I/O checkout.
2. PCSS in conjunction with Contractor shall test signals under process conditions. Preferred test method will always be to execute test wherever possible to end elements. For example, preferred test will prove valve open/close limit switches by operating valve, not by installing a jumper on limit switch contacts. However if equipment or process is not available to test a signal over its entire calibrated range, PCSS may test using a simulation methods and make a note on sign-off form.
3. The following I/O tests shall be performed:
 - a. Discrete Input: At device or instrument, change signal condition from inactive to active state. Observe results on all indicators within loop such as HMI screens, OIT screens, pilot lights, horns, beacons, etc.
 - b. Analog Input: Test analog signal over entire engineering range at various intervals including 0, 50%, and 100% as well as on increasing and decreasing range. Observe results on all indicators within loop such as HMI screens, OIT screens, recorders, digital indicators, etc.
 - c. Discrete output signals shall be tested by switching equipment to manual control at the HMI and OIT nodes and turning output on or using other means to turn output on. Then verify equipment responds accordingly.
 - d. Analog output signals shall be tested by switching equipment to manual control at HMI and OIT nodes and turning output on or other means to turn output on. Then verify equipment responds accordingly.

I. Testing of Automatic Control Strategies:

1. All automatic control strategies shall be verified using actual process equipment and instruments, or other means, to verify logic performs as expected. Verify faults and logical failure scenarios for control strategies such as instrument failures, equipment failures, loss of communication between HMI Server and PLC, loss of peer-to-peer communication, out of range testing for analog inputs, loss of power, and all other strategies specified in control strategy document.

J. Repeat all systems tests specified under factory testing.

- K. UPS shall be tested to verify UPS switch power correctly while keeping all UPS powered loads online. Also, test sizing of UPS by switching off line power to UPS and verify if they maintain specified run time.
- L. For all panels with enclosures modified by this Contract, internal control panel temperature shall be tested under full running conditions to ensure proper cooling/ventilation is being provided.
- M. Upon successful completion of ORT, PCSS shall submit a record copy of test results as specified in PART 1 and request scheduling of FDT.

3.05 FIELD TESTING - FUNCTIONAL DEMONSTRATION TEST (FDT)

- A. After facility is started-up and running treatment process in automatic control to extent possible, a Functional Demonstration Test shall be performed. Purpose of FDT is to allow Engineer or Owner representatives to witness actual functionality, performance, and stability of system while connected to process equipment.
- B. Required Documents for Test:
 - 1. Set of panel drawings and wiring diagrams from ORT with corrections noted
 - 2. Set of Contract Documents - all drawings and specifications.
 - 3. All design change related documentation.
 - 4. Signed-off master copy of the PCSS developed field testing signoff forms.
 - 5. Testing procedures.
 - 6. Copy of completed calibration forms.
 - 7. One copy of all O&M Manuals for PCSS supplied equipment.
- C. A witnessed FDT shall be performed on each process area. To extent possible, repeat testing performed during ORT.
- D. Daily schedule specified to be followed during factory tests shall also be followed during FDT.
- E. After coordinating with Operations, a "Black Start" of the plant shall be performed to confirm plant operation recovers as specified in Contract Documents. Black start means shutting off power to the plant and turning it back on. Separate tests shall be performed by recovering the plant while on generator (if a generator is specified) and while on utility power.
- F. Punch list items and resolutions noted during test shall be documented on Punch list/Resolution form. In event of rejection of any part or function test procedure, PCSS shall perform repairs, replacement, and/or retest within 10 days.
- G. Upon successful completion of the FDT, PCSS shall submit a record copy of test results as specified in "Part 1 - General".

3.06 FIELD TESTING - SITE ACCEPTANCE TEST (SAT)

- A. After completion of FDT, and system is started-up and running treatment process in automatic control to extent possible, system shall undergo a test as defined in Section 01465 "Equipment Testing and Start-up" Section.
- B. While this test is proceeding, Engineer and Owner shall have full use of system. Only plant operating personnel shall be allowed to operate equipment associated with live plant processes. Plant operations shall remain responsibility of Owner and decision of plant operators regarding plant operations shall be final.
- C. During this test, PCSS personnel shall be present as required to address any potential issues that would impact system operation. PCSS is expected to provide personnel for this test who have an intimate knowledge of hardware and software of system. When PCSS personnel are not on-site, PCSS shall provide cell phone/pager numbers that Owner personnel can use to ensure that support staff is available by phone and/or on-site within four hours of a request by operations staff.
- D. Any malfunction during test shall be analyzed and corrections made by PCSS. In event of rejection of any part or function, PCSS shall perform repairs or replacement within 4 hours.
- E. Throughout duration of SAT, no software or hardware modifications shall be made to system without prior approval from Owner or Engineer.

END OF SECTION

APPENDIX 13302-A: EXAMPLE INPUT/OUTPUT (I/O) STATUS SIGN OFF FORM

An example template for I/O Status signoff form to be used for documenting testing results to Owner is attached. PCSS is required, prior to testing, to create a project specific I/O Status signoff form based on attached template or approved equal. PCSS may obtain an electronic copy of template from Engineer or develop it on their own.

APPENDIX 13302-B: EXAMPLE AUTOMATIC CONTROL STRATEGIES SIGN OFF FORM

An example template for Automatic Control Strategies signoff form to be used for documenting testing results to Owner is attached. PCSS is required, prior to testing, to create a project specific Automatic Control Strategies signoff form based on attached template or approved equal. PCSS may obtain an electronic copy of template from Engineer or develop it on their own.

[Project Name] Appendix A - Input/Output (I/O) Status Sign-Off Form

4-Jun-14

All Sections below are required to be filled out by PCSS as part of Field Testing.
Instrument Alarm Setpoint - Setpoint for any alarms set by PCSS
Wiring Complete - Signal wired from field device to PLC
I/O Tested - Signal tested from field device to SPADA HMI

PLC	Signal Tag	Description	Range or Active State when closed	P&ID	Signal	Chan	Instru- ment Alarm Setpoint	Calibrate, config, and Wiring complete	PCSS I/O testing	Date	I/O Testin g to the HMI	Date	Notes
PLC-SC	LI-4000-1	Secondary Clarifier No. 1 Sludge Level	0-10 ft	8	AI	2	1						
PLC-SC	LI-4000-3	Secondary Clarifier No. 3 Sludge Level	0-10 ft	8	AI	2	1						
PLC-SC	SI-4100-1	RAS Pump No. 1 Speed Feedback	0-100%	14	AO	2	1						
PLC-SC	SI-4100-1	RAS Pump No. 4 Speed Feedback	0-100%	15	AO	2	1						
PLC-SC	SI-4100-1	RAS Pump No. 5 Speed Feedback	0-100%	14	AO	2	1						
PLC-SC	SI-4100-1	WAS Pump No. 1 Speed Feedback	0-100%	14	AO	2	1						
PLC-SC	N/A	Spare Slot	N/A		Spare	2	5						
PLC-SC	SC-4100-1	RAS Pump No. 1 Speed Setpoint	0-100%	14	AO	2	7						
PLC-SC	SC-4100-2	RAS Pump No. 2 Speed Setpoint	0-100%	14	AO	2	7						
PLC-SC	SC-4100-3	RAS Pump No. 3 Speed Setpoint	0-100%	14	AO	2	7						
PLC-SC	SC-4110-1	WAS Pump No. 1 Speed Setpoint	0-100%	14	AO	2	7						
PLC-SC	Spare	Spare	N/A		AO	2	7						
PLC-SC	Spare	Spare	N/A		AO	2	7						
PLC-SC	TSH-4000-1	Secondary Clarifier No. 1 High Torque	Normal	8	DI	3	1						
PLC-SC	XA-4000-1	Secondary Clarifier No. 1 Motor Overload	Normal	8	DI	3	1						
PLC-SC	WAHH-4000-1	Secondary Clarifier No. 1 High Torque	Normal	8	DI	3	1						
PLC-SC	YRI-4000-1	Secondary Clarifier No. 1 On/Off	On	8	DI	3	1						
PLC-SC	YCI-4000-1	Secondary Clarifier No. 1 In Remote	In Remote	8	DI	3	1						
PLC-SC	YFI-4100-1	RAS Pump No. 1 VFD Fault	Normal	14	DI	3	1						
PLC-SC	FAL-4100-1	RAS Pump No. 1 Low Flow	Normal	14	DI	3	1						
PLC-SC	Spare	Spare	Normal	14	DI	3	1						
PLC-SC	YRI-4100-1	RAS Pump No. 1 Running	Running	14	DI	3	1						
PLC-SC	YCI-4100-1	RAS Pump No. 1 In Remote	In Remote	14	DI	3	1						
PLC-SC	YFI-4110-1	WAS Pump No. 1 VFD Fault	Normal	14	DI	3	1						
PLC-SC	FAL-4110-1	WAS Pump No. 1 Low Flow	Normal	14	DI	3	1						
PLC-SC	Spare	Spare	Normal	14	DI	3	1						
PLC-SC	YRI-4110-1	WAS Pump No. 1 Running	Running	14	DI	3	1						
PLC-SC	YCI-4110-1	WAS Pump No. 1 In Remote	In Remote	14	DI	3	1						
PLC-SC	HSS-4000-2	Secondary Clarifier No. 2 Start Command	Start	8	DO	4	6						
PLC-SC	Spare	Spare	N/A		DO	4	6						
PLC-SC	HSS-4100-2	RAS Pump No. 2 Start Command	Start	14	DO	4	6						
PLC-SC	HSS-7000-2	Sludge Holding Tank Tank Blower No. 2 Start Command	Start	17	DO	4	6						
PLC-SC	HSS-4100-5	RAS Pump No. 5 Start Command	Start	15	DO	4	6						
PLC-SC	Spare	Spare	N/A		DO	4	6						
PLC-SC	HSS-4105-1	Secondary Sludge Pump No. 2 Start/Stop	Start	15	DO	4	6						
PLC-SC	HSS-4110-2	WAS Pump No. 2 Start/Stop Command	Start	15	DO	4	6						
PLC-SC	7160-F01	Sludge Loadout LCP Pumping Indicator	Pumping	17	DO	4	6						
PLC-SC	Spare	Spare	N/A		DO	4	6						
PLC-SC	HSS-7115-2	Sludge Holding Tank Mixer No. 2 Start	Start	17	DO	4	6						
PLC-SC	Spare	Spare	N/A		DO	4	6						
PLC-SC	HSS-7117-2	Sludge Holding Tank Discharge Valve No. 2 Open CMD	Open	17	DO	4	6						
PLC-SC	HSS-7117-2	Sludge Holding Tank Discharge Valve No. 2 Close CMD	Close	17	DO	4	6						
PLC-SC	HSS-7120-2	TS Transfer Pump No. 2 Start Command	Start	17	DO	4	6						
PLC-SC	Spare	Spare	N/A		DO	4	6						

Page 1 of 1

[Project Name] Appendix B - Automatic Control Strategies Sign-Off Form
All Sections below are required to be filled out by PCSS as part of Testing
Auto, Control Strategies. - Loop operational in Automatic as defined in Control Strategies

Control Strategies Loop #	Control Strategy Description	P&ID	Auto. Control Strategy	Date	Notes
LOOP 281 - 284	LOW FLOW PUMPS	8			
LOOP 290	LOW EQ CHANNEL FLOW NO. 4	8			
LOOP 300	MICROFILTRATION AIR SUPPLY LOW PRESSURE	10			
LOOP 351, 352	SITE LIFT STATION PUMP NO. 1 AND NO. 2	12			
LOOP 355	SITE LIFT STATION HIGH AND LOW LEVEL CONTROL	12			
LOOP 371, 372	SLUDGE HOLDING TANK NO. 1 AND NO. 2 LEVEL	14			
LOOP 381, 382	SLUDGE TRANSFER PUMPS	14			
LOOP 385	SLUDGE TRANSFER PUMPS REMOTE START/STOP COMMAND	14			
LOOP 700	EFFLUENT PUMPING STATION LEVEL	14			
LOOP 701, 702, 703	EFFLUENT PUMP NO. 1	14			
LOOP 840	POST AERATION CHANNEL AIR FLOW CONTROL	15			
LOOP 900	SLUDGE TRANSFER PUMPS DISCHARGE FLOW	8			
LOOP 971	CENTRIFUGE SLUDGE FEED PUMP NO. 1	8			
LOOP 1001	CENTRIFUGE NO. 1 SLUDGE FEED FLOW CONTROL	8			
LOOP 1411, 1412	SODIUM HYPOCHLORITE STORAGE TANKS LEVEL	8			
LOOP 1421, 1422	SODIUM HYPOCHLORITE PUMPS	8			
LOOP 1430	SODIUM HYPOCHLORITE STORAGE TANKS CONTAINMENT AREA HIGH LEVEL DETECTION	14			
LOOP 2051, 2052, 2053	DIESEL ENGINE GENERATOR STATUS	14			
LOOP 2055	TRANSFER SWITCH STATUS	14			
LOOP 2060	GENERATOR KILOWATTS MONITORING	14			
APPENDIX ONE	EQUIPMENT RESTART DURING A POWER LOSS WITH THE GENERATOR RUNNING	14			
APPENDIX TWO	EQUIPMENT RESTART WITH POWER RESTORED AFTER A POWER LOSS	14			
N/A	SELF-HEALING CAPABILITIES OF NETWORK	N/A			
N/A	REDUNDANT SCADA SERVER FAILOVER AND RECOVERY	N/A			

SECTION 13303 TRAINING

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Furnish training as specified herein.
- B. This Section covers the training requirements for all devices and systems furnished and installed as detailed on the Drawings.
- C. Refer to Section 13300.

1.02 RELATED WORK

- A. Refer to Section 13300.

1.03 SUBMITTALS

- A. Refer to Section 13300 for general submittal requirements.
- B. Training Plan Submittal
 - 1. The training plan shall include “Manufacturer Training” information, including:
 - a. Details of each course, including definitions, objectives, and target audience of each course.
 - b. Prerequisites of each course.
 - c. Available dates, available locations, and duration for each class.
 - 2. The training plan shall include “Onsite Training” information, including:
 - a. Details of each course, including definitions, objectives, and target audience of each course.
 - b. Schedule of training courses including proposed dates, duration and locations of each class.
- C. Training Manuals
 - a. Training manuals shall be provided for all training classes. The quantity of manuals for each class shall be defined by the “Number of Trainees per Course” shown in the table below multiplied by the number of times the course will be given. Training material for multiple courses may be combined into a single manual provided that each trainee is provided with a copy of the manual at the start of each course.
 - b. The required contents for each training manual is defined in the individual course sections below.

PART 2 PRODUCTS

2.01 N/A

PART 3 EXECUTION

3.01 GENERAL

- A. The cost of the training programs shall be included in the Contract price. Cost of manufacturer's training shall be included in the contract for three (3) County staff members for each of the classes listed below.
- B. The training and instruction shall be directly related to the system being supplied. The training program shall represent a comprehensive program covering all aspects of the operation and maintenance of the system.
- C. All training schedules shall be coordinated with and at the convenience of the Owner. Shift training may be required to correspond to the Owner's working schedule.
- D. All onsite instructors must be intimately familiar with the operation and control of the Owner's facilities.
- E. Provide detailed training manuals to supplement the training courses. The manuals shall include specific details of equipment supplied and operations specific to the project. The manuals shall be provided in hardcopy for each student. Provide electronic copy of each training manual in PDF format for Owner's future use.
- F. The trainer shall make use of teaching aids, manuals, slide/video presentations, etc. After the training services, all training materials shall be delivered to Owner.
- G. The Owner reserves the right to videotape all custom training sessions. All training tapes shall become the sole property of the Owner.
- H. Cost of Travel for off-site training
 - 1. Travel expenses shall be included in the contract for each of three (3) County staff members to attend all manufacturer training classes including flight, car rental, hotel room, and meals. All flights shall originate from Long Island or New York City airports.

3.02 TRAINING SUMMARY

A. The following training courses listed in the summary table shall, as a minimum, be provided:

Description	Minimum Course Duration (hours)	Number of Trainees per each Course Session	Number of Times Course to be Given	Intended Audience
Manufacturer's Training				
Proficiency Cimplicity Fundamentals	32	3	1	Maintenance, Administrator
Proficiency Cimplicity Advanced Development	24	3	1	Maintenance, Administrator
Proficiency Historian Fundamentals	16	3	1	Maintenance, Administrator
Programmable Logic Controller (PLC) Basic	32	3	1	Maintenance, Administrator
Programmable Logic Controller (PLC) Advanced	32	3	1	Maintenance, Administrator
Onsite Training (training sessions defined below shall be provided for Cedar Creek and Glen Cove)				
Installed Control System	4	6	1	Maintenance, Administrator
Operator Training	8	5	2	Operations
PLC Hardware/Software	4	6	1	Maintenance, Administrator
HMI System Configuration	8	6	1	Maintenance, Administrator
Instruments	8	6	1	Maintenance
Software Maintenance	2	2	1	Maintenance
Historian and System Reports Configuration	4	6	1	Maintenance
Fiber Optic Cable Training	8	6	1	Maintenance
Fault Tolerant Server Training (training to be performed by vendor retained by PCSS)	8	8	1	Maintenance, Administrator

B. Definitions of audience roles

1. Administrator - personnel responsible for maintaining the HMI / SCADA system.
2. Maintenance - personnel responsible for maintaining the field controller hardware and instrumentation system.
3. Operations - personnel responsible for daily plant operations.

3.03 MANUFACTURER'S TRAINING

A. Human Machine Interface (HMI) Software

1. Provide manufacturer's standard training courses for OWNER'S personnel in the configuration, programming, and installation of the HMI software supplied as listed in the table above. Conduct course in separate beginner and advanced training sessions.
2. This training shall be conducted no more than one month before the Witnessed Factory Test (WFT).

B. Historian

1. Provide manufacturer's standard training courses for Owner's personnel in the configuration, programming, and installation of the Historian software supplied as listed in the table above.
2. This training shall be conducted no more than one month before the Witnessed Factory Test (WFT).

C. Programmable Logic Controller (PLC) Hardware and Software

1. Provide manufacturer's standard training courses for the Owner's personnel in the operation, configuration, programming, installation, and maintenance of the PLC hardware and software supplied. Conduct this course in separate beginner and advanced training sessions as listed in the table above. Conduct this course in separate beginner and advanced training sessions.
2. The training shall be conducted no more than two months before the WFT.
3. The following hardware training shall be provided as a minimum:
 - a. Hardware maintenance for the PLC equipment provided.
 - b. Test, adjustment, and calibration procedures.
 - c. Troubleshooting and diagnosis.
 - d. Component removal and replacement.
 - e. Periodic maintenance.
4. The following software training shall be provided as a minimum:
 - a. System configuration.
 - b. Application specific program development/programming.
 - c. Uploading/downloading programs.
 - d. Documenting program/configuration.
 - e. System backups and reload procedures.
 - f. TCP/IP addressing procedures.
 - g. Network communications configuration.

3.04 ONSITE TRAINING

- A. Training personnel shall be intimately familiar with the control system equipment, its manipulation, and configuration. Training personnel shall command knowledge of system debugging, program modification, troubleshooting, maintenance procedure, system operation,

and programming, and shall be capable of transferring this knowledge in an orderly fashion to technically oriented personnel.

B. Installed Control System Training

1. Provide installed control system training for the Owner's personnel at the Owner's facility. The objective of this training is to provide personnel with a detailed understanding of the control system configuration and implementation specific to the system that is being supplied. The training shall be held before the Functional Demonstrator Test (FDT), but not more than two months before. The training shall include, but not limited to, the following:
 - a. A description of the Control system, including system hardware components and specific equipment arrangements, and explanations of how the hardware and software supplied under this Contract is used for the operation and control of the facilities.
 - b. A block diagram presentation of the Control system showing how and what information flow within the system and what each functional unit does.
 - c. An explanation of the operator interfaces including a demonstration of how to use an operator's workstation to monitor, control, navigate, display trends, and all other operational features of the system. Discussion of process control of individual processes shall be addressed outside of this course.
 - d. A walkthrough of the installed system explaining each of the items covered in the functional units' discussion. The features and functions of operator controls and interfaces shall be discussed.
 - e. Periodic maintenance.
 - f. Troubleshooting and diagnosis.
 - g. Network configuration, communications, and operation.
 - h. TCP/IP addressing procedures for all Ethernet devices.
 - i. UPS System Training
 - 1) Status Monitoring
 - 2) Troubleshooting
 - 3) Service Bypass Procedures
 - 4) Replacement of Batteries or UPS System
2. The training manual for this course shall include the network block diagram for the entire system, a description of the major system components, maintenance steps, troubleshooting steps
3. Training shall consist of classroom instructions and hands-on instruction utilizing the Owner's system.

C. Operator Training

1. Operator training shall cover plant operation with the control system and use of the HMI display screens, including at a minimum all the following items:
 - a. Basics of HMI control and navigation
 - b. Alarming and Interlocks
 - c. Auto functionality of automated processes and HMI control.
 - d. Failure modes of equipment and operator responses.

2. Training for operators shall be held once the HMI server racks and workstations are installed and tested at the plant. This training needs to be completed before cutover takes place.
3. Operator training shall be held at the convenience of the OWNER. This training may be held during the day, late at night, or very early in the morning to accommodate the OWNER'S shift schedule.
4. The O&M Operator Manuals defined in Section 13306 shall be used as the training manual for this course.
5. Fifty percent of all Operator training shall be "hands on" utilizing the installed Control System to the fullest extent possible. Confirm the operability of the Control System before commencing training. Training performed using a non-functioning Control System shall be rejected and repeated.

D. Programmable Logic Controller (PLC) Hardware and Software

1. Provide training for the Owner's personnel in the operation, maintenance, troubleshooting, etc. with the PLC hardware and software system. The training shall be held before the FDT, but not more than two months before.
2. Training and instruction shall be specific to the system that is being supplied.
3. Training shall consist of classroom instructions and hands-on instruction utilizing the Owner's system.
4. Detailed training shall be provided on the actual configuration and implementation for this Contract. Training shall cover all aspects of the PLC system that will allow the Owner's personnel to maintain, modify, troubleshoot, and develop future additions/deletions to the PLC system. The training shall cover the following subjects as a minimum and shall include sections in the training manual for each subject:
 - a. PLC system overview.
 - b. PLC system architecture.
 - c. PLC system hardware components and specific equipment arrangements.
 - d. PLC system startup, shut down, load, backup, and PLC failure recovery.
 - e. Periodic maintenance.
 - f. Troubleshooting and diagnosis down to the I/O card level.
 - g. PLC configuration, communications, and operation.

E. HMI System Configuration

1. Provide training for the Owner's personnel in the operation, maintenance, troubleshooting, and modification of the HMI application being provided. The training shall be held before the FDT, but not more than two months before.
2. Training and instruction shall be specific to the system that is being supplied.
3. Training shall consist of classroom instructions and hands-on instruction utilizing the Owner's system.

4. Training shall cover all aspects of the HMI system that will allow the Owner's personnel to maintain, modify, troubleshoot, and develop future additions/deletions to the system. The training shall cover the following subjects as a minimum and shall include sections in the training manual for each subject:
 - a. HMI system architecture.
 - b. HMI Redundancy
 - c. HMI Driver configuration
 - d. HMI Database development
 - e. Graphic display objects
 - f. Adding new graphic displays
 - g. Troubleshooting and diagnosis

F. Instrument Training

1. Provide instruction on the maintenance of the field and panel instrumentation for the Owner's instrumentation technicians. This training shall be conducted before the FDT, but no more than 1 month before and at a time suitable to the Owner. This training shall take place at the Owner's facility. As a minimum the following training shall be included with corresponding sections in the training manual:
 - a. Training in standard hardware maintenance for the instruments provided.
 - b. Specific training for the actual instrumentation configuration to provide a detailed understanding of how the equipment and components are arranged, connected, and set up for this Contract.
 - c. Test, adjustment, and calibration procedures.
 - d. Troubleshooting and diagnosis.
 - e. Periodic maintenance.

G. Software Maintenance

1. Provide training of how to back-up PLCs, HMIs, OITs, and any other software in this system.
2. Provide training on PLC program structure, HMI configuration structure, tips in how to edit programming code, and other items which will supplement the maintenance staff's ability to edit and maintain the programs.
3. The O&M Software Maintenance Manuals defined in Section 13306 shall be used as the training manual for this course.

H. Historian and System Reports Configuration

1. Provide training on the Historian and Reporting system. The training shall be held before the FDT, but not more than two months before. As a minimum the following training shall be included with corresponding sections in the training manual:
 - a. Historian configuration, including how to add new tags to the historian and set up logging.
 - b. Report configuration and repair of failed reports.
 - c. Database maintenance and backup

I. Fiber Optic Cable Training

1. Provide one half-day training and instruction on the maintenance of the fiber optic system and how to use the tools and testing equipment provided in this Section for the Owner's instrumentation technicians and electricians for up to four students. This training shall be conducted immediately following installation and testing of fiber optic cable and at a time suitable to the Owner. Provide a hands-on course using actual network as well additional fiber pieces as required. This training shall take place at the Owner's facility. As a minimum the following shall be included:
 - a. Fiber cable layout and basic of cable construction.
 - b. "Jumper" installation
 - c. Testing procedures.
 - d. Troubleshooting and diagnosis.
2. Provide one half-day training showing how to use the tools and on termination techniques and testing equipment provided in this Section prior to installation. Provide a hands-on course using actual network as well additional fiber pieces as required.

J. Fault Tolerant Server Training

1. Training on the fault tolerant server shall be provided by vendor that the PCSS retains to supply the fault tolerant server system as shown in the table above and as explained in Sections 13306 and 13310.

END OF SECTION

SECTION 13305 CONTROL DESCRIPTIONS

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. This Section provides the control strategies that shall be used to program and test the SCADA system. Refer to Section 13306 for additional requirements.
- B. The control descriptions described herein are broken into a two-layer concept. The first layer of control, local control, is at that piece of equipment or that piece of equipment's panel or drive. The second layer of control is at the SCADA system, which includes the programmable logic controllers (PLCs), the operator interface terminals (OITs), and the GE Cimplicity Human-Machine Interface (HMI) system. When a control description refers to the "SCADA PLC/HMI/OIT" layer, it refers to control logic performed within the associated PLC for that area, the graphic displays at the associated control panel operator interface terminal (OIT), and graphic displays at the GE Cimplicity system.
- C. All monitoring, control, alarming, and setpoint functionality shall be programmed into both the GE Cimplicity HMI and the control panel OITs.
- D. Detailed control descriptions *written in italics* are existing features that are included for reference.

1.02 RELATED WORK

- A. Refer to Section 13306 for Applications Engineering Services.

PART 2 PRODUCTS

2.01 NOT USED

PART 3 EXECUTION

3.01 GENERAL

- A. The control descriptions are sorted by loop number for each area. The loop index has three columns associated with it; Loop Number, Loop Description, and Page. Each loop is associated with a specific SCADA I/O cabinet location to which it shall communicate.

3.02 CONTROL FUNCTION DEFINITIONS AND GENERAL CRITERIA

- A. These general criteria are required for all programming being performed at both, Cedar Creek WPCP and Glen Cove WWTP. The hardware and/or software functions noted by this paragraph reference are to be implemented by the SCADA PLC control system specified herein.
- B. Any interlocks that are stated as hardwired interlocks shall interlock the equipment locally. If that hardwired interlock is also wired to the SCADA PLC, the PLC shall be programmed to shut down that equipment also.

- C. Equipment shall be capable of being controlled from the SCADA system if the local hand switch in the field is in the Remote” or “Auto” position.
- D. Unless otherwise stated in the control descriptions, each piece of equipment that is controlled from the SCADA system shall have a Hand-Off-Auto selector on an HMI popup display. When in the hand position, the equipment shall run; when in the off position, the equipment shall stop; and when in the Auto position, the equipment shall be controlled from the associated automatic control strategy.
- E. Each piece of equipment that is controlled from the SCADA system shall have an “Remote” status indicated at the HMI/OIT if the hand switch at the equipment is in the Remote or Auto position. The equipment can only be controlled from the SCADA system when in “Remote”.
- F. The PLC shall stop a motor or drive in its program if it does not receive the remote status signal or one of its software interlocks trip.
- G. Motors with VFD controls shall be provided with HMI adjustable minimum and maximum speed setpoints. If the VFD is used in a PID control loop, the output of the controller shall not fall below or exceed the minimum and maximum speed setpoints, except where explicitly stated in the detailed control descriptions below.
- H. When an analog signal goes outside the 4-20 mA range due to a failure at the instrument or PLC card, the following SCADA programming shall take place:
 - 1. The PLC shall hold the last “good” value received before the analog signal went into alarm, and this held value shall be the one displayed at the HMI/OIT.
 - 2. “Signal Failure” shall be alarmed at the HMI/OIT system, and a red, flashing box shall be indicated around the analog value at the HMI/OIT to indicate that the signal being displayed is not the current value.
 - 3. If the analog signal is associated with a control loop and/or calculation, the PLC shall use the last good value of the analog signal to perform that function.
- I. All interlocks that shut down (Stop a piece of equipment and prevent it from being restarted or moved) shall be shown on the popup graphic for that piece of equipment.
- J. The run status of all motors shall be used to calculate runtime hours in the PLC and indicate it at the HMI/OITs graphics. These runtime calculations shall also be recorded in the historian. Runtimes shall be calculated as follows with the decimal places as shown:
 - 1. Current Day’s Runtime in XX.XX Hrs
 - 2. Yesterday’s Runtime in XX.XX Hrs
 - 3. Current Month’s Runtime in XXX.X Hrs
 - 4. Last Month’s Runtime in XXX.X Hrs
 - 5. Total Runtime in XXXXXX Hrs (Include a reset button that is for supervisor level only)

- K. All flow indications shall be totalized. Daily flow totals shall be in Gallons and shall be rounded to the nearest gallon. Monthly and accumulated totals shall be in Millions-of-Gallons and shall be rounded to two decimals (X.XX).

1. Current Day's Flow Totalization
2. Yesterday's Flow Totalization
3. Current Month's Flow Totalization
4. Last Month's Flow Totalization
5. Total Flow Totalization

Totalizers not used for SPDES reporting shall be paused if any of the following occur. Totalizers used for SPDES reporting shall be coordinated with the County during construction. At a minimum, the final effluent flow shall never be paused:

1. The flow signal is outside the 4-20 mA range.
2. The value of the flow input is less than 2% of the full range of the input.
3. The pump associated with the flowmeter is not running.

L. Motor Failures

1. Supervisor level users shall be able to adjust the time delays used to generate the following alarms.
2. The PLC will generate "Run Failure" alarm when the PLC is calling for a motor to run, and the run status remains off for an adjustable time period. The start output command shall be de-energized and the motor shall be prevented from starting until reset is issued from the HMI. The Run Failure will be initially set at 15 seconds and adjusted during startup, if necessary. The maximum allowable setpoint for all pumps shall be limited to 90 seconds unless approved by the Owner.
3. The PLC will generate "Stop Failure" alarm when the PLC is calling for a motor to run, and the run status remains off for an adjustable time period. The start output command shall be de-energized and the motor shall be prevented from starting until reset is issued from the HMI. The Stop Failure will be initially set at 15 seconds and adjusted during startup, if necessary. The maximum allowable setpoint for all pumps shall be limited to 90 seconds unless approved by the Owner.
4. For all motors with adjustable speed control, the PLC will generate a "Speed Deviation" alarm when the motor is running, and the speed feedback signal does not match the commanded speed (within a deadband initially set to 10%) for an adjustable time period. The motor shall remain running.

M. Valve Failures

1. Supervisor level users shall be able to adjust the time delays used to generate the following alarms.

2. For all discrete valves (open-close), the PLC will generate a “Fail to Open” alarm when the PLC is sending an open command to the valve, and the PLC does not receive an open limit status signal from the valve for an adjustable time period.
3. For all discrete valves (open-close), the PLC will generate a “Fail to Close” alarm when the PLC is sending a close command to the valve, and the PLC does not receive a close limit status signal from the valve for an adjustable time period.
4. For all analog valves, the PLC will generate a “Position Deviation” alarm when the position feedback signal does not match the commanded position (within a deadband initially set to 10%) for an adjustable time period.

N. Analog Alarms

1. Alarms shall be programmed in the PLC for all analog signals as follows.
2. The following alarms (setpoints are supervisor adjustable) will be generated in the PLC based on the analog feedback value and then transmitted to the HMI/OIT. Each alarm shall include the ability for individual enabling and disabling. Supervisor level users shall be able to set a common time setpoint for each analog signal that will be used to generate the following alarms after the associated timer expires.
 - a. High-High
 - b. High
 - c. Low
 - d. Low-Low
 - e. Loss of Signal (Analog signal out of range)
3. A “calibration mode” shall be provided for every analog signal which shall hold the last value during instrument calibration. When active, calibration mode shall be clearly indicated by placing a yellow rectangle around the analog value on any local OITs and in the HMI system. After an adjustable time period (initially set at 1 hour), the calibration mode shall be automatically disabled.

O. Discrete Alarms

1. For all discrete alarm signals wired to the PLC (float switches, pressure switches, overload alarms, etc.) the alarms shall be programmed in the PLC to alarm after an adjustable time delay expires to eliminate nuisance alarming. Safety alarms (e.g. E-stop) shall not delay more than 1 second before alarming. The timer for each alarm shall be set during startup.

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3.03 CEDAR CREEK WPCP CONTROL DESCRIPTIONS

LOOP 1500-1 THRU 10 PRIMARY SEDIMENTATION TANKS 1 THRU 10 SLUDGE BLANKET LEVEL

General: The sludge blanket level shall be monitored in each sedimentation tank and used for controlling the primary sludge pumps. This loop is typical for all primary sedimentation tanks 1 thru 10.

Control:

Auto:

The sludge blanket level signal shall be used to control the associated primary sludge pump. Refer to Loop 1540-1 thru 10.

Alarms / Monitoring:

SCADA PLC/HMI/OIT:

Primary Sedimentation Tank Sludge Blanket Level

LOOP 1500-1 THRU 10 PRIMARY SEDIMENTATION TANKS 1 THRU 10 SLUDGE BLANKET LEVEL

General: The sludge blanket level shall be monitored in each sedimentation tank and used for controlling the primary sludge pumps. This loop is typical for all primary sedimentation tanks 1 thru 10.

Control:

Auto:

The sludge blanket level signal shall be used to control the associated primary sludge pump. Refer to Loop 1540-1 thru 10.

Alarms / Monitoring:

SCADA PLC/HMI/OIT:

Primary Sedimentation Tank Sludge Blanket Level

**LOOP 1510-1 THRU 10 PRIMARY SEDIMENTATION TANKS 1 THRU 10
LONGITUDINAL COLLECTORS**

General: The longitudinal collectors can be monitored and controlled by the operator from the local OIT and from the SCADA system. This loop is typical for all primary sedimentation tanks 1 thru 10.

Control:

Local (Local Control Station):

A hand/Off/Auto switch is provided at the local control station near the collector.

Hand:

When the Hand/Off/Auto switch is in the "Hand" position, the collector is started from the local control panel.

Off:

When the Hand/Off/Auto selector switch is in the "Off" position, the collector shall stop.

Auto:

When the Hand/Off/Auto selector switch is in the "Remote" position, the collector control shall be from the SCADA PLC/HMI/OIT.

SCADA PLC/HMI/OIT:

Manual Control:

The collector can be manually started or stopped by the operator at the HMI.

Auto Control:

None

Alarms / Monitoring:

SCADA PLC/HMI/OIT:

Motor Running
Shear Pin Alarm
Overload Alarm

LOOP 1520-1 THRU 10

**PRIMARY SEDIMENTATION TANKS 1 THRU 10 CROSS
COLLECTORS**

General: The cross collectors can be monitored and controlled by the operator from the local OIT and from the SCADA system. This loop is typical for all primary sedimentation tanks 1 thru 10.

Control:

Local (Local Control Station):

A hand/Off/Auto switch is provided at the local control station near the collector.

Hand:

When the Hand/Off/Auto switch is in the "Hand" position, the collector is started from the local control panel.

Off:

When the Hand/Off/Auto selector switch is in the "Off" position, the collector shall stop.

Auto:

When the Hand/Off/Auto selector switch is in the "Remote" position, the collector control shall be from the SCADA PLC/HMI/OIT.

SCADA PLC/HMI/OIT:

Manual Control:

The collector can be manually started or stopped by the operator at the HMI.

Auto Control:

None

Alarms / Monitoring:

SCADA PLC/HMI/OIT:

Motor Running
Shear Pin Alarm
Overload Alarm

LOOP 1530-1 THRU 10 PRIMARY SEDIMENTATION TANKS 1 THRU 10 SCUM WEIRS

General: The scum weirs can be monitored and controlled by the operator from the local OIT and from the SCADA system. This loop is typical for all primary sedimentation tanks 1 thru 10; however, the automatic control strategy is a common control strategy shared by tanks 1 thru 10.

Control:

Local (Local Control Station):

A hand/Off/Auto switch is provided at the local control station near the scum weir.

Hand:

When the Hand/Off/Auto switch is in the "Hand" position, the scum weir is started from the local control panel.

Off:

When the Hand/Off/Auto selector switch is in the "Off" position, the scum weir shall stop.

Auto:

When the Hand/Off/Auto selector switch is in the "Remote" position, the scum weir control shall be from the SCADA PLC/HMI/OIT.

SCADA PLC/HMI/OIT:

Manual Control:

The scum weir cycle can be manually started or stopped by the operator at the HMI.

Auto Control:

An HMI adjustable setpoint for "Time Between Scum Removal Cycles" shall be provided. Once the timer expires, the scum removal cycle shall begin with Primary Sedimentation Tank 1. If the Tank 1 scum weir is "Ready" for automatic control (in remote, in automatic, and not failed), then the PLC shall call for it to run. If it is not ready, the sequence shall automatically skip to the next "Ready" scum weir.

After commanding the scum weir to run, the PLC shall remove the run command once the run status is received. The PLC shall wait for the scum weir to finish its sequence before proceeding to the next tank.

If the run status is not received within 10 seconds of issuing the command, a "Fail-to-Run" alarm shall be generated, and the cycle would advance to the next tank in the sequence.

After the scum weir for Tank #10 has completed its sequence, the cycle is completed, and the time between cycles timer shall start.

Alarms / Monitoring:

SCADA PLC/HMI/OIT:

Remote Status
Motor Running
Shear Pin Alarm

LOOP 1540-1 THRU10 PRIMARY SLUDGE PUMP CONTROL

General: The primary sludge pumps transfer sludge from the primary sedimentation tanks to the digesters. This loop is typical for all primary sludge pumps 1 thru 10; however, the automatic control strategy is a common control strategy shared by pumps 1 thru 10.

Control:

Local (Local Control Panel):

Hand:

When the Hand/Off/Auto switch is in the "Hand" position, the pump is started from the local control panel.

Off:

When the Hand/Off/Auto selector switch is in the "Off" position, the pump shall be stopped.

Auto:

When the Hand/Off/Auto selector switch is in the "Auto" position, the pump control shall be from the SCADA PLC/HMI/OIT.

SCADA PLC/HMI/OIT:

Software Interlocks:

If the sludge blanket level is low-low, the pump shall stop and not be allowed to start in both manual and automatic modes.

Manual Control:

The pump can be manually started or stopped by the operator at the HMI.

Auto Control:

When the loop is placed in automatic mode, the pump's on/off control shall be automatically controlled by the PLC as described below:

Only one pump will be active at a given time. Each pump shall start when the associated sludge blanket level (refer to Loop 1500-1 thru 10) is above the HMI adjustable start setpoint (initially set at 5 feet). If multiple pumps are required to run at the same time, then the pump with the higher priority (Pump 1 shall have a higher priority than Pump 2, and Pump 2 shall have a higher priority than Pump 3, etc.) shall be called to run.

The pump speed of the active pump shall be automatically controlled by a PID controller in the PLC to maintain an HMI adjustable flow setpoint (initially set at 275 GPM). The PID controller's process variable for pumps 1 thru 6 (Loop 1550) shall be the North Primary Tank Sludge Flowmeter (Primary Sludge to Digesters 1 thru 6) Flowmeter, and the process variable for pumps 7 thru 10 (Loop 1555) shall be the South Tank Primary Sludge Flowmeter (Primary Sludge to Digesters 7 thru 9).

The pump shall stop when the sludge blanket level in the storm water basin falls below the HMI adjustable stop setpoint (initially set at 3.5 feet).

Alarms / Monitoring:

SCADA PLC/HMI/OIT:

Motor Running
Remote Status
Overload Alarm
Seal Water Pressure Low
High Discharge Pressure Alarm
Discharge Valve Open
Discharge Valve Auto Status

LOOP 1550 NORTH TANK PRIMARY SLUDGE FLOW TO DIGESTERS 1 THRU 6

General: The primary sludge flow to digesters 1 thru 6 is the North tank flowmeter and shall be monitored and used for controlling the speed of primary sludge pumps 1 thru 6.

Control:

Auto:

The primary sludge flow to digesters 1 thru 6 shall be monitored and used for controlling the speed of primary sludge pumps 1 thru 6. Refer to Loop 1540-1 thru 10.

Alarms / Monitoring:

SCADA PLC/HMI/OIT:

Primary Sludge Flow to Digesters 1 thru 6

LOOP 1555 SOUTH TANK PRIMARY SLUDGE FLOW TO DIGESTERS 7 THRU 9

General: The primary sludge flow to digesters 7 thru 9 is the South tank flowmeter and shall be monitored and used for controlling the speed of primary sludge pumps 7 thru 10.

Control:

Auto:

The primary sludge flow to digesters 7 thru 9 shall be monitored and used for controlling the speed of primary sludge pumps 1 thru 6. Refer to Loop 1540-1 thru 10.

Alarms / Monitoring:

SCADA PLC/HMI/OIT:

Primary Sludge Flow to Digesters 7 thru 9

LOOP 1560-01,02 TOTAL SUSPENDED SOLIDS FLOW

General: A total suspended solids analyzer is located on each of the North and South tank primary sludge lines. These are used to calculate pounds of primary sludge being delivered to the digesters.

Alarms / Monitoring:

SCADA PLC/HMI/OIT:

North Tank Primary Sludge Total Suspended Solids
South Tank Primary Sludge Total Suspended Solids

LOOP 1570 DIGESTER SLUDGE FEED CALCULATION

General: The flow of sludge to digesters will be a combination of thickened sludge from GBTs, fat, oil, and grease from the scum tipping weirs, and primary sludge from the primary sedimentation tanks. The total Lbs of sludge being delivered to the digesters will be calculated by the PLC.

Alarms / Monitoring:

SCADA PLC/HMI/OIT:

The total Lbs of sludge being delivered to the digesters shall be calculated as follows:

1. Lbs of primary sludge from North = North primary sludge flow * North primary sludge TSS
2. Lbs of primary sludge from South = South primary sludge flow * South primary sludge TSS
3. Lbs of GBT sludge = WAS Flow * WAS TSS * Sludge Captured SP, where the sludge captured SP is operator adjustable, initially set at 0.99.

Additionally, the total pounds (WAS + Primary) shall be calculated.

If the total calculated Lbs is greater than an HMI adjustable high alarm SP (initially set at 100,000 Lbs), an alarm will be issued at SCADA so that the operators can make flow adjustments.

LOOP 2000-1 THRU 6 AERATION TANKS 1 THRU 6 DISSOLVED OXYGEN

General: Dissolved Oxygen shall be measured in each of the four passes (Passes A, B, C, and D) of each of the six aeration tanks. This loop is typical for all aeration tanks 1 thru 6.

Alarms / Monitoring:

SCADA PLC/HMI/OIT:

Pass A Dissolved Oxygen
Pass B Dissolved Oxygen
Pass C Dissolved Oxygen
Pass D Dissolved Oxygen

LOOP 2010-1 THRU 6 AERATION TANKS 1 THRU 6 AIR FLOW

General: Air flow shall be measured in each of the four passes (Passes A, B, C, and D) of each of the six aeration tanks. This loop is typical for all aeration tanks 1 thru 6.

Alarms / Monitoring:

SCADA PLC/HMI/OIT:

Pass A Air Flow
Pass B Air Flow
Pass C Air Flow
Pass D Air Flow

LOOP 2060-1 THRU 6 AERATION TANKS 1 THRU 6 SETTLED SEWAGE FLOW CONTROL

General: Settled Sewage flow shall be measured in each of the four passes (Passes A, B, C, and D) of each of the six aeration tanks. Settled sewage flow passes into the aeration tanks through four flow control valves on each of the four passes (Passes A, B, C, and D) in each tank. The aeration tanks are typically fed thru passes A and C. Under a storm event, the tanks will also be fed through passes B and D. However, this will be done manually by the operators by opening the Passes B and D settled sewage control valves. This loop is typical for all aeration tanks 1 thru 6; however, the automatic control strategy is a common control strategy shared by all of the six aeration tanks.

Control:

Local (Valve Actuator):

Local:

When the Local/Off/Remote switch is in the "Local" position, the valve is controlled from the hand switches on the actuator.

Off:

When the Local/Off/Remote switch is in the "Off" position, the valve is stopped at its current position.

Remote:

When the Local/Off/Remote switch is in the "Remote" position, the valve is controlled from the SCADA PLC/HMI/OIT.

SCADA PLC/HMI/OIT:

Manual Control:

The valve can be manually positioned by the operator at the HMI.

Auto Control:

When the loop is placed in automatic mode, the valve shall be automatically controlled by the PLC as described below:

The settled sewage flow shall be automatically divided evenly among all of the in-service aeration tanks. The flowmeters and control valves on passes A and C of each tank will be used in conjunction with a most-open-valve control strategy in the PLC to split the flows evenly among all of the passes.

Alarms / Monitoring:

SCADA PLC/HMI/OIT:

Pass A Settled Sewage Flow
Pass B Settled Sewage Flow
Pass C Settled Sewage Flow
Pass D Settled Sewage Flow
Pass A Valve Opened Status
Pass A Valve Closed Status
Pass A Valve Position Feedback
Pass B Valve Opened Status
Pass B Valve Closed Status
Pass B Valve Position Feedback
Pass C Valve Opened Status
Pass C Valve Closed Status
Pass C Valve Position Feedback
Pass D Valve Opened Status
Pass D Valve Closed Status
Pass D Valve Position Feedback

**LOOP 2070-1 THRU 6 AERATION TANKS 1 THRU 6 RETURN ACTIVATED SLUDGE
(RAS) FLOW**

General: RAS flow shall be measured in passes A and C of each of the six aeration tanks.
This loop is typical for all aeration tanks 1 thru 6.

Alarms / Monitoring:

SCADA PLC/HMI/OIT:

Pass A RAS Flow
Pass C RAS Flow

LOOP 2080-1 THRU 12 MIXED LIQUOR TO FINAL TANKS 1 THRU 6 AND 9 THRU 14 FLOW CONTROL

General: Mixed liquor flows from the North aeration tanks (1 thru 3) through a channel and into final tanks 1 thru 6 via a distribution box. Mixed liquor flows from the South aeration tanks (4 thru 6) through a channel and into final tanks 9 thru 14 via a distribution box.

Mixed liquor flow from the aeration tanks to the twelve final tanks (1 thru 6 and 9 thru 14) is measured by a magnetic flowmeter at each final tank.

Mixed liquor flow to the final tanks is controlled by modulating valves at each final tank. This loop is typical for all 12 final tanks; however, the automatic control strategy is a common control strategy shared by all 12 final tanks.

Control:

Local (Valve Actuator):

Local:

When the Local/Off/Remote switch is in the "Local" position, the valve is controlled from the hand switches on the actuator.

Off:

When the Local/Off/Remote switch is in the "Off" position, the valve is stopped at its current position.

Remote:

When the Local/Off/Remote switch is in the "Remote" position, the valve is controlled from the SCADA PLC/HMI/OIT.

SCADA PLC/HMI/OIT:

Manual Control:

The valve can be manually positioned by the operator at the HMI.

Auto Control:

When the loop is placed in automatic mode, the valve shall be automatically controlled by the PLC as described below:

The flow control valves and mixed liquor flowmeters at the final tanks will be used to control the flow into each tank so that the flow is split evenly among all active final tanks.

Alarms / Monitoring:

SCADA PLC/HMI/OIT:

Mixed Liquor Flow to Final Tank
Valve Opened Status
Valve Closed Status
Valve Position Feedback

**LOOP 2100-1,2 RETURN ACTIVATED SLUDGE WELLS (NORTH AND SOUTH) LEVEL
AND TOTAL SUSPENDED SOLIDS**

General: Level and Total Suspended Solids (TSS) are measure in each of the North and South RAS Wells.

Control:

Auto:

The RAS wetwell signals will be used by the Final Tank RAS flow control valves (Loop 2110-1 thru 12) to automate the RAS flow to the RAS sludge wells.

Alarms / Monitoring:

SCADA PLC/HMI/OIT:

North RAS Well Level
South RAS Well Level
North RAS Well Total Suspended Solids
South RAS Well Total Suspended Solids

**LOOP 2110-1 THRU 12 RETURN ACTIVATED SLUDGE (RAS) FROM FINAL TANKS 1
THRU 6 AND 9 THRU 14 FLOW CONTROL**

General: Final tanks 1 thru 6 feed RAS to the North RAS well. Final tanks 9 thru 14 feed RAS to the South RAS well. A level transmitter exists in each RAS wetwell. A RAS flow meter and a flow control valve exist for each final tank. The flow control valves maintain a level in the wetwells by throttling the valve positions. This loop is typical for all twelve final tanks.

Control:

Local (Valve Actuator):

Local:

When the Local/Off/Remote switch is in the "Local" position, the valve is controlled from the hand switches on the actuator.

Off:

When the Local/Off/Remote switch is in the "Off" position, the valve is stopped at its current position.

Remote:

When the Local/Off/Remote switch is in the "Remote" position, the valve is controlled from the SCADA PLC/HMI/OIT.

SCADA PLC/HMI/OIT:

Manual Control:

The valve can be manually positioned by the operator at the HMI.

Auto Control:

When the loop is placed in automatic mode, the valve shall be automatically controlled by the PLC as described below:

A PID controller in each wetwell will be used to maintain the level at an operator adjustable setpoint, and a flow PID controller for each final tank will be used to control the RAS flow entering each tank. The output of the North RAS wetwell level controller shall be the flow setpoint to each of the final tank flow controllers for Final Tanks 1 thru 6. The output of the South RAS wetwell level controller shall be the flow setpoint to each of the final tank flow controllers for Final Tanks 9 thru 14.

Alarms / Monitoring:

SCADA PLC/HMI/OIT:

RAS Flow Final Tank
Valve Opened Status
Valve Closed Status
Valve Position Feedback

LOOP 5000-1 THRU10

RETURN ACTIVATED SLUDGE PUMP CONTROL

General: The 5 North RAS pumps transfer sludge from the North wetwell to the aeration tanks. The 5 South RAS pumps transfer sludge from the South wetwell to the aeration tanks.

Control:

Local (VFD):

Hand:

When the Hand/Off/Auto switch is in the "Hand" position, the pump is started from the local control panel.

Off:

When the Hand/Off/Auto selector switch is in the "Off" position, the pump shall be stopped.

Auto:

When the Hand/Off/Auto selector switch is in the "Auto" position, the pump control shall be from the SCADA PLC/HMI/OIT.

SCADA PLC/HMI/OIT:

Software Interlocks:

If a low-low level is detected in one of the RAS wells, the associated pumps shall be shut down and prevented from starting in both manual and automatic mode.

Manual Control:

The pump can be manually started or stopped by the operator at the HMI.

Auto Control:

When the loop is placed in automatic mode, the pump's on/off control shall be automatically controlled by the PLC as described below:

Each set of RAS pumps (North and South) will be set up in a Lead, Lag1, Lag2 configuration with two standby pumps. If the level in the associated wetwell is above the lead start level (initially set at 4 feet), then the lead pump will start.

The lead pump's speed is automatically adjusted by a PID controller to maintain a flow setpoint that is calculated as follows:

$$\text{RAS Flow to Aeration Tanks} = \text{Total Settled Sewage Flow} * \text{Percentage Setpoint (initially 33\%)}$$

The process variable for this controller shall be the sum of the associated aeration tank RAS flow transmitters (Loop 2070-1 thru 6) for the tanks that are in service. In-service shall be determined based on the position of the settled sewage flow (Loop 2060). If flow to a tank is greater than an HMI adjustable value, initially set at 1 MGD, then the tank shall be indicated as "In-service".

If the PID controller output goes to full speed, and the setpoint is still not being met, the next pump in the sequence will start. The active pumps will be controlled from the same PID controller and run at the same speed.

The North pumps and the South pumps will have two individual Flow PID controllers.

A pressure PID controller shall also be included so that the operator can choose to control the pump speed based on discharge pressure (Loop 5010-01,02) in lieu of flow. Each set of pumps (North and South) will have a pressure controller. The pressure setpoint can be adjusted by the operator (initially set at 9.5 PSI).

Alarms / Monitoring:

SCADA PLC/HMI/OIT:

Motor Running
Remote Status
RAS Pump Discharge Flow

LOOP 5010-01,02 RETURN ACTIVATED SLUDGE PUMPS DISCHARGE HEADER PRESSURE

General: RAS Pumps discharge header pressure shall be measured for both the North pumps and the South pumps.

Control:

Auto:

The RAS pump header pressure signals shall be used by the pressure controller in Loop 5000-01 thru 10.

Alarms / Monitoring:

SCADA PLC/HMI/OIT:

North RAS Pumps Discharge Header Pressure
South RAS Pumps Discharge Header Pressure

LOOP 5020-1 THRU4

WASTE ACTIVATED SLUDGE PUMP CONTROL

General: There are two North WAS pumps that pump from the North RAS Well and two South WAS pumps that pump from the South RAS Well. The WAS pumps feed sludge from the RAS wetwells to the GBTs.

Control:

Local (VFD):

Hand:

When the Hand/Off/Auto switch is in the "Hand" position, the pump is started from the local control panel.

Off:

When the Hand/Off/Auto selector switch is in the "Off" position, the pump shall be stopped.

Auto:

When the Hand/Off/Auto selector switch is in the "Auto" position, the pump control shall be from the SCADA PLC/HMI/OIT.

SCADA PLC/HMI/OIT:

Software Interlocks:

The WAS pumps cannot run unless the associated gravity belt thickener is operational. The PCSS shall configure the GBT PLC to send the status of the GBTs to the PLC-ATCC-3 over the plant network.

Manual Control:

The pump can be manually started or stopped by the operator at the HMI.

Auto Control:

When the loop is placed in automatic mode, the pump's on/off control shall be automatically controlled by the PLC as described below:

There are two North WAS pumps and two South WAS pumps that feed sludge from the RAS wetwells to the GBTs. Only one pump from the North and one pump from the South can run at a given time.

A Duty/Standby selector shall be provided for the two North WAS pumps and a Duty/Standby selector shall be provided for the two South WAS pumps.

The duty pump will start if the level in the associated wetwell is above the start SP.

The operator will enter a LBS to waste setpoint from the North and from the South. Based on the total suspended solids (TSS) (Loop 2100) measured in the RAS well, the required WAS flow will be calculated as follows:

North WAS Flow = North Lbs Setpoint / TSS in North RAS Well
South WAS Flow = South Lbs Setpoint / TSS in South RAS Well

The speed of the pump will vary to maintain the flow setpoint.

LOOP 5510 DAF TANK NO. 7 EQUIPMENT

General: DAF Tank No. 7 is used as a backup to the scum collector system. DAF Tank No. 7 is comprised of a top collector, a bottom collector, a bottom screw conveyor, and Settled Solids Pump No. 7. The system can be controlled manually from the hand/off/auto selector switches on the control panel or it can be controlled from the SCADA system.

Control:

Local (Local Control Station):

A hand/Off/Auto switch is provided at the local control panel in the DAF Control Room for each of the following equipment: top collector, bottom collector, bottom screw conveyor, and Settled Solids Pump No. 7. The hand switches shall function as follows:

Hand:

When the Hand/Off/Auto switch is in the "Hand" position, the equipment is started from the local control panel.

Off:

When the Hand/Off/Auto selector switch is in the "Off" position, the equipment shall stop.

Auto:

When the Hand/Off/Auto selector switch is in the "Remote" position, the equipment control shall be from the SCADA PLC/HMI.

SCADA PLC/HMI/OIT:

Manual Control:

The equipment can be manually started or stopped by the operator at the HMI.

Auto Control:

When in automatic mode, DAF Tank No. 7 shall be controlled from a timer in the PLC. An HMI adjustable "Off Time" setpoint and an HMI adjustable "On

Time” setpoint shall be provided for the system. When the off timer expires, the top collector, bottom collector, bottom screw, and settled solids pump shall start. They shall all remain operating until the on timer expires. At that point the equipment shall stop and the off timer shall begin timing.

Alarms / Monitoring:

SCADA PLC/HMI/OIT:

Sludge Thickening Tank No. 7 Top Collector Running
Sludge Thickening Tank No. 7 Top Collector Remote
Sludge Thickening Tank No. 7 Top Collector Start/Stop
Sludge Thickening Tank No. 7 Bottom Collector Running
Sludge Thickening Tank No. 7 Bottom Collector Remote
Sludge Thickening Tank No. 7 Bottom Collector Start/Stop
Sludge Thickening Tank No. 7 Bottom Screw Conveyor Running
Sludge Thickening Tank No. 7 Bottom Screw Conveyor Remote
Sludge Thickening Tank No. 7 Bottom Screw Conveyor Start/Stop
Settled Solids Pump No. 7 Running
Settled Solids Pump No. 7 Remote
Settled Solids Pump No. 7 Start/Stop
Settled Solids Pumps Discharge Flow

LOOP 5550 THICKENED SLUDGE WETWELL

General: The thickened sludge wetwell consists of a wetwell and two pumps. The pumps can be controlled manually from the hand/off/auto selector switches on the control panel or they can be controlled from the SCADA system. A level transmitter in the wetwell allows for level monitoring from the SCADA system and for automating the pump operation.

Control:

Local (Local Control Station):

A hand/Off/Auto switch is provided at the local control panel in the DAF Control Room for each of the pumps. The hand switches shall function as follows:

Hand:

When the Hand/Off/Auto switch is in the "Hand" position, the pump is started from the local control panel.

Off:

When the Hand/Off/Auto selector switch is in the “Off” position, the pump shall stop.

Auto:

When the Hand/Off/Auto selector switch is in the "Remote" position, the pump control shall be from the SCADA PLC/HMI.

SCADA PLC/HMI/OIT:

Manual Control:

The pump can be manually started or stopped by the operator at the HMI.

Auto Control:

When the loop is placed in automatic mode, the pump's on/off control shall be automatically controlled by the PLC as described below:

Pumps 1 and 2 shall operate in a lead/Lag sequence. The lead/lag selection shall be in either Operator Mode or Alternation Mode as selected by the operator at the HMI. In operator mode, the operator shall select Lead, Lag, or Offline for each pump from the HMI using radio buttons on a popup display. The order can be changed at any time, but no two pumps can be selected to have the same lead/lag position. For example, if Pump 1 is the lead pump, then it must be placed offline before Pump 2 can be selected as the lead pump. When placed offline, the pump shall not run in automatic mode. In alternation mode, the pumps shall automatically alternate after the lead pump is automatically stopped by the control strategy. If the lead pump fails, or if the lead pump is placed into local mode or manual mode, the lag pump shall run in its place.

The lead pump shall start when the wetwell level rises above an HMI adjustable Lead Start Level Setpoint.

The Lag pump shall start when the wetwell level rises above an HMI adjustable Lag Start Level Setpoint.

The Lag pump shall stop when the wetwell level falls below an HMI adjustable Lag Stop Level Setpoint.

The Lead pump shall stop when the wetwell level falls below an HMI adjustable Lead Stop Level Setpoint.

Alarms / Monitoring:

SCADA PLC/HMI/OIT:

Thickened Sludge Wetwell Level
Thickened Sludge Pump No. 3 Running
Thickened Sludge Pump No. 3 Remote
Thickened Sludge Pump No. 3 Start/Stop
Thickened Sludge Pump No. 4 Running
Thickened Sludge Pump No. 4 Remote
Thickened Sludge Pump No. 4 Start/Stop
Thickened Sludge Header Discharge Flow

LOOP 5560 SUBNATANT SLUDGE WETWELL

General: The subnatant sludge wetwell consists of a wetwell and two pumps. The pumps can be controlled manually from the hand/off/auto selector switches on the control panel or they can be controlled from the SCADA system. A level transmitter in the wetwell allows for level monitoring from the SCADA system and for automating the pump operation.

Control:

Local (Local Control Station):

A hand/Off/Auto switch is provided at the local control panel in the DAF Control Room for each of the pumps. The hand switches shall function as follows:

Hand:

When the Hand/Off/Auto switch is in the "Hand" position, the pump is started from the local control panel.

Off:

When the Hand/Off/Auto selector switch is in the "Off" position, the pump shall stop.

Auto:

When the Hand/Off/Auto selector switch is in the "Remote" position, the pump control shall be from the SCADA PLC/HMI.

SCADA PLC/HMI/OIT:

Manual Control:

The pump can be manually started or stopped by the operator at the HMI.

Auto Control:

When the loop is placed in automatic mode, the pump's on/off control shall be automatically controlled by the PLC as described below:

Pumps 1 and 2 shall operate in a lead/Lag sequence. The lead/lag selection shall be in either Operator Mode or Alternation Mode as selected by the operator at the HMI. In operator mode, the operator shall select Lead, Lag, or Offline for each pump from the HMI using radio buttons on a popup display. The order can be changed at any time, but no two pumps can be selected to have the same lead/lag position. For example, if Pump 1 is the lead pump, then it must be placed offline before Pump 2 can be selected as the lead pump. When placed offline, the pump shall not run in automatic mode. In alternation mode, the pumps shall automatically alternate after the lead pump is automatically stopped by the

control strategy. If the lead pump fails, or if the lead pump is placed into local mode or manual mode, the lag pump shall run in its place.

The lead pump shall start when the wetwell level rises above an HMI adjustable Lead Start Level Setpoint.

The Lag pump shall start when the wetwell level rises above an HMI adjustable Lag Start Level Setpoint.

The Lag pump shall stop when the wetwell level falls below an HMI adjustable Lag Stop Level Setpoint.

The Lead pump shall stop when the wetwell level falls below an HMI adjustable Lead Stop Level Setpoint.

Alarms / Monitoring:

SCADA PLC/HMI/OIT:

Subnatant Well Level
Subnatant Pump No. 3 Running
Subnatant Pump No. 3 Remote
Subnatant Pump No. 3 Start/Stop
Subnatant Pump No. 4 Running
Subnatant Pump No. 4 Remote
Subnatant Pump No. 4 Start/Stop
Subnatant Header Discharge Flow

LOOP 6500-1 THRU 9 DIGESTER MONITORING

General: Signals will shall be monitored by the local OIT and SCADA system via hardwired inputs to the PLC. This loop is typical for all digesters 1 thru 9

Control:

None

Alarms / Monitoring:

SCADA PLC/HMI/OIT:

Hardwired:

Digester Cover Position Indication
Digester Temperature Indication
Digester Sludge Level High Alarm

LOOP 6510-1 THRU 14 DIGESTER SLUDGE CIRCULATION PUMPS

General: Sludge circulation pumps are used to recirculate sludge within each digester. They can be monitored and controlled by the operator from the local OIT and from the SCADA system. This loop is typical for all pumps 1 thru 14

Control:

Local (Local Control Station):

A hand/Off/Auto switch is provided at the local control station near the pump.

Hand:

When the Hand/Off/Auto switch is in the "Hand" position, the pump is started from the local control panel.

Off:

When the Hand/Off/Auto selector switch is in the "Off" position, the pump shall stop.

Auto:

When the Hand/Off/Auto selector switch is in the "Remote" position, the pump control shall be from the SCADA PLC/HMI/OIT.

SCADA PLC/HMI/OIT:

Manual Control:

The pump can be manually started or stopped by the operator at the HMI.

Auto Control:

None

Alarms / Monitoring:

SCADA PLC/HMI/OIT:

Motor Running
Remote Status
Overload
Discharge Pressure High
Seal Water Pressure Low

LOOP 6520-1 THRU 10 DIGESTER GAS RECIRCULATION COMPRESSOR

General: Gas Recirculation Compressors are used to recirculate digester gas within each digester. They can be monitored and controlled by the operator from the local OIT and from the SCADA system. This loop is typical for all compressors 1 thru 10

Control:

Local (Local Control Station):

A hand/Off/Auto switch is provided at the local control station near the compressor.

Hand:

When the Hand/Off/Auto switch is in the "Hand" position, the compressor is started from the local control panel.

Off:

When the Hand/Off/Auto selector switch is in the "Off" position, the compressor shall stop.

Auto:

When the Hand/Off/Auto selector switch is in the "Remote" position, the compressor control shall be from the SCADA PLC/HMI/OIT.

SCADA PLC/HMI/OIT:

Manual Control:

The compressor can be manually started or stopped by the operator at the HMI.

Auto Control:

None

Alarms / Monitoring:

SCADA PLC/HMI/OIT:

Motor Running
Remote Status
Malfunction
Suction Pressure Low
Discharge Pressure High
Discharge Temperature High

LOOP 6530-1 THRU 4 DIGESTER PRIMARY GAS COMPRESSORS 1 THRU 4

General: Primary Gas Compressors 1 thru 4 are used to transfer digester gas from the digesters to the digester gas sphere. They are only capable of being controlled locally from the local control panels near the compressors. This loop is typical for all compressors 1 thru 4.

Control:

Local (Local Control Station):

Start and stop buttons are provided at the local control panel.

On and Off buttons are provided for the 50% Unloading Valve SV-1.

On and Off buttons are provided for the 100% Unloading Valve SV-2.

SCADA PLC/HMI/OIT:

Manual Control:

None.

Auto Control:

None.

Alarms / Monitoring:

Local Control Panel:

Motor Running
50% Unloading Valve SV-1 Open
100% Unloading Valve SV-2 Open

SCADA PLC/HMI/OIT:

Motor Running
50% Unloading Valve SV-1 Open
100% Unloading Valve SV-2 Open

LOOP 6530-6 THRU 10 DIGESTER PRIMARY GAS COMPRESSOR

General: Primary Gas Compressors are used to transfer digester gas from the digesters to the digester gas sphere. They can be monitored and controlled by the operator from the local OIT and from the SCADA system. This loop is typical for all compressors 6 thru 10; however, the automatic control strategy is a common control strategy shared by compressors 6 thru 10.

Control:

Local (Local Control Station):

A hand/Off/Auto switch is provided at the local control station near the compressor.

Hand:

When the Hand/Off/Auto switch is in the "Hand" position, the compressor is started from the local control panel.

Off:

When the Hand/Off/Auto selector switch is in the "Off" position, the compressor shall stop.

Auto:

When the Hand/Off/Auto selector switch is in the "Remote" position, the compressor control shall be from the SCADA PLC/HMI/OIT.

SCADA PLC/HMI/OIT:

Manual Control:

The compressor can be manually started or stopped by the operator at the HMI.

Auto Control:

The compressors shall operate in a Lead/Lag 1/Lag 2/Standby sequence. The lead/lag selection shall be in either Operator Mode or Alternation Mode as selected by the operator at the HMI. In operator mode, the operator shall select Lead, Lag 1, Lag 2, Standby1, Standby2, or Offline for each compressor from the HMI using radio buttons on the popup display. The order can be changed at any time, but no two compressors can be selected to have the same lead/lag position. For example, if Compressor 1 is the lead compressor, then it must be placed offline before Compressor 2 can be selected as the lead compressor. When placed offline, the compressor shall not run in automatic mode. In alternation mode, the compressors shall alternate after the lead compressor is automatically stopped by the control strategy. Alternation mode shall automatically sequence the lead/lag order once per week. For example, the Lead compressor will become the Standby, Standby to Lag 2, Lag2 to Lag 1, and Lag 1 to Lead.

The operator can manually enter a Sphere Pressure Setpoint for a PID pressure controller which shall output a compressor speed signal between 0-100%. When initially placed into automatic mode, the lead compressor shall start. The speed of the lead compressor shall be automatically controlled via the associated PID controller using the sphere pressure signal as the process variable.

Once the speed command signal for that compressor reaches the adjustable “Start Lag 1” setpoint (initially set to 95%) and the pressure setpoint is greater than the process variable by more than an adjustable deadband, the second compressor (Lag 1) shall start. With the two compressors running, the two compressors shall vary their speed to meet the flow demand. Both compressors shall run at the same speed. An additional setpoint, “Start Lag 2” setpoint (initially set to 95%) shall control the third compressor (Lag 2) in a similar fashion. All three compressors shall run at the same speed.

When the controller output falls below the “Stop Lag 2” setpoint and the flow value is below the flow setpoint by more than the adjustable deadband, the Lag 2 compressor shall stop. The remaining compressors shall then vary speed to meet the flow demand.

When the controller output falls below the “Stop Lag 1” setpoint and the flow value is below the flow setpoint by more than the adjustable deadband, the Lag 1 compressor shall stop. The Lead compressor shall then vary speed to meet the flow demand.

An adjustable timer shall be provided and shall time out before starting or stopping a lag compressor, to avoid unnecessary starting and stopping.

The lead compressor will always run unless the pressure setpoint is zero or an interlock causes the compressor to shut down. No more than three (3) compressors shall run at one time. In the event that the next compressor in a sequence fails to start, the next compressor in the sequence shall start.

Adjustable minimum speed and maximum speed setpoints shall be provided for each compressor. All setpoints shall adhere to the minimum and maximum setpoint restrictions. For example, if the maximum speed setpoint is set to 90% the PID controller shall not output a speed higher than 90%. Similarly, if the “Start Lag 1” setpoint is set to 95% and the maximum speed setpoint is changed to 90%, the “Start Lag 1” setpoint shall automatically change such that the controller will not be prevented from starting the next compressor in the sequence.

All speed control, manual and automatic, shall prevent the compressors from running above and below the maximum and minimum speeds, respectively.

Alarms / Monitoring:

SCADA PLC/HMI/OIT:

- Motor Running
- Remote Status
- Malfunction
- Suction Pressure Low
- Discharge Pressure High
- Discharge Temperature High

LOOP 6600-1 THRU 22 DIGESTER COMBUSTIBLE GAS MONITORING

General: Combustible gas detectors shall be monitored at the digester control panel via the gas detector system controllers and tied into the PLC via Ethernet communication signals for monitoring at the SCADA system.

Alarms / Monitoring:

Digester Control Panel Gas Monitoring Controller:

For each sensor:

- %LEL
- High %LEL Alarm
- Sensor Fault

The controller shall be configured such that each sensor triggers the existing audible alarms and strobe lights at the following locations when high LEL is detected in the associated area:

- Two (2) strobes wired to Pull Box 14 (PB #14)
- One (1) strobe wired to Pull Box 15 (PB #15)
- Three (3) strobes wired to Pull Box 19 (PB #19)
- Two (2) strobes wired to Pull Box 20 (PB #20)
- Four (4) strobes wired to Pull Box 22 (PB #22)
- One (1) strobe wired to Pull Box 25 (PB #25)

SCADA PLC/HMI/OIT:

Ethernet:

- Combustible Gas - Sludge Heater Room North (J1) Indication
- Combustible Gas - Sludge Heater Room South (J2) Indication
- Combustible Gas - Sludge Heater Room West (J3) Indication
- Combustible Gas - Compressor Room East (J4) Indication
- Combustible Gas - Compressor Room Center (J5) Indication
- Combustible Gas - Compressor Room West (J6) Indication
- Combustible Gas - Digester Basement West (J7) Indication
- Combustible Gas - Digester Basement by Water Pumps (J8) Indication
- Combustible Gas - Digester Basement by Circ. Pumps (J9) Indication
- Combustible Gas - Digester Basement South (J10) Indication
- Combustible Gas - Digester Basement by Transfer Pumps (J11) Indication
- Combustible Gas - Digester Basement North (J12) Indication
- Combustible Gas - Basement - Between Dig. 5 and 6 Indication
- Combustible Gas - Basement - Between Dig. 6 and 8 Indication
- Combustible Gas - Basement - Between Dig. 7 and 8 Indication
- Combustible Gas - Basement - Between Dig. 8 and 9 Indication
- Combustible Gas - Basement - Between Dig. 5 and 6 Indication
- Combustible Gas - Basement - Between Dig. 5 and 7 Indication
- Combustible Gas - Basement - Between Dig. 6 and 7 Indication
- Combustible Gas - Basement - Between Dig. 6 and 8 Indication
- Combustible Gas - Methane System 1 Indication
- Combustible Gas - Methane System 2 Indication
- Combustible Gas - Channels 1/2 Sensor Fault

Combustible Gas - Channels 3/4 Sensor Fault
Combustible Gas - Channels 5/6 Sensor Fault
Combustible Gas - Channels 7/8 Sensor Fault
Combustible Gas - Channels 9/10 Sensor Fault
Combustible Gas - Channels 11/12 Sensor Fault
Combustible Gas - Channels 13/14 Sensor Fault
Combustible Gas - Channels 15/16 Sensor Fault
Combustible Gas - Channels 17/18 Sensor Fault
Combustible Gas - Channels 19/20 Sensor Fault

LOOP 6610 DIGESTER GAS DRYER SYSTEM MONITORING

General: The existing gas dryer system shall be monitored from the SCADA system. Several signals shall be monitored from the dryer system PLC directly. Other signals shall be hardwired directly to PLC-J.

Alarms / Monitoring:

SCADA PLC/HMI/OIT:

Signals Monitored from the Dryer Control Panel PLC via Ethernet

Common Alarm
Differential Pressure Across Particulate Pre-Filter
Differential Pressure Across Coalescing Filter 1
Differential Pressure Across Coalescing Filter 2

Signals Monitored via Hardwired Signals to PLC-J

Duplex Coalescing Filter Drip Trap Moisture Detected Alarm
Dryer Condensate Line Moisture Detected Alarm

LOOP 7000 ENGINE CONTROL ROOM CONTROL PANEL

General: The Engine Control Room Control Panel replaces the existing "New Remote Status Panel". The control panel provides control for the seven aeration blowers and the seven raw sewage pumps. It also provides enable/disable functionality for the five outfall pumps. This control description includes control requirements for all equipment being controlled from the Engine Control Room Control Panel.

Control:

Local (Engine Control Room Control Panel):

Aeration Blowers 1 through 7 and Sewage Pumps 1 through 7

A Local/Off/Remote switch is provided at the control panel for each aeration blower and each sewage pump.

Local:

When the Local/Off/Remote switch is in the "Local" position, the equipment shall be controlled from the respective local control panel only. The blower shall

be controlled from the local blower control panel. The sewage pump shall be controlled from the sewage pump local control panel. This permissive shall be via hardwired logic independent of the PLC.

Off:

When the Local/Off/Remote selector switch is in the "Off" position, the equipment shall stop. This interlock shall be via hardwired logic independent of the PLC.

Remote:

When the Local/Off/Remote selector switch is in the "Remote" position, the equipment control shall be from the SCADA PLC/HMI/OIT.

Outfall Pumps 1 through 5

A Disable/Enable selector switch is provided at the control panel for each outfall pump. The outfall pumps are started and stopped from the Effluent Pumping and Chlorination Building. This selector enables or disables the ability for operations to run the pumps.

Disable:

When the Disable/Enable switch is in the "Disable" position, the equipment shall not be allowed to run. This interlock shall be via hardwired logic independent of the PLC.

Enable:

When the Disable/Enable switch is in the "Enable" position, the equipment shall be allowed to run from the local control panel in the Effluent Pumping and Chlorination Building. This permissive shall be via hardwired logic independent of the PLC.

Remote:

None. There is no control of the outfall pumps from PLC-ECR.

SCADA PLC/HMI/OIT:

Manual Control:

When in remote mode, the blowers and sewage pumps can be started or stopped by the operator at the HMI. There is no control of the outfall pumps from PLC-ECR

Auto Control:

None

Alarms / Monitoring:

SCADA PLC/HMI/OIT:

Sewage Pump No. 1 Speed
Sewage Pump No. 2 Speed
Sewage Pump No. 3 Speed
East & West Wet Well Level
Sewage Pump No. 6 Speed
Sewage Pump No. 7 Speed
Blower No.1 Vane Position
Blower No.1 Vane Current
Blower No.2 Vane Position
Blower No.2 Vane Current
Blower No.3 Vane Position
Blower No.3 Vane Current
Blower No.4 Vane Position
Blower No.4 Vane Current
Blower No.5 Vane Position
Blower No.5 Vane Current
Blower No.6 Vane Position
Blower No.6 Vane Current
Blower No.7 Vane Position
Blower No.7 Vane Current
Domestic Water Flow #1
Domestic Water Flow #2
Domestic Water Flow #3
Domestic Water Flow #4
Seal Water Flow to the Raw Sewage Pumps
Start Pump A-1
Start Pump A-2
Start Pump A-2
Start Pump A-3
Sewage Pump A-1 Warning
Sewage Pump A-3 Warning
Sewage Pump A-1 Malfunction
Sewage Pump A-2 Malfunction
Sewage Pump A-2 Malfunction
Sewage Pump A-3 Malfunction
Grit Building MCC panel Failure
Influent Screening MCC Panel Failure
Effluent Screening Building MCC panel Failure
Aeration Tanks North MCC Panel Failure
Aeration Tanks South MCC Panel Failure
Sludge Thickening Building MMC Failure
Blower No. 1 Motor Winding Temperature High
Blower No. 2 Motor Winding Temperature High
Blower No. 3 Motor Winding Temperature High
Blower No. 4 Motor Winding Temperature High
Blower No. 1 Malfunction
Blower No. 2 Malfunction

Blower No. 3 Malfunction
Blower No. 4 Malfunction
Blower No. 5 Malfunction
Blower No. 6 Malfunction
Blower No. 7 Malfunction
Sec. Gas Compressor No. 1 Discharge Temperature High
Sec. Gas Compressor No. 2 Discharge Temperature High
Sec. Gas Compressor No. 1 Suction Pressure Low
Sec. Gas Compressor No. 2 Suction Pressure Low
Low Influent Flow
Low Effluent Water Pressure
Low Domestic Water Pressure
Emergency Generator OFF
Pump Station Malfunction
Low Instrument Air Pressure "B" Building Components
Domestic Water Level High
Domestic Water Level Low
Gas Leak M.E.B Basement North
Gas Leak M.E.B First Floor North
Gas Leak M.E.B Basement South
Gas Leak M.E.B First Floor South
Gas Leak Compressor Building
East Wet Well Level Abnormal
West Wet Well Level Abnormal
Boiler Room General Alarm
Sewage Pump No. 1 Running
Sewage Pump No.1 Remote
Sewage Pump No. 2 Running
Sewage Pump No.2 Remote
Sewage Pump No. 3 Running
Sewage Pump No.3 Remote
Sewage Pump No. 4 Running
Sewage Pump No.4 Remote
Sewage Pump No. 5 Running
Sewage Pump No.5 Remote
Sewage Pump No. 6 Running
Sewage Pump No.6 Remote
Sewage Pump No. 7 Running
Sewage Pump No.7 Remote
Blower No. 1 Running
Blower No.1 Remote
Blower No. 2 Running
Blower No.2 Remote
Blower No. 3 Running
Blower No.3 Remote
Blower No. 4 Running
Blower No.4 Remote
Blower No. 5 Running
Blower No.5 Remote
Blower No. 6 Running
Blower No.6 Remote

Blower No. 7 Running
Blower No.7 Remote
Outfall Pump No. 1 Running
Outfall Pump No. 2 Running
Outfall Pump No. 3 Running
Outfall Pump No. 4 Running
Outfall Pump No. 5 Running
Wet Well East Selected
Wet Well West Selected
PLC Reset Button
PLC-ECR Enclosure Door Intrusion

LOOP 7010 ELECTRICAL DISTRIBUTION SYSTEMS

General: The electrical distribution systems shall be monitored from the SCADA system vis Modbus/TCP protocol.

Alarms / Monitoring:

SCADA PLC/HMI/OIT:

Unit Substation T1/T2

Primary Switch 1 thru 4 Open/Closed Status
Transformer Temperature Alarms 1 and 2
Main Breakers 1 thru 4 Open/Closed Status
Branch Breakers 1 thru 10 Open/Closed Status
Future Breakers 1 thru 8 Open/Closed Status

Unit Substation T8

Primary Switch 1 thru 4 Open/Closed Status
Transformer Temperature Alarms 1 and 2
Main Breakers 1 thru 4 Open/Closed Status
Branch Breakers 1 thru 8 Open/Closed Status
Future Breakers 1 thru 4 Open/Closed Status

Switchgear S1

Breakers 1 thru 20 Open/Closed Status
Feeders 1 thru 20 Amperes
Feeders 1 thru 20 KWH
Feeders 1 thru 20 KW Demand
Feeders 1 thru 20 Power Factor

Grit Building Switchgear

Primary Switch 1 thru 4 Position Indications

Main Switchgear

15KV Main Breakers 1 thru 4 Open/Closed Status
15KV Branch Breakers 1 thru 4 Open/Closed Status
Transformer Temperature Alarm
5KV Breakers 1 thru 4 Open/Closed Status

MCC P10-P11

Breakers 1 thru 20 Open/Closed Status
Feeders 1 thru 20 Amperes
Feeders 1 thru 20 KWH
Feeders 1 thru 20 KW Demand
Feeders 1 thru 20 Power Factor

LOOP 7310 HVAC SYSTEM – BUILDING A

General: RIO-HVAC-A will replace the existing RTU-A and monitor the instruments in Building A used for HVAC control. RIO-HVAC-A communicates via CAT6 to the existing Admin Building server rack. The existing server rack is tied into the new plant fiber ring, where PLC-HVAC-B will be able to communicate with the RIO.

Alarms / Monitoring:

SCADA PLC/HMI/OIT:

A-AHU 1 Inlet Hot Water Pressure
A-AHU 1 Inlet Hot Water Temp
A-AHU 1 Inlet Cold Water PSI
A-AHU 1 Inlet Cold Water Temp
A-AHU 1 Hot Deck Air Temp
A-AHU 1 Cold Deck Air Temp
Laboratory Humidity
Laboratory Temperature

LOOP 7320 HVAC SYSTEM – BUILDING C

General: RIO-HVAC-C will replace the existing RTU-C and monitor the instruments in Building C used for HVAC control. RIO-HVAC-C communicates via CAT6 to a new fiber optic communication enclosure (FOCE-MANT). FOCE-MANT is part of the new plant fiber ring, where PLC-HVAC-B will be able to communicate with the RIO.

Alarms / Monitoring:

SCADA PLC/HMI/OIT:

Domestic HW Low Flow Switch
CHW Pump C-P19 On
CHW Pump C-P20 On
CHW Pump C-P21 On
CHW Pump C-P22 On
Absorber Total Waste Steam
Chilled Water Supply Temp
Primary Heat Exchanger Waste Steam

Chilled Water Return Temp
Chiller Water Flow
F.O. Pump Discharge PSI
Domestic HW Temp
Engine/Boiler cond. Tank Level
F.O. Tank Strainer Delta-P
Combined Fuel Oil Supply Flow
Combined Fuel Oil Return Flow
CW Makeup Water PSI
Outdoor Temperature
HHW Makeup Water PSI
Screened Effluent Return Temp
Fuel Oil Tank #19 Level
Fuel Oil Tank #20 Level
Dig. 1-4 Space Heating HW Flow
Dig. 5-9 Space Heating HW Flow
Secondary Heat Exch. Waste Steam
Screen Effluent Supply Temp
Hot Water Supply Temp.
Primary Heat Exch. #1 Shell PSI
Primary Heat Exch. #2 Shell PSI
Primary Heat Exch. #3 Shell PSI
Primary Heat Exch. #4 Shell PSI
HHW Primary Heat Exch. Inlet PSI
HHW Primary Heat Exch. Inlet Temp
HHW Primary Heat Exch. Outlet PSI
HHW Primary Heat Exch. Outlet Temp

LOOP 7330 HVAC SYSTEM – BUILDING J

General: RIO-HVAC-J will replace the existing RTU-J and monitor the instruments in Building J used for HVAC control. RIO-HVAC-J communicates via CAT6 to a new fiber optic communication enclosure (FOCE-DIG). FOCE-DIG is part of the new plant fiber ring, where PLC-HVAC-B will be able to communicate with the RIO.

Alarms / Monitoring:

SCADA PLC/HMI/OIT:

Dig. 1-4 CP Digester #1 Temp
Dig. 1-4 CP Digester #3 Temp
Dig. 1-4 CP Digester #4 Temp
Dig. 5-9 CP Digester #5 Temp
Dig. 5-9 CP Digester #7 Temp
Dig. 5-9 CP Digester #8 Temp
Heat Exchanger 1-3 Flow
Heat Exchanger 1-3 Inlet Temp
Heat Exchanger 1-3 Outlet Temp
Heat Exchanger 4-6 Inlet Temp

Heat Exchanger 4-6 Outlet Temp
Heat Exchanger 4-6 Flow

LOOP 7340 HVAC SYSTEM – BUILDING K

General: RIO-HVAC-K will replace the existing RTU-K and monitor the instruments in Building K used for HVAC control. RIO-HVAC-K communicates via CAT6 to a new fiber optic communication enclosure (FOCE-THK). FOCE-THK is part of the new plant fiber ring, where PLC-HVAC-B will be able to communicate with the RIO.

Alarms / Monitoring:

SCADA PLC/HMI/OIT:

Chill Water Supply Pressure
Chill Water Supply Temp.
Hot Water Supply Pressure
Hot Water Supply Temp.
R-AHU 1 Cold Deck Air Temp.
R-AHU 1 Hot Deck Air Temp.
R-AHU 2 Cold Deck Air Temp.
R-AHU 2 Hot Deck Air Temp.

LOOP 7350 HVAC SYSTEM – BUILDING R

General: RIO-HVAC-R will replace the existing RTU-R and monitor the instruments in Building R used for HVAC control. RIO-HVAC-R communicates via CAT6 to a new fiber optic communication enclosure (FOCE-TERT). FOCE-TERT is part of the new plant fiber ring, where PLC-HVAC-B will be able to communicate with the RIO.

Alarms / Monitoring:

SCADA PLC/HMI/OIT:

Chill Water Supply Pressure
Chill Water Supply Temp.
Hot Water Supply Pressure
Hot Water Supply Temp.
Laboratory Humidity
Laboratory Temperature
R-AHU 1 Cold/Hot Deck Temp
R-AHU 2 Cold/Hot Deck Temp
R-AHU 7 Cold/Hot Deck Temp

LOOP 7360 HVAC SYSTEM – BUILDING B

General: PLC-HVAC-B is a new PLC Enclosure to be located next to the existing Boiler Pump Control Panel (BPCP). PLC-HVAC-B will replace the existing RTU-B

located in the BPCP. The hardwired I/O, as indicated by this section and shown in Appendix A, landed in RTU-B shall be rerouted to be terminated in the new PLC-HVAC-B Enclosure.

Alarms / Monitoring:

SCADA PLC/HMI/OIT:

C-P5A ON
C-P5B ON
C-P5C ON
Boiler Opacity Alarm
Boiler High Flue Temp Alarm
Boiler Master Auto Lead/Lag Select
Boiler Master Boiler 1 Lead Select
Boiler Master Boiler 2 Lead Select
Boiler Master Boiler 3 Lead Select
Boiler Master Boiler 4 Lead Select
Refrigerant Leak Alarm
Domestic HW Low Flow
Chilled Water Low Flow
Boiler 1 High HW Discharge PSI
Boiler 1 Low HW Discharge PSI
Boiler #1 Common Alarm Output
Boiler 2 High HW Discharge PSI
Boiler 2 Low HW Discharge PSI
Boiler #2 Common Alarm Output
Boiler 3 High HW Discharge PSI
Boiler 3 Low HW Discharge PSI
Boiler #3 Common Alarm Output
Boiler 4 High HW Discharge PSI
Boiler 4 Low HW Discharge PSI
Boiler #4 Common Alarm Output
Boiler Master Boiler start
Boiler Master Boiler Stop
Boiler Master Common Alarm
BMC Call for a Lead
FOP-1A-ON
FOP-1B-ON
FOP-1C-ON
C-P26 ON
C-P27 ON
C-P28 ON
C-P29 ON
C-P5 ON
C-P6 ON
C-P7 ON
C-P8 ON
C-P1 ON
C-P2 ON
C-P3 ON

C-P4 ON
Boiler #1 Call for Heat
Boiler #1 Safety Lockout
Boiler #1 Boiler Avail. Contact
Boiler #1 Fuel Valve Open
Boiler #1 Boiler in Hand
Boiler #1 Boiler in Auto
Boiler #1 High Gas Pressure
Boiler #1 Low Gas Pressure
Boiler #2 Call for Heat
Boiler #2 Safety Lockout
Boiler #2 Boiler Avail. Contact
Boiler #2 Fuel Valve Open
Boiler #2 Boiler in Hand
Boiler #2 Boiler in Auto
Boiler #2 High Gas Pressure
Boiler #2 Low Gas Pressure
Boiler #3 Call for Heat
Boiler #3 Safety Lockout
Boiler #3 Boiler Avail. Contact
Boiler #3 Fuel Valve Open
Boiler #3 Boiler in Hand
Boiler #3 Boiler in Auto
Boiler #3 High Gas Pressure
Boiler #3 Low Gas Pressure
Boiler #4 Call for Heat
Boiler #4 Safety Lockout
Boiler #4 Boiler Avail. Contact
Boiler #4 Fuel Valve Open
Boiler #4 Boiler in Hand
Boiler #4 Boiler in Auto
Boiler #4 High Gas Pressure
Boiler #4 Low Gas Pressure
Chiller 1A On
Chiller 1B On
Control Room Humidity
Control Room Temp

LOOP 7540

PROTECTED AND DOMESTIC WATER FLOWS

General: Protected and domestic water flowmeters shall tie into the plant PLCs for monitoring from the SCADA system. PLC and HMI/OIT programming shall be provided for all of these flowmeters, including those being tied into existing PLCs.

Alarms / Monitoring:

SCADA PLC/HMI/OIT:

Fire Pump Flow in the Fire Pump Building (PLC-FPB)

Seal Water Flow to the Raw Sewage Pumps (existing Protected Waster Pump Control Panel)

Building L Protected Water Flow (existing Outfall PLC in the Outfall Pump Control Panel)

Building U Protected Water Flow (existing Biofilter Control Panel PLC in Building U)

Building S Protected Water Flow (existing Main Control Panel in the Dewatering Control Room)

Building S Domestic Water Flow (existing PLC-Polymer in the Building S Polymer Room).

Building J Protected Water Flow (existing PLC-GBT in the Gravity Belt Thickener Control Room in Building H)

Building J/K Protected Water Flow (PLC-GBT in the Gravity Belt Thickener Control Room in Building H)

Building J/K Domestic Water Flow (PLC-GBT in the Gravity Belt Thickener Control Room in Building H)

Building F/J Protected Water Flow (PLC-PST1 in Building F)

3.04 GLEN COVE WWTP CONTROL DESCRIPTIONS

LOOP 0100-A,B,C,D INFLUENT PUMP DRYWELL GAS MONITORING

General: Gas detectors shall be located in the Influent Pump Drywell and shall be continuously monitored by the Gas Detection Control Panel in the Headworks Building Electrical room, and monitored by the PLC for generating alarms on the SCADA system. The gas detection system shall monitor (4) four sensors measuring combustible gas (%LEL), Hydrogen Sulfide (H₂S, ppm), Oxygen (%), and Carbon Monoxide (ppm).

Control: None

Monitoring:

Local (Remotely mounted transmitter)

%LEL indication
H₂S indication
Oxygen indication
Carbon Monoxide indication

Local (Gas Detection Control Panel OIT)

%LEL indication
H₂S indication
Oxygen indication
Carbon Monoxide indication

SCADA PLC/HMI:

Ethernet:

%LEL Indication
H₂S indication
Oxygen indication
Carbon Monoxide indication

LOOP 0501-A,B,C,D SCREENING AREA BASEMENT GAS MONITORING

General: Gas detectors shall be located in the Screening Area Basement and shall be continuously monitored by the Gas Detection Control Panel in the Headworks Building Electrical room, and monitored by the PLC for generating alarms on the SCADA system. The gas detection system shall monitor (4) four sensors measuring combustible gas (%LEL), Hydrogen Sulfide (H₂S, ppm), Oxygen (%), and Carbon Monoxide (ppm).

Control: None

Monitoring:

Local (Remotely mounted transmitter)

%LEL indication
H₂S indication
Oxygen indication
Carbon Monoxide indication

Local (Gas Detection Control Panel OIT)

%LEL indication
H₂S indication
Oxygen indication
Carbon Monoxide indication

SCADA PLC/HMI:

Ethernet:

%LEL Indication
H₂S indication
Oxygen indication
Carbon Monoxide indication

LOOP 0502-A,B,C,D SCREENING AREA MAIN FLOOR GAS MONITORING

General: Gas detectors shall be located in the Screening Area Main Floor and shall be continuously monitored by the Gas Detection Control Panel in the Headworks Building Electrical room, and monitored by the PLC for generating alarms on the SCADA system. The gas detection system shall monitor (4) four sensors measuring combustible gas (%LEL), Hydrogen Sulfide (H₂S, ppm), Oxygen (%), and Carbon Monoxide (ppm).

Control: None

Monitoring:

Local (Remotely mounted transmitter)

%LEL indication
H₂S indication
Oxygen indication
Carbon Monoxide indication

Local (Gas Detection Control Panel OIT)

%LEL indication
H₂S indication
Oxygen indication
Carbon Monoxide indication

SCADA PLC/HMI:

Ethernet:

%LEL Indication
H₂S indication
Oxygen indication
Carbon Monoxide indication

LOOP 1000 GRIT CHAMBER SCREW

General: The grit chamber screw shall have an adjustable time setpoint for on/off control from SCADA.

Control:

Local (Existing Grit Screw Control Panel)

Local: When the Local/Off/Remote selector is in “Local”, control of the grit chamber screw shall be from the Local Control Panel.

Off: When the Local/Off/Remote selector is in “Off”, the grit chamber screw shall not run.

Remote: When the Local/Off/Remote selector is in “Remote”, control of the grit chamber screw shall be transferred to SCADA.

SCADA PLC/HMI:

Manual:

The grit chamber screw can be manually started or stopped by the operator at the HMI.

Auto:

The grit chamber motor shall have an operator adjustable “time on” and “time off” setpoint from the HMI. When initially placed in auto, the motor will run until this “time on” setpoint (in seconds) has been elapsed. The motor shall then remain off until the “time off” setpoint (in minutes) has been elapsed. The motor shall continue to cycle through the “time on” and “time off” cycles as long as the grit screw is the “Remote-Auto” mode.

Monitoring:

Local (Existing Grit Screw Control Panel):

Ready Status
Submerged Conveyor Run Status
Conveyer Run Status
Alarm

SCADA PLC/HMI:

Run Status
Remote Status (Auto)
Alarm

LOOP 1500-1,2,3,4 PRIMARY SETTLING TANKS

General: Each primary settling tank includes a local control panel for monitoring and controlling the clarifier drive. Monitoring and of the tank drive and alarms shall be provided by SCADA.

Control:

Local (Existing Local Control Panel)

E-Stop: When the E-Stop button is not pressed the primary settling tank clarifier drive shall run continuously unless a shutdown alarm is active. If the E-Stop button is pressed

Monitoring:

SCADA PLC/HMI:

Clarifier Running
Shutdown Alarm (Torque)

LOOP 2000 BLOWER SYSTEM AIR FLOW

General: Air flow from the blowers to the aeration tanks is continuously monitored on the blower common header using an Venturi flow tube and differential pressure transmitter for flow.

Control: The blower air flow (in SCFM) shall be used as the process variable in the blower flow PID controller as described in the aeration tank air flow control loop (4500-1 and 2). The calculation to convert air flow to SCFM shall be a function of the blower air header pressure, air temperature, and the air header flow (in ACFM).

$$\text{Flow (SCFM)} = \frac{\text{Flow (ACFM)}}{\left(\frac{\text{Temp } (^{\circ}\text{F}) + 460^{\circ}\text{R}}{520^{\circ}\text{R}}\right) * \left(\frac{14.7\text{psia}}{\text{Pressure (psig)} + 14.7\text{psia}}\right)}$$

Flow (ACFM) = Header air flow feedback

Temp (°F) = Discharge air temperature (received from Turblex or APG Neuros blower PLC depending on which blower is operating)

Pressure (psig) = Gauge pressure at aeration header as described by Loop 2010

Monitoring:

Local (Remotely mounted transmitter):

Flow indication

SCADA PLC/HMI:

Flow indication (ACFM)
Flow indication (SCFM)

LOOP 2005 AERATION HEADER BLOWOFF VALVE

General: A Blowoff valve on the aeration header can be manually positioned from the operator at the Master Aeration Control Center operator interface terminal (OIT).

Control:

Local (Valve Actuator):

Local: When the Local/Off/Remote selector is in the “Local” position, the valve can be open, closed, and stopped from the valve actuator.

Off: When the Local/Off/Remote selector is in the “Off” position, the valve shall stay at its current position.

Remote: When the Local/Off/Remote selector is in the “Remote” position, the valve control shall be transferred to the SCADA system.

SCADA PLC/HMI:

Manual:

The valve can be manually positioned by the operator at the HMI/OIT by entering a percent open setpoint.

Auto:

None

Monitoring:

Local (Valve actuator):

Open Status
Closed Status
Remote Status
Position Indication

SCADA PLC/HMI:

Open Status
Closed Status
Remote Status
Position Indication

LOOP 2010 BLOWER SYSTEM AIR PRESSURE

General: Air pressure from the blowers to the aeration tanks is continuously monitored on the blower common header.

Control: The blower air pressure shall be used to convert the air flow for Loops 2000 and 2100-1 thru 8 from actual cubic feet per minute (ACFM) to standard cubic feet per minute (SCFM), as described in the flow loops.

Monitoring:

Local (Remotely mounted transmitter):

Pressure Indication

SCADA PLC/HMI:

Pressure Indication

LOOPS 2100-1 THRU 8 AERATION TANK INLET AIR FLOW

General: Air flow to each aeration tank is continuously monitored using an insertion Venturi tube and differential pressure transmitter for flow.

Control:

Aeration tank flow shall be used as the process variable in the aeration tanks' associated valve flow PID controller as described in the aeration tank air flow control loop (2150).

The calculation to convert air flow to SCFM shall be a function of the air header pressure, air temperature, and the aeration tank flow (in ACFM) measured at each aeration tank.

$$\text{Flow (SCFM)} = \frac{\text{Flow (ACFM)}}{\left(\frac{\text{Temp (}^{\circ}\text{F)} + 460^{\circ}\text{R}}{520^{\circ}\text{R}}\right) * \left(\frac{14.7\text{psia}}{\text{Pressure (psig)} + 14.7\text{psia}}\right)}$$

Flow (ACFM) = Aeration tank flow feedback

Temp (°F) = Aeration tank inlet air temperature feedback as described by Loop 2110 below

Pressure (psig) = Gauge pressure at aeration header as described by Loop 2010 above

Monitoring:

Local (Remotely mounted transmitter):

Flow indication

SCADA PLC/HMI:

Flow indication (ACFM)
Flow indication (SCFM)

LOOPS 2110-1 THRU 8 AERATION TANK INLET AIR TEMPERATURE

- General:** Air temperature to each aeration tank is continuously monitored using an insertion style temperature probe.
- Control:** Temperature feedback shall be used to convert the air flow for Loops 2000 and 2100-1 thru 8 from actual cubic feet per minute (ACFM) to standard cubic feet per minute (SCFM), as described in the flow loops.
- Monitoring:**

Local (transmitter):

None

SCADA PLC/HMI:

Temperature indication

LOOPS 2150-1 THRU 8 AERATION TANK INLET AIR FLOW CONTROL VALVES

- General:** The aeration tank inlet flow control valve controls air flow into the aeration tank. Control shall include manual and automatic open/close operation and position adjustment of the valve. In automatic mode, the Master Aeration Control Panel PLC (PLC-MACP) allows the operator to select between constant flow control or dissolved oxygen (DO) control for controlling the valve position. Most open valve control shall be provided to improve efficiency of the aeration system. When enabled, the PLC shall open the “most-open-valve” to a predetermined most open valve setpoint. This control strategy is for Loop 2150-1 and shall be typical for all eight valves.

Control:

Local (Valve actuator):

- Local: When the Local/Off/Remote selector is in the “Local” position, the valve can be open, closed, and stopped from the valve actuator.
- Off: When the Local/Off/Remote selector is in the “Off” position, the valve shall stay at its current position.
- Remote: When the Local/Off/Remote selector is in the “Remote” position, the valve control shall be transferred to the SCADA system.

SCADA PLC/HMI:

Manual:

The valve can be manually positioned by the operator at the HMI by entering a percent open setpoint.

Auto:

The flow measurement FI-2100-1 shall be the process variable to a Flow PID Controller (FIC-2100-1). The output of FIC-2100-1 shall control the position of valve BFV-2150-1. If the valve is in manual mode, the PID shall be halted and the current valve position shall be written to the PID controller's control variable (CV), such that there shall be a bumpless transition between manual and auto control modes.

The flow setpoint shall be determined by the Flow Control/DO Control selection on the HMI. If the system is set to "Flow Control," the operator shall be responsible for entering a flow setpoint on the HMI. If the system is set to "DO Control" the output of the corresponding DO controller (AIC-2250-1A/B) shall be used as the setpoint to FIC-2100-1.

The operator selectable DO reading, as described in Loop 2250-1B, shall be the process variable to a DO PID Controller (AIC-2250-1A/B). The output of the controller shall be the set point to flow controller FIC-2100-1 when "DO Control" is selected by the operator at the HMI. AIC-2250-1A/B shall be programmed as a cascade loop to FIC-2100-1, with AIC loop as the primary loop and FIC as the secondary loop. The operator shall enter the DO set point to the AIC controller at the HMI.

The flow setpoint of FIC-2100-1 shall be added to a "required flow" register which shall summate all flow setpoints from loops FIC-2100-1 thru 8. The "required flow" register shall then be used to calculate the flow setpoint the blower in operation as described in loops 4500-1 and 2 below.

Most Open Valve Sequence

As indicated herein, there are several PID controllers that are responsible for controlling DO, flow, valve position, and blower speed. The most open valve strategy is provided to increase efficiency of these control loops.

Most open valve (MOV) control is only available when the cascaded DO control is also enabled. There shall be supervisor level adjustable setpoints for “number of most open valves” (initially 1) and “most open valve position” (initially 100%).

When MOV is enabled, after a time delay, the valve with the highest position feedback will become the most-open-valve. If the “number of most open valves” setpoint is greater than 1, the same calculation shall be performed until all MOVs are determined (i.e. if the number of MOVs is set to 2, then the valves with the 2 highest positions will be assigned as a MOV). After the valve is assigned as a MOV, the valve output shall no longer be controlled by the Flow PID, but be forced to the MOV position setpoint. While the valve is a MOV the flow controller shall be paused, such that the PID loop is not “wound up.”

The valve(s) shall continue to operate as a MOV until one valve that is not a MOV is positioned by its flow controller within X% of the MOV, where X represents a supervisor level adjustable setpoint. (e.g. if X=5, and the MOV position setpoint is 100%, if a valve that is not the MOV is positioned to 95% position or more (for more than a time delay), the condition has been satisfied). Once this condition is met, all valves shall return to normal flow control at which point the MOV shall again be determined as described above.

Monitoring:

Local (Valve actuator):

Open Status
Closed Status
Remote Status
Position Indication

SCADA PLC/HMI:

Open Status
Closed Status
Remote Status
Position Indication

LOOPS 2200-1A-1E, 3A-3E, 5A-5E, 7A-7E AERATION TANK MIXERS

General: Each aeration tank has five (5) mixers. Running status for each mixer from tanks 1, 3, 5, and 7 shall be monitored by SCADA. An alarm shall be generated at SCADA if the aeration tank is “Online” and the mixer is not confirmed running after an operator adjustable length of time.

Control:

Local (Local Control Station):

The mixers can be started/stopped using push buttons on the local control station mounted on the aeration tank handrails.

Local (MCC):

The mixers can be started/stopped using push buttons on the MCC bucket located in the Influent Pump Station electrical room.

Monitoring:

Local (Local Control Station):

Run status

Local (MCC):

*Run status
Seal Failure
Heat Sensor Active*

SCADA PLC/HMI:

Run status

LOOPS 2200-2A-2E, 4A-4E, 6A-6E, 8A-8E AERATION TANK MIXERS

General: Each aeration tank has five (5) mixers. Running status for each mixer from tanks 2, 4, 6, and 8 shall be monitored by SCADA. The existing CP-01 is monitoring the mixers. The run status shall be added to the SCADA system. An alarm shall be generated at SCADA if the aeration tank is “Online” and the mixer is not confirmed running after an operator adjustable length of time.

Control:

Local (Local Control Station):

The mixers can be started/stopped using push buttons on the local control station mounted on the aeration tank handrails.

Local (MCC):

The mixers can be started/stopped using push buttons on the MCC bucket located in the Influent Pump Station electrical room.

Monitoring:

Local (Local Control Station):

Run status

Local (MCC):

Run status
Seal Failure
Heat Sensor Active

SCADA PLC/HMI:

Run status

LOOPS 2250-1A THRU 8A AERATION TANK DISSOLVED OXYGEN

General: Dissolved oxygen is continuously measured for each aeration tank.

Control: Loops 2250-1A thru 8A shall be used in the DO control strategy indicated by Loops 2250-1B thru 8B.

Monitoring:

Local (transmitter):

Anoxic Zone Dissolved Oxygen (PPM)

SCADA PLC/HMI:

Anoxic Zone Dissolved Oxygen (PPM)

LOOPS 2250-1B THRU 8B AERATION TANK DISSOLVED OXYGEN

General: Dissolved oxygen is continuously measured in the aeration tank. Dissolved oxygen is used for automatic air flow control as described by Loop 2150.

Control: The operator shall select whether the dissolved oxygen reading from AE-2250-1A, the dissolved oxygen reading from AE-2250-1B, the average between the two, or a weighted average between the two shall be used as the process variable to the DO PID controller (AIC-2250-1A/B). If the weighted average mode is selected, an HMI adjustable weight setpoint for each DO sensor shall be used to calculate the weighted average. The weighted average shall be calculated as follows:

$DO_{1A} = \text{DO Feedback of Sensor 1A}$
 $DO_{1B} = \text{DO Feedback of Sensor 1B}$
 $W_{1A} = \text{Weight Setpoint of Sensor 1A}$
 $W_{1B} = \text{Weight Setpoint of Sensor 1B}$
 $DO_{PV} = \text{PV Used in the DO PID Controller}$

$$DO_{PV} = \frac{DO_{1A} \times W_{1A} + DO_{1B} \times W_{1B}}{W_{1A} + W_{1B}}$$

If either of the sensor signals is lost, the good signal from the other DO sensor shall be used in the PID controller and an alarm shall be generated at the HMI.

The output of the controller AIC-2250-1A/B shall be the set point to flow controller FIC-2100-1 when “DO Control Mode” is selected by the operator at the HMI. The output of FIC-2100-1 shall control valve BFV-2250-1. AIC-2250-1A/B shall be programmed as a cascade loop, with AIC loop as the primary loop and FIC as the secondary loop, as described in loop 2150. The operator shall enter the DO set point to the AIC controller at the HMI.

Monitoring:

Local (transmitter):

Dissolved Oxygen (PPM)

SCADA PLC/HMI:

Dissolved Oxygen (PPM)

LOOPS 2300 AERATED EFFLUENT TROUGH DISSOLVED OXYGEN

General: Dissolved oxygen is continuously measured in the aerated effluent trough.

Control: None

Monitoring:

Local (transmitter):

Dissolved Oxygen (PPM)

SCADA PLC/HMI:

Dissolved Oxygen (PPM)

LOOPS 2350 SPRAY WATER PUMPS

General: Two (2) Spray Water Pumps located in the Control Building Basement continuously provide spray water to the Aeration Tanks. Running status for each pump shall be monitored by SCADA. If neither pump is running for an operator adjustable length of time, an alarm shall be generated at SCADA.

Control: None

Monitoring:

SCADA PLC/HMI:

Pump 1 Run Status
Pump 2 Run Status

LOOP 3000-1,2,3,4 FINAL SETTLING TANKS

General: Each final settling tank includes a local control panel for monitoring and controlling the clarifier drive, the scum pump, and the scum spray. Monitoring and start stop control of the scum pumps and spray shall be provided by SCADA.

Control:

Local (Existing Local Control Panel)

E-Stop: When the E-Stop button is not pressed the final settling tank clarifier drive shall run continuously unless a shutdown alarm is active. If the E-Stop button is pressed

Hand: When the Scum pump Hand/Off/Auto selector is in "Hand", the scum pump shall run. When the Scum spray Hand/Off/Auto selector is in "Hand", the scum spray shall be on.

Off: When the Scum pump Hand/Off/Auto selector is in "Off", the scum pump shall not run. When the Scum spray Hand/Off/Auto selector is in "Off", the scum spray shall not be on.

Auto: When the Scum pump Hand/Off/Auto selector is in "Auto", the scum pump shall run based on the timer settings in the control panel. When the Scum spray Hand/Off/Auto selector is in "Auto", the scum spray shall be on when the scum pump is running.

Monitoring:

Local (Existing Local Control Panel):

*Clarifier Running
Scum Pump Running
Alarm
Shutdown Alarm (Audible)*

SCADA PLC/HMI:

Clarifier Running
Scum Pump Running
Alarm
Shutdown Alarm

LOOPS 3500 UV DISINFECTION SYSTEM

General: Final effluent from the Final Settling Tanks is treated via UV disinfection prior to discharging. Signals from the UV System's System Control Center are connected via Ethernet for monitoring and control from the HMI.

Control: Local control from the Trojan System Control Center (SCC).

Monitoring:

SCADA PLC/HMI:

Various statuses shall be monitored from the UV System. A register list of available statuses will be provided by the UV vendor for use by the PCSS. The HMI system shall be capable of monitoring a minimum of 500 UV statuses and shall replicate the OIT graphics of the UV System SCC. The statuses shall include but not be limited to:

UV System Flow
UV Transmittance
UV Dosage (Calculated System Dose)
UV Dose Setpoint (Design Dose Setpoint)
Bank and Channel Run Statuses
Bank Lead/Lag statuses
Bank mode status (auto/manual/etc)
Bank Power Level
Bank Runtimes
System Health Statuses
Critical, Major, and Minor Alarms
Low Dose Alarm
Not Enough Channel Alarm
PLC Low Battery Fault
PLC Watchdog Pulse (Used to generate Loss of Communication)
Redundant PLC Fault
Flowmeter Fault
Low UVT Alarm
UVT Analyzer Fault
UV System Power Failure (UPS is ON)
Time to next wipe sequence
Wiper sequence timer setpoint
Wiper Group Enabled Status (for each wiper group)
Wiper Group in Remote (for each wiper group)
Wiper Group Sequence in Progress (for each wiper group)
Wiper Group in Local (for each wiper group)

Wiper Group Wiping Suspended (for each wiper group)
Wiper Group not in Remote Auto (for each wiper group)
Wiper Group System High Pressure Shutdown (for each wiper group)
Wiper Group Mode (for each wiper group)
Bank Lamp Hours (for each bank)
Bank Intensity (for each bank)
Bank Runtime Hours (for each bank)
Lamp On Status (for each lamp)
Ballast On Status (for each ballast)
Lamp Fault Status (for each lamp)
Ballast Fault Status (for each ballast)
An additional 50 statuses to be determined during construction)

LOOP 4300-1 THRU 3

NITRATE RETURN SCREW PUMPS

General: Three (3) existing VFD driven screw pumps shall be monitored and controlled by PLC-ELEC. Control shall include manual and automatic operation from SCADA. In automatic mode, PLC-ELEC shall be capable of speed control based on the final effluent flow.

Control:

Local (VFD)

Local: When the VFD is in "Local", control of the screw pump shall be from the VFD keypad.

Remote: When the VFD is in "Remote", control of the screw pumps shall be transferred to the SCADA system.

SCADA PLC/HMI:

Software Interlocks:

If no effluent flow is measured from the effluent flowmeter, the pumps shall stop and not be allowed to start.

If the effluent flow is higher than a supervisor adjustable high flow setpoint, the pumps shall stop.

Manual:

The screw pumps can be manually started or stopped by the operator at the HMI. The speed of the pump can also be controlled by the operator at the HMI.

Auto:

In auto, the screw pumps shall operate in a Lead/Standby 1/Standby 2 sequence to maintain a percentage of effluent flow (%), as entered by the operator at the HMI. The effluent flow percentage that is entered at the

HMI shall be common for all three (3) pumps. The pump shall continuously run to maintain the effluent flow percentage until there is no effluent flow. When the lead pump stops, it shall become the Standby 2 pump, the Standby 2 pump shall become the Standby 1, and the Standby 1 pump shall become the lead.

The speed of the pump shall vary to maintain the percentage of effluent flow (Loop 4550) as follows:

$$\text{Calculated Flow Setpoint (GPM)} = \left(\text{Total Effluent Flow} * \frac{\% \text{ of Effluent Flow}}{100} \right)$$

$$\text{Pump Speed (\%)} = \left(\frac{\text{Flow Setpoint (GPM)}}{\text{Pump Capacity (GPM)}} \right) * 100$$

Monitoring:

Local (VFD):

Various alarms/monitoring available from VFD keypad

SCADA PLC/HMI:

Speed Indication
VFD Mode
Manual Mode
Screw Pump Run Status
Grease Pump Run Status
Remote
Fault

LOOP 4450 PARSHALL FLUME FINAL EFFLUENT FLOW

General: An existing ultrasonic flow transmitter continuously monitors the flow of final effluent through an open-channel Parshall flume to the Glen Cove creek. The existing signal from the ultrasonic flow transmitter shall be tied into the new RIO-FINAL in the Sodium Hypochlorite Building.

Control: The final effluent flow shall be used to calculate the flow setpoint of nitrate return flow as required by Loop 4300.

Monitoring:

Local (Remotely mounted transmitter):

Flow Indication

SCADA PLC/HMI:

Flow Indication

LOOP 4500 AUTOMATIC BLOWER CONTROL

General: The Glen Cove WWTP has three existing blowers; a Hoffman multistage blower, an APG Neuros air bearing turbo blower, and a Turblex single stage blower. The new MACP shall be responsible for controlling the APG Neuros and Turblex blowers. The Hoffman blower shall only be operated in local/manual control and will not be connected to the new MACP PLC. Only one blower shall operate at a time in a lead/standby configuration. The blowers will be controlled to maintain the flow demand to the aeration tanks.

Control:

The Turblex and APG Neuros blowers shall operate in a lead/standby configuration. In auto, the blower will maintain a flow setpoint (SCFM) that is calculated as the sum of all aeration tank flow setpoints as calculated in loop 2150. If the flow setpoint falls below the minimum flow that the blower can provide, the operator will be alerted to open the blowoff valve manually. The operator shall select Lead, Standby or Offline for each blower from the HMI using radio buttons on the graphic display. The order can be changed at any time, but the blowers cannot be selected to have the same lead/standby position. For example, if the Turblex Blower is selected as the lead blower, then it must be placed offline before the APG Neuros Blower can be selected as the lead blower. When placed offline, the blower shall not run in automatic mode.

In automatic mode, the lead blower shall always run unless all aeration tanks are offline, the summation of flow setpoints to all aeration tanks is zero, or an interlock causes a blower to shut down. If the lead blower does not turn on or is interlocked, the standby blower shall be started. The flow measurement FI-2000 shall be the process variable to a Flow PID Controller (FIC-2000). The output of FIC-2000 shall control blower speed. Starting, stopping, and the airflow setpoint for FIC-2000 shall be controlled by the PLC-MACP as determined by the aeration control strategy (loop 2150).

LOOP 4500-1 TUBLEX AERATION BLOWER

General: An existing Turblex blower is currently used for providing air to the aeration tanks. Existing controls allow for manual or automatic operation from the existing master control panel. The master control panel shall be replaced with a new master control panel as required by Section 13300 and shall communicate with the Turblex Local Control panel via Ethernet. The existing program shall be modified such that manual and automatic control of the blower is provided as required.

Control:

Local (Turblex Local Blower Panel):

The existing Turblex local blower panel includes an OIT on the front of the panel. The OIT allows for manual or automatic operation. If the OIT selection is set to local/manual operation, the operator may start and stop the blower and control the airflow manually. The OIT shall be modified such that when the blower is placed in “Remote” control is transferred to the new PLC-MACP.

SCADA PLC/HMI:

Software Interlocks:

If the plant utility power is not available, the Turblex blower shall not start.

Manual:

The blower can be started, stopped, and airflow can be controlled by the operator at the HMI.

Auto:

The Turblex blower shall operate in a lead/standby strategy as described in the automatic blower operation Loop 4500 above.

Monitoring:

Local (Remotely mounted transmitter):

Various Statuses via the OIT

SCADA PLC/HMI (via EtherNet/IP):

The following statuses shall be obtained via new message instructions programmed into the Turbplex PLC to transmit various control signals to the PLC-MACP over the Ethernet network. Additional signals shall also be monitored by the HMI system over the Ethernet network. See the OIT photos included in Section 13300-Appendix D for screens displaying the information required to be monitored by the new HMI.

In addition to the signals explicitly displayed on the existing OIT, additional signals may be required to be transmitted from the PLC that are calculated or monitored in the PLC but are not apparent by viewing the OIT. Provide the following:

- 20 additional discrete signals to be determined during startup
- 20 additional analog signals to be determined during startup

LOOP 4500-2 APG NEUROS AERATION BLOWER

General: An existing APG Neuros turbo blower is currently used for providing air to the aeration tanks. Existing controls allow for manual operation from the APG Neuros OIT. The new master control panel required by Section 13300 shall communicate with the APG Neuros PLC via Ethernet. The new PLC-MACP shall communicate via EtherNet/IP using the existing register mapping included in the existing O&M documentation to control the blower starting, stopping and speed.

Control:

Local (APG Neuros Blower Enclosure):

The existing APG Neuros blower enclosure includes an OIT on the front of the enclosure. The OIT currently allows for manual operation. If the OIT selection is set to local/manual operation, the operator may start and stop the blower and control the airflow manually. The PLC and OIT shall be modified as necessary so that when the blower is placed in "Remote" control is transferred to the new PLC-MACP. The "Remote Mode" selection button previously reserved for future and shall be used for transferring control to the PLC-MACP.

SCADA PLC/HMI:

Manual:

The blower can be started, stopped, and airflow can be controlled by the operator at the HMI.

Auto:

The APG Neuros blower shall operate in a lead/standby strategy as described in the automatic blower operation Loop 4500 above.

Monitoring:

Local (Remotely mounted transmitter):

Run Status
Stopped
Control Power On
Various Statuses via the OIT

SCADA PLC/HMI (via EtherNet/IP):

Statuses shall be obtained via the EtherNet/IP protocol over the Ethernet network. See the Communication Information included in Section 13300-Appendix B for a comprehensive list of all signals required to be monitored.

LOOP 5000-1 THRU 6

RETURN ACTIVATED SLUDE (RAS) PUMPS

General: Six (6) RAS pumps are located in the Control Building Basement. RAS pumps 1 through 3 are high rate return pumps, and RAS pumps 4 through 6 are low rate return pumps. The RAS pumps send return activated sludge from the Final Settling Tanks to on-line aeration tanks.

Control:

Local (VFD Panel):

Bypass: When the VFD/Bypass selector is in "Bypass," the pump shall be started across the line.

VFD: When the VFD/Bypass selector is in "VFD," the pump shall be started using the VFD controls.

Hand: When the Hand/Off/Remote selector is in "Hand", the pump shall run.

Off: When the Hand/Off/Remote selector is in "Off", the pump shall not run

Remote: When the Hand/Off/Remote selector is in “Remote”, control of the pump shall be transferred to the pump local control stations.

Local (Local Control Station):

Hand: When the Hand/ Remote selector is in “Hand”, the pump shall run.

Remote: When the Hand/Off/Remote selector is in “Remote”, control of the pump shall be transferred to SCADA.

SCADA PLC/HMI:

Manual:

The pump can be started, stopped, and have its speed controlled by the operator at the HMI.

Auto:

The operator can select to use the High Rate pumps, or the Low Rate pumps from the HMI. This selection will determine which pumps are called to run based on the Lead/Standby or Lead/Lag sequences explained below. If the High Rate pumps are selected, the Low Rate pumps shall not be called to start in automatic mode. If none of the pumps for the corresponding selection are available, an alarm shall be generated.

The total flow to the aeration tanks is determined by an operator adjustable ratio. the RAS flow setpoint shall be calculated in the PLC by multiplying the ratio setpoint and the total raw water flow. The ratio setpoint shall be initially set to 1.0. When placed into automatic mode, the lead pump shall run. The speed of the lead pump shall be automatically controlled to maintain the calculated RAS flow setpoint. A PID flow controller shall be used, where the process variable is the RAS flow as measured by loop 5005 or 5010, depending on the high or low rate pump selection. The output of the PID controller is a pump speed between 0-100%.

$$RAS_{flow} \text{ Setpoint (gpm)} = (Raw \text{ Water Flow(gpm)}) * Ratio \text{ of Raw Flow Setpoint}$$

If the calculated RAS flow demand is either above the maximum flow capacity with all three (3) Low Rate pumps running, or below the minimum flow capacity with the High Rate pumps running, an alert shall notify the operator that switching the pumps is necessary after a delay timer. For example, if the RAS flow setpoint is calculated as 2000 GPM, but the Low Rate Pumps cannot meet this setpoint (minus an adjustable deadband) at 100% speed, the SCADA system shall alert the operator that the High Rate Pumps are required to meet the required flow setpoint.

Pumps 1, 2, and 3 (High Rate Pumps)

The High Rate Pumps shall operate in a Lead/Standby 1/Standby 2 sequence. The lead pump selection shall be in either Operator Mode or Alternation Mode as selected by the operator at the HMI. In operator mode, the operator shall select Lead, Standby 1, Standby 2, or Offline for each pump from the HMI using radio buttons on the graphic display. The order can be changed at any time, but no two pumps can be selected to have the same lead/standby position. For example, if Pump 1 is selected as the lead pump, then it must be placed offline before Pump 2 can be selected as the lead pump. When placed offline, the pump shall not run in automatic mode. In alternation mode, the pumps shall automatically alternate after the lead pump is automatically stopped by the control strategy. When the lead pump stops, it shall become the Standby 2 pump, the Standby 2 pump shall become the Standby 1, and the Standby 1 pump shall become the lead.

Pumps 4, 5, and 6 (Low Rate Pumps)

The Low Rate Pumps shall operate in a Lead/Lag 1/Lag 2 sequence. The lead pump selection shall be in either Operator Mode or Alternation mode as selected by the operator at the HMI. In operator mode, the operator shall select Lead, Lag 1, Lag 2, or Offline for each pump from the HMI using radio buttons on the graphic display. The order can be changed at any time, but no two pumps can be selected to have the same lead/lag position. If the Low Rate Pumps are selected for operation and the lead pump reaches a “start lag 1” setpoint (initially set to 100%), the lead pump shall be called to run at an adjustable “minimum lag 1 starting speed” setpoint (initially set to 50%). Once the lead pump has reached the minimum lag starting speed, the second pump (lag 1) shall be called to start. With two pumps running, both pumps shall vary their speed to meet the flow demand. Both pumps shall run at the same speed. If the flow setpoint and the two running pumps reach the “start lag 2” setpoint (initially set to 100%), the lead and lag 1 pumps shall be called run at an adjustable “minimum lag 2 starting speed” setpoint (initially set to 75%). With both pumps running at the minimum lag 2 starting speed, the lag 2 pump shall be called to start. If all three (3) Low Rate Pumps are running and the flow setpoint is not met, an alarm shall be generated at SCADA, alerting the operator that a High Rate pump is required to meet the flow demand.

Monitoring:

Local (VFD Control Panel):

Control Power On
Run Status
Motor Safe/Off
Remote
Bypass Mode
Fault
Speed Indication
Input Amps
Output Amps
Runtime Hours

Local (VFD):

Various alarms/monitoring available from VFD keypad

SCADA PLC/HMI:

Speed Indication
Run Status
Remote
Fault
Bypass

LOOP 5005 HIGH RATE RAS FLOW

General: An existing ultrasonic flow meter continuously monitors the flow of high rate RAS discharged from the high rate RAS pumps. The existing signal from the ultrasonic flow transmitter shall be tied into the new PLC-ELEC in the Control Building Electrical Room.

Control: Used for controlling the RAS flow for the High Rate RAS pumps as described in loop 5000 above. This flowmeter shall only be used when pump 5000-1,2,3 are selected for use.

Monitoring:

Local (Remotely mounted transmitter):

Flow Indication

SCADA PLC/HMI:

Flow Indication

LOOP 5010 LOW RATE RAS FLOW

General: An existing ultrasonic flow meter continuously monitors the flow of low rate RAS discharged from the low rate RAS pumps. The existing signal from the ultrasonic flow transmitter shall be tied into the new PLC-ELEC in the Control Building Electrical Room.

Control: Used for controlling the RAS flow for the Low Rate RAS pumps as described in loop 5000 above. This flowmeter shall only be used when pump 5000-4,5,6 are selected for use.

Monitoring:

Local (Remotely mounted transmitter):

Flow Indication

SCADA PLC/HMI:

Flow Indication

LOOP 5210 WASTE ACTIVATED SLUDE (WAS) FLOW CONTROL VALVE

General: A modulating control valve is used to vary the waste activated sludge flow. Manual and automatic control is provided to maintain a WAS flow setpoint.

Control:

Local (MCC Panel):

Local: When the Local/Off/Remote selector is in “Local”, the pump can be started and stopped from the MCC.

Off: When the Local/Off/Remote selector is in “Off”, the pump shall not run.

Remote: When the Local/Off/Remote selector is in “Remote”, control of the pump shall be transferred to SCADA.

SCADA PLC/HMI:

Manual:

The valve can be opened, closed, and have its position controlled by the operator at the HMI.

Auto:

The valve shall maintain a flow setpoint (GPM) entered by the operator at the HMI. The position of the valve shall vary to maintain an operator adjustable flow setpoint using a PID flow controller (FIC-5250), where the process variable for the PID controller is the total WAS flow, as measured by Loop 5250. The PID controller shall output a valve position signal between 0 and 100%.

Monitoring:

Local (VFD):

Valve Position

SCADA PLC/HMI:

Valve Position

LOOP 5250 WASTE ACTIVATED SLUDGE (WAS) FLOW

General: An existing ultrasonic flow meter continuously monitors the flow of WAS. A new signal from the ultrasonic flow transmitter shall be tied into the new RIO-IPS in the Headworks Building.

Control: The WAS flow shall be used as the process variable in the WAS valve flow PID controller as described in the aeration tank air flow control loop (5210).

Monitoring:

Local (Remotely mounted transmitter):

Flow Indication

SCADA PLC/HMI:

Flow Indication

LOOP 5400-1,2 SEAL WATER PUMPS

General: Seal water pumps provide seal water to the process pumps. The run status shall be monitored and alarmed if neither pump is running.

Control:

Local (Local Control Station):

Off: When the On/Off selector is in "Off," the pump shall not start.
On: When the On/Off selector is in "On," the pump is started.

Monitoring:

An alarm shall be generated by the PLC if neither pump is running for more than an adjustable time.

Local (MCC):

Runtime Hours

SCADA PLC/HMI:

Run Status

LOOP 6000-1 thru 3 BELT FILTER PRESSES 1 THRU 3

General: PLC and OIT programming have been previously provided for three (3) Belt Filter Presses. The following is intended to describe the current functionality of the system to be replicated by the Cimplicity HMI.

Control:

For local operation, the desired belt filter press must be selected using the selector switch at the Belt Filter Press Main Control Panel (CP-01). The PLC shall lock out the two Belt Filter presses not selected (i.e. only one belt filter press shall operate at any one time).

Local (BFP Local Control Panel):

Hand: When the Hand/Off/Auto selector is in "Hand," the "Hand Mode" indicator will be illuminated. The operator shall perform the following sequence to safely start the belt filter press:

The operator will start the washwater pump and hydraulic pump using the "Start" push-buttons. With the washwater pump running, the washwater valve shall become energized.

The operator should not proceed until the belts are fully tensioned; no interlock is provided to prevent the operator from starting the belt drive.

The belt drive is started by pressing the “Belt Drive Start” push-button. The operator should not proceed until the belts are fully pre-wetted. Once the belts are pre-wetted, a “Belt Filter Press Ready” contact shall be energized and the “Press Ready” indicator shall be illuminated. The operator may now start the conveyor by pressing the “Conveyor Start” push button, start the sludge pump by pressing the “Sludge Pump Start” push button, and start the polymer pump by pressing the “Polymer Pump Start” push button.

The operator can manually stop the belt filter press by using the respective Stop push buttons in the reverse order explained above.

Off: When the Hand/Off/Auto selector is in “Off,” the belt drive shall not start.

Auto: When the Hand/Off/Auto selector is in “Auto”, the operator shall be able to start the belt filter press by pressing the Auto Start push button. Control shall also be available via SCADA to allow for starting of the belt filter press from the Cimplicity HMI.

SCADA PLC/HMI:

The Cimplicity HMI shall replicate the equipment matrix displayed on the graphic user interface at CP-01. Each belt filter press shall have its own matrix which indicates the combination of pumps, valves, and motorized equipment that should be on/open, depending on the pumping location for each sludge pump. The operator shall be able to select from the HMI which sludge pump feeds each belt filter press, as described in Loop 6200 and as indicated by the matrix below:

Belt Filter Press No. 1

Equipment ID	Pump P-1 to BFP-1	Pump P-2 to BFP-1	Pump P-3 to BFP-1
Inline Grinder G1	O	O	O
Sludge Pump P1	O	C	C
Sludge Pump P2	C	O	O
Sludge Pump P3	C	C	O
Motorized Plug Valve PV-1	O	O	O
Motorized Plug Valve PV-2	C	C	C
Motorized Plug Valve PV-3	C	C	C
Motorized Plug Valve PV-4	C	O	O
Motorized Plug Valve PV-5	C	C	O
Existing Belt Filter Press BFP-1	O	O	O
Belt Filter Press BFP-2	C	C	C
Belt Filter Press BFP-3	C	C	C
Existing Conveyor	O	O	O
Existing Truck Loader	O	O	O
Conveyor C-1	C	C	C
Conveyor C-2	C	C	C
Conveyor C-3	C	C	C
Conveyor C-4	C	C	C
Conveyor C-5	C	C	C
Polymer Skid PY-1	O	O	O
Polymer Skid PY-2	C	C	C
Polymer Skid PY-3	C	C	C
Polygone Feed Pump PG-1*	C	C	C
Zetalyte Feed Pump ZL-1	O	O	O

O=Open/On; C=Closed/Off

*Shall be called to turn on via the CP-01

Belt Filter Press No. 2

Equipment ID	Pump P-1 to BFP-2	Pump P-2 to BFP-2	Pump P-3 to BFP-2
Inline Grinder G1	O	O	O
Sludge Pump P1	O	C	C
Sludge Pump P2	C	O	C
Sludge Pump P3	C	C	O
Motorized Plug Valve PV-1	C	C	C
Motorized Plug Valve PV-2	O	O	O
Motorized Plug Valve PV-3	C	C	C
Motorized Plug Valve PV-4	O	C	C
Motorized Plug Valve PV-5	C	C	O
Existing Belt Filter Press BFP-1	C	C	C
Belt Filter Press BFP-2	O	O	O
Belt Filter Press BFP-3	C	C	C
Existing Conveyor	C	C	C
Existing Truck Loader	O	O	O
Conveyor C-1	O	O	O
Conveyor C-2	C	C	C
Conveyor C-3	O	O	O
Conveyor C-4	O	O	O
Conveyor C-5	O	O	O
Polymer Skid PY-1	C	C	C
Polymer Skid PY-2	O	O	O
Polymer Skid PY-3	C	C	C
Polygone Feed Pump PG-1*	C	C	C
Zetalyte Feed Pump ZL-1	O	O	O

O=Open/On; C=Closed/Off

*Shall be called to turn on via the CP-01

Belt Filter Press No. 3

Equipment ID	Pump P-1 to BFP-3	Pump P-2 to BFP-3	Pump P-3 to BFP-3
Inline Grinder G1	O	O	O
Sludge Pump P1	O	C	C
Sludge Pump P2	C	O	C
Sludge Pump P3	C	C	O
Motorized Plug Valve PV-1	C	C	C
Motorized Plug Valve PV-2	C	C	C
Motorized Plug Valve PV-3	O	O	O
Motorized Plug Valve PV-4	O	C	C
Motorized Plug Valve PV-5	O	O	C
Existing Belt Filter Press BFP-1	C	C	C
Belt Filter Press BFP-2	C	C	C
Belt Filter Press BFP-3	O	O	O
Existing Conveyor	C	C	C
Existing Truck Loader	O	O	O
Conveyor C-1	C	C	C
Conveyor C-2	O	O	O
Conveyor C-3	O	O	O
Conveyor C-4	O	O	O
Conveyor C-5	O	O	O
Polymer Skid PY-1	C	C	C
Polymer Skid PY-2	C	C	C
Polymer Skid PY-3	O	O	O
Polygone Feed Pump PG-1*	C	C	C
Zetalyte Feed Pump ZL-1	O	O	O

O=Open/On; C=Closed/Off

*Shall be called to turn on via the CP-01

Manual:

The belt filter press can be started or stopped by the operator at the HMI. The start and stop command from the HMI shall perform the same functionality as the “Auto Start” and “Auto Stop” push buttons on CP-01.

Auto:

The belt filter press shall not automatically start. Automatic sequences shall be performed by the CP-01 after the system is manually started by the operator from the HMI.

Monitoring:

SCADA PLC/HMI (Typical for each Belt Filter Press):

Belt Filter Press Ready
Common Alarm
Conveyor Running
Conveyor Fail
Emergency Stop
Washwater Low Pressure
Hydraulic Pressure Fault
Belt Misaligned
Belt Broken
Belt Drive Fail
No Cake
20 additional I/O signals to be determined during construction

LOOP 6200-1 thru 3 BELT FILTER PRESS SLUDGE PUMPS 1 THRU 3

General: PLC and OIT programming have been previously provided for three (3) Belt Filter Press Sludge Pumps. The following is intended to describe the current functionality of the system to be replicated by the Cimplicity HMI.

Control:

Local (Sludge Pump MCC):

Hand: When the Hand/Off/Auto selector is in "Hand," the pump shall run. The speed of the pump can be manually adjusted using the potentiometer on the respective sludge pump MCC.

Off: When the Hand/Off/Auto selector is in "Off," the pump shall not run.

Auto: When the Hand/Off/Auto selector is in "Auto", control of the sludge pump shall be transferred to the PLC. In auto mode, the sludge pump requires a start command from the PLC in order to run. The speed of the pump can be manually controlled using the graphic user interface on the belt filter press control panel. Control shall also be transferred to SCADA to allow for control of the sludge pumps from the Cimplicity HMI.

SCADA PLC/HMI:

Any of the three (3) sludge pumps shall be capable of feeding any of the three (3) belt filter presses. The operator shall be able to choose which sludge pump feeds each belt filter press from the HMI. Only one sludge pump shall be required to feed a belt filter press at a time.

Auto:

The sludge pump shall run upon receiving the “Press Ready” status, as described in Loop 6000. The sludge pump can have its speed controlled by the operator at the HMI.

Monitoring:

SCADA PLC/HMI:

Running
Speed Indication
Overload
Fault
High Temperature
High Pressure

LOOP 7000

EMERGENCY GENERATOR

General: An emergency generator shall supply power to the UV system in the event of a power failure. Generator running status shall be monitored by the SCADA system. An alarm shall be generated at SCADA if there is a power failure and generator run status is not received within an adjustable time setpoint.

Control: None

Monitoring:

SCADA PLC/HMI:

Generator Running

LOOP 7050 POWER MONITORING

General: Power monitors located in the substation will monitor various data of the plant's power consumption.

Control:

SCADA PLC/HMI:

Software Interlocks:

If the plant utility power is not available, only the APG Neuros blower is available to start.

Monitoring:

SCADA PLC/HMI (Hardwired):

Utility Power Available

SCADA PLC/HMI (via Ethernet):

Various Power Monitoring Data (minimum of 20 signals from each power monitor)

LOOP 7350-1 thru 3 FUEL OIL TANKS 1 THRU 3 LEVEL MONITORING

General: Three (3) diesel fuel tanks are continuously monitored with two monitoring panels. A storage tank located outside and there are two day tanks located in the generator room. The SCADA system will provide monitoring of the tank level and alarm in the event that the storage tank leaks.

Control: None

Monitoring:

SCADA PLC/HMI:

Storage Tank (Tank #1) Level Indication
Storage Tank Leak Alarm
Day Tank #2 Level
Day Tank #3 Level

LOOP 7900 ALARM DIALER

General: An existing Antx Dialog Elite alarm dialer is configured to callout alarms during unmanned hours. The new Win-911 software included in Section 13316 shall be configured to call staff in a similar approach as the existing system. Since the plant is not staffed 24 hours, the callouts should be configured so that the Cedar Creek plant is called after Glen Cove working hours. Additionally, an alarm dialer graphic shall be created in the Cimplicity HMI which indicates the active alarm callouts.

Control: None

Monitoring:

SCADA PLC/HMI:

Influent Well High
Primary Clarifier #1 Failure
Primary Clarifier #2 Failure
Primary Clarifier #3 Failure
Primary Clarifier #4 Failure
Final Clarifier #1 Failure
Final Clarifier #2 Failure
Final Clarifier #3 Failure
Final Clarifier #4 Failure
Multistage Blower #1 Failure
Blower #3 (APG Neuros Blower Failure)
Blower #4 (Turblex Blower Failure)
High-Rate RAS Flow (Low Flow)
Low-Rate RAS Flow (Low Flow)
Screw Pump #1 Failure
Screw Pump #2 Failure
Screw Pump #3 Failure
UV Disinfection Major Alarm
Power Failure
Influent Pump Failure
20 spare callouts to be determined during construction

END OF SECTION

SECTION 13306
APPLICATIONS ENGINEERING SERVICES

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. All requirements defined in this section apply to work being performed at both Cedar Creek WPCP and Glen Cove WWTP, unless specifically noted as pertaining to only one facility.
- B. Provide all programming, configuration, and related services required to achieve a fully integrated and operational system as specified herein. All equipment shall be controlled in full conformity with the contract drawings, process control descriptions, specifications, engineering data, instructions, and recommendations of the equipment manufacturer. Coordinate the control system for proper operation with related equipment and materials furnished by other suppliers under other Sections of these specifications and with related existing equipment. The scope of work required at each of the two plants is described below.
- C. All work shall be coordinated with plant operating personnel to minimize impacts on daily operation. Delays caused for any reason shall be noted and formally submitted to the Engineer and the Owner in the form of a letter.
- D. The HMI and OIT symbols, colors, tag naming, alarming, functionality, and overall appearance shall follow the standards and conventions documentation. Prior to commencing any HMI and OIT development work, the PCSS shall coordinate with the Owner (refer to coordination meetings requirements below) to obtain the standards that need to be followed for the project.
- E. The PLC symbols or tagnames shall follow the standards and conventions documentation, which may be obtained from the Owner.
- F. At both Cedar Creek WPCP and Glen Cove WWTP perform the following:
 - 1. Provide configuration of the operator interface terminals (OITs) shown on the system architecture. All alarm functions, setpoints, control functions, and monitoring signals that are required for the HMI system shall also be included in the OITs.
 - 2. Provide configuration of the HMI System Software and drivers provided for all equipment shown on the drawings, including equipment provided by vendor package systems.
 - a. Perform programming of the Cimplicity HMI system to monitor and control all aspects of the plant as required by this contract. This shall include graphic display development (including animations, control, and alarming), database development, communication driver configuration, IP address configuration, and testing. All functions defined as "HMI" in the control descriptions (Specification Section 13305) shall be programmed into the Cimplicity HMI system. At a minimum provide:
 - 1) Provide color graphic displays for use by the system operating and supervisory personnel.
 - 2) Provide trending for:
 - a) All analog values
 - b) Discrete alarms identified during construction.
 - 3) Provide control system diagnostics including:

- a) SCADA Server Statuses (Active as Primary Server, In Standby as Secondary Server, and SCADA server fail)
 - b) PLC communication statuses and I/O card failures
 - c) UPS statuses as defined in specification section 13305 and 13335.
 - 4) The HMI software shall be responsible for the real-time database, graphic screens, graphic development, set point modification, data archiving, etc.
 - 5) The system shall allow the operator to manually control (by keyboard entry and mouse type pointing device) the status of pumps, valves, etc. (i.e., on/off, open/close, setpoint value, etc.) when viewing the appropriate graphic screens on the HMI.
3. Provide configuration of the software alarm dialer required by Section 13316, such that up to 15 users are called, emailed, and texted in the event of an alarm. Voice calls shall be established through a Voice over Internet Protocol (VoIP) connection that is coordinated with the Operators IT department. Callout functionality shall be setup and tested during factory testing by means of a temporary VoIP setup (e.g. Google Voice). Both text messages and emails shall be configured to be sent through email. Email notifications shall be sent directly to the user's email address. Text messages shall be sent through cell service provider email to SMS gateway email addresses. Alarms shall be configured such that each user is only contacted at predetermined times and by area. (e.g. John Smith is contacted between 8am and 5pm for Glen Cove - UV alarms only) The alarm dialer shall prompt the user for acknowledgement, along with instructions on how to acknowledgement for all methods of communication. The system shall be configured such that if an alarm is not acknowledged by a user the alarm dialer shall notify the next user after a time delay.
4. Provide an alarm management diagnostic screen that can be used by plant staff to identify nuisance alarms and shall be used during construction to identify and resolve nuisance alarms prior to Substantial Completion. Built in functionality of the HMI software (such as VisiconX) and Proficy Historian Alarm archiver shall be utilized in order to most effectively identify these alarms. The screen shall allow users to filter alarms by area and shall display the total number of occurrences during the time frame. The following information shall be provided on the graphic:
- a. The total number of active alarms.
 - b. Display the top 15 alarms by frequency over a user defined time frame.
 - c. Display the top 15 alarms by frequency over predefined time frames (hourly, 6 hours, daily, weekly).
5. Provide a communication management diagnostic screen. The screen shall can be used by plant staff to identify communication failures of the fault tolerant fiber optic ring. The screen shall be arranged by plant area and show the communication status using both color coding and descriptions of the communication status. The graphic shall also include the time at which the communication failure first started. The graphic shall differentiate between ports that are not forwarding data under normal operation and ports that are not forwarding because a failure.
6. All process control functions including PID, calculations, sequencing, timing, etc., shall be performed in the PLC.
7. The PCSS shall configure the Proficy Historian server to include historical data collection of all points added to the system under this contract.

8. Provide configuration of the SCADA Historian Software.
9. Provide configuration of system reports using the plant's Hach-WIMS reporting software.
10. Provide for and test communications and functionality between all connected devices (such as PLCs) and the HMI software packages, including devices supplied by others, as depicted on the system architecture drawings in order to provide a comprehensive working system of data collection, storage and reporting.

G. The following work shall be performed at the Cedar Creek WPCP:

1. Provide configuration of the SCADA system equipment and software provided as follows:
 - a. Provide all PLC programming as follows:
 - 1) Perform programming of new PLCs as indicated on the System Architecture drawings (I-2 through I-6) at the Nassau County Cedar Creek Water Pollution Control Plant to monitor and control all equipment required by this contract. As a minimum, this shall include control logic, system diagnostics, flow totalization, runtime calculations, communication driver configuration, IP address configuration, and testing. All functions required by the control descriptions (Specification Section 13305) shall be programmed into the associated PLCs.
 - 2) Perform real-time process control, including proportional integral derivative control action, sequencing, process calculations, etc.
 - 3) All process control functions including PID, calculations, sequencing, timing, etc., shall be done in PLC.
 - b. Perform Cimplicity HMI SCADA programming (new graphic displays, database points, and driver configuration, testing) for the following existing PLCs and controllers. Minimum requirements are defined herein and in Section 13305.
 - 1) Influent Screenings Facility PLC located in the Electrical Room of the Influent Screenings Facility.
 - 2) Effluent Screenings and Disinfection Facility PLCs located in the L Building. Develop graphic displays for the following PLCs:
 - a) Outfall Pump Control Panel
 - b) Screened Effluent Control Panel
 - c) Chlorination Control Panel
 - d) Sluice Gates Control Panel
 - e) Outfall Level Control Panel
 - 3) Grit System Control Panel located in the Grit Control Room.
 - c. Perform PLC and HMI programming to monitor the County's Protected and Domestic Water flowmeters. This shall include programming of existing plant PLCs being used to tie in the flow signals. Refer to Section 13300 and the electrical drawings.
 - d. Perform PLC and HMI programming to monitor the 8 existing digester gas flowmeters.
 - e. Perform PLC and HMI programming to monitor the 22 new gas detectors from the SCADA system.
 - f. Perform PLC and HMI programming to monitor the digester cover levels from the SCADA system.
2. Process areas at the Cedar Creek WPCP indicated on the system architecture as having existing Cimplicity servers shall be migrated into the new SCADA servers (VM-1 and VM-2). The workstation previously used as a server shall be reconfigured to run as a client workstation.

3. Provide configuration such that all networked devices shown on the system architecture (new and existing) shall be updated by the existing time server.
4. Provide configuration of the networking components as shown on the System Architecture drawings and the Fiber Optic Network drawings.

H. The following work shall be performed at the Glen Cove WWTP:

1. Provide configuration of the SCADA system equipment and software provided as follows:
 - a. Provide all PLC programming as follows:
 - 1) Perform programming of new PLCs as indicated on the System Architecture and as shown on the P&IDs. At a minimum, this shall include control logic, system diagnostics, flow totalizations, runtime calculations, communication driver configuration, IP address configuration, and testing. All functions required by the control descriptions (Section 13305) shall be programmed into the associated PLCs.
 - 2) Perform real-time process control, including proportional integral derivative control action, sequencing, process calculations, etc.
 - 3) All process control functions including PID, calculations, sequencing, timing, etc., shall be done in the PLC.
 - b. Perform Cimplicity HMI SCADA programming (new graphic displays, database points, and driver configuration) for the following existing PLCs and controllers. Minimum requirements are defined herein and in Section 13305.
 - 1) Belt Filter Press Main Control Panel (CP-01) PLC
 - 2) APG Neuros Blower PLC
 - 3) Turblex Blower PLC
 - 4) UV PLC
2. Provide support and configuration of the fault tolerant server furnished by the during startup services provided by the manufacturer.
 - a. The PCSS shall be present during startup services provided by the fault tolerant server manufacturer as indicated in Section 13310. These services are provided for setup of the redundant hardware and for creation of the “base” virtual machine which will be used as the template to be cloned for all virtual servers that will be created for this project.
 - b. The PCSS shall provide configuration of the Virtual Machine Manager software.
 - c. The PCSS shall networking configuration of the fault tolerant server as required by 13320.
3. Provide new Cimplicity graphics to interface with systems that have previously been programmed. This includes interfacing with the Belt Filter Press PLCs for controlling the presses, sludge pumps, and associated controls as described in Section 13305. The PCSS shall also be responsible for interfacing with the APG Neuros and Turblex blower systems.

4. The system has previously been configured such that the HMI servers at the Bay Park Sewage Treatment Plant shall be responsible for monitoring all Bay Park pump stations and plant. The HMI server at the Cedar Creek Water Pollution Control Plant shall be responsible for monitoring both the Cedar Creek and Glen Cove Pump Stations and the Cedar Creek plant. The new Glen Cove workstations shall be configured such that the data for any pump station or plant shall be available to the HMI clients. (e.g. an HMI client at Glen Cove shall have access to data from a Cedar Creek pump station through the Cedar Creek HMI server.)
5. The existing alarm dialer includes some alarm callouts that are not monitored by other PLCs and RIOs located throughout the plant. Up to 20 signals shall be wired to the RIO-ADMIN from the existing alarm dialer to allow callout via the new software dialer system.
6. Provide configuration of the time server virtual machines for each plant. The time server shall be configured such that the correct port (UDP port 123) is opened only for a preapproved Internet time server, and shall only be opened to the local time server. The local time server shall utilize the Network Time Protocol (NTP) to set all servers, computer workstations, and PLCs. The time server shall update the time on a daily basis at 3 AM.
7. Provide configuration of the networking components as shown on the System Architecture drawing (GI-2 through GI-3) and the Fiber Optic Network (GI-5).
 - a. A 10Gb link shall be established to the Ethernet switches, fault tolerant servers, and the network attached storage.

1.02 RELATED WORK

- A. Refer to Section 13300 “IC- General Provisions.”
- B. Refer to Section 13320- “Control and Data Network Equipment” for networking requirements.

1.03 SUBMITTALS

- A. Provide all required submittals in accordance with Section 01300. The submittals listed below shall be provided as a minimum;
 1. Operator Interface
 2. Controller Program
 3. Reports
 4. Historical Data Management
 5. Software Maintenance documentation
 6. Operations and Maintenance Manuals
- B. Operator Interface
 1. Graphics shall follow the Nassau County SCADA standards and match the existing graphics at the Cedar Creek and Bay Park facilities. A copy of the SCADA standards shall be provided to the PCSS for use during the operator interface development.

2. Submit a draft of all proposed graphic displays, examples of each type of pop-up (faceplate) displays, and examples of trends. For those graphics which will be duplicated more than once for similar type of equipment, submit the graphics for the first equipment only. It is acceptable if some examples are taken directly available from existing Cimplicity applications from either the Cedar Creek or Bay Park plants.
3. Following the draft graphics review meeting and prior to the factory test, submit a ready-for testing version of all graphic displays. These graphics should be completely finished other than the incorporation of comments and changes resulting from testing.
4. Submitted graphic displays and trends shall be no less than 8.5 inches by 11 inches and in full color.

C. Controller Program Submittal

1. Submit a standard controls submission showing the general programming standards and conventions that will be used for common equipment. For example, one programming block used for all pumps of similar function. Electronic submission of Adobe Portable Document Format ("pdf") files in lieu of paper submittals is acceptable. Review will be for general program organization, level of documentation, and overall programming standards (basic pump and valve control, for example). The review will not attempt to confirm the logic works correctly for every loop.
 - a. PLC programs showing ladder logic, function block, high level language or other controller language used. Include individual rung, network, and/or command descriptions with abundant comments to clearly identify function and intent of each code segment. Each logic segment shall be clearly presented, the function of each timer described, the purpose of each subroutine call labeled and defined, etc. Program documentation shall be sufficiently clear to allow determination of compliance with the process control requirements included in the control descriptions and with the Drawings. The submittal shall demonstrate that all logic provided under this project follows the same structure and format and reflects a common programming approach.
 - b. Submit a memory usage report for the controller. This report shall indicate total memory capacity and unused memory capacity.
 - c. Submit cross reference index of I/O allocation and controller memory address. Every physical I/O point as well calculated or virtual I/O required for the implementation of the process scheme shall be included.
2. Submit details of control system communication. Submit a "memory map" or other means showing which signals are exchanged between PLCs. Also submit a HMI tag database showing all signals exchanged between the PLCs and HMI. Any specific communication block memory addresses shall be defined.

D. Historical Data Management

1. Following the Historical Workshop, submit all aspects of the historical data management system and shall include as a minimum the following:
 - a. A complete listing of all signals to be collected and stored. This listing shall include data sampling rate and duration for which the data will be immediately accessible.
 - b. Data reduction methods, rates, and duration data will be immediately accessible.
 - c. Storage space requirements and supporting calculations.

- d. Description of historical database design, including data flow diagram, table definitions, procedures used, and queries used. Method of accumulating and displaying run times and flow totals shall be described. Method of interfacing to the reporting system shall be defined. Methods of handling Data Quality Flags shall be defined. Method of storing and displaying trending information shall be defined.
- e. Description of methodology for restoring data collected locally during times that the historical data management system is not available. Description of database failure and recovery, including data correction.
- f. Description of selecting only the active real-time data source for systems that are utilizing redundant data acquisition nodes.
- g. List of data source interfaces to be used with the system (for example, OPC, file collection, historian-historian collector, HMI applications, etc.)

E. Reports

- 1. Following the Historical Workshop, submit all aspects of the reports generation system and shall include as a minimum the following:
 - a. A complete list of all reports to be developed.
 - b. A complete listing of all signals to be reported, including calculated values.
 - c. Description of reporting data storage design, including method data is polled and stored.
 - d. Description of methodology for entering manual data and interfaced used.
 - e. Procedures for recall, generation and printing of reports
 - f. Printout of each report to be provided with details of each cell, where data comes from, and calculation of raw data.

F. O&M Manuals - Software Maintenance Manuals

- 1. Include these manuals as part of Section 13300 "Final System Documentation" and use them for operator training as explained in Section 13303. This required information is in addition to all requirements of Section 13300.
- 2. Software Listings and Databases- Submit hard copies of the same information required in the "Controller Program Submittal" except include files updated to reflect the as built system. Include PDF versions of these files in the CD specified below.
- 3. PID Loop Tuning Parameters - Submit annotated chart recorder traces or computer system trend screen printouts showing tuned control loop response to plus and minus 40 percent of full span step changes of loop setpoint for each individual loop. For cascade loops, submit charts showing response of the secondary loop with secondary setpoint on manual and also response of the entire cascade control loop in automatic mode. Include a description of tuning methodology used.
- 4. Machine Readable Documentation - Provide two sets of as built software documentation on CD-ROMs in original electronic format for all PLC, HMI systems, reporting systems, Historian Systems, and any other programs developed under this Contract. All changes made during or after testing, start-up, and commissioning shall be incorporated.
- 5. If available as part of the software provided, supply hardcopies of configuration information for the HMI systems, reporting systems, Historian Systems, and any other programs developed under this Contract.

G. O&M Manuals - Operator Manuals

1. Provide Operator's Manuals prior to final acceptance of the system.
2. These manuals shall be separately bound and shall contain all information necessary for the operator to monitor and control the plant from the control system. The manuals shall be written in non-technical terms and shall be organized for quick access to each detailed description of the operator's procedure. Manuals shall contain, but not be limited to, the following information:
 - a. A comprehensive table of contents of the manual.
 - b. One general section that in detail explains the layout and configuration of the HMI and OIT systems including the following:
 - 1) Login / logout procedures
 - 2) How alarms are annunciated
 - 3) How to acknowledge alarms
 - 4) How to navigate to various displays
 - 5) Color conventions used and how to interpret them
 - 6) Troubleshooting communication errors
 - c. One section for each plant area that includes the following:
 - 1) A detailed description of the operation of the HMI and OIT including all appropriate displays. Include screenshots of each HMI and OIT display screen and annotating each function in text is an acceptable format for presenting this information.
 - 2) Control descriptions.
 - 3) How to change setpoints.
 - 4) Step-by-step procedures for starting up or shutting down a station
 - a) How to control the station manually
 - b) How to control the station automatically
 - d. One section on using historical data
 - 1) How to view trends
 - 2) Complete, step-by-step procedures for printing reports and entering manual data.
 - e. Complete, step-by-step procedures for performing system or selected file backup and restoration including archiving historical data. Include recommended archiving schedule for historical data.
 - f. Operational description for operating HMI computer equipment and peripherals including printers, CD-ROMs, removable bulk storage devices, UPS, etc. Description shall include procedures for typical maintenance and troubleshooting tasks.
 - g. A complete glossary of terms and definition of acronyms.
 - h. List of personnel to be contacted for warranty and emergency services, including name, address, telephone number, pager or cell phone number, fax number, and email address.
3. Include these manuals as part of Section 13300 "Final System Documentation" and use them for operator training as explained in Section 13303. This required information is in addition to all requirements of Section 13300.

1.04 MAINTENANCE

- A. Refer to section 13300.

1.05 WARRANTY

- A. Refer to Section 13300 and supplement that with the requirements below.
- B. All application work shall be warranted in accordance with Section 01740.
- C. Provide telephone technical support within 4 hours of warranty claim. If failure cannot be resolved by telephone, provide onsite technical support within 24 hours of warranty claim.

1.06 COORDINATION MEETINGS AND WORKSHOPS

- A. Refer to Section 13300. The meetings below are in addition to the meetings specified in that section.
- B. Schedule and conduct a draft graphics review meeting. The purpose of this meeting shall be to present draft graphics for the Owner's and Engineer's review and feedback prior to creating the full set of graphics for review. For repetitive graphics such as graphics for multiple process trains, include an example of the first graphic only for discussion. Include discussion of process and overview displays, examples of pop-ups, trends, and system navigation tools. Expect major comments and incorporate any changes resulting from those comments.
- C. Schedule and conduct a historical data management and reports workshop. The purpose of this workshop shall be to discuss and solicit Engineer/Owner input for storage and management of historical data, format of daily, monthly and yearly reports, for the development of data entry templates, report formats and layouts, and user interface displays for accessing and generating reports. Bring examples of all these documents for review and discussion.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 GENERAL

- A. The system specified herein shall perform the following generalized functions:
 - 1. The system shall allow the operator to control equipment such as pumps and valves as shown on the Drawings and as defined in Section 13305 control descriptions.
 - 2. Perform real-time process control, including proportional integral derivative control action, sequencing, process calculations, etc.
 - 3. Collect, calculate, and store accurate, reliable operating information for present and future uses.
 - 4. Assist remote site operating personnel by noting and communicating off normal operating conditions and equipment failures.
 - 5. Accumulate and store equipment running times for use in preventative maintenance.

6. Provide color graphic displays and reports for use by the system operating and supervisory personnel.
7. Provide trending for all analog values.
8. Provide control system diagnostics.
9. All process control functions including PID, calculations, sequencing, timing, etc., shall be done in the process controller. The HMI software shall perform the real-time database, report generation, graphic screens, program development, set point modification, data archiving, etc.
10. The system shall allow the operator to manually control (by keyboard entry and mouse type pointing device) the status of pumps, valves, etc. (i.e., on off, open close, setpoint value, etc.) when viewing the appropriate graphic screen on the HMI.

3.02 CONTROLLER PROGRAMS

- A. All applications programs shall be developed in a structured manner and shall follow an intuitive arrangement so that an instrumentation technician with basic programming knowledge will be able to understand. Programs shall utilize standard program templates or subroutines for repetitive logic such as equipment control, flow total calculations, equipment runtime calculations.
- B. Make changes to the application programs and software configuration, based on comments during the submittals, the factory tests, the field tests, and during the commissioning process to meet the design intent, at no additional cost to the Owner.
- C. Customized PLC application shall be provided to the Owner in electronic file format at the conclusion of the project.

3.03 GRAPHIC DISPLAYS - GENERAL

- A. The HMI and OIT symbols, colors, tag naming, alarming, functionality, and overall appearance shall follow the County's standards and conventions documentation. Prior to commencing any HMI and OIT development work, the PCSS shall coordinate with the Owner (refer to coordination meetings requirements below) to obtain the standards that need to be followed for the project.
- B. The PLC symbols or tagnames shall follow the standards and conventions documentation, which may be obtained from the Owner.
- C. All displays shall contain and continuously update the displayed process variables, date and time of day. All process values shall be displayed in engineering units. All displays shall incorporate references to both instrumentation tag numbers and plant equipment numbers. All process variables shall be displayed on their associated display(s) with correct engineering units. Process variables shall display their associated data quality flags.

- D. All operator commands related to controlling field devices or system attributes shall require multiple keystrokes or mouse actions to protect against inadvertent operations. The operator shall receive confirmation of the selected point to be controlled, at which time a cancellation of the control can be affected.
- E. Process graphic displays shall be based on the new and existing P&ID's, site plan drawings, mechanical drawings and electrical drawings included in these Contract Documents. The graphic displays shall depict process flow streams, process structures, and all major items of process equipment and control devices in a schematic format.
- F. All main graphical screens shall include a title bar, main graphic area, navigational buttons, and alarm summary bar. Title bar shall be displayed on the top of each screen and include display name, description and time/date. The main graphical area shall contain primary screen data in graphical format. Navigational buttons shall include a minimum of main menu, trends, main alarm summary, and security log in. The alarm summary bar shall display the last three valid alarms on the bottom of each screen.
- G. Animation shall be provided to mimic level changes in tanks or vessels, and to mimic rotation of rotating equipment when running. Valve colors shall change when opened and closed.
- H. Unless specifically noted, all timers, setpoints, alarm actuation levels, etc., shall be adjustable from the operator interface.
- I. The system shall show field conditions with text that can alternate (i.e., OPEN/CLOSE, START/STOP, HIGH/LOW) and change color correspondingly. Field devices that are tri state must be represented in three conditions.
- J. Conditions in the field designated as alarm conditions shall report to the operator workstation, actuate an audible alarm, and provide a visual blinking image on the associated graphic page. All alarms and events should be displayed on the screen and archived.
- K. All interlocks that affect equipment operation shall be identified both by alarm and by HMI indication.
- L. All analog inputs shall be checked for out of range (via high and low limit checks) and alarmed.
- M. All process flow streams shall be labeled and color coded using the project color schedule in in the standards and conventions document. All structures and equipment shall be identified by name and appropriate equipment and loop tags.
- N. Color coding for equipment status and alarms shall be as indicated in the standards and conventions document.
- O. Automatically record all alarm and events should any of the following sequences or events occur:
 - 1. Date/Time entry
 - 2. Limit changes
 - 3. Any commanded or uncommanded change of any point

4. Alarm conditions
 5. PLC activation or deactivation
 6. Operator login or logout activity
- P. There may be additional general programming requirements listed in Part 1 of the Section 13305 control descriptions section that impact the HMI configuration.

3.04 SPECIFIC GRAPHIC SCREENS

- A. At a minimum, provide the following types of graphic screen indicated below at both Cedar Creek WPCP and Glen Cove WWTP.
1. Plant Overview screen shall include a site plan representation, indicating the geographic location of each process, and each building.
 2. Main menu (index) screen shall be developed to link all plant process screens and pump stations. The screen shall be a complete and logical listing of the names and number of all screens, arranged by the sewage treatment plant that the pump station serves.
 3. Individual process screens shall graphically screen key process variables and equipment statuses for all process areas. No operator entries shall be done from these screens. Individual screens for each area shall include all process components, including tanks, pumps, drives, process instrumentation, valves, and mechanical devices. These diagrams shall be generally depicted from the P&ID's and there shall be at least 1 screen per P&ID on average. The process screens shall provide the ability for the operator to go to individual equipment popup screens.
 4. Popup screens shall be provided for each piece of equipment to start/stop equipment, open/close valves, implement automatic control, adjust set points, establish and adjust tuning parameters, set alarm limits and initiate a sequence
 5. Provide miscellaneous equipment, not shown on the process overview graphic, for all process areas.
 6. Main alarm summary screen shall screen the following information on each alarm: Time, tag name, description, alarm type, current value and status. An acknowledge alarm button shall acknowledge all new unacknowledged alarms. The acknowledged and unacknowledged alarms shall be different colors. Acknowledged alarms shall clear automatically after the condition is corrected.
 7. Alarm diagnostic screen used for identifying nuisance alarms.
 8. PLC system diagnostic screens, showing the operational status and fault conditions of all PLC components, including processors, I/O modules, OIT's, power supplies, and UPS units.
 9. Communications diagnostic screens, showing the details of network status, communications status of all major components including network switches, Operator Workstations, peripheral devices and network components.

10. Maintenance screens shall screen the raw value for each analog and digital I/O point in the system, organized by process area. They shall also allow the operators/maintenance personnel to enter an override value for an analog point that is then used by the system instead of the value read from the input card / communications link.
11. Communications diagnostic screens, showing the details of network status, communications status of all major components, including Operator Workstations, peripheral devices, and network components. Provide a communications graphic that shows the communication status to the Cedar Creek and Bay Park plants.
12. Trend screens with the capability to screen up to eight operator-assigned analog and/or digital process variables. Each analog value will be shown on a trend screen.

B. CEDAR CREEK WPCP

At Cedar Creek WPCP, provide the following graphic screens at a minimum:

1. Aeration Tanks Overview
2. Aeration Tank Details (1 per tank for 6 tanks)
3. Final Tanks
4. North RAS Pump Station
5. South RAS Pump Station
6. Primary Tanks Overview
7. Primary Tank Detail (1 per tank for 10 tanks)
8. Primary Sludge Pumps
9. DAF #7 Tank and Equipment
10. The following graphics are Wonderware graphics existing on the workstation in the Boiler Control Room and shall be re-created in Cimplicity:
 - a. Sewer Maintenance Building K HVAC System
 - b. Digester Tanks Sludge Temperature (Combine with “Digester Detail” screen listed below)
 - c. Digester Heat Exchangers 4-6
 - d. Digester Heat Exchangers 1-3
 - e. Waste Steam Flow
 - f. Heat Exchangers
 - g. Chilled Water
 - h. Fuel Oil
 - i. Administration Building A HVAC System
 - j. Tertiary Treatment Building R HVAC System
 - k. Hot Water System
 - l. Boiler Room Overview
 - m. Boiler 1
 - n. Boiler 2
11. Digester Overview
12. Digester Detail (One per digester)
13. Digester Primary Gas Compressors
14. Digester Sludge Recirculation Pumps
15. Digester Gas Recirculation Pumps
16. Influent Screens Overview
17. Influent Screens Detail (1 per screen for 4 screens)
18. Influent Screenings Facility

19. Grit Tanks 1 & 2 Overview
20. Grit Pumps 1 thru 3
21. Grit Pumps 4 and 5
22. Grit Cyclones and Classifier
23. Influent Screenings Overview
24. Influent Bar Screens 1 and 2
25. Influent Bar Screens 3 and 4
26. Influent Wet Wells and Influent Pumps
27. Outfall Wetwell and Pumps
28. Screened Effluent Wetwell and Pumps (1 thru 4)
29. Screened Effluent Wetwell and Pumps (5 thru 8)
30. Eluent Sluice Gates (1 thru 7)
31. Effluent Chlorination System Overview
32. Effluent Chlorination Metering Pumps
33. Effluent Chlorine Analyzers and Sample Pumps
34. A minimum of 15 additional process graphic displays to be determined during construction
35. Main menu (index) screen shall be developed to link to all plant areas. The screen shall be a complete and logical listing of the names of all screens.
36. Individual process screens shall graphically screen key process variables and equipment statuses for all process areas. No operator entries shall be done from these screens. Individual screens for each area shall include all process components, including tanks, pumps, drives, process.

C. GLEN COVE WWTP

At Glen Cove WWTP, in addition to the screens described above, at a minimum provide the following graphic screens:

1. Gas detection monitoring screen, including the current sensor values for the Screening Area basement, Screening Area main floor, and Influent Pump Drywell.
2. Aeration Related Graphics Including:
 - a. Aeration system overview
 - b. Aeration tank detail (1 per tank/total of 8 graphics)
3. Blower Graphics Including:
 - a. Blower system overview
 - b. APG Neuros Blower Detail
 - 1) Diagnostics screens displaying blower statuses such as temperatures, flows, vibration, etc., which are listed in Section 13300 Appendix B.
 - c. Turblex Blower Detail
 - 1) Diagnostics screens displaying blower statuses such as temperatures, flows, vibration, etc., to replicate existing data displayed on the Local Blower OIT as indicated in Section 13300 Appendix D.
4. RAS Pumping Screen
5. Belt Filter Press Graphics including:
 - a. Belt Filter Press Overview

- b. BFP Detail (1 per belt filter press/total of 3 graphics)
 - c. Auxiliary systems screens for sludge pumps, gates, valves, and chemical systems associated with the BFP as described by the control descriptions. Screens should reflect the existing OIT screens, when possible.
- 6. Primary Settling and Headworks (signals monitored by RIO-IPS)
- 7. Final Overview (Secondary Settling, UV Treatment, and Final Effluent Flow)
- 8. UV System Overview
- 9. UV System Detail (typical for 2 channels)
- 10. Nitrate Return Pumping (Screw Pumps)
- 11. Seal and spray water pumping
- 12. Alarm Dialer Screen Showing Signals that will generate a callout and which callouts are active.
- 13. In addition to the screens listed a minimum of 10 process graphic displays determined during construction shall be provided.

3.05 SECURITY

- A. The system shall be configured and implemented with security to prevent unauthorized access. The system shall allow authorized changes to system operation through defined user accounts and password verification.
- B. Coordinate with Owner user account information, including login name and password for each account.
- C. Security levels of "display only", "operator mode", "supervisor mode", and "engineer mode" shall be available through assignable passwords. On system startup, the "display only" security level shall automatically be entered. In the "display only" mode, information is available to be displayed on the screen but no changes may be made. In the "operator mode", changes may be made to process set points, times, etc.; however, the overall control concepts may not be modified. In the "supervisor mode", all operator functions can be modified and any special reports or critical process set points (data can be modified; however, the overall control concepts may not be modified). In the "engineer mode" level, all user modifiable parameters of the system shall be available for modification.

3.06 ALARM/EQUIPMENT STATUS REPORTING

- A. The alarm log shall display all alarms as they occur. The alarm message shall include the time of occurrence, tag name, tag number, and whether it is a low, high, or failure alarm. When the point in alarm returns to normal, the time, point identification number, and return to normal shall be displayed. All reports shall include the plant equipment number of the associated device.

- B. The equipment status shall be logged whenever a change in status occurs (i.e., start, stop). The equipment status log shall include the time, equipment name, tag number, and the particular change in status.

3.07 HISTORICAL DATA MANAGEMENT

- A. The following features shall be provided for processing and storage of system historical data:
 - 1. Each system point (analog or digital, real or pseudo) shall have the capability of being historically logged. A point shall have the capability of being deleted from historical log at any time. It shall be easy to add or delete system points using minimal keystrokes.
 - 2. All process analogs and all flow totals and run time indications of all primary process equipment motors shall be sampled and stored in the historical data management system.
 - 3. Data Processing: The real time instantaneous values shall be stored in a historical log file on the hard disk at defined sampling rates.
 - 4. Data Correction: Historical data shall be manually modifiable by personnel with appropriate security levels. Such data shall be differentiated from actual monitored values on reports, in the database and in trends.
 - 5. Data Quality: Data Quality flags shall propagate to the next higher level of the history based on user selectable percentage determining tolerance levels for averages and totals. If the percentage of suspect data exceeds the tolerance level, the suspect data flag propagates to the next higher level. Maximums and minimums shall be taken from good data.
 - 6. Manual Input Data Handling: This data shall consist of additional values not obtainable by the system such as laboratory analysis for use in reports. All manually entered data shall be entered and stored in the appropriate engineering units. All data entered shall be displayed for con-firmation on the display prior to incorporation to the database.

3.08 REPORTS

CEDAR CREEK WPCP:

- A. Screen shots of the existing Cedar Creek WWTP HACH-WIMS reports are provided at the end of this section. The data in the cells of these reports is currently either manually entered or is populated from the existing report database that is independent of the plant SCADA system historian. These reports shall be modified as follows:
 - 1. All manually entered report cells shall be modified to automatically receive data from the plant SCADA historian VM-6 (see drawing I-2) if the data is available in the plant historian.
 - 2. All automatically entered report cells that are populated from the existing report database shall be modified to automatically receive data from the new plant SCADA historian VM-6 (see drawing I-2).
 - 3. The details of the report requirements shall be discussed during the historical data management and reports workshop.

- B. New reports shall be added to include new data available in the SCADA historian as a result of the recent plant upgrades and this SCADA System Improvements project. Requirements for these reports shall be discussed during the historical data management and reports workshop. A minimum of 5 additional reports shall be included.
 - 1. All manually entered report cells shall be modified to automatically receive data from the plant SCADA historian VM-6 (see drawing I-2) if the data is available in the plant historian.
 - 2. All automatically entered report cells that are populated from the existing report database shall be modified to automatically receive data from the new plant SCADA historian VM-6 (see drawing I-2).

GLEN COVE WWTP:

- C. Quantity and format of reports shall be determined at the historical data management and reports workshop and as a minimum shall include shift, daily, monthly and yearly reports. Provide a minimum of 4 reports. See attachment A of this Section for examples of reports to be provided.
- D. The system shall be able to generate reports from on-line historical data files or prompt the user for the appropriate archived data files.
- E. Reports shall be initiated automatically based upon time of day or manually upon operator request.
- F. User interface displays for report generation shall be developed with easy recall of reports by entering time:day:year target values.
- G. User interface displays shall allow the operator to define the destination of the report (e.g., display, printer, computer file, etc.) and when it is to be printed (e.g., immediately, on demand, or automatically at a specified time).
- H. It shall be possible to print quality tags alongside the value.
- I. Values for which there are no data available shall be identified with a special character. Thus, only values which are actually zero shall be printed as such.
- J. Operational Report Types. The following operational report types shall be provided with the system:
 - 1. Shift Operation Summary Report:
 - a. An operator-adjustable time interval shift operation report shall summarize plant operation from the start and finish time of operation.
 - b. The report format shall consist of the following: correct date, plant name, report name, page number, group headings, subheadings, point identification, and engineering units.

2. Daily Operation Summary Report
 - a. The daily operation report shall summarize plant operation for the previous day. The printed information shall be the stored values (not averages) including scanned, lab, and manually entered data.
 - b. The report format shall consist of the following: correct date, plant name, report name, page number, group headings, subheadings, point identifications, and engineering units.
 - c. The daily minimum, average, maximum, and total where applicable shall also be calculated and printed for each point and stored.
3. Monthly Operation Summary Report:
 - a. The monthly operation summary report shall summarize plant operation for the previous calendar month.
 - b. The report format shall be arranged so that the first several pages shall conform to the requirements of the state regulatory agencies and may be separated from the rest of the monthly operation report for transmittal to the regulatory agency.
 - c. The report format shall be similar to the daily operation summary report and shall consist of the following: month and year, plant name, report name, page number, group headings, sub-headings, point identifications, and engineering units.
 - d. Monthly minimum, average, maximum, and totals, where applicable, shall also be printed for each column of points printed.
4. Annual Operation Summary Report:
 - a. The annual operation summary report shall summarize plant operation for the previous calendar year. The report shall consist of scanned data, lab data, and manually entered data.
 - b. The format of the report shall be identical with the monthly operation summary report except for replacing month with year in the heading and replacing date with calendar month.

3.09 TESTING

- A. Refer to section 13302.
- B. Supplement to Field Testing requirements
 1. Prior to leaving the site, use the Owner's programming computer to monitor all PLC processors online, make on-line changes, upload and download the processor to ensure programming software version compatibility.
 2. Loop Tuning - All PID control loops (single or cascade) shall be tuned following device installation but prior to commencement of the Functional Demonstration Test.
 - a. Optimal loop tuning shall be achieved either by auto-tuning software or manually by trial and error, Ziegler-Nichols step-response method, or other documented process tuning method.
 - b. Determine and configure optimal tuning parameters to assure stable, steady state operation of final control elements running under the control PID. Each control loop that includes anti-reset windup features shall be adjusted to provide optimum response following startup from an integral action saturation condition.

- c. Tune all PID control loops to eliminate excessive oscillating final control elements. Loop parameters shall be adjusted to achieve a decay ratio of 1 / 4 or better. In addition, loop steady state shall be achieved at least as fast as the loop response time associated with critical damping.
- d. Loop performance and stability shall be verified by step changes to setpoint in the field.
- E. Submit loop tuning documentation as specified in Part 1 of this Sections.

3.10 TRAINING

- A. Refer to Section 13303 for training requirements

3.11 EXISTING SCADA SYSTEM REPORTS

- A. Following are screenshots of the existing SCADA system reports for the Cedar Creek WPCP. These reports shall be modified by the PCSS as explained above.

CSP-01 Influent Flow Totalizers - Monthly Data Entry

File Edit Format

Jun 2016 Thursday, June 16, 2016 Comments Calc Approve

Entry Min Max Daily Limit Min Max Var Info 200030 Inf Plant Q Totalizer 12 - 12 Lower Head (MG) Equation

	Daily Com	200030 - Inf Plant Q Totalizer 12 - 12 Lower	200031 - Inf Plant Q Totalizer 7 - 7 Lower Header	200032 - Inf Plant Q Totalizer 12 - 12 Lower	200033 - Inf Plant Q Totalizer 7-7 Lower Header	200041 - Inf Plant Q Totalizer 12 - 12 Upper	200042 - Inf Plant Q Totalizer 7 - 7 Upper Header	200043 - Inf Plant Q Totalizer 12 - 12 Upper	200044 - Inf Plant Q Totalizer 7-7 Upper Header	200045 - Inf Plant Q Total Flow 12 - 12 MG	200046 - Inf Plant Q Total Flow 7 - 7 MG
2 Thu		85878.3	7638.0	27.4	24.0	24447.0	10018.0	23.0	29.0	50.4	53.0
3 Fri		85907.4	7663.0	29.1	25.0	24471.0	10047.0	24.0	29.0	53.1	54.0
4 Sat		85937.8	7685.0	30.4	22.0	24496.0	10074.0	25.0	27.0	55.4	49.0
5 Sun		85965.7	7709.0	27.9	24.0	24519.0	10103.0	23.0	29.0	50.9	53.0
6 Mon		85996.9	7734.0	31.2	25.0	24544.0	10133.0	25.0	30.0	56.2	55.0
7 Tue		86025.9	7758.0	29.0	24.0	24567.0	10164.0	23.0	31.0	52.0	55.0
8 Wed		86057.1	7782.0	31.2	24.0	24593.1	10194.0	26.1	30.0	57.3	54.0
9 Thu		86084.8	7807.0	27.7	25.0	24616.0	10223.0	22.9	29.0	50.6	54.0
10 Fri		86114.7	7830.0	29.9	23.0	24640.0	10252.0	24.0	29.0	53.9	52.0
11 Sat		86142.9	7854.0	28.2	24.0	24664.0	10280.0	24.0	28.0	52.2	52.0
12 Sun		86171.5	7877.0	28.6	23.0	24686.0	10309.0	22.0	29.0	50.6	52.0
13 Mon		86200.4	7901.0	28.9	24.0	24710.0	10338.0	24.0	29.0	52.9	53.0
14 Tue		86228.1	7924.0	27.7	23.0	24733.0	10367.0	23.0	29.0	50.7	52.0
15 Wed		86259.2	7948.0	31.1	24.0	24758.0	10396.0	25.0	29.0	56.1	53.0
16 Thu			7972.0		24.0		10425.0		29.0		53.0
17 Fri											
18 Sat											
19 Sun											
20 Mon											
21 Tue											
22 Wed											
23 Thu											
24 Fri											
25 Sat											
26 Sun											
27 Mon											
28 Tue											
29 Wed											
30 Thu											
MIN		85,850.9	7,614.0	27.4	22.0	24,424.0	9,989.0	22.0	27.0	50.4	49.0
MAX		86,259.2	7,972.0	31.2	25.0	24,758.0	10,425.0	26.1	31.0	57.3	55.0
AVG		86,054.8	7,793.5	29.1	23.9	24,591.2	10,207.0	23.8	29.1	52.9	52.9
SUM		1,290,821.6	124,696.0	436.9	382.0	368,868.1	163,312.0	357.0	465.0	793.9	847.0

Data Entry sheet for 12- 12 & 7 to 7 plant flows daily

Purchased Water Usage As Measured On Site (Custom Data Entry Form)			
File Edit Format Help Keypad			
<div> <div> </div> <div> Start Date: 6 / 1 /2016 Current Date: Comment </div> </div>			
A1	<div> <div>Save</div> <div>Approve</div> <div>Calc</div> <div>Show Calcs</div> </div>		
	A	B	C
1			
2			
3	June, 2016		
4	Purchased Water Usage As Measured On Site		
5	Wed	06/01/16	589,152
6	Thu	06/02/16	728,572
7	Fri	06/03/16	641,358
8	Sat	06/04/16	772,590
9	Sun	06/05/16	676,368
10	Mon	06/06/16	668,819
11	Tue	06/07/16	738,433
12	Wed	06/08/16	733,040
13	Thu	06/09/16	687,500
14	Fri	06/10/16	615,048
15	Sat	06/11/16	743,732
16	Sun	06/12/16	531,760
17	Mon	06/13/16	648,852
18	Tue	06/14/16	729,052
19	Wed	06/15/16	645,256
20	Thu	06/16/16	660,908
21	Fri	06/17/16	
22	Sat	06/18/16	
23	Sun	06/19/16	
24	Mon	06/20/16	
25	Tue	06/21/16	
26	Wed	06/22/16	
27	Thu	06/23/16	
28	Fri	06/24/16	
29	Sat	06/25/16	
30	Sun	06/26/16	
31	Mon	06/27/16	
32	Tue	06/28/16	
33	Wed	06/29/16	
34	Thu	06/30/16	
35	Fri	07/01/16	

Plant potable water usage 8" & 12" lines combined

ZZ Process Chemicals Used (Custom Data Entry Form)

File Edit Format Help KeyPad

Start Date: 6 / 1 /2016 Current Date: Wednesday, June 15, 2016 Comment

J21 J21*2.7 Save Approve Calc Show Calcs

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
1	CEDAR CREEK WASTEWATER TREATMENT FACILITY CHEMICALS USED															June, 2016
2																
3																
4			107711	107721	107722	107723	107724	107725	107726	107727	107731	107732	107733	107741	107742	107743
5	Date		Straight data	Straight data	Calculated	Straight data	Straight data	Straight data	Calculated	Calculated	Straight data	Calculated	Calculated	Calculated	Straight data	Calculated
6			Sodium Hypochlorite	Inches Polymer	Gallons Polymer	Hours Dewatering	Gallons Polymer	Lines Pump Hours	TOTAL HOURS	Pump 1&2	Lines Pump Hours	TOTAL HOURS	Pump 3&4	Gallons Polygone	Number of Polygone	Gallons Polygone
7			Used at GBT	Used at GBT	Operated	Used at BFP	Pump 1 & 2	RUN	Usage	Pump 3 & 4	RUN	Usage	Digester to BFP	Pumps On-line	Used at BFP	
8	Wed	06/01/16	2,989	2.00	52	15.50	148	1,373.60	0.00	0	619.70	2.50	7	7	4	16.4
9	Thu	06/02/16	4,913	2.00	52	24.00	192	1,373.60	0.00	0	622.80	3.10	8	8	3	19.0
10	Fri	06/03/16	4,994	3.00	78	15.00	115	1,373.60	0.00	0	624.90	2.10	6	6	1	4.0
11	Sat	06/04/16	4,994	2.00	52	0.00	0	1,373.60	0.00	0	624.90	0.00	0	0	0	0.0
12	Sun	06/05/16	5,095	2.00	52	0.00	0	1,373.60	0.00	0	624.90	0.00	0	0	0	0.0
13	Mon	06/06/16	6,220	3.00	78	22.00	252	1,373.60	0.00	0	627.80	2.90	8	8	4	23.2
14	Tue	06/07/16	4,652	3.00	78	24.00	240	1,373.60	0.00	0	631.20	3.40	9	9	4	25.3
15	Wed	06/08/16	4,800	3.00	78	22.50	250	1,373.60	0.00	0	635.00	3.80	10	10	3	17.8
16	Thu	06/09/16	3,576	2.00	52	20.00	283	1,373.60	0.00	0	638.90	3.90	11	11	4	21.1
17	Fri	06/10/16	2,986	2.00	52	19.00	227	1,373.60	0.00	0	642.20	3.30	9	9	2	10.0
18	Sat	06/11/16	2,910	2.00	52	0.00	0	1,373.60	0.00	0	642.20	0.00	0	0	0	0.0
19	Sun	06/12/16	3,165	2.00	52	0.00	0	1,373.60	0.00	0	642.20	0.00	0	0	0	0.0
20	Mon	06/13/16	2,595	2.00	52	22.00	241	1,373.60	0.00	0	645.60	3.40	9	9	4	23.2
21	Tue	06/14/16	4,557	2.00	52	21.50	133	1,373.60	0.00	0	649.00	3.40	9	9	4	22.7
22	Wed	06/15/16	5,691	2.00	52	22.50	191	1,373.60	0.00	0	652.90	3.90	11	11	3	17.8
23	Thu	06/16/16	4,299	2.00	52	24.00	233	1,373.60	0.00	0	656.20	3.30	9	9	4	25.3
24	Fri	06/17/16														
25	Sat	06/18/16														
26	Sun	06/19/16														
27	Mon	06/20/16														
28	Tue	06/21/16														
29	Wed	06/22/16														
30	Thu	06/23/16														
31	Fri	06/24/16														
32	Sat	06/25/16														
33	Sun	06/26/16														
34	Mon	06/27/16														
35	Tue	06/28/16														
36	Wed	06/29/16														
37	Thu	06/30/16														
38	Fri	07/01/16														

Chemical usage data entry sheet.

Chlorine Used in Process (Custom Data Entry Form)																								
File Edit Format Help KeyPad																								
<div> <div>Start Date: 6/1/2016</div> <div>Current Date: Friday, June 17, 2016</div> <div>Comment</div> </div>																								
<div> <div>Save</div> <div>Approve</div> <div>Calc</div> <div>Show Calcs</div> </div>																								
K23	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	V	
1	NY NASSAU (CEDAR CREEK WWTP)															June, 2016								
2	Chlorine Cost / gal							0.716																
3	Anti-bulk Mix Ratio (parts water to parts chlorine)							4.00																
4																								
5																								
6	Date		EFFLUENT DISINFECTION				RAS CHLORINATION					RAW SEWAGE PRE-CHLORINATION				Scrubber Chlorine Usage								
Gallons / Day			Gallons / Hr	Gallons / Min	Cost / Day	Gallons / Day	RAS Chlorination Gallons	Gallons / Hr	Gallons / Min	Cost / Day	Gallons / Day	Gallons / Hr	Gallons / Min	Cost / Day	Gallons / Day	Gallons / Hr	Gallons / Min	Cost / Day						
7	Wed	01	2,225	92.71	1.55	1,593.10	1,955	489	81.46	1.36	349.95	153	6.38	0.11	109.55	421	18	0	301					
8	Thu	02	2,505	104.38	1.74	1,793.58	2,465	616	102.71	1.71	441.24	180	7.50	0.13	128.88	31	1	0	22					
9	Fri	03	2,810	117.08	1.95	2,011.96	2,825	706	117.71	1.96	505.68	457	19.04	0.32	327.21	80	3	0	57					
10	Sat	04	2,315	96.46	1.61	1,657.54	3,555	889	148.13	2.47	636.35	344	14.33	0.24	246.30	18	1	0	13					
11	Sun	05	2,650	110.42	1.84	1,897.40	2,702	676	112.58	1.88	483.66	225	9.38	0.16	161.10	36	2	0	26					
12	Mon	06	3,070	127.92	2.13	2,198.12	3,130	783	130.42	2.17	560.27	320	13.33	0.22	229.12	43	2	0	31					
13	Tue	07	3,055	127.29	2.12	2,187.38	2,810	703	117.08	1.95	502.99	390	16.25	0.27	279.24	42	2	0	30					
14	Wed	08	3,230	134.58	2.24	2,312.68	2,070	518	86.25	1.44	370.53	344	14.33	0.24	246.30	28	1	0	20					
15	Thu	09	2,355	98.13	1.64	1,686.18	1,220	305	50.83	0.85	218.38	396	16.50	0.28	283.54	44	2	0	32					
16	Fri	10	2,245	93.54	1.56	1,607.42	520	130	21.67	0.36	93.08	318	13.25	0.22	227.69	34	1	0	24					
17	Sat	11	1,935	80.63	1.34	1,385.46	690	173	28.75	0.48	123.51	397	16.54	0.28	284.25	7	0	0	5					
18	Sun	12	1,900	79.17	1.32	1,360.40	690	173	28.75	0.48	123.51	411	17.13	0.29	294.28	40	2	0	29					
19	Mon	13	2,220	92.50	1.54	1,589.52	1,301	325	54.21	0.90	232.88	432	18.00	0.30	309.31	63	3	0	45					
20	Tue	14	2,835	118.13	1.97	2,029.86	1,875	469	78.13	1.30	335.63	292	12.17	0.20	209.07	35	1	0	25					
21	Wed	15	2,970	123.75	2.06	2,126.52	1,830	458	76.25	1.27	327.57	198	8.25	0.14	141.77	0	0	0	0					
22	Thu	16	2,910	121.25	2.02	2,083.56	2,030	508	84.58	1.41	363.37	262	10.92	0.18	187.59	290	12	0	208					
23	Fri	17														487	20	0	349					
24	Sat	18																						
25	Sun	19																						
26	Mon	20																						
27	Tue	21																						
28	Wed	22																						
29	Thu	23																						
30	Fri	24																						
31	Sat	25																						
32	Sun	26																						
33	Mon	27																						
34	Tue	28																						
35	Wed	29																						
36	Thu	30																						
37	Fri	01																						
38	Total		41,230	1,718	29	29,520.68	31,668	7,917	1,319	22	5,668.57	5,119	213	4	3,665.20	1,699.00	70.79	1.18	1,216.48					
39	Average		2,577	107	2	1,845.04	1,979	495	82	1	354.29	320	13	0	229.08	99.94	4.16	0.07	71.56					
40	Maximum		3,230	135	2	2,312.68	3,555	889	148	2	636.35	457	19	0	327.21	487.00	20.29	0.34	348.69					
41	Minimum		1,900	79	1	1,360.40	520	130	22	0	593.08	153	6	0	109.55	0.00	0.00	0.00	0.00					

Chlorine usage data entry sheet

Weather (MDE) - Monthly Data Entry

File Edit Format

Jun 2016 Saturday, June 04, 2016 Comments Calc Approve

Entry Min Max Daily Limit Min Max Var Info Equation 200015 Weather (Weather)

CSP-01 Influent Monitoring				
	01 Production and Treatment Log	200011 - Precipitation (Rain Gauge) inches	200015 - Weather Weather	200016 - Wind Wind
4 Sat		0.00	cloudy	calm
5 Sun		0.66	Clouds / Rain	SE
6 Mon		0.02	Clouds / Lt. Rain	SE
7 Tue		0.00	Partly Cloudy	SW
8 Wed		0.68	Partly Cloudy	NW
9 Thu		0.00	Clear	W
10 Fri		0.00	Clear	NW
11 Sat		0.00	Cloudy	S
12 Sun		0.00	Cloudy	NW
13 Mon				
14 Tue		0.00	Clear	N
15 Wed		0.00	Clear	W
16 Thu		0.00	Cloudy	Calm
17 Fri				
18 Sat				
19 Sun				
20 Mon				
21 Tue				
22 Wed				
23 Thu				
24 Fri				
25 Sat				
26 Sun				
27 Mon				
28 Tue				
29 Wed				
30 Thu				
MIN		0.00	-	-
MAX		0.68	-	-
AVG		0.09	-	-
SUM		1.37	-	-

Weather conditions data entry sheet

SS Primary Treatment (CDE) (Custom Data Entry Form)

File Edit Format Help KeyPad

Start Date: 6/17/2016 Current Date: Comment

B10 Shift 3 (2:30pm - 10:30pm) Save Approve Calc Show Calcs

	A	B	C	D	E	F	G	H	I	J	K	L
1	Primary Treatment Worksheet											
2												
3	Date	Friday, June 17, 2016										
4	Primary Clarifier Polings											
5	Shift	1	2	3	4	5	6	7	8	9	10	
6	Shift 1 (10:30pm - 6:30am)											
7												
8	Shift 2 (6:30am - 2:30pm)											
9												
10	Shift 3 (2:30pm - 10:30pm)											
11												
12	Average											
13												
14	Raw Sludge Totalizers											
15			Shift 1 (10:30pm - 6:30am)	Shift 2 (6:30am - 2:30pm)	Shift 3 (2:30pm - 10:30pm)	Total						
16	North Side Tanks (1 - 6)"	Finish										
17		Start										
18	South Side Tanks (7 - 10)	Finish										
19		Start										

Primary area data entry sheet

SS Secondary Treatment (CDE) (Custom Data Entry Form)

File Edit Format Help KeyPad

Start Date: 6/17/2016 Current Date: Comment

B10 Aeration Basin Avg. Save Approve Calc Show Calcs

SUE2

Secondary Treatment Worksheet

Date: Friday, June 17, 2016 Dissolved Oxygen (mg/l)

Aeration Basin No. 1				Aeration Basin No. 2				Aeration Basin No. 3				Aeration Basin No. 4				Aeration Basin No. 5				Aeration Basin No. 6				
Shift	1A	1B	1C	1D	2A	2B	2C	2D	3A	3B	3C	3D	4A	4B	4C	4D	5A	5B	5C	5D	6A	6B	6C	6D
Shift 1 (10:30 - 6:30)																								
Shift 2 (6:30 - 2:30)																								
Shift 3 (2:30 - 10:30)																								
Pass Average																								
Aeration Basin Avg.																								

RAS From Final Tanks (MGD)

Shift	1	2	3	4	5	6	9	10	11	12	13	14
Shift 1 (10:30 - 6:30)												
Shift 2 (6:30 - 2:30)												
Shift 3 (2:30 - 10:30)												
RAS Average Flow												

Final Clarifier Polings (ft)

Shift	1	2	3	4	5	6	9	10	11	12	13	14
Shift 1 (10:30 - 6:30)												
Shift 2 (6:30 - 2:30)												
Shift 3 (2:30 - 10:30)												
Sec. Clar. Blanket Avg.												

30 Minute Settability Tests (ml)

Shift	1B	1D	2B	2D	3B	3D	4B	4D	5B	5D	6B	6D
Shift 1 (10:30 - 6:30)												
Shift 2 (6:30 - 2:30)												
Shift 3 (2:30 - 10:30)												
30 Min Sett. Average												

Gallons Wasted to GBTs

	North (gpm)	South (gpm)	Total (gpm)
Shift 1 (12 - 8)			
Shift 2 (8 - 4)			
Shift 3 (4 - 12)			
Average (gpm)			
Total (million gallons)			

Plant Effluent

Settleable Solids			pH			Temp. deg C
Time Sampled	Time Analyzed	Results (ml/L)	Time Sampled	Time Analyzed	Results (SU)	
Duplicate pH						
Average						
Max						
Min						
Entered By:						
Verified By:						

Secondary area data entry sheet

SS Chlorine Use and Monitoring (CDE) (Custom Data Entry Form)

File Edit Format Help KeyPad

Start Date: 6/17/2016 Current Date: Fri, June 17, 2016 07:00 am Comment

Save Approve Calc Show Calcs

B13		A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	
2	Date:	Friday, June 17, 2016								Chlorine Use and Monitoring										
3		T Bld. Tank Levels								L Bld. Day Tank Levels			"Post (gpm)"	RAS Chlorination (gpm)		Chlorine Residuals				
4	TIME	1	2	3	4	5	6	7	8	1	2	3		North	South	Titrate	3-Hour delay	Chlorine Sample		
5		Sodium Hypochlorite Storage								To RAS Chlorination	To Disinfection		To Disinfection							
6	12am																	3 AM		
7	1am																	6 AM		
8	2am																	10 AM		
9	3am																	2 PM		
10	4am																	6 PM		
11	5am																	10 PM		
12	6am																	MPN		
13	7am																			
14	8am																			
15	9am																			
16	10am																			
17	11am																			
18	12pm																			
19	1pm																			
20	2pm																			
21	3pm																			
22	4pm																			
23	5pm																			
24	6pm																			
25	7pm																			
26	8pm																			
27	9pm																			
28	10pm																			
29	11pm																			
30	Average																			
32	Deliveries	No. 1	No. 2	No. 3	RAS Dilution Factor (Enter Daily)					Enter this number daily (Currently 0.25)										
33	Gallons																			
34	Calculated Values	Flow to Disinfection (Using Avg. Flow)												Gallons						
35		Flow to RAS (Using Avg. Flow * Dilution Factor)																		
36		Total Calculated to RAS (Using Tank Dif.)																		
37		Total Calculated to Disinfection (Using Tank Dif.)																		
38		Total All Tanks at Beginning of Day																		
39		Total All Tanks at End of Day																		
40		Flow to Odor Control										0								
41	Total Sodium Hypochlorite Use										0									

T-building chlorine monitoring & residual data entry sheet

SS Anaerobic Digestion (CDE) (Custom Data Entry Form)								
File Edit Format Help KeyPad								
<div> <div> </div> <div> Start Date: 6/17/2016 Current Date: </div> <div> Comment </div> </div>								
<div> <div> <div>A15</div> <div>Digester Gas Totals</div> </div> <div> <div>Save</div> <div>Approve</div> <div>Calc</div> <div>Show Calcs</div> </div> </div>								
	A	B	C	D	E	F	G	
1	Date	Friday, June 17, 2016			Anaerobic Digestion Worksheet			
2	Waste Gas Totalizer							
3		1	2	3	4	5	6	
4	End							
5	Start							
6	Total							
7								
8	Digester Gas Totals							
9		Dig. 1		Dig. 3		Dig. 4		
10		2" Line	4" Line	2" Line	4" Line	2" Line	4" Line	
11	End							
12	Start							
13	Total							
14								
15		Digester Gas Totals						
16		Dig. 5	Dig. 7	SD 2	SD 6	SD 8	SD 9	
17	End							
18	Start							
19	Total							

Digester data entry sheet

Days of Sludge Storage (MDE) - Monthly Data Entry

File Edit Format

Jun 2016 Monday, June 13, 2016 Comments Calc Approve

Entry Min Daily Limit Min Var Info Daily Comment
 Max Max Equation

	04 Residuals Managment Log	1.08 Anaerobic 108251 - Days of Sludge Storage (From Access DB)
4 Sat		6.60
5 Sun		5.80
6 Mon		5.00
7 Tue		5.10
8 Wed		5.60
9 Thu		6.00
10 Fri		6.20
11 Sat		6.30
12 Sun		5.40
13 Mon		4.90
14 Tue		5.30
15 Wed		5.60
16 Thu		6.30
17 Fri		
18 Sat		
19 Sun		
20 Mon		
21 Tue		
22 Wed		
23 Thu		
24 Fri		
25 Sat		
26 Sun		
27 Mon		
28 Tue		
29 Wed		
30 Thu		
MIN		4.90
MAX		7.00
AVG		5.93
SUM		94.90

Sludge storage data entry sheet

SS GBT Worksheet (CDE) (Custom Data Entry Form)															
File Edit Format Help KeyPad															
<div> <div>Start Date: 6/17/2016</div> <div>Current Date:</div> <div>Comment</div> </div> <div> <div>Save</div> <div>Approve</div> <div>Calc</div> <div>Show Calcs</div> </div>															
A18	Shift 3 (10:30pm-2:30am)														
Gravity Belt Thickener Worksheet															
Date Friday, June 17, 2016															
Sludge Total Solids Concentration															
Time		Sample	Primary Sludge	Thickened WAS	BFP Feed										
Shift 1 (10:30pm-6:30am)		pH													
		Solids													
Shift 2 (6:30am-2:30pm)		pH													
		Solids													
Shift 3 (10:30pm-2:30am)		pH													
		Solids													
Average Solids															
Polymer Use															
Shift		GBT		BFP											
		No. 1	No. 2												
Shift 1 (10:30pm-6:30am)		Start			GBT level measured in feet and converted to gallons assuming 8 feet diameter tank (376 gallons/ft).										
Shift 3 (10:30pm-2:30am)		End													
Total Daily Use Gallons															
Polygon Totalizer															
Shift		Belt Filter Press										Digester to BFP			
		1	2	3	4	5	6	7	8	9	10	Tote 1		Tote 2	
												Tote	Clock	Tote	Clock
Shift 1 (10:30pm-6:30am)		Start													
Shift 3 (10:30pm-2:30am)		End													
Total															

GBT data entry sheet

SS Dewatering (CDE) (Custom Data Entry Form)

File Edit Format Help KeyPad

Start Date: 6/17/2016 Current Date: Fri, June 17, 2016 03:00 pm

Save Approve Calc Show Calc

B19

Date		Dewatering Worksheet									
		BFP No. 1	BFP No. 2	BFP No. 3	BFP No. 4	BFP No. 5	BFP No. 6	BFP No. 7	BFP No. 8	BFP No. 9	BFP No. 10
	TIME	Sludge Feed (gpm)	Sludge Feed (gpm)	Sludge Feed (gpm)	Sludge Feed (gpm)	Sludge Feed (gpm)	Sludge Feed (gpm)	Sludge Feed (gpm)	Sludge Feed (gpm)	Sludge Feed (gpm)	Sludge Feed (gpm)
		Dewatered Cake %	Dewatered Cake %	Dewatered Cake %	Dewatered Cake %	Dewatered Cake %	Dewatered Cake %	Dewatered Cake %	Dewatered Cake %	Dewatered Cake %	Dewatered Cake %
4	10:30am										
5	12:00pm										
6	1:30pm										
7	3:00pm										
8	4:30pm										
9	5:00am										
10	6:30am										
11	8:00am										
12	9:30am										
13	11:00am										
14	12:30pm										
15	2:00pm										
16	2:30pm										
17	4:00pm										
18	5:30pm										
19	7:00pm										
20	8:30pm										
21	10:00pm										
22											
23	Average										
24											
25	Total Press Operating Hours	0.0	0	0	0	0	0	0	0	0	0
26											
27	Presses Online	0									
28	Total Operating Hours										
29	Average % Dewatered Cake All Presses										

Dewatering data entry sheet

SS Grit Removal (Custom Data Entry Form)

File Edit Format Help KeyPad

Start Date: 6/17/2016 Current Date: Comment

Save Approve Calc Show Calcs

	A	B	C	D	E	F	G	H	I	J	K	L
1	Grit Removal Worksheet											
2	Date	Friday, June 17, 2016										
3												
4	Time	Grit Tank Service			Grit Flow (GPM)				Degritter Inlet Pressure (PSI)			
5		1	2	3	1	2	3	4	1	2	3	4
6	Shift 1 (10:30pm-6:30am)											
7												
8												
9	Shift 2 (6:30am-2:30pm)											
10												
11	Shift 3 (2:30pm-10:30am)											
12												
13												
14	Average											
15												

Grit removal data entry sheet

CSP-06 Chemical Deliveries - Monthly Data Entry

File Edit Format

Jun 2016 Tuesday, June 21, 2016 Comments Calc Approve

Entry Min Daily Limit Min Var Info 107251 Hypo Delivery No. 1 Manifest (Number)
Max Max Equation

	05 Treatm ent Chem ical Lor	107251 - Hypo Delivery No. 1 Manifest	107252 - Hypo Delivery No. 1 Gallons	107261 - Hypo Delivery No. 2 Manifest	107262 - Hypo Delivery No. 2 Gallons	107271 - Hypo Delivery No. 3 Manifest	107272 - Hypo Delivery No. 3 Gallons	107351 - GBT Polymer Delivery No. 1 Lbs	107352 - GBT Poly Delivery No. 1 Gallons	107451 - BFP Polymer Delivery No. 1 Lbs	107452 - BFP Poly Delivery No. 1 Gallons	107551 - Hydroxide Delivery No. 1 Manifest	107552 - Hydroxide Delivery No. 1 Gallons	107554 - **Tank No. 1 Hydroxide Delivery Pounds	107662 - Polygon Delivery (Digester) Totes	107671 - Polgone Delivery (BFP) Totes
4 Sat			4800													
5 Sun			4800													
6 Mon			4800													
7 Tue			4800													
8 Wed																
9 Thu					4800											
10 Fri																
11 Sat					4800											
12 Sun			4800													
13 Mon			4800													
14 Tue			4800							44920	5181					
15 Wed																
16 Thu					4800											
17 Fri																
18 Sat																
19 Sun																
20 Mon																
21 Tue																
22 Wed																
23 Thu																
24 Fri																
25 Sat																
26 Sun																
27 Mon																
28 Tue																
29 Wed																
30 Thu																
MIN		-	4,800	-	4,800	-	-	-	-	44,920	5,181	-	-	-	-	-
MAX		-	4,815	-	4,800	-	-	-	-	44,920	5,181	-	-	-	-	-
AVG		-	4,802	-	4,800	-	-	-	-	44,920	5,181	-	-	-	-	-
SUM		-	43,215	-	14,400	-	-	-	-	44,920	5,181	-	-	-	-	-

Chemical delivery data entry sheets

SS Daily Sample Information (CDE) (Custom Data Entry Form)																	
File Edit Format Help KeyPad																	
<div> <div>Start Date: 6/17/2016</div> <div>Current Date:</div> <div>Comment</div> </div>																	
<div> <div>Save</div> <div>Approve</div> <div>Calc</div> <div>Show Calcs</div> </div>																	
B5	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
1	Daily Sample Report Influent/Effluent																
2																	
3																	
4	Friday, June 17, 2016																
5	Sample location: Influent Bld. E Sample Type: Plant Influent										Sample Location: Plant Effluent						
6			Settleable Solids		pH				Settleable Solids		pH						
7		Time	Plant Flow	Time Analyzed	Results	Time Sampled	Time Analyzed	Results	Temp.	Time Analyzed	Results	Time Sampled	Time Analyzed	Results	Temp.		
8			MGD		ml/L			SU	Deg C		ml/L			SU	Deg C		
9		11:00 PM															
10		12:00 PM															
11		1:00 AM															
12		2:00 AM															
13		3:00 AM															
14		4:00 AM															
15		5:00 AM															
16		6:00 AM															
17		7:00 AM															
18		8:00 AM															
19		9:00 AM															
20		10:00 AM															
21		11:00 AM															
22		12:00 PM															
23		1:00 PM															
24		2:00 PM															
25		3:00 PM															
26		4:00 PM															
27		5:00 PM															
28		6:00 PM															
29		7:00 PM															
30		8:00 PM															
31		9:00 PM															
32		10:00 PM															
33	Compliance Day		Average														
34	(7 AM Current Day -		Maximum	66.00													
35	6 AM Next Day)		Minimum	34.00													
36	Day		Average														
37	(12 PM - 11 PM)		Maximum														
38			Minimum														
39																	
40	Entered By																
41																	
42	Verified By																
43																	

SPDES sampling data entry sheet

NaOH levels at scrubber's data entry sheet

SS Scrubber Sodium Hypochlorite - Monthly Data Entry																								
File Edit Format																								
Sunday, June 26, 2016																								
Comments Calc Approve																								
Var Info 107851 Hypochlorite Delivery No. 1 Manifest (Number)																								
Equation																								
Scrubber Sodium Hypochlorite																								
OS	107831 - Hypochlorite Delivery No. 1 Manifest	107832 - Hypochlorite Delivery No. 1 Manifest	107833 - Hypochlorite Delivery No. 1 To Tank	107834 - Hypochlorite Delivery No. 1 To Tank	107835 - Hypochlorite Delivery No. 1 To Tank	107836 - Hypochlorite Delivery No. 1 To Tank	107837 - Hypochlorite Delivery No. 1 To Tank	107838 - Hypochlorite Delivery No. 1 To Tank	107839 - Hypochlorite Delivery No. 1 To Tank	107840 - Hypochlorite Delivery No. 1 To Tank	107841 - Hypochlorite Delivery No. 1 To Tank	107842 - Hypochlorite Delivery No. 1 To Tank	107843 - Hypochlorite Delivery No. 1 To Tank	107844 - Hypochlorite Delivery No. 1 To Tank	107845 - Hypochlorite Delivery No. 1 To Tank	107846 - Hypochlorite Delivery No. 1 To Tank	107847 - Hypochlorite Delivery No. 1 To Tank	107848 - Hypochlorite Delivery No. 1 To Tank	107849 - Hypochlorite Delivery No. 1 To Tank	107850 - Hypochlorite Delivery No. 1 To Tank	107851 - Hypochlorite Delivery No. 1 To Tank	107852 - Hypochlorite Delivery No. 1 To Tank	107853 - Hypochlorite Delivery No. 1 To Tank	107854 - Hypochlorite Delivery No. 1 To Tank
4 Sat																								
5 Sun																								
6 Mon																								
7 Tue																								
8 Wed																								
9 Thu																								
10 Fri																								
11 Sat																								
12 Sun																								
13 Mon																								
14 Tue																								
15 Wed																								
16 Thu																								
17 Fri																								
18 Sat																								
19 Sun																								
20 Mon																								
21 Tue																								
22 Wed																								
23 Thu																								
24 Fri																								
25 Sat																								
26 Sun																								
27 Mon																								
28 Tue																								
29 Wed																								
30 Thu																								
MIN																								
MAX																								
AVG																								
SUM																								

Chlorine levels at scrubber's data entry sheet

Semi-Annual Effluent Coliform Grab Sample (Custom Data Entry Form)

File Edit Format Help KeyPad

Start Date: 4 / 4 /2016 Current Date: Comment

B2 Semi-Annual Effluent Coliform Grab Sample Save Approve Calc Show Calcs

	A	B	C	D	E	F	G	H	I	J	K	L	M
1													
2		Semi-Annual Effluent Coliform Grab Sample											
3		Monday, April 04, 2016											
4		Time	Grab Sample Lab ID Number	Grab Sample Day	Grab Sample Date	Grab Sample Time	Effluent Dissolved Oxygen	Effluent Temperature	Effluent Chlorine Residual 3 Hrs Hold	Effluent Flow (At Grab Sample)	Effluent Total Coliform (Grab)	Effluent Fecal Coliform (Grab)	
5		1 am											
6		2 am											
7		3 am											
8		4 am	cc-16-00555						0.60	33.0	700	22	
9		5 am											
10		6 am	cc-16-00556						0.60	27.0	790	49	
11		7 am											
12		8 am	cc-16-00557						0.70	37.0	110	8	
13		9 am											
14		10 am	cc-16-00558						0.70	56.0	330	11	
15		11 am											
16		Noon	cc-16-00559						0.50	60.0	280	11	
17		1 pm											
18		2 pm	cc-16-00560						0.60	60.0	490	49	
19		3 pm											
20		4 pm	cc-16-00561						0.50	59.0	1,300	5	
21		5 pm											
22		6 pm											
23		7 pm											
24		8 pm											
25		9 pm											
26		10 pm											
27		11 pm											
28		Midnight											

Special Coliform testing data entry sheet

END OF SECTION

NO TEXT ON THIS PAGE

SECTION 13310
COMPUTER SYSTEM HARDWARE

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Refer to Section 13300.
- B. Existing virtual machines at the Cedar Creek WPCP which are designated for the Plant SCADA system include the Windows Server 2012 R2 operating system. The operating system for these systems shall be upgraded to Windows Server 2019 Standard Edition.

1.02 RELATED WORK

- A. Section 13300 "Instrumentation and Controls - General Provisions."
- B. Section 13315 "HMI System Software."
- C. Section 13316 "Additional SCADA System Software."

1.03 SUBMITTALS

- A. Refer to Section 13300.
- B. Descriptive literature, bulletins, catalog cuts and Drawings for the equipment specified herein.
- C. Complete bill of materials for the equipment.
- D. Spare parts list.
- E. Fault tolerant server installed software operability submittal
 - 1. Submit documentation on all software being installed on each VM of the fault tolerant server. The documentation shall include the system requirements of the virtual machine that the software is installed, and minimum system requirements of each software installed on each VM. The documentation shall include documentation from each software manufacturer that the software is compatible with virtualized environments. The software shall be coordinated with the fault tolerant server manufacturer and documentation shall be submitted that indicates that the software is compatible on the fault tolerant server.

1.04 WARRANTY

- A. Provide next day computer manufacturer on-site service for all computer system hardware devices covering parts and labor for 5 years from date of purchase. The on-site service is to be performed by an authorized representative of the manufacture of the installed equipment.

PART 2 PRODUCTS

2.01 TECHNOLOGY OBSOLESCENCE MITIGATION

- A. Refer to Section 13300.
- B. Due to rapidly evolving technology of the equipment specified herein, the requirements specified are to establish a baseline for the type of equipment required. Provide the latest hardware and software of similar specification at the time of purchase equivalent in cost to that which is specified. The procedure for submitting and releasing the equipment shall be as follows:
 - 1. PCSS shall submit for approval the required data for the equipment as part of the Hardware submittal.
 - 2. Equipment shall be ordered as late as possible dependent on the construction schedule to ensure the latest equipment available is provided. Just prior to ordering, resubmit for approval the required data of the latest available hardware and software equivalent in cost to that which is specified. No equipment shall be ordered more than 3 months prior to when it is needed to be continuously used on the project.

2.02 CONTROL ROOM FURNITURE

- A. General
 - 1. Control room furniture shall be provided for operations staff to monitor the workstations indicated on the system architecture drawings.
- B. Physical
 - 1. The console color and finish shall be coordinated with the Owner. PCSS shall submit charts and/or demo pieces and receive Owner approval prior to ordering.
 - 2. The main working surface of the control console shall be rectangular and top surface shall be laminate or laminate covered. The main working area shall be a minimum of 10 feet long, but final dimensions and layout shall be coordinated with the Owner prior to purchase to meet space requirements of the room and sizing requirements to fit the required hardware.
 - 3. The console shall be a modular, expandable and reconfigurable workstation that shall be provided with components necessary to accommodate Workstation towers, keyboards, uninterruptible power supplies, and ancillary computer hardware as shown in the Drawings.
 - 4. The console shall include aluminum articulating arm mounts for all LCD monitors indicated on the Drawings. The monitor mount shall attach directly to the console.
 - 5. The console shall include a power supply with a minimum of ten outlets for the Cedar Creek WPCP and five outlets for the Glen Cove WWTP.

6. Console shall provide ample work surface and sufficient risers to accommodate the specified equipment. Space for computer towers shall exist in a rack cabinet or a method shall be provided to mount such equipment under the desk's work surface. Space for two future workstations shall be provided at both the Cedar Creek and Bay Park plants.
7. Center desks, return desks, and corner sections shall feature modesty panels and an integrated cable management system that provides grommets, discrete routing of video/monitor cables. Legs shall have leveling capability.
8. The console shall be comprised of end frames and/or intermediate frames with horizontal stringers and decorative end panels.
9. Two swivel task chairs shall with arm rests shall be provided with each control console. The chair shall be capable of height adjustment and shall have wheels. Chair cushions shall be covered with a synthetic leather type material or another material that may be easily wiped clean.

C. Mounting Hardware

1. All hardware needed for assembly shall be provided. Panel bolts, washers, and clips with captive nuts suitable for use rack rails shall be included where appropriate. Slide kits (including drawers), where appropriate, shall be of ball bearing operation. Friction or roller type slides are not acceptable.

D. Installation Services

1. Services shall include shipment and console shall be installed onsite by manufacturer or manufacturer's approved vendor.
2. The PCSS shall be responsible for installation of all computer equipment provided under this contract. All wiring shall be installed in a neat and professional manner, utilizing cable trays and organizers.

E. Warranty

1. Lifetime warranty on all fixed steel structure frame components.
2. A 10-year warranty on adjustable, sliding or hinged components and laminated surfaces.
3. A two-year warranty on all electrical components and chairs.

F. Manufacturer(s)

1. Winsted Corporation – Sight Line Console with Task Chairs Model 11760.
2. Approved equal.

2.03 SPARE PARTS

- A. General requirements for spare parts are specified in Section 13300.

2.04 WORKSTATION

A. General:

1. Workstations shall be set-up to run PLC, HMI, and Reporting software depending on their use as shown on the system architecture drawings.
2. Tower chassis workstation

- B. One (1) Intel Quad-Core processor, 2.8 GHz or greater, minimum of 8 MB L3 cache on chip die, 2133 MHz front side bus minimum.

- C. 16 GB of RAM, 2133MHz speed minimum, 2 DIMMS maximum.

D. Media Drives:

1. DVD \pm Dual-layer Drive with both Read and Write Capability.

E. Expansion slots:

1. Two Full Height PCI slots.
2. One Full Height PCI Express slot.

F. Internal Disk:

1. 300 GB of usable storage minimum, consisting of one 300 GB SATA, 7,200 RPM (minimum) hard drive.

- G. Video graphics capable of 1920 x 1200 pixels, 70 Hz refresh rate and 32-bit true color minimum. VGA, DVI, and HDMI or Display Port outputs. 512MB of dedicated video RAM minimum. Card must be dual monitor capable.

H. I/O Ports & Devices:

1. Minimum of four USB 2.0 ports.

I. Interface Devices:

1. Generic USB 104 key (Windows) keyboard, no hot keys onboard.
2. Two button USB optical mouse with scroll wheel.
3. Monitor:
 - a. LCD 24-inch nominal size.
 - b. Native Resolution: 1920 x 1080 resolution at 70 Hz is required to meet the HMI development screen resolution standards.
 - c. 16 ms response time maximum.

- d. 250 nits (cd/m²) brightness minimum.
- e. 400 to 1 contrast ratio minimum.
- f. Vertical viewing angle of 85 degrees minimum.
- g. Horizontal viewing angle of 85 degrees minimum.
- h. Analog GRB, Digital DVI-D, and HDMI or Display Port video input connector types.
- i. Adjustable height stand.
- j. Soundbar.

J. Networking:

- 1. Two network cards in addition to any on-board network interface.
- 2. All network interfaces shall have the following features:
 - a. Support for latest Microsoft operating system.
 - b. Gigabit Ethernet port, copper connection accepting standard CAT6 cables for Ethernet communications.
 - c. IEEE 802.3ab support for gigabit networking standard.
 - d. IEEE 802.Q VLAN support.
 - e. Auto sensing 10/100/1000 Mbps.
 - f. SNMP manageable.

K. Power supplies shall operate from the voltage specified in Section 13300.

L. Operating System:

- 1. Latest release of 64-bit Windows 10.

M. Backup Imaging Software:

- 1. Backup software is required in addition to the default Microsoft Windows Backup utility included with the operating system. The backup software shall have the following features:
 - a. Support the Windows operating system installed on server.
 - b. Perform full system backups including all open files, system state and open database files without the need to stop any services or applications running on the server.
 - c. Full restore of server from bare metal state.
 - d. Restore individual files from tape to original locations or to alternative locations on the server.
 - e. Backup job scheduler capable of supporting multiple schedules for full, incremental and partial backup jobs.
 - f. Backup software shall keep a log file of the status of all backup and restore activities. Log file shall easily export to a text file.

- 2. Provide Acronis or Symantec back-up software or equal.

N. Other Software:

- 1. The latest version of Microsoft Office Professional shall include the following programs at a minimum:
 - a. Microsoft Excel.
 - b. Microsoft Word.
 - c. Microsoft Access.

- d. Microsoft PowerPoint.
- 2. Virus scan and protection software either McAfee Virus Scan Enterprise or Symantec Norton Antivirus Business Pack (Latest Edition). Virus software shall be provided with definition updates for 5 years.
- 3. Additional software required by the software installation matrix at the end of this Section.
- O. Manufacturers:
 - 1. Dell T5820.
 - 2. HP Z620.
 - 3. IBM

2.05 MICROSOFT WINDOWS SERVER CLIENT ACCESS LICENSES (CALs)

- A. Provide Client Access Licenses (CALs), appropriated on a per-device basis, to connect all networked devices shown on Drawings and specified herein, plus 25 percent spare. Provide ten (10) device CALs at minimum, per Windows server.
- B. Provide Remote Desktop Services Client Access Licenses (RDS CALs). Provide five (5) device RDS CALs at a minimum, per Windows server.

2.06 IP BASED – KEYBOARD TRAY/MONITOR/CONSOLE KVM SWITCH:

- 1. Monitor/keyboard tray shall be a 19" rack mounted drawer with 17" built in Monitor and Keyboard with a pointer device.
- 2. Keyboard shall fit within the drawer and be equipped with a built-in pointing device.
- 3. Monitor shall be 17" diagonal size and capable of 1280 x 1024 pixel resolution minimum.
- 4. Drawer shall be 1U height and include hardware for mounting the monitor and keyboard. Monitor hardware shall allow the monitor to lay flat in drawer or fold up when the drawer is opened.
- 5. Provide necessary cables and power supplies for operation and interface with the KVM switch. Provide a USB/VGA to CAT6 connector for each server being tied into the KVM.
- 6. KVM shall allow sharing of the keyboard, video, and mouse between all servers mounted within the rack.
- 7. Manufacturer:
 - a. Dell.
 - b. HP.
 - c. Or equal.

2.07 RACK MOUNTED FAULT TOLERANT SCADA SERVER

- A. Provide a resilient, fault-tolerant server with replicated and monitored lock-step hardware in the SCADA Rack. This Fault Tolerant Server shall provide 99.999% uptime. Manufacturer shall be capable of 24/7 monitoring of the health of the server components via the internet.
- B. Server configured for installation in rack environment occupying 4U of rack space to run five (5) virtual machines.
- C. (1) 10-Core Intel® Xeon® Processors, 2.2 GHZ or greater, minimum of 12 MB L3 cache per customer replaceable unit (CRU).
- D. 128 GB of RAM, fully buffered with ECC and 1333 MHz speed minimum, 8 DIMMs maximum, per CRU.
- E. Media Drives:
 - 1. DVD ± Dual-layer Drive with both Read/Write Capability.
- F. Expansion Slots:
 - 1. 4 PCI Express slot per CRU (to be used for optional dual-port Gigabit network cards).
- G. Internal Disk Array:
 - 1. Support for the following RAID configurations: 1, 5, 6, 10.
 - a. Configure internal disks using the RAID 5 configuration.
 - 2. 900 GB of usable storage minimum, consisting of (4) 300 GB SAS, 15,000 RPM hard drives per CRU.
 - 3. Hard drives shall be hot swappable.
 - 4. Array controller shall utilize the SAS 6 Gbit/s technology to connect to all hard drives.
 - 5. Server shall accommodate a minimum of eight hard drives per CRU.
- H. Video graphics capable of 1024 x 768 pixels, 70 Hz refresh rate and 16-bit color minimum. VGA output.
- I. I/O Ports & Devices:
 - 1. Minimum of four USB 2.0 ports.
- J. Interface Devices:
 - 1. Manufacturer's Keyboard and Mouse.
- K. Server shall be connected to the Keyboard/Video/Mouse (KVM) Tray as shown on Drawings.

L. Networking:

1. Two dual-port on-board network cards per CRU.
2. Two optional dual-port network cards per CRU.
3. All network interfaces shall have the following features:
 - a. Support for latest Virtualization server operating system.
 - b. Gigabit Ethernet port, copper connection accepting standard CAT-6 cables for Ethernet communications.
 - c. Support for PCI-X or PCI bus in the server.
 - d. IEEE 802.3ab support for gigabit networking standard.
 - e. Support for Ethernet port teaming across network adapter cards for increased bandwidth and fault tolerance of both adapter and attached Ethernet switch.
 - f. IEEE 802.3ad Link aggregation support.
 - g. IEEE 802.Q VLAN support.
 - h. Auto sensing 10/100/1000 Mbps.
 - i. A minimum of 1-10GBps Ethernet port.
 - j. SNMP manageable.

M. Redundant power supplies each with separate power cords. Power supplies shall be auto switching.

N. Operating system:

1. Bare metal host Operating System (OS), known as the Hypervisor 1 (HV-1), shall be VMware vSphere6 Essentials (3 host kit) or Microsoft Hyper-V.
2. Manufacturer shall provide companion software to HV-1, HV-2 to monitor and report the health of the server components.
3. HV-1 shall be used to create and manage virtual environments for which the OS shall be Windows Server 2019 Standard Edition.
 - a. Furnished virtual machine operating system(s) shall be compatible with the HMI, PLC programming, and any other system software furnished on the project.
4. Provide all CD or DVD media required to reinstall operating system and system drivers from bare metal server configuration.

O. Software for Virtual Machines:

1. The latest version of Microsoft Office Professional with the following programs at a minimum:
 - a. Microsoft Excel.
 - b. Microsoft Word.
 - c. Microsoft Access.
 - d. Microsoft PowerPoint.
2. Virus scan and protection software either McAfee Virus Scan Enterprise or Symantec Norton Antivirus Business Pack (Latest Edition). Virus software shall be provided with definition updates for 5 years.

P. Start-up Assistance:

1. Provide Virtualization vendor start-up assistance services. Service shall consist of a minimum of 8 hours for simultaneous on-site set-up, configuration and technical training of PCSS staff including, but not limited to the following tasks: Unpacking all system components, hardware module setup, network configuration, internal data disks setup and the testing of individual components. Following set-up, test the system in the presence of the PCSS to ensure system and software is functioning properly. PCSS will then load applications on servers in the presence of the Stratus representative. Stratus to provide a written report documenting the testing results, the initial configuration of the system and any reference documentation to the PCSS. "JumpStart" installation shall take place at PCSS programming location.
2. Coordinate the execution of this service with the PCSS.

Q. Recurring Services: Platform Support:

1. Provide on-going real-time failure prevention and failure recovery support by manufacturer for two years after JumpStart Installation assistance has been completed. The manufacturer shall monitor the health of individual components and report back to their Customer Assistance Center via the internet (provided by the Owner) on any Operating System, software or hardware issues. In the event of a detected failure or pending failure, hardware identical to the part that has failed shall be sent next business day without any additional cost to the Owner. Upon recognition by the manufacturer or Owner of a hardware or software issue, a manufacturer's representative shall be available within two hours to assist in identifying the issue and developing a response plan to address the issue. Uptime Assurance Software upgrades shall be provided at no additional cost during the course of a two-year period.

R. Miscellaneous:

1. Include 19" rack sliding mounting rails with cable management arms.

S. Server:

1. Stratus ftServer 2900.
2. Or Equal.

2.08 WINDOWS BASED NETWORK ATTACHED STORAGE

- A. Network attached storage (NAS) drive shall provide full system backups for all computers on the local area network. USB connected drives are not acceptable. NAS shall also be configured to store backup historical archives.
1. NAS drive shall be rack mountable.
 2. Drive shall include a minimum of three (3) USB 2.0 and two (2) Gigabit Ethernet RJ45 ports.
 3. Minimum of 2.13 GHz dual core processor or greater.

4. Minimum of 8GB RAM.
5. Minimum total raw storage of 4 TB.
6. Drive shall have a minimum of 4 bays and a RAID 5 configuration with a hot swappable drive.
7. NAS drive shall be controlled by an onboard microprocessor.
 - a. NAS operating system shall be capable of configuring backup settings for every individual computer on the plant's SCADA network.
 - b. Operating system shall support the total number of computers on the network with 2 spare.
 - c. The drive's operating system shall support file sharing across all plant workstation operating system platforms.

B. Manufacturers:

1. Synology RS1619xs+
2. Dell – PowerVault NX400.
3. Buffalo Technologies – TeraStation Rackmount WSS.
4. Or equal.

PART 3 EXECUTION

3.01 GENERAL

- A. Refer to Section 13300.

3.02 SOFTWARE INSTALLATION MATRIX

Key:

Ex: Existing Software

Up: Upgrade Existing Software

◆: New Software provided under this contract

CEDAR CREEK WPCP:

- A. The following table provides a matrix of the primary software packages that are to be furnished, installed, and configured on each node.
- B. In addition to the software shown in this matrix, the PCSS shall install the software upgrades on the existing Cimplicity servers and workstations as required by Section 13315.
- C. PCSS shall install all software and ensure it is functioning properly. Other miscellaneous software shall also be installed as required to meet the functionality provided within the contract documents. Any additional miscellaneous software must be first approved by the Engineer. Refer to the system architecture drawings for additional requirements.

	MS Windows Server 2019	HMI Developer	HMI Server Runtime w/ specified options	HMI I/O Drivers (Include SNMP)	HMI Client Runtime	PLC Programming Software	OIT Configuration Software	Virtual Machine Hardware Monitoring and Config Tools	Historian software	Reporting software	Reporting Software Client	MS Windows 10 Professional	MS Office	Alarm Dialer Software	Anti-Virus Software	Backup Imaging Software
UWLISCADACCSV02 (Existing)	Up	◆		◆									Ex	◆	Ex	Ex
UWLISCADACCSV03 (Existing)	Up		◆	◆									Ex	◆	Ex	Ex
UWLISCADACCWS05					◆						◆	◆	◆		◆	◆
UWLISCADACCWS06					◆						◆	◆	◆		◆	◆
UWLISCADACCWS07					◆						◆	◆	◆		◆	◆

GLEN COVE WWTP:

- A. The following table provides a matrix of the primary software packages that are to be furnished, installed, and configured on each node. PCSS shall install all software and ensure it is functioning properly. Other miscellaneous software shall also be installed as required to meet the functionality provided within the contract documents. Any additional miscellaneous software must be first approved by the Engineer.

	MS Windows Server 2019	HMI Developer	HMI Server Runtime w/ specified options	HMI I/O Drivers	HMI Client Runtime	PLC Programming Software	OIT Configuration Software	Virtual Machine Hardware	Virtual Machine Hardware Monitoring and Configuration Tools	Historian Software	Historian Client Tools	Reporting Software	Reporting Software Client	MS Windows 10 Professional	MS Office	Alarm Dialer Software	Anti-Virus Software	Backup Imaging Software
UWLISCADAGCSV02	◆	◆		◆											◆	◆	◆	◆
UWLISCADAGCSV03	◆		◆	◆											◆	◆	◆	◆
UWLISCADAGCSV04	◆									◆		◆			◆		◆	◆
UWLISCADAGCSV05	◆																◆	◆
UWLISCADAGCSV06	◆																◆	◆
UWLISCADAGCWS01					◆	◆	◆	◆	◆		◆		◆	◆	◆		◆	◆
UWLISCADAGCWS02					◆						◆		◆	◆	◆		◆	◆
UWLISCADAGCWS03					◆						◆		◆	◆	◆		◆	◆
UWLISCADAGCWS04					◆						◆		◆	◆	◆		◆	◆

END OF SECTION

SECTION 13311
PLC HARDWARE AND SOFTWARE

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. This Section includes Programmable logic controllers for control of process equipment, process-oriented machinery, and process systems.

1.02 RELATED WORK

- A. Section 13300 "Instrumentation and Controls - General Provisions."
- B. Section 13315 "HMI System Software."
- C. Section 13330 "Control Panel Enclosures and Panel Equipment."
- D. Section 13335 "Single-Phase UPS."

1.03 SUBMITTALS

- A. Refer to Section 13300.
- B. Descriptive literature, bulletins, catalog cuts and Drawings for the equipment specified herein.
- C. Complete bill of materials for the equipment.
- D. Any deviation of the hardware or software systems from the preliminary submittal included in the Project Plan shall be described in detail.
- E. Spare parts list.

1.04 REFERENCE STANDARDS

- A. ASTM D 999-91: Vibration.
- B. (CFR) Title 47, Part 18 (European EN 55011 (formerly CISPR 11)).
- C. CSA Certification Class I, Division 2, Group A, B, C, D Hazardous or non-hazardous locations.
- D. IEC 60068-2.1 Environmental testing – Part 2-1: Tests - Test A: Cold, 2.2 Environmental testing - Part 2: Tests. Tests B: Dry heat, 2.3, 2.6 Environmental testing - Part 2: Tests - Test Fc: Vibration (sinusoidal) and 2.27 Environmental testing. Part 2: Tests. Test Ea and guidance: Shock.
- E. IEC 61000 Electromagnetic compatibility (EMC) - Testing and measurement techniques:
 - 1. Part 4-2: Electrostatic discharge immunity test.
 - 2. Part 4-3: Radiated, radio frequency, electromagnetic field immunity test.

- 3. Part 4-4: Electrical fast transient/burst immunity test.
- 4. Part 4-5: Surge immunity test.
- 5. Part 4-6: Immunity to conducted disturbances, induced by radio-frequency fields.
- F. IEC 61131-3: Programmable controllers - Part 3: Programming languages.
- G. IEC 801-3: RFI Immunity.
- H. IEC 801-5: Ground Continuity.
- I. IEC 801-2: Electrostatic Discharge.
- J. IEEE 472-1974/ANSI C37.90/90A-1974 (Surge Withstand) IEEE Standard for Relays and Relay Systems Associated with Electric Power Apparatus.
- K. MIL STD 461B CS02: RFI/EMI Susceptibility.
- L. NEMA Pub No ICS2-230.42: Showering Arc Test.
- M. NSTA Project 1A.
- N. UL 508 and CSA Standard C22.2 No. 142 (Isolation Voltages).

1.05 DELIVERY, STORAGE AND HANDLING

- A. Deliver PLC components in packaging designed to prevent damage from static electricity and physical damage.
- B. Store PLC equipment according to manufacturer requirements. At a minimum, store indoors in clean, dry space with uniform temperature to prevent condensation. Protect PLCs from exposure to dirt, fumes, water, corrosive substances, and physical damage. Also, protect the PLC from all forms of electrical and magnetic energy that could reasonably cause damage.

1.06 NOMENCLATURE AND IDENTIFICATION DEFINITIONS

- A. AI: Analog Input.
- B. AO: Analog Output.
- C. Fixed I/O: A PLC style consisting of a fixed number of I/O, a processor, and a power supply all in one enclosure. Some fixed PLCs have limited expansion ability.
- D. CPU: Central Processing Unit.
- E. DI: Discrete Input.
- F. Distributed I/O: Hardware specially designed to function as Remote I/O.
- G. DO: Discrete Output.

- H. HMI: Human-Machine Interface.
- I. I/O Input and/or Output.
- J. Master/Slave: Communication between devices in which one device, the master, controls all communications. The other devices, the slaves, respond only when queried by the master. Typically used in a Remote I/O application.
- K. Modular: A PLC style consisting of cards that are assembled to comprise a complete unit. All I/O, CPU, and Power Supply are dedicated cards. Typically, these cards are inserted into a chassis.
- L. Peer to Peer: Communication between two or more devices, typically PLC's, in which each device can control the communication exchange.
- M. PID: Control action, proportional plus integral plus derivative.
- N. PLC: Programmable Logic Controller.
- O. OIT: Operator Interface Terminal
- P. Remote I/O: I/O that is located remotely from the processor, which communicates via Ethernet
- Q. SCADA: Supervisory Control and Data Acquisition.

1.07 SPARE I/O AND SLOTS

- A. Each panel containing PLC I/O shall include at least 20 percent (minimum of four) points of each type (AI, AO, DI, and DO) for future use, regardless of whether any of those point types are used in that panel or not. Because future I/O points are being provided under this contract for future instrumentation, the spare requirement shall be calculated as follows: Provide 20% of (used I/O + Future I/O) for spare I/O. The spares shall be the same type of I/O modules supplied.
- B. For chassis-based PLC systems, provide at least two spare slots for addition of future I/O in each chassis provided. For non-chassis-based PLC systems, provide adequate space to the right of the last I/O card in each row of I/O cards for at least two future I/O cards (width should be based on the widest I/O card provided in panel).
- C. Spare output points that require the use of an external relay shall be supplied with the external relay.
- D. Regardless of the spare requirement, all installed unused points on all I/O modules shall be wired to terminal blocks in the order that they occur on the I/O modules. Unwired spares shall not be acceptable.

1.08 MANUFACTURER SUPPORT

- A. Provide a written proposal for a manufacturer support agreement for products specified herein for a minimum of 12 months starting at final completion of the project. The cost of this manufacturer support agreement shall not be included in the Contract Price. The support agreement shall be executed in the name of, and for the benefit of, the Owner. At a minimum, this agreement shall provide the Owner with:
1. 8 AM to 5 PM, 5 day per week manufacturer telephone support.
 2. Access to the manufacturer's technical support website.
 3. Software and firmware updates.

PART 2 PRODUCTS

2.01 CHASSIS-BASED PROGRAMMABLE LOGIC CONTROLLER SYSTEM

- A. General:
1. Provide Programmable Logic Controller equipment with the required memory and functional capacity to perform the specified sequence of operation with the scheduled input and output points.
 2. Processor Systems shall include processor, power supply, input/output modules, communication modules, redundancy modules, and remote interface modules as required to meet system requirements.
 3. Furnish products listed and classified by Underwriters Laboratories (UL), CSA, or FM approval as suitable for purpose specified and indicated.
 4. All equipment and devices furnished hereunder shall be designed for continuous industrial service. The system shall contain products of a single manufacturer, insofar as possible, and shall consist of equipment models that are currently in production.
 5. All equipment furnished shall be designed and constructed so that in the event of power interruption the systems shall go through an orderly shutdown with no loss of memory, and resume normal operation without manually resetting when power is restored.
 6. PLCs shall communicate between the SCADA servers and field-mounted transducers, switches, controllers, and process actuators. Communications protocol shall be completely transparent to process operators at the Human Machine Interface (HMI).
 7. PLC shall be capable of stand-alone operation in the event of failure of the communication link to the HMI system.
 8. Remote Input/Output (RIO) Units shall include input/output modules, interface modules, communication modules, and power supply to meet system input and output requirements.
 9. Temperature: All PLC hardware shall operate at an ambient temperature of 0° to 60° C (32° to 140° F), with a storage ambient temperature rating of -25° to 70° C (-40° to 185° F).

10. Relative Humidity: Programmable Controller hardware shall function continuously in the relative humidity range of 10 percent to 95 percent non-condensing.
 11. Degree of protection: NEMA 1 (IP20).
 12. All products shall have corrosion protection.
- B. All major assemblies and sub-assemblies, circuit boards, and devices shall be identified using permanent labels or markings indicating:
1. Modules product type such as analog or digital.
 2. Modules catalog number.
 3. Modules major revision number.
 4. Modules minor revision number.
 5. Module manufacturer vendor.
 6. Module serial number.
- C. All necessary cables shall be included. All cables and connectors shall be as specified by the manufacturer. Cables shall be assembled and installed per the manufacturer recommendations.
- D. Central Processing Unit (CPU):
1. CPU shall be, at a minimum, a 16-bit microprocessor that provides system timing and is responsible for scheduling I/O updates, with no user programming required to ensure discrete or analog update. It shall execute user relay ladder logic programs, communicate with intelligent I/O modules, and perform on-line diagnostics. The CPU shall consist of a single module which solves application logic, stores the application program, stores numerical values related to the application processes and logic, and interfaces to the I/O.
 2. CPU shall sample all the discrete and analog inputs and outputs including internal coils and registers, and service special function modules every scan. The CPU shall process the I/O with user program(s) stored in memory, then control the outputs based on the results of the logic operation.
 3. Supply the CPU with a battery-backed time of day clock and calendar.
 4. CPU family shall allow for user program transportability from one CPU model to another.
- E. Diagnostics:
1. CPU shall perform on-line diagnostics that monitor the internal operation of the PLC. If a failure is detected, the CPU shall initiate system shutdown and fail-over. The following, at a minimum, shall be monitored: Memory failure, memory battery low, and general fault, communications port failure, scan time over run, I/O failure, and analog or special function I/O module failure.

2. All diagnostic information shall be accessible to the host communications interfaces and to the PLC program.
3. PLC shall have indicators and on-board status area to indicate the following conditions:
 - a. CPU run.
 - b. CPU error or fault.
 - c. I/O failure or configuration fault.
 - d. Status of Battery or back-up power module.
 - e. Communications indicator.

F. Memory:

1. User program and data shall be contained in non-volatile battery backed memory of type CMOS RAM program memory or equivalent.
2. Memory Backup System: provide lithium battery backup or equivalent capable of retaining all memory for a minimum of three months and a Flash memory system capable of reloading program in the event of memory loss.
 - a. Backup Storage: The backup battery or module shall be capable of being replaced without disrupting memory integrity. Provide a visual indication of low battery voltage or module error and an alarm bit in the PLC program.
 - b. SD Memory Card: Memory card storage capacity shall be greater than processor memory capacity. Memory cards shall be installed in processors for factory testing.
3. Operating system shall be contained in non-volatile firmware. The memory containing the operating system shall be field updateable via a separate update tool.

G. Programming Environment:

1. Programming port: The PLC shall include a serial USB or Ethernet port for programming.
2. On-Line programming: Application programs may be modified or stored while the CPU is running, with minimal impact on the scan time.
3. Online programming including runtime editing.
4. IEC 61131-3 programming languages supported: Ladder logic, function block, sequential function chart, and structure text.
5. Supply all hardware and software necessary to program the CPU in these languages.

H. Communication Ports:

1. CPU shall be expandable and supplied with additional modules to support the required communication interfaces as indicated on the drawings.

I. Remote I/O Communications:

1. CPU shall be capable of communicating with RIO racks via the Ethernet network.
2. Diagnostic and equipment status information shall be available from each RIO.

3. Remote I/O system shall have available a remote input/output arrangement capable of operation at locations physically separated from the PLC CPU as detailed on the drawings.
4. Communication with the remote I/O arrangement shall be through CAT6 cabling.

J. Power Supplies:

1. PLC shall have chassis mounted power supplies to power the chassis backplane and provide power for the processor and applicable modules.
2. Power supplies shall have a clearly visible LED to indicate that the incoming power is acceptable, and the output voltage is present.
3. Power supplies shall feature over-current and over-voltage protection and should be designed to operate in most industrial environments without the need for isolation transformers.
4. Power supplies shall be sized to accommodate the anticipated load plus 30%.
5. DC power supplies shall be capable of handling ripple up to 2.4V peak to peak.
6. AC Line Voltage rating of 85 to 265Vac, 47 - 63Hz.
7. Power supplies shall allow for brown outs of at least 1/2 of a cycle, a harmonic rate of 10%, and will sustain continuous operation through momentary interruptions of AC line voltage of 10ms or less.
8. Automatically shut down the Programmable Controller system whenever its output power is detected as exceeding 125% of its rated power.
9. Provide surge protection, isolation, and outage carry-over up to 2 cycles of the AC line.
10. Redundant power supplies will comply with all the requirements of non-redundant power supplies in addition to the features stated below.
 - a. Redundant power supplies shall be designed to share the current required by the chassis. In the event of a failure of one redundant power supply, the remaining supply will accommodate the entire load of the chassis without disruption to the chassis activity.
 - b. Provide a failsafe fuse that is not accessible by the customer.
 - c. Provide a solid-state relay connection to allow for failure annunciation when wired to an input module.
 - d. Diagnostic LED status indicators for Power and redundancy.

K. Chassis:

1. PLC system shall be chassis based.
2. All system and signal power to the CPU and support modules shall be distributed on the backplane. No interconnecting wiring between these modules via plug-terminated jumpers shall be acceptable.

3. All system modules, main and expansion chassis shall be designed to provide for free air flow convection cooling. No internal fans or other means of cooling, except heat sinks, shall be permitted.
4. All system modules including the processor shall be removable from the chassis or inserted into the chassis while power is being supplied to the chassis without faulting the processor or damaging the modules.

L. Discrete Input & Output Modules:

1. General:
 - a. Digital input and output modules shall provide ON/OFF detection and actuation.
 - b. I/O count and type shall be as required to implement the functions specified plus an allowance for active spares, as noted below.
 - c. Modules shall be designed to be installed or removed while chassis power is applied.
 - d. Modules shall have indicators to display the status of communication, module health and input / output devices.
 - e. Each module shall have the following status indicators.
 - 1) On/Off state of the field device.
 - 2) Module's communication status.
2. Module Specifications (120VAC Input Module):
 - a. Individually Isolated input channels
 - b. Nominal Input Voltage: 120VACc.
 - c. On-State Current: 15mA @132V AC, 47 - 63Hz maximum.
 - d. Maximum Off-State Voltage: 20V.
 - e. Maximum Off-State Current: 2.5mA.
 - f. Number of Points per Card: 16.
3. Module Specification (120 VAC Solid State Output Module):
 - a. Each triac type discrete output shall have an associated interposing relay located in the same control panel. 120 VAC power for relay outputs shall be provided from the associated motor starter control circuit (when used with motor starters) or other 120 VAC source (when I/O is not associated with a particular motor starter).
 - b. Output Voltage Range: 74 - 265 VAC, 47 - 63 Hz.
 - c. Output Current Rating:
 - 1) Per Point: 0.5A maximum @ 30 degrees C; 0.25 A maximum @ 60 degrees C; Linear Derating.
 - 2) Per Module: 4A maximum @ 30 degrees C; 2A maximum @ 60 degrees C; Linear Derating.
 - d. Surge Current Per Point: 5A for 43ms each, repeatable every 2s @ 60 degrees C.
 - e. Minimum Load Current: 10mA per point.
 - f. Maximum On-State Voltage Drop: 1.5V peak @ 2.0A and 6V peak @ load less than 50mA.
 - g. Maximum Off-State Leakage: 2.5mA per point.
 - h. Number of Points per Card: 16.
4. Module Specifications (Individually Isolated, Relay Contact Output Module):
 - a. Output Voltage Range: 10 - 265 VAC, 47 - 63 Hz, 5 - 125 VDC.
 - b. Output Current Rating:
 - 1) Per Point: 2.5A maximum.

- 2) Per Module: 16A maximum.
- c. Power Rating (Steady State): 250 VA maximum for 125 VAC inductive output.
- d. Maximum Off-State Leakage: 0 mA per point.
- e. Configurable States:
 - 1) Fault Per Point: Hold Last State, ON or OFF.
 - 2) Program Mode Per Point: Hold Last State, ON or OFF.
- f. Number of Points per Card: 16.

M. Analog Input & Output Modules:

- 1. General:
 - a. Analog input modules shall convert an analog signal that is connected to the module's screw terminals into a digital value. The digital value representing the magnitude of the analog signal shall be transmitted on the backplane. Analog output modules shall convert a digital value that is delivered to the module via the backplane into an analog signal on the module's screw terminals.
 - b. Modules shall be designed to be installed or removed while chassis power is applied.
 - c. Modules shall have indicators to display the status of communication, module health and input / output devices.
 - d. Each analog module shall provide both hardware and software indication when a module fault has occurred. Each module shall have an LED fault indicator and the programming software shall display the fault information.
 - e. Analog modules shall be software configurable through the I/O configuration portion of the programming software.
 - f. Following status shall be capable of being examined in ladder logic:
 - 1) Module Fault Word: Provides fault summary reporting.
 - 2) Channel Fault Word: Provides under-range, over-range and communications fault reporting.
 - 3) Channel Status Words: Provides individual channel under-range and over-range fault reporting for process alarm, rate alarms and calibration faults.
 - g. 24 VDC power for analog instrument loops shall be provided as a part of the system. 24 VDC power supply shall be derived from the 120 VAC input power circuit to the PLC. Field side of the 24 VDC power sources(s) shall have individual or grouped (of logically associated circuits) fusing and be provided with a readily visible, labeled blown fuse indicator.
- 2. Differential Analog Input Module (individually isolated):
 - a. Input Range: 0-20 mA.
 - b. Resolution: approximately 16 bits across range.
 - c. Input Impedance: Greater than 249 Ohms.
 - d. Overvoltage Protection: 8V ac/dc with on-board current resistor.
 - e. Normal Mode Rejection: 60 dB at 60 Hz.
 - f. Common Mode Noise Rejection: 120 dB at 60 Hz, 100 dB at 50 Hz.
 - g. Isolation Voltage:
 - 1) Channel to Ground/Chassis - 100% tested at 1000 VDC minimum for 1s based on 250 VAC.
 - h. Provide individual isolators, in addition to the surge suppression devices specified, in the control panels listed in Section 13330 for all signals that enter the panel from outside the building. Substitution of Isolated Analog cards to meet this requirement is acceptable.
 - i. Number of Points per Card: 8.

3. Individually Isolated Analog Output Current Module:
 - a. Output Current Range: 4 to 20 mA.
 - b. Current Resolution: 12 bits across 20 mA.
 - c. Open Circuit Detection: None.
 - d. Output Overvoltage Protection: 24V ac/dc maximum.
 - e. Output Short Circuit Protection: 20 mA or less (electronically limited).
 - f. Calibration Accuracy: Better than 0.1% of range from 4 mA to 20 mA.
 - g. Calibration Interval: 12 months typical.
 - h. Number of Points per Card: 8.
4. Communications Interfaces:
 - a. PLC will be capable of the following communication protocols as shown on the drawings:
 - 1) 10BASE-T/100BASE-TX Ethernet communication.
 - a) Modbus TCP/IP
 - b) Communication between Allen Bradley PLCs shall be via EtherNet/IP protocol (EtherNet Industrial Protocol).
 - 2) USB port for diagnostics and configuration.
 - b. When required provide a Communications Interface Module mounted in the chassis or the equivalent port directly on the CPU.

N. Manufacturers:

1. Provide all PLCs from a single manufacturer. If the PLC manufacturer has authorized third party vendors to provide modules that are compatible with their platforms, then products manufactured by these authorized third-party vendors will be acceptable.
2. Provide the PLC system by one of the following:
 - a. Rockwell Automation: 1756 ControlLogix
 - b. Schneider-Electric: Modicon M580 Series
 - c. Emerson: PAC Systems RX3i Series.

2.02 COMPACT PROGRAMMABLE LOGIC CONTROLLER
(FOR PLC-FPB AND PLC-ADMIN)

- A. Provide Programmable Logic Controller equipment with the required memory and functional capacity to perform the specified sequence of operation with the scheduled input and output points.
- B. Processor Systems shall include integral processor, power supply, input/output modules, communication modules, and remote interface modules as required to meet system requirements.
- C. PLC shall support expansion I/O modules but not be chassis based in design.
- D. Furnish products listed and classified by Underwriters Laboratories (UL), CSA, or FM approval as suitable for purpose specified and indicated.
- E. All equipment and devices furnished hereunder shall be designed for continuous industrial service. The system shall contain products of a single manufacturer, insofar as possible, and shall consist of equipment models that are currently in production.

- F. All equipment furnished shall be designed and constructed so that in the event of power interruption the systems shall go through an orderly shutdown with no loss of memory and resume normal operation without manually resetting when power is restored.
- G. The PLCs shall communicate between the operator workstation and field-mounted transducers, switches, controllers, and process actuators. Communications protocol shall be completely transparent to process operators at the Human Machine Interface (HMI).
- H. The PLC shall be capable of stand-alone operation in the event of failure of the communication link to the HMI subsystem.
- I. Agency and environmental specifications:
 - 1. Electrical supply voltage to the PLC shall be 120 VDC.
 - 2. Vibration: 3.5 mm Peak-to-Peak, 5 - 9 Hz: 1.0G, 9 - 150 Hz. The method of testing is to be based upon IEC 68-2-6 and JIS C 0911 standards for vibration. The system shall be operational during and after testing. Vibration Rating of 2.0G maximum peak acceleration for 10 to 500Hz. in accordance with at least one of the following:
 - a. Installed rating: DIN rail mounted PLC: 10 - 57 Hz, amplitude 0.075 mm, acceleration 25 - 100 Hz.
 - b. Panel or plate mounted PLC: 2 - 25 Hz, amplitude 1.6mm, acceleration 25 - 200 Hz.
 - c. In compliance with IEC 60068 and IEC 61131.
 - 3. Shock: 15G, 11 msec. The method of testing is to be based upon IEC 68-2-27 and JIS C 0912 standards for shock. The system is to be operational during and after testing.
 - 4. Temperature:
 - a. Operating Temperature: 0° to 60 °C (+32° to 140 °F).
 - b. Storage Temperature: -25° to 70 °C (-40° to 185 °F).
 - 5. Relative Humidity:
 - a. Operating Relative Humidity: 10 to 95%, non-condensing.
 - 6. Noise Immunity: Programmable Controller system shall be designed and tested to operate in the high electrical noise environment of an industrial plant as governed by the following regulations: IEEE 472, IEC 801, MILSTD 461B, IEC 255-4, NEMA ICS 2-230.40, and ANSI/IEEE C-37.90A-1978.
 - 7. Altitude:
 - a. Operation: 0 - 6,500 feet.
 - b. Storage: 0 - 9,800 feet.
 - 8. Degree of protection: NEMA 1 (IP20).
 - 9. All products shall have corrosion protection.
- J. All major assemblies and sub-assemblies, circuit boards, and devices shall be identified using permanent labels or markings indicating:
 - 1. Modules product type such as analog or digital.

2. Modules catalog number.
 3. Modules major revision number.
 4. Modules minor revision number.
 5. Module manufacturer vendor.
 6. Module serial number.
- K. All necessary cables shall be included. All cables and connectors shall be as specified by the manufacturer. Cables shall be assembled and installed per the manufacturer recommendations.
- L. Central Processing Unit (CPU):
1. CPU shall be, at a minimum, a 16-bit microprocessor that provides system timing and is responsible for scheduling I/O updates, with no user programming required to ensure discrete or analog update. It shall execute user relay ladder logic programs, communicate with intelligent I/O modules, and perform on-line diagnostics. The CPU shall consist of a single module which solves application logic, stores the application program, stores numerical values related to the application processes and logic, and interfaces to the I/O.
 2. CPU shall sample all the discrete and analog inputs and outputs including internal coils and registers, and service special function modules every scan. The CPU shall process the I/O with user program(s) stored in memory, then control the outputs based on the results of the logic operation.
 3. Supply CPU with a battery-backed time of day clock and calendar.
 4. CPU family shall allow for user program transportability from one CPU model to another.
- M. Diagnostics:
1. CPU shall perform on-line diagnostics that monitor the internal operation of the PLC. If a failure is detected, the CPU shall initiate system shutdown and fail-over. The following, at a minimum, shall be monitored: Memory failure, memory battery low, and general fault, communications port failure, scan time over run, I/O failure, and analog or special function I/O module failure.
 2. All diagnostic information shall be accessible to the host communications interfaces and to the PLC program.
 3. PLC shall have indicators and on-board status area to indicate the following conditions:
 - a. CPU run.
 - b. CPU error or fault.
 - c. I/O failure or configuration fault.
 - d. Status of Battery or back-up power module.
 - e. Communications indicator.

N. Memory:

1. User program and data shall be contained in non-volatile battery backed memory of type CMOS RAM program memory or equivalent.
2. Memory Backup System: provide lithium battery backup or equivalent capable of retaining all memory for a minimum of three months and a Flash memory system capable of reloading program in the event of memory loss.
 - a. Backup Storage: The backup battery or module shall be capable of being replaced without disrupting memory integrity. Provide a visual indication of low battery voltage or module error and an alarm bit in the PLC program.
 - b. Flash or SD Memory Card: Memory card storage capacity shall be equal to or greater than processor memory capacity. Memory cards shall be installed in processors for factory testing.
3. Operating system shall be contained in non-volatile firmware. The memory containing the operating system shall be field updateable via a separate update tool.

O. Programming Environment:

1. Programming port: The PLC shall utilize a serial, USB, or Ethernet port for programming.
2. On-Line programming: Application programs may be modified or stored while the CPU is running, with minimal impact on the scan time.
3. Online programming including runtime editing
4. IEC 61131-3 programming languages supported: Ladder logic, function block, sequential function chart, and structure text.
5. Supply all hardware and software necessary to program the CPU in these languages.

P. Analog and Digital I/O:

1. PLC shall include embedded I/O and/or expansion I/O modules to accommodate project needs.
2. PLC shall support a variety of discrete and analog modules to meet required project I/O

Q. Communication Ports:

1. Include minimum of 1: 10/100 Mbps Ethernet port.
2. The CPU shall be expandable and supplied with additional modules to support the required communication interfaces.

R. Manufacturers:

1. Provide all PLCs, including compact-type and chassis-based type) from a single manufacturer. If the PLC manufacturer has authorized third party vendors to provide modules that are compatible with their platforms, then products manufactured by these authorized third-party vendors will be acceptable.

2. Provide the PLC system by one of the following:
 - a. Rockwell Automation: CompactLogix.L24 Series
 - b. Schneider-Electric: Modicon M340.

2.03 TURBLEX REPLACEMENT CPU

- A. A new Allen-Bradley SLC 5/05 processor shall be provided to replace the existing SLC 5/04 processor at the Glen Cove WWTP. The new processor is provided so that Ethernet communications can be established between the Turblex PLC, the MACP, and the HMI system. The processor model shall be Allen-Bradley 1747-L553. The existing serial connection to the Turblex OIT shall be reconnected to the new CPU.

2.04 PLC SOFTWARE

- A. Provide a PLC configuration and application development software package complete with documentation and disks. The PLC software package and associated licensing and/or activation shall be installed on the computers shown on the Drawings.
- B. Software package shall allow on-line/off-line program development, annotation, monitoring, debugging, uploading, and downloading of programs to the PLCs.
- C. All required hardware (including cables, cable adapters, etc.) for connection to PLCs shall be furnished.
- D. All software licenses required to achieve the functionality described in the Specifications shall be provided.
- E. Software package shall include a software license agreement allowing the Owner the right to use the software as required for any current or future modification, documentation, or development of the PLCs furnished for this project. All licenses must be activated in the Owner's name and be turned over to the Owner at the conclusion of the project.
- F. The customized PLC application shall be provided to the Owner in electronic file format at the conclusion of the project.
- G. Software provided shall be capable of the following IEC 61131-3 functions:
 1. Ladder logic.
 2. Function block.
 3. Sequential function chart.
 4. Structure text.
- H. In addition to the above editors, an add-on instruction editor shall work with any of the above-mentioned editors to create custom reusable function blocks. This software shall allow any of the derived function blocks to be modified on-line.
- I. Software shall be Microsoft Windows-based and run on the supplied computers.

- J. Software shall include a security feature to prevent unauthorized personnel from modifying and downloading the programs.
- K. Provide an I/O simulator which allows the PLC application load program to be tested on a PC with simulated analog and digital inputs and outputs, allowing I/O testing and debugging to be performed in a safe, isolated environment without the need for running the PLC CPU and process I/O boards.
- L. The following software shall be provided:
 - 1. If Rockwell Automation PLCs have been provided, provide RSLogix5000 Professional Edition.
 - 2. If Schneider Electric PLCs have been provided, provide Unity Pro XL Edition.
 - 3. If Emerson PLCs have been provided, provide Proficy Machine Edition.
 - 4. Provide RSLogix 500 for programming of the Turblex PLC.

2.05 OPERATOR INTERFACE TERMINAL (OIT)

- A. OITs shall be mounted on control panels and shall run interface software separate from the HMI software specified in Section 13315.
- B. Manufacturers:
 - 1. Provide operator interface terminals (OIT) of the same manufacturer as the PLC hardware provided. The OIT shall be one of the following:
 - a. Allen-Bradley PanelView Plus Series.
 - b. Emerson Quickpanel+ series.
 - c. Modicon Magelis
- C. Software:
 - 1. Operator Interface Terminal shall be pre-packaged with all configuration and programming software necessary to perform functions as shown on drawings and within the specifications.
 - 2. Integrated OIT software shall have the following features:
 - a. Trending.
 - b. Data Logging.
 - c. Alarms.
 - d. Graphic Symbols.
 - e. Animations.
- D. I/O Ports and Devices:
 - 1. OIT shall have a minimum of one Ethernet 10/100 Mbps for connectivity or programming.
 - 2. OIT shall have a minimum of one Serial RS232 port.
 - 3. Compact flash ports shall be Type 2.

4. OIT shall have a minimum of one USB port.

E. Display:

1. OIT display size:
 - a. OITs mounted in control panels for Glen Cove WWTP shall be 10"
 - b. OITs at the Cedar Creek WPCP shall be 10-15" as indicated on the system architecture drawings.
2. Type of display for the OIT shall be Color Active Matrix TFT.
3. Display resolution shall be a minimum 800 x 600.
4. Display shall support touch screen input.

F. Environmental:

1. Rating: OIT shall be rated to maintain the rating of the control panel it will be mounted in. Refer to the panel schedule in the Appendices to Section 13330 for enclosure environmental ratings.
2. Temperature: Operating temperature range of the OIT shall range 0 - 50 °C.

2.06 SPARE PARTS

A. General requirements for spare parts are specified in Section 13300.

B. The following PLC spare parts shall be furnished:

1. Processors: Provide spare processor unit(s) for each unique processor installed.
2. OIT: Provide spare OITs for each unique type installed.
3. Memory Cards: Provide spares for each type of card installed.
4. I/O Cards: Provide spares for each unique I/O module type installed. Provide two or 10 percent of installed quantity, whichever is greater.
5. Network interface, remote I/O, and communication modules: Provide one spare communication module for each unique communication module installed.
6. Specialty Modules: Provide as a minimum a spare of each type of module identified. Provide an additional spare for every ten modules of a specific type installed.
7. PLC Power supplies: Provide spare power supplies for each unique power supply installed.
8. Chassis: Provide spare chassis for each unique chassis installed.
9. Fixed PLCs: Provide spares for each unique type of PLC installed.

10. Miscellaneous components (including cables): Provide spares for each unique component installed.

PART 3 EXECUTION

3.01 GENERAL INSTALLATION

- A. Maintain area free of dirt and dust during and after installation of programmable controller products.
- B. Anchor PLCs within enclosures as recommended by the PLC manufacturer.
- C. Ventilation slots shall not be blocked or obstructed by any means.
- D. Examine areas, surfaces, and substrates to receive PLCs for compliance with requirements, installation tolerances, and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.
- E. Install in accordance with manufacturer's instructions.
- F. Unload, unpack and transport equipment to prevent damage or loss.
- G. Replace damaged components as directed by Engineer.

3.02 PANEL LAYOUT

- A. Coordinate size and configuration of enclosure to meet project requirements. Drawings indicate maximum dimensions for PLCs, minimum clearances between PLCs, and adjacent surfaces and other items.
- B. Comply with indicated maximum dimensions and clearances, or with PLC vendors required distances if they are greater than the distances indicated.
 1. Provide spacing around PLC as required by the PLC manufacturer to ensure adequate cooling. Ensure that the air surrounding the PLC has been conditioned to maintain the required temperature and humidity range.
 2. Wires entering and exiting PLC components shall be sized to comply with the PLC manufacturers requirements. Doors on all components shall be able to be fully closed when all the wires are installed.
 3. For chassis mounted PLCs, no wiring, wire ducts, or other devices shall obstruct the removal of cards from the rack.
 4. PLC lights, keys, communication ports, and memory card slots shall be accessible at all times. Lights shall be visible at all times when enclosure door is opened.
- C. Control panel designer shall provide independent line fuses or circuit breakers, per the PLC manufacturer recommendation, for each power supply, input module, output module, and other modules with separately derived power requirements.

- D. Control panel designer shall insure that communication signals, 4-20 mA signals (including those with embedded HART), are properly conditioned for the PLC and protected from all sources of radiated energy or harmonics.
- E. Each PLC (including all I/O) shall be powered from the UPS power conditioning system in Section 13335.
- F. Where multiple sets of mechanical equipment are provided for process redundancy, arrange their field connections to I/O modules so that the failure of a single I/O module will not disable the redundant system. This applies to all I/O types. The acceptability of the I/O arrangement shall be at the discretion of the engineer.
- G. Provide all required cables, cords, and connective devices for interface with other control system components.

END OF SECTION

SECTION 13315
HMI SYSTEM SOFTWARE

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Refer to Section 13300.
- B. Furnish and install a Human Machine Interface (HMI) system as shown on the Drawings and as specified herein.
- C. The HMI software shall be purchased as a lump sum per item 3 of the Bid Form section of these contract specifications. . The software shall be purchased from AutomaTech, per Quotation No. 107232-0 and Resolution No. 162-2015 included at the end of this section.

1.02 RELATED WORK

- A. Section 13300 "Instrumentation and Controls - General Provisions."
- B. Section 13310 "Computer System Hardware."

1.03 SUBMITTALS

- A. Refer to Section 13300.
- B. Descriptive literature, bulletins, catalog cuts and drawings for the equipment specified herein.
- C. Complete bill of materials for the equipment.
- D. Any deviation of the hardware or software systems from the preliminary submittal included in the Project Plan shall be described in detail.
- E. Spare parts list.

1.04 WARRANTY

- A. Refer to Section 13300.

1.05 MANUFACTURER SUPPORT

- A. Manufacturer's support of the software shall be included in the contract price for a minimum of two years from the date of purchase. At a minimum, the support shall provide the Owner with:
 - 1. 8 AM to 5 PM, 5 day per week manufacturer telephone support.
 - 2. Access to the manufacturer's technical support website.
 - 3. Software updates.
- B. Manufacturer's support shall be included for the duration of the project for all HMI and historian licenses.

- C. Provide a written proposal for a manufacturer support agreement for all products specified herein for a minimum of 12 months starting at final completion of the project. The cost of this manufacturer support agreement shall not be included in the Contract Price. The support agreement shall be executed in the name of, and for the benefit of, the Owner. At a minimum, this agreement shall provide the Owner with:

- 1. 8 AM to 5 PM, 5 day per week manufacturer telephone support.
- 2. Access to the manufacturer's technical support website.
- 3. Software updates.

1.06 GENERAL LICENSING REQUIREMENTS

- A. All licenses must be activated in the Owner's name and be turned over to the Owner at the conclusion of the project.
- B. Licensing for the Cimplicity and Historian software shall be software through activation servers located on the primary SCADA server.

PART 2 PRODUCTS

2.01 HUMAN MACHINE INTERFACE (HMI) SOFTWARE REQUIREMENTS

- A. General Requirements:
 - 1. HMI software shall be the latest version at time of project plan submittal of one of the following packages and shall be compatible with the operating system supplied with the computers:
 - a. Proficy HMI/SCADA – Cimplicity by GE Intelligent Platforms to satisfy the Nassau County SCADA standards. No alternatives shall be acceptable.
 - 2. HMI software shall have a distributed, client/server system architecture based on OPC and Component Object Technology (COM). This architecture shall employ a local area network (LAN) as the method for communicating among stations, allowing 'client' nodes to be added to view the HMI graphics and data resident on 'server' nodes. The HMI software shall be capable of displaying data from and writing values directly to other nodes from the HMI SCADA server without the need to duplicate the data in the local HMI system.
 - 3. In addition to the client/server networking described in Paragraph 2.01, A, 2, the HMI software shall support the use of terminal services. The user shall be able to have multiple configurations (view-only, view, and configure) without the need to purchase or install separate configurations.
 - 4. There shall be a redundant pair of SCADA servers responsible for the collection of data from the field devices and the distribution of all data to the HMI clients. Upon failure of the primary server the backup shall resume normal operations within 15 seconds without manual intervention. Means shall be provided to allow historical data and alarm log collection without interruption regardless of server switchover. The system shall have the ability for the primary node to come online and be integrated into the system with no

action required by the user, once it is available again. The primary and the backup SCADA server will support the following tasks:

- a. Status of which node is the active server shall be provided to the graphics package (for use in dynamic connections for operator indication).
 - b. Real time Data synchronization: Any data which has been configured for animation or program execution purposes and which does not get updated from the process data, shall also be synchronized from the primary to backup.
 - c. Alarm Synchronization: The alarm queues and alarm acknowledgment information shall be synchronized between the primary and backup SCADA.
5. HMI software shall support alarm synchronization between all server and client nodes. All HMI Client nodes shall display and update the master database held on the SCADA servers and shall display the same alarm information at the same time. It shall not be necessary to acknowledge any alarm at more than one HMI workstation. The system shall have the ability such that acknowledging an alarm at any workstation shall acknowledge that alarm at all workstations.
 6. No HMI client shall communicate directly with the field devices. Data for client display nodes shall be collected from the currently online SCADA server. The runtime client nodes shall include full read/write and supervisory control capabilities. The number of client licenses shall be as shown on System Architecture Drawing and as indicated in the Software Installation Matrix in Section 13310.
 7. Primary Servers shall be supplied with full development software installed whereas the Secondary servers and clients shall be supplied with run-time or view packages. It shall be possible for personnel with adequate security clearance to perform all configuration tasks from the Primary Servers.
 8. HMI software shall permit manual data entry through any of the terminals. This data shall consist entering or changing alarm limits, setpoints, or constants.
 9. HMI software shall provide an open architecture that allows interaction with other programs. It shall provide a mechanism for other programs to access individual data elements and fields within the database in real time. File transfer mechanisms are not acceptable; the access shall be direct to the memory-resident databases held on the SCADA Servers.
 10. VisiconX shall be supported.

B. Licensing Requirements:

CEDAR CREEK WPCP:

1. All licenses must be activated in the Owner's name and be turned over to the Owner at the conclusion of the project.

2. The existing Cimplicity license at the Dewatering Building (Building S) control room with Cimplicity Server Standard Development/Runtime 35,000 point I/O with redundancy shall be exchanged with a software license with the newest revision of Cimplicity Server Unlimited I/O with Development/Runtime with redundancy. The software license shall then be transferred for use with the Primary HMI server (VM-1) as shown on the Drawings and indicated on the Software Installation Matrix as required in Section 13310. The software license shall include I/O drivers that can communicate with the native protocols of the existing Allen Bradley and GE PLCs and the new PLC and equipment provided for this project as well as all of the UPS systems via SNMP protocol (refer to Section 13335). The license shall allow for an unlimited number of graphic displays.
3. The existing Cimplicity license at the Dewatering Building (Building S) control room with Cimplicity Server Standard Runtime 35,000 point I/O with redundancy shall be exchanged with a software license with the newest revision of Cimplicity Server Runtime Unlimited I/O with redundancy. The software license shall then be transferred for use with the Secondary HMI server (VM-2) as shown on the Drawings and indicated on the Software Installation Matrix as required in Section 13310. The software license shall include I/O drivers that can communicate with the native protocols of the existing Allen Bradley and GE PLCs and the new PLC and equipment provided for this project as well as all of the UPS systems via SNMP protocol (refer to Section 13335). The license shall allow for an unlimited number of graphic displays.
4. The servers in the Dewatering Building (Building S) control room currently hosting the redundant pair of Cimplicity Server 35,000 point I/O licenses that are to be moved to VM-1 and VM-2 (see above) shall be provided with HMI runtime viewers (client) licenses. These clients shall have software licenses with the newest revision of Cimplicity Viewer Standard Runtime edition. The license shall allow for an unlimited number of graphic displays.
5. The server currently hosting Cimplicity Server I/O Runtime in the GBT Building shall be converted to an HMI runtime viewer (client). This client shall have a software license with the newest revision of Cimplicity Viewer Standard Runtime edition. The license shall allow for an unlimited number of graphic displays.
6. The redundant pair of Cimplicity Server Unlimited I/O Development/Runtime software licenses in the Generator Building shall be upgraded to the latest revision of Cimplicity Server Unlimited I/O point with Development/Runtime.
7. Five (5) HMI runtime viewer (client) software licenses in the Generator Building shall be upgraded to the newest revision of Cimplicity Viewer Standard Runtime edition.
8. Existing HMI runtime viewer (client) hardware keys shall be exchanged for software licenses with the newest revision of Cimplicity Viewer Standard Runtime edition. The hardware keys to be replaced shall include, but not be limited to:
 - a. PLC-Polymer Industrial Workstation (Building S)
 - b. Odor Control Room Workstation (Building S)
 - c. Programming Laptop
9. The existing HMI runtime viewer (client) license located in the Engine Control Room shall be upgraded to a software license with the newest revision of Cimplicity Viewer Standard

Runtime edition. This license shall then be transferred to the new HMI workstation in the Boiler Control room.

10. Provide a HMI runtime viewer (client) license for each connected operator workstation as shown on Drawings and specified herein, plus one spare. The license shall allow viewing of unlimited I/O points. The license shall allow an unlimited number of graphic displays. Provide three (2) licenses for use with the following:
 - a. Two (2) clients

GLEN COVE WWTP:

11. All licenses must be activated in the Owner's name and be turned over to the Owner at the conclusion of the project.
 12. Provide a HMI development license for the Primary Server as shown on Drawings and indicated on the Software Installation Matrix as required in Section 13310. The license shall include the host redundancy option. The license shall allow viewing and configuration of unlimited I/O points. The license shall allow an unlimited number of graphic displays. Provide one (1) license for use with the following:
 - a. One (1) primary server at Glen Cove Waste Water Treatment Plant
 13. Provide a HMI server license for the Secondary SCADA server as shown on the Drawings and indicated on the Software Installation Matrix as required in Section 13310. The license shall include the host redundancy option. The license shall allow collection of unlimited I/O points and have no licensing restrictions on the number of connected HMI clients. The license shall allow an unlimited number of graphic displays and allow an unlimited number of operator logins available. Provide one (1) license for use with the following:
 - a. One (1) secondary server at Glen Cove Waste Water Treatment Plant
 14. Provide a HMI runtime viewer (client) license for each connected operator workstation as shown on Drawings and specified herein, plus one spare. The license shall allow viewing of unlimited I/O points. The license shall allow an unlimited number of graphic displays. Provide five (5) licenses for use with the following:
 - a. Four (4) clients at Glen Cove Waste Water Treatment Plant
 - b. One (1) spare client.
- C. HMI software shall support sharing data from its database to other databases through SQL queries for real-time data and alarm information.
1. OLE for Process Control (OPC). The HMI software shall be both an OPC client for communicating to any OPC complaint server as well as an OPC server to serve data to any OPC complaint client.
 2. The HMI software shall have scripting embedded as part of the development environment and shall be used for pre-built scripts & custom scripts. It shall also support search and replace and the ability to copy all forms modules and scripts from one object to the next.
 3. OCX or ActiveX. The HMI software shall support the ability to have any third party OCX (ActiveX control) placed into its container. All third party controls shall have the right to behave like any object created by the HMI software. The HMI software shall contain any

bad or misbehaving OCX or ActiveX control and be able to shut down the control without shutting down the graphic picture, system, or Node.

4. HMI software shall support real-time SQL database connectivity.

D. Graphic Displays:

1. Graphic display package shall provide a means of creating and displaying color object-oriented graphic displays that will be used by the operator to monitor and control the process. Real-time values being read from the field devices shall be capable of being displayed in a variety of user-configurable formats.
2. Graphic displays shall be standard Microsoft Windows files and shall be able to be stored on the system disk, a floppy diskette, virtual (RAM) disk or file server, based on user-entered selections. There shall be no limit (other than physical disk size) to the number of displays that can be developed and accessed on-line.
3. Support for displays larger than the size of the monitor shall be provided. If used, graphics should be dynamically re-sized or scroll bars shall be provided to allow the user to move to other areas of the display. Also, support for using Multi Display Screens for viewing graphics shall also be available without any complex configurations or with minimal programming.
4. Graphic display package shall be supplied with a library of common graphic objects and symbols that can readily be incorporated into operator displays.
5. If the HMI manufacturer offers a specialized wastewater package that includes unique symbols and functions to improve graphics development, the package shall be provided.
6. Graphic display package shall be capable of importing graphics from other drawing packages such as CorelDRAW and AutoCAD.
7. Graphic display package shall be capable of importing graphics from Microsoft Windows clipboard.
8. Graphic editor shall be menu driven, and contain standard geometric symbols such as lines, circles, rectangles, etc., making creation, modification and copying of graphics a simple task. The graphic editor shall be provided with "wizards" and other scripting functions to reduce screen development time.
9. Animation connections shall be constructed using an intuitive Point and Click interface for point configuration without additional user configuration.
10. Graphic editor shall have capability of multiple dynamics of differing type to be applied to the same object (e.g., a size dynamic, and a color dynamic both added to a rectangle).
11. A method shall be provided for allowing graphics objects or groups of objects to be re-used easily. It shall allow the developer to insert native language prompts that request appropriate tag or other animation information whenever the object or grouped object is reused in another graphic display. These objects, either single or grouped, shall be intelligent, Windows wizard-like objects, so that it is possible to have a single prompt

request and substitution. A method shall be provided to update all these wizards used in the application if the Master object from the library is updated.

E. Trend System:

1. Dynamic trend displays shall plot at least eight user selectable analog values in an x-y format, with each plot using a unique color. Trends shall be plotted using current or historical information, with the ability to trend backward or forward from that time reference using a single command. The user shall be able to request exact numeric values for any point in the trend by moving the mouse to the point in the graphic. The trend displays shall use shading to emphasize when a particular point crosses a reference value.
2. Trending system shall be capable of creating transparent trends so that real-time and historical data can be directly compared.
3. It shall be possible to display each trend pen with a different y-axis scale complete with engineering units.
4. It shall be possible to "zoom" in on data as highlighted by an operator selectable window.
5. It shall be possible to export all trend information to a data file that is readily accessible from standard spreadsheet packages.
6. It shall be possible to display historical data, data from text files generated with standard spread sheet software packages, and SQL linked data from relational databases all on the same trend.

F. Database:

1. Database development package shall include the ability to add tags that provide access and control of all PLC data by bit and register.
2. Various input/output hardware assignments, as well as processing functions, shall be assigned to named tags or "function blocks." Multiple tags can be tied together to perform more complex functions. As an alternative, the database may be built by browsing third party OPCServers, and selecting the required tags. It shall not be necessary to type or otherwise manually enter any part of the OPC tag or addressing information to build the database. The database building tool shall support the import of OPC Tag groups as a single action, as well as individual tags.

G. Alarm and Event System:

1. Software package shall perform alarm monitoring of discrete and analog inputs/outputs. Alarms shall be capable of being assigned to one of three severity categories with each category producing a distinct sound via the System speaker.
2. In order to logically divide a process into smaller units, the system shall allow for named individual alarm areas to be defined. These alarm areas shall be definable on an individual tag level. All alarm areas shall be accessible by each tag.

3. Alarm condition shall be specified as a discrete input or output change of state, analog values above and below limits, high or low analog rate-of-changes as defined in the database, or failed communication link.
4. System shall print a descriptive message with a time stamp and user ID on the alarm printer or to an alarm file whenever any of the following events occur:
 - a. Alarm.
 - b. Alarm acknowledgment.
 - c. Data entry into a tag.
 - d. Restarting the HMI software.

H. Error Detection, Recovery, and Diagnostics:

1. Software driver shall provide on-line diagnostics that display the current status and operation of the local area network and its nodes. The diagnostic display shall include the LAN adapter status for the machine showing the display, as well as the current number of messages, errors and retries.
2. HMI software shall automatically detect and recover from any network condition or software problem that results in a failure of communications between the HMI client and the SCADA server(s) or between the SCADA server and I/O devices. It shall be possible to log all connection/disconnection events of sessions between the SCADA server and clients.
3. If network communications errors are detected, the software shall automatically indicate that the data (on graphic displays, in historical files, etc.) is no longer valid and shall replace the invalid data with user defined characters or pre-defined status text. The HMI software shall automatically attempt to re-establish communications, and, if successful, shall then replace the characters with valid data. This capability shall be built-in to the software and shall not require any user programming or other user-dependent actions to implement.

I. Print Facilities:

1. Operator interface software shall support at least one alarm/event printer and one report printer. Printers shall support network (Ethernet based) printers.

J. Historical Data:

1. System shall provide for archival of all historical data. Data shall be archived for long-term storage and retrieval. The long-term historical data to be archived shall be stored in an OLE DB compliant file format to facilitate access to operator activity, system events, alarm messages, and point values using relational-database compatible software for data analysis, reporting and archiving. Short-term historical data (less than 90 days) may be stored in a format readily accessible to the HMI software.
2. System shall be capable of logging all system activity such as command and macro usage, operator comments, system errors, system messages, and communication network errors, if selected by the operator/system administrator.
3. System shall provide for automatic purging of short-term historical data files.

4. Data Quality: Data Quality flags shall be provided to indicate the quality of all data points stored in any data archive.
5. Manual Input Data Handling: This data shall consist of additional values not obtainable by the SCADA system such as laboratory analysis for use in reports. All manually entered data shall be entered and stored in the appropriate engineering units.

K. Security:

1. HMI software shall provide a minimum of four levels of security to prevent unauthorized usage or modification of the system.
2. Operator interface functions such as commands, macros, graphic displays, OLE objects, and point IDs shall be capable of each being assigned a separate security level.
3. After a predetermined time of no operator activity, which is adjustable by the system administrator, the operator workstation shall default to the lowest system security.
4. Software package shall provide the ability to "lock" a user into the runtime graphics environment. Specifically, disabling any combination of the following shall be supported:
 - a. Starting other applications.
 - b. Switching to other applications that may be running.
 - c. Exiting from the software package.
 - d. Keystrokes (i.e., <Ctrl><Alt><Delete>, <Alt><Tab>).
 - e. Switching to graphics configuration mode.

L. I/O Device Communications:

1. A software driver shall be supplied to communicate with every type of device shown on the systems architecture drawings. The communications driver shall be configurable on-line.
2. Software package shall include an I/O driver capable of performing all scanning of PLC data tables for transferring analog and discrete data to and from the PLCs. The Driver shall allow scanning of an unlimited number of tags. Driver shall include capability to communicate via native Allen Bradley and GE protocols for existing equipment. Additional protocol families shall be provided as required to connect all equipment connected to the SCADA network as shown on the system architecture drawings. Scan periods shall be adjustable to ensure that the PC/PLC communications is scanning at the fastest possible time increment, without data degradation. All communications between the PLCs and the operator interface software shall use the Local Area Network (LAN) directly.
3. Use of Microsoft OPC 2.0 or later shall be supported. The OPC Server shall have the capability to be used for PLC communication.
4. Device communications program shall perform error checking on messages such as lost response (time-out) and data error (checksum, LRC, CRC, etc.). If communications errors are detected, the software shall automatically indicate that the data (on graphic displays, in historical files, etc.) is no longer valid. The invalid data shall be replaced with user-defined characters or pre-defined text. The HMI software shall automatically attempt to re-establish communications, and, if successful, shall then replace the characters with valid data. These

capabilities shall be built-in to the software and shall not require any user programming or other actions to implement. Failover to a user-configurable back-up port shall be provided as a function of the driver.

5. Software driver shall include a diagnostic program capable of running on-line or off-line that can monitor message rates from the communication program. The diagnostic program shall display the number of new messages, retries, time-outs, any occurrences of error, and the specific error code.

2.02 HISTORIAN SOFTWARE

A. General:

1. Historian software shall be a separate software package from the HMI. It shall run on a server as shown on the System Architecture Drawing.
2. Historian software shall store time series data.
3. Use of the Historian to serve data to HMI client trend screens shall be acceptable if this is a native feature of the Historian.

B. Data Storage:

1. Data shall be directly stored in a standard enterprise database management system (DBMS). Data shall be directly stored in the DBMS, i.e., not passed through systems such as Microsoft Access and linked via ODBC or other mechanism into the DBMS. To insure stable operation of the network, the architecture shall incorporate native utilization of the enterprise database platform including stored procedures, triggers, and tuned indexes will allow for your facility.
2. DBMS shall feature high-speed data collection and retrieval, precise time stamp resolution, and multiple time zone support.
3. DBMS shall have a fault-tolerant architecture including the ability to 'store and forward' and automatically reconnect.
4. Where redundant historical servers are included in the project design, all software licenses shall be included to provide full redundant functionality for those servers.
5. Where a Network Attached Storage (NAS) device is provided, historical data shall be automatically backed up using the archive manager tool.

C. Licensing Requirements:

1. Provide a Historian license for each Historian Server shown on Drawings and indicated on the Software Installation Matrix as required in Section 13310. The license shall allow historical collection of 5,000 tags and have at least 5 connected HMI clients. The license shall allow an unlimited number of alarm and event archiving. The historian shall be capable of collecting data from either redundant server in the event of a server failure. Any additional licensing required to provide support for redundancy shall be provided. Provide one (1) license for use with the following:

a. One (1) Historian server at Glen Cove Waste Water Treatment Plant

D. Historian software shall be the latest version of Proficy Historian by GE Intelligent Platforms to satisfy the Nassau County SCADA standards. No alternatives shall be acceptable.

PART 3 EXECUTION

3.01 GENERAL

A. Refer to Section 13300.

END OF SECTION

152
309

RESOLUTION NO. 162 - 2015

**A RESOLUTION AUTHORIZING THE STANDARDIZATION OF SCADA
SYSTEM HMI SOFTWARE PLATFORM FOR ALL COUNTY WASTEWATER
FACILITIES PURSUANT TO NEW YORK STATE GENERAL MUNICIPAL LAW
SECTION 103(5)**

Passed by Nassau County Legislature on
9/21/15 A voice vote was taken with 18
Legislators present.
Voting: aye 18, nay 0, abstained 0, recused 0
Became a resolution on
With the approval of the County Executive

APPROVED AS TO FORM
Deputy County Attorney

WHEREAS, the Department of Public Works is preparing bid specifications for the Supervisory Control and Data Acquisition (SCADA) improvements for the County owned wastewater treatment plants and various pumping stations; and

WHEREAS, the Department represents that a critical aspect of the SCADA improvements is the human machine interface (HMI) software platform; and

WHEREAS, based upon its experience operating the County's wastewater facilities, and its review of HMI software, the Department has concluded that it is essential that the software platform that serves as the primary HMI system for multiple treatment plants, as well as remote facilities (i.e. pump stations), should be the same across all of the facilities. Based upon its knowledge and experience the Department represents that a single HMI platform is critical for the following reasons:

- A single HMI platform allows the operations and maintenance staff to be trained

on a single software package. Having multiple software types would require plant staff to be trained and knowledgeable in the operating, maintaining, and configuring of multiple systems.

- Standardization will be difficult when multiple HMI platforms are used. Symbols may appear and animate differently; and, alarms on the two (2) systems will likely function differently in how they appear and how they are acknowledged; and, HMI security will likely function differently on different platforms. These differences may increase the chances for an error to occur in the operation of the facilities.
- Any needed third-party software applications, such as a computerized maintenance management system, will need to be compatible with the HMI software. If multiple HMI platforms are utilized, it is likely that compatibility issues will arise.
- Multiple HMI software platforms would likely have differing hardware requirements, would necessitate multiple software support agreements, and require additional time and effort for maintenance and upgrades, etc.; all resulting in increased costs; and

WHEREAS, as represented by the Department, the wastewater facilities already utilize software developed by GE Cimplicity for the control of several individual processes (local control stations), the Department strongly advocates expanding the use of GE Cimplicity for the HMI platform to eliminate the need to modify the existing local control stations and continues use of software with which the operations staff is already familiar; and

WHEREAS, New York General Municipal Law § 103(5) provides that this Legislature may adopt a resolution by a three-fifths vote of its members authorizing standardization of equipment, now therefore, be it

RESOLVED, that this Legislature hereby approves and authorizes the standardization of the HMI software platform for all County wastewater facilities for

reasons of efficiency and economy as set forth herein and in accordance with New York State General Municipal Law § 103(5); and be it further

RESOLVED, that based on the representations of the Department of Public Works and the recommendation of the Commissioner of the Department, the County Executive is authorized to standardize the HMI software platform for all County wastewater facilities and specify the purchase and installation of GE Cimplicity software.

APPROVED


County Executive

DATE

9/28/15



We Make Plant Information Flow

138 Industrial Park Road Plymouth, MA 02360

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QUOTATION

Number	107232-0
Revision	03/04/2020 11:12:32
Quote Date	03/04/2020
Page	1

Quote valid for 30 days.

Freight & taxes not included.

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Quote Valid through 05/31/2021

Quotation is prepared for the "Nassau County Cedar Creek WPCP and Glen Cove WWTP SCADA System Improvement Contractor" who shall be the project's general contractor or the Process Control System supplier subcontractor/vendor.

**All part number changes are due to being the latest version of software.

**Acceleration Plan (Support) is quoted for 3 years.

Purchase order to be made out to GE Digital C/O AutomaTech as GE will invoice directly.

Presented To		Job/Rel #	Quoted By	Terms	Ship Via	Salesman
MATTHEW LICK		Nassau County	Jessica Buonopane	Net 30 Days	FOB Factory	Robert Kulick
Quantity	U/M	Description			Price	Extension
		Item #	ORDERING INSTRUCTIONS Purchase order made out to GE DIGITAL and emailed to orders@automatech.com. Please include full end user contact information for registration and reference quote number above. GE Terms & Conditions apply unless Customer & GE have signed and agreed upon Terms & Conditions which override standard T&Cs. GLEN COVE LICENSING			
1	EA	COMMENT	PRIMARY			
1	EA	CI110SSDUNLIMEN-R	Cimplicity v11.0 Server Standard Development/Runtime Unlimited Points, English, Redundancy			\$12,205.44 \$12,205.44
1	EA	APN-PREM-PER-AUTO-BDL	Acceleration Plan Support Bundle - Premier Level for Automation Annual Contract 3 Years of Support			\$5,858.61 \$5,858.61
1	ea	DR-G00P253V0QK	Drivers IGS- Industrial Gateway Server for Basic Points 253 Additional IGS Protocols IOT Gateway plug in No Tags IGS Premier SNMP Suite-SNMP and Ping			\$3,782.50 \$3,782.50
1	EA	APN-PREM-PER-AUTO-BDL	Acceleration Plan Support Bundle - Premier Level for			\$1,666.08 \$1,666.08

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QUOTATION

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MATTHEW LICK	Nassau County	Jessica Buonopane	Net 30 Days	FOB Factory	Robert Kulick
Quantity	U/M	Item #	Description	Price	Extension
			Automation Annual Contract 3 Years of Support		
1	EA	COMMENT	BACKUP	\$0.00	\$0.00
1	EA	CI110SSRUNLIMEN-R	Cimlicity v11.0 Server Standard Runtime, Unlimited Points, English, Redundancy	\$4,324.32	\$4,324.32
1	EA	APN-PREM-PER-AUTO-BDL	Acceleration Plan Support Bundle - Premier Level for Automation Annual Contract 3 Years of Support	\$2,075.67	\$2,075.67
1	ea	DR-G00P253V0QK	Drivers IGS- Industrial Gateway Server for Basic Points 253 Additional IGS Protocols IOT Gateway plug in No Tags IGS Premier SNMP Suite-SNMP and Ping	\$1,891.25	\$1,891.25
1	EA	APN-PREM-PER-AUTO-BDL	Acceleration Plan Support Bundle - Premier Level for Automation Annual Contract 3 Years of Support	\$833.04	\$833.04
1	EA	COMMENT	RUNTIME VIEWERS (4) for Glen Cove WWTP (1) Spare Client	\$0.00	\$0.00
5	EA	CI110VRSEN	Cimlicity v11.0 Viewer Runtime Standard Viewer English	\$1,129.44	\$5,647.20
5	EA	APN-PREM-PER-AUTO-BDL	Acceleration Plan Support Bundle - Premier Level for Automation Annual Contract 3 Years of Support	\$542.13	\$2,710.65
1	EA	COMMENT	HISTORIAN	\$0.00	\$0.00
1	EA	HS80S0000500000-A	Historian v8.0 Standard 5000 Points with Alarms & Events	\$20,450.06	\$20,450.06
1	EA	APN-PREM-PER-AUTO-BDL	Acceleration Plan Support Bundle - Premier Level for Automation Annual Contract 3 Years of Support	\$9,816.02	\$9,816.02

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Glen Cove Subtotal \$71,260.84

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Page	3

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Quantity	U/M	Item #	Description	Price	Extension	

			CEDAR CREEK UPGRADE LICENSING			
1	EA	COMMENT	Upgrade/Replace 200239389 PRIMARY	\$0.00	\$0.00	
1	EA	CI110SSDUNLIMEN-R	Cimplicity v11.0 Server Standard Development/Runtime Unlimited Points, Englsih, Redundancy	\$6,102.72	\$6,102.72	
1	EA	APN-PREM-PER-AUTO-BDL	Acceleration Plan Support Bundle - Premier Level for Automation Annual Contract 3 Years of Support	\$5,858.61	\$5,858.61	
1	EA	DR-G00P253V0	Drivers IGS-Industrial Gateway Server For Basic Points 253 Additional IGS Protocols No IOT Gateway Plugin Tags	\$488.75	\$488.75	
1	EA	APN-PREM-PER-AUTO-BDL	Acceleration Plan Support Bundle - Premier Level for Automation Annual Contract 3 Years of Support	\$430.56	\$430.56	
1	EA	COMMENT	Upgrade/Replace 200239395 BACKUP	\$0.00	\$0.00	
1	EA	CI110SSRUNLIMEN-R	Cimplicity v11.0 Server Standard Runtime, Unlimited Points, Englsih, Redundancy	\$2,162.16	\$2,162.16	
1	EA	APN-PREM-PER-AUTO-BDL	Acceleration Plan Support Bundle - Premier Level for Automation Annual Contract 3 Years of Support	\$2,075.67	\$2,075.67	
1	EA	DR-G00P253V0	Drivers IGS-Industrial Gateway Server For Basic Points 253 Additional IGS Protocols No IOT Gateway Plugin Tags	\$244.80	\$244.80	
1	EA	APN-PREM-PER-AUTO-BDL	Acceleration Plan Support Bundle - Premier Level for Automation Annual Contract	\$215.28	\$215.28	

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Page	4

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Quantity	U/M	Item #	Description	Price	Extension	
			3 Years of Support			
1	EA	COMMENT	Upgrade/Replace 200239390-394	\$0.00	\$0.00	
5	EA	CI110VRSEN	Cimlicity v11.0 Viewer Runtime Standard Viewer English	\$564.72	\$2,823.60	
5	EA	APN-PREM-PER-AUTO-BDL	Acceleration Plan Support Bundle - Premier Level for Automation Annual Contract 3 Years of Support	\$542.13	\$2,710.65	
1	EA	COMMENT	Upgrade/Replace 200253425	\$0.00	\$0.00	
1	EA	CI110VRSEN	Cimlicity v11.0 Viewer Runtime Standard Viewer English	\$564.72	\$564.72	
1	EA	APN-PREM-PER-AUTO-BDL	Acceleration Plan Support Bundle - Premier Level for Automation Annual Contract 3 Years of Support	\$542.13	\$542.13	
1	EA	COMMENT	NEW License for Programming Laptop	\$0.00	\$0.00	
1	EA	CI110VRSEN	Cimlicity v11.0 Viewer Runtime Standard Viewer English	\$1,129.44	\$1,129.44	
1	EA	APN-PREM-PER-AUTO-BDL	Acceleration Plan Support Bundle - Premier Level for Automation Annual Contract 3 Years of Support	\$542.13	\$542.13	
1	EA	COMMENT	Upgrade/Replace 200212701 & 100341927	\$0.00	\$0.00	
2	EA	CI110VRSEN	Cimlicity v11.0 Viewer Runtime Standard Viewer English	\$564.72	\$1,129.44	
2	EA	APN-PREM-PER-AUTO-BDL	Acceleration Plan Support Bundle - Premier Level for Automation Annual Contract 3 Years of Support	\$542.13	\$1,084.26	
1	EA	COMMENT	NEW Runtime Clients	\$0.00	\$0.00	

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Number	107232-0
Revision	03/04/2020 11:12:35
Quote Date	03/04/2020
Page	5

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MATTHEW LICK		Nassau County	Jessica Buonopane	Net 30 Days	FOB Factory	Robert Kulick
Quantity	U/M	Item #	Description	Price	Extension	
2	EA	CI110VRSEN	Cimlicity v11.0 Viewer Runtime Standard Viewer English	\$1,129.44	\$2,258.88	
2	EA	APN-PREM-PER-AUTO-BDL	Acceleration Plan Support Bundle - Premier Level for Automation Annual Contract 3 Years of Support	\$542.13	\$1,084.26	
1	EA	COMMENT	Upgrade/Replace 100320908 Step up to UNL - PRIMARY	\$0.00	\$0.00	
1	EA	CI110SSDUNLIMEN-R	Cimlicity v11.0 Server Standard Development/Runtime Unlimited Points, English, Redundancy	\$7,054.32	\$7,054.32	
1	EA	APN-PREM-PER-AUTO-BDL	Acceleration Plan Support Bundle - Premier Level for Automation Annual Contract 3 Years of Support	\$5,853.26	\$5,853.26	
1	ea	DR-G00P253V0QK	Drivers IGS- Industrial Gateway Server for Basic Points 253 Additional IGS Protocols IOT Gateway plug in No Tags IGS Premier SNMP Suite-SNMP and Ping	\$3,782.50	\$3,782.50	
1	EA	APN-PREM-PER-AUTO-BDL	Acceleration Plan Support Bundle - Premier Level for Automation Annual Contract 3 Years of Support	\$1,666.08	\$1,666.08	
1	EA	COMMENT	Upgrade/Replace 100320910 Step up to UNL - BACKUP	\$0.00	\$0.00	
1	EA	CI110SSRUNLIMEN-R	Cimlicity v11.0 Server Standard Runtime, Unlimited Points, English, Redundancy	\$2,348.58	\$2,348.58	
1	EA	APN-PREM-PER-AUTO-BDL	Acceleration Plan Support Bundle - Premier Level for Automation Annual Contract 3 Years of Support	\$2,073.78	\$2,073.78	
1	ea	DR-G00P253V0QK	Drivers IGS- Industrial Gateway Server for Basic Points 253 Additional IGS Protocols IOT Gateway plug in No Tags	\$1,891.25	\$1,891.25	

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QUOTATION

Number	107232-0
Revision	03/04/2020 11:12:36
Quote Date	03/04/2020
Page	6

Quote valid for 30 days.

Freight & taxes not included.

Orders ship FOB Factory.

Bill to: CDM Smith, Inc
100 Crossways Park Drive West
Suite 415
Woodbury, NY 11797

Ship to: CDM Smith, Inc
60 Crossways Park West
Suite 340
Woodbury, NY 11797

Presented To	Job/Rel #	Quoted By	Terms	Ship Via	Salesman
MATTHEW LICK	Nassau County	Jessica Buonopane	Net 30 Days	FOB Factory	Robert Kulick
Quantity	U/M	Item #	Description	Price	Extension

			IGS Premier SNMP Suite-SNMP and Ping		
1	EA	APN-PREM-PER-AUTO-BDL	Acceleration Plan Support Bundle - Premier Level for Automation Annual Contract 3 Years of Support	\$833.04	\$833.04
1	EA	COMMENT	NEW Runtime Viewers	\$0.00	\$0.00
2	EA	CI110VRSEN	Cimplicity v11.0 Viewer Runtime Standard Viewer English	\$1,129.44	\$2,258.88
2	EA	APN-PREM-PER-AUTO-BDL	Acceleration Plan Support Bundle - Premier Level for Automation Annual Contract 3 Years of Support	\$542.13	\$1,084.26
1	EA	COMMENT	Upgrade/Replace 200012109	\$0.00	\$0.00
1	EA	CI110VRSEN	Cimplicity v11.0 Viewer Runtime Standard Viewer English	\$564.72	\$564.72
1	EA	APN-PREM-PER-AUTO-BDL	Acceleration Plan Support Bundle - Premier Level for Automation Annual Contract 3 Years of Support	\$542.13	\$542.13
				Cedar Creek Subtotal \$61,400.87	

Please note remit address may have changed;
please confirm correct vendor and remit address
on ordering instructions included with this quote.

Total \$132,661.70

SECTION 13316
ADDITIONAL SCADA SYSTEM SOFTWARE

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Refer to Section 13300.
- B. Furnish and install additional software to provide required functionality as shown on the Drawings and as specified herein.

1.02 RELATED WORK

- A. Section 13300 "Instrumentation and Controls - General Provisions."
- B. Section 13310 "Computer System Hardware."

1.03 SUBMITTALS

- A. Refer to Section 13300.
- B. Descriptive literature, bulletins, catalog cuts and drawings for the equipment specified herein.
- C. Complete bill of materials for the equipment and software.
- D. Any deviation of the hardware or software systems from the preliminary submittal included in the Project Plan shall be described in detail.
- E. Spare parts list.

1.04 WARRANTY

- A. Refer to Section 13300.

1.05 MANUFACTURER SUPPORT

- A. Provide a written proposal for a manufacturer support agreement for all products specified herein for a minimum of 12 months starting at final completion of the project. The cost of this manufacturer support agreement shall not be included in the Contract Price. The support agreement shall be executed in the name of, and for the benefit of, the Owner. At a minimum, this agreement shall provide the Owner with:
 - 1. 8 AM to 5 PM, 5 day per week manufacturer telephone support.
 - 2. Access to the manufacturer's technical support website.
 - 3. Software updates.

1.06 GENERAL LICENSING REQUIREMENTS

- A. All licenses must be activated in the Owner's name and be turned over to the Owner at the conclusion of the project.

PART 2 PRODUCTS

2.01 SOFTWARE ALARM DIALERS

- A. General: Software shall be capable of being used with email, cell phones, and Voice over Internet Protocol (VoIP) calling. The software shall communicate directly with the SCADA database. It shall be able to communicate with the Cimplicity HMI software specified in Section 13315. It shall come equipped with security options.
- B. Function: Software shall provide real-time alarm notification telephone via VoIP calling. VoIP connection shall be established by coordinating with the plant Operator's IT department. SMS shall be sent via email (using the email-to-text feature provided by the user's cell phone provider) and email notifications shall be configured. Email connections shall be established by proper configuration of firewall rules which shall allow a connection the Owner and Operators mail servers for email, and cell provider email servers for email to text. A list of phone numbers, email addresses, and cell phone numbers and cell carrier information shall be provided by the Owner and Operator. The firewall shall also be configured to allow an acknowledgement response from contacted personnel.
 - 1. Notifications shall be configured for a minimum of 15 users to be contacted via phone, text, and email services. Each user shall be configured to be contacted during designated times during the day. A list of users, phone numbers, email addresses, and contact periods shall be provided by the Owner and Operator.
- C. Manufacturer: Software shall be the latest version of the following:
 - 1. WIN-911 Enterprise Edition software by Specter Instruments.
 - 2. Or equal.
- D. Physical Hardware: The software shall be accompanied by a compatible modem, as recommended by the manufacturer, to allow the software and computer to dial pagers and phone systems. The modem shall be provided with an analog to digital IP converter such that is compatible with the redundant rack mountable server.

2.02 REPORTING SOFTWARE

- A. General:
 - 1. Reporting software shall be a separate software package from the HMI. It shall run on the Historian server as shown on the Drawings.
 - 2. Reporting software shall be licensed to allow at least two concurrent users and development for at least ten report templates.

3. Additional licenses, if required for the reporting package, shall be provided to include support for the selected HMI software.
4. Reporting software shall be provided with a minimum of 1 year of support from the manufacturer.
5. Reporting software shall allow for reports to be created from data stored in the Historian's archives.

B. Reports:

1. Process report generation software shall provide the means to process and store data for historical records. Software shall be flexible so that contents of the reports can be easily modified. The software shall provide for collecting, processing and storing values.
2. Reporting software shall be the latest version of the following:
 - a. Hach WIMS
 - b. XLReporter Professional Edition by SyTech.
 - c. Or equal.
3. An interface shall be provided to the HMI software/Historian for automatic collection of daily/hourly/15 minute/one minute summarized data from historical file. Interfaces shall run with no user intervention and shall be able to be run as a Windows Service.
4. Following data collection functions shall be provided:
 - a. Instantaneous values may be collected based on the change value of the data point.
 - b. Instantaneous values shall be averaged every 15 minutes. For some state reports, this 15-minute data will be retained.
 - c. 15 minute averages shall be maintained for 72 hours.
 - d. 15 minute averages shall be reduced to hourly averages and maintained for 60 days.
 - e. Hourly averages shall be reduced to daily averages and maintained for 18 months.
5. For each 24-hour period, the maximum and minimum values and totalized value for flow signals shall be maintained for 18 months.
6. All averages shall have the capability of being archived to removable media.
7. Capability shall be provided to obtain log information on demand for screen display and archival to removable media.
8. Reporting software shall be able to interface with the HMI Software and Historian Software and shall be compatible with the operating system supplied with the computers.
9. A calculation extension capability shall be provided to perform calculations on data that have been accumulated for report generation. Calculations shall include:
 - a. Standard operators (+, -, *, and /).
 - b. Functions (abs, retrieve forward or backward any day, exponential and logs, reciprocal, round, if-then-else, averages, and summations for daily, moving, weekly, monthly, and fiscal periods).
 - c. Difference (with specified rollover or without).

10. Reporting system shall generate reports from process and operation data stored in historical files or a database. The reporting software shall retrieve these data upon specifying a time period.
11. Date and time configuration shall be developed to meet the facility requirements. For example, a "day range" may start at 7:00:00 AM and end at 6:59:59 AM instead of midnight.
12. Reports shall be capable of being initiated automatically based upon time of day, month and year, or by event trigger. Reports shall also be capable of being generated manually upon operator'(s) request.
13. When the reports are generated manually, the reporting system shall be able to interface with the operator(s) through the HMI software to generate the needed reports. The operator interface should prompt the user to enter a day, a month and a year to retrieve the data.
14. User interface displays shall allow the operator to define the destination of the report (e.g., display, printer, computer file, email, etc.) and when it is to be printed (e.g., immediately, on demand, or automatically at a specified time).
15. Reporting system shall start automatically when re-starting the workstation to ensure data is not lost during power fail or system fail.
16. Reporting system shall include several security settings that will give permissions to develop and modify data while limiting unauthorized access to data monitoring and/or data entry.
17. It shall be possible to print data quality tags alongside the value.

PART 3 EXECUTION

3.01 GENERAL

- A. Refer to Section 13300.

END OF SECTION

SECTION 13320
CONTROL AND DATA NETWORK EQUIPMENT

PART 1 GENERAL

1.01 PCSS SCOPE OF WORK

- A. The following shall apply to both the Cedar Creek WPCP and Glen Cove WWTP
1. Furnish the labor and materials, including fiber optic communication enclosures (FOCEs), patch panels, network switches, etc., required to install and bring into operation the control and data network as shown on the Drawings and specified herein.
 2. The network shall be capable of supporting communications between all servers, operator workstations, operator interface terminals, programmable logic controllers (PLCs), remote I/O (RIO) racks, and other communication devices as shown on the system architecture block diagram(s). The main plant network shall be configured as a fault-tolerant ring topology such that if there is a break in the fiber optic cable or the loss of an Ethernet switch, the network shall continue to communicate by re-routing the data packets. The Ethernet switches shall be configured using rapid spanning tree protocol (RSTP) or a similar protocol to accomplish the fault tolerant feature.
 3. Furnish all necessary cables, face plates, connectors, modems, transceivers, repeaters, modules; splice kits, etc. required for a complete and operational network. The system architecture diagram(s) are for network understanding only. Some communication devices may be required for network operation, which may not be explicitly shown on the Drawings. The PCSS shall be responsible for setting up the Local Area Network in order to establish a functional SCADA network that seamlessly connects all buildings into one network.
 4. The Cedar Creek and Bay Park plants have an existing partial networking scheme that was created for equipment added under a previous project. The PCSS shall create a networking scheme for the Cedar Creek and Glen Cove plants which does not conflict with the existing equipment or scheme. The network scheme shall include subnets and virtual LANs (VLANs) for each location or area. Subnets shall be no larger than 510 hosts (/23 net mask). All IP addresses shall reside in the 172.16.0.0 thru 172.31.255.255 address ranges as coordinated with the Owner during construction. The existing networking scheme shall be provided to the PCSS for use when creating the networking scheme under this project. Existing devices with IP addresses shall be included in the scheme to avoid conflicts. Layer 3 routing shall be configured such that devices needing to communicate between subnets shall be established. Communication between subnets shall be minimized. The subnets shall include dedicated IP addressing ranges for each area and shall include existing and new equipment and reserved spare IP addresses for future equipment.
 - a. The SCADA network at the Cedar Creek and Glen Cove plants shall be configured in a hierarchy as described in ISA-95. This hierarchy is commonly referred to as the Purdue reference model.

- B. In addition to the general requirements, provide the following networking configuration specific to the Cedar Creek WPCP
 - 1. The networking scheme shall include the following VLANs at a minimum. Any routing required between VLANs shall be configured on the existing Layer 3 Ethernet switches (UWLISCADACCES01 and UWLISCADACCES02) mounted in the Server Rack in the Admin Building Computer Room.
 - a. Cedar Creek Plant SCADA Network
 - b. Cedar Creek HVAC Network
 - c. Cedar Creek Digester RIO Network
 - d. Cedar Creek Power Monitoring Equipment
 - e. Cedar Creek Wireless Lan (WLAN)
 - 2. Virtual networking configuration shall be performed on the existing Fault Tolerant SCADA servers to ensure that data is transmitted properly. The virtual network connection shall be a minimum of 1Gbps.
- C. In addition to the general requirements, provide the following networking configuration specific to the Glen Cove WWTP
 - 1. Virtual networking configuration shall be performed on the Fault Tolerant SCADA servers to ensure that data is transmitted properly. The virtual network connection shall be a minimum of 1Gbps.
 - 2. Furnish, configuration, installation, and testing of the VPN/Firewall equipment necessary to connect the Glen Cove, Cedar Creek, and Bay Park plants as indicated on the drawings and specified herein.

1.02 RELATED WORK

- A. Fiber optic cable and conduit are specified in Section 13321.
- B. Refer to the drawing package for network architecture drawings, cable and conduit routing, and equipment locations.
- C. Refer to Section 13300 "Instrumentation and Controls - General Provisions."
- D. Refer to Section 13320 "Appendix A - Cedar Creek WPCP Schedule of 19" Enclosures."
- E. Refer to Section 13320 "Appendix B - Glen Cove WWTP Schedule of 19" Enclosures."

1.03 SUBMITTALS

- A. Refer to Section 13300.
- B. Descriptive literature, bulletins, catalog cuts and Drawings for the equipment specified herein.
- C. Complete bill of materials for the equipment.
- D. Spare parts list.

- E. Complete system architecture diagram showing in schematic form, the interconnections between major hardware components including control centers, panels, power supplies, consoles, computer and peripheral devices, networking equipment, processors, I/O modules, local operator interfaces, process equipment vendor controllers, and like equipment. The system architecture shall be complete and shall depict all required cables, media type between components, network protocol used at each network level, details on connection requirements such as cable pinouts, port numbers, and rack slot numbers. The intent of this specification requirement is to develop a diagram that is complete in every aspect to allow purchase of all required equipment by part number, and to allow a qualified technician to interconnect all equipment without having to refer to additional manuals or literature. Sheet size shall be 11"x17" and using more than one sheet is acceptable.
- F. Detailed drawing of each fiber optic communication enclosure depicting the CAT6 connections from the field devices to the CAT6 patch panel (CPP) and from the CPP to the Ethernet Switch. Details for each port on the Ethernet switch shall be defined, including VLAN assignments, the connected device, and the full IP address of the device.
- G. Requirements for diagrams of the fiber connections within the FOCEs are detailed in Section 13321.

1.04 REFERENCE STANDARDS

- A. Refer to Section 13300.

1.05 QUALITY ASSURANCE

- A. Refer to Section 13300.

1.06 SYSTEM DESCRIPTION

- A. System Responsibility:
 - 1. The drawings and specifications depict a control and data network, which shall function as one unit. This network may be comprised of multiple communication protocols over various media.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Refer to Section 13300.

1.08 PROJECT/SITE REQUIREMENTS

- A. Refer to Section 13300.

1.09 MAINTENANCE

- A. Refer to Section 13300.

1.10 WARRANTY

- A. Refer to Section 13300.

1.11 NOMENCLATURE AND IDENTIFICATION

- A. Refer to Section 13300.

PART 2 PRODUCTS

2.01 RACK-MOUNTABLE MANAGED FIBER OPTIC ETHERNET SWITCH (FOR USE IN ALL FOCE)

A. General

1. Provide a modular, rack-mountable, managed Ethernet switch for connection to the control network as shown in the system architecture drawings and specified herein. The switch shall be used to create a fault tolerant fiber optic ring with automatic failover.

B. Physical Features

1. Modular 19" rack-mountable enclosure
2. Modular construction such that additional copper and fiber ports can be added and removed
3. Minimum fiber uplinks: 8 x 100/1000 SFP ports
4. Minimum fiber SFP modules: Four (4) Gigabit Ethernet SFP modules shall be provided and shall be hot pluggable into the SFP uplink. Ports shall be duplex LC for use with multi-mode fiber optic cable. Dust caps shall be provided for SFP modules not in use.
5. Minimum copper ports: 16 x 10/100/1000 T(X) RJ45 ports. A minimum of 8 copper ports shall be PoE/PoE+ ports, compliant with IEEE 802.3af/at.
6. Operating temperature: 0 to 130 °F
7. Power: 120VAC redundant power supplies
8. Enclosure: Metal case

C. Network Features

1. Fault tolerant for use in a ring topology. The switch shall be able to detect a blocked port and redirect data flow in the opposite direction within 30ms.
2. Full duplex on all port
3. Auto negotiation and manual configurable speed and duplex
4. Wire speed switching fabric
5. IEEE 802.1w Rapid Spanning Tree Protocol
6. IGMP snooping

7. IGMP filtering
8. Configuration password protected
9. Configuration backup capability required
10. SNMP V3
11. 802.1Q VLAN
12. Port-Based VLAN
13. Lock port function for blocking unauthorized access based on MAC address.

D. Manufacturers

1. Moxa
2. Cisco
3. Hirschmann
4. Or equal

2.02 RACK-MOUNTABLE VPN/FIREWALL

A. General

1. For use to create secure tunnels between the waste water treatment facilities.
2. The VPN/Firewall shall be a single hardware device capable of supporting the specified features below. The device shall be designed for protecting Ethernet networks from threats.
3. The VPN/Firewall shall perform stateful inspection of incoming data packets to verify communication meets the requirements configured within the firewall.
 - a. The firewall shall:
 - 1) Control network access for specific protocols and applications. The user shall be able to define custom network protocol identities
 - 2) Develop policy based firewall rules and routing
 - 3) Block data packets based on country of origin
4. VPN/Firewall networking shall include QoS functionality.
5. Remote access services shall include:
 - a. SSL VPN server with the minimum requirements:
 - 1) Layer 3 tunneling
 - 2) AES-128, 192, and 256 encryption
 - 3) Windows (32 and 64-bit): Windows Vista, Windows 7, Windows 8
 - 4) X.509 v.3 Authentication standards

B. Physical Features

1. Modular 19" rack-mountable enclosure- no larger than 2U.
2. Enclosure: Metal Case
3. Power: 100-240VAC, redundant
4. Operating temperature: 0 to 45 °C
5. Drives: 1HDD, 1 SD card minimum

C. Network Features

1. One (1) port of each of the following:
 - a. LAN
 - b. WAN
 - c. Sync
 - d. DMZ
2. Full duplex on all port

D. Additional Requirements

1. Encrypted VPN throughput: 300 Mbit/s
2. Firewall throughput: 2 Gbit/s
3. Concurrent connections: 100

E. Manufacturers

1. Cisco
2. Phoenix Contact mGuard Centerport²
3. Or equal.

2.03 RACK-MOUNTABLE LAYER 3 MANAGED FIBER OPTIC ETHERNET SWITCH
(FOR USE IN SERVER RACK)

A. General:

1. Provide a modular, rack-mountable, managed Ethernet switch for connection to the control network backbone as shown in the system architecture and specified herein. The switch shall be used to create a fault tolerant fiber optic ring with automatic failover.

B. Physical Features:

1. Modular 19" rack-mountable enclosure.

2. Modular construction such that additional copper and fiber ports can be added and removed.
3. Minimum fiber uplinks: 8 x 100/1000 SFP ports.
4. Minimum fiber Ports: Four (4) Gigabit Ethernet ports shall be hot pluggable into the SFP uplink. Ports shall be duplex LC for use with multi-mode cable. Dust caps shall be provided for SFP modules not in use. The final quantity of SFP ports shall be based on the equipment connected to each switch and must include a minimum of 2 ports designated for spare.
5. Minimum copper ports: 16 x 10/100/1000 T(X) RJ45 ports. The final quantity of copper ports shall be based on the equipment connected to each switch and must include a minimum of 5 ports designated for spare.
6. A minimum of two (2) 10Gbps copper ports shall be provided.
7. Operating temperature: 0 to 130 °F.
8. Power: 120VAC redundant power supplies.
9. Enclosure: Metal case.

C. Network Features:

1. Fault tolerant for use in a ring topology if shown on Drawings. The switch shall be able to detect a blocked port and redirect data flow within 30ms.
2. Layer 3 switching.
3. Full duplex on all port.
4. Auto negotiation and manual configurable speed and duplex.
5. Wire speed switching fabric.
6. IEEE 802.1w Rapid Spanning Tree Protocol.
7. IGMP snooping.
8. IGMP filtering.
9. Configuration password protected.
10. Configuration backup capability required.
11. SNMP V3.
12. 802.1Q VLAN
13. Port-Based VLAN

14. Lock port function for blocking unauthorized access based on MAC address.

D. Manufacturers:

1. Cisco.
2. Moxa.
3. Hirschmann.

2.04 MODBUS RTU/TCP GATEWAY

- A. Provide a Modbus RTU/TCP gateway as shown on the System Architecture and as specified herein. If the PLC system is provided with a module that is capable of directly communicating Modbus RTU via RS485, then this gateway will not be required.

B. I/O Ports and Devices:

1. Gateway shall have a minimum of one (1) Ethernet 10/100 Mbps port.
2. Minimum of one (1) RS-485 and one (1) RS-232 ports for serial communication.
3. Ethernet protocol: Modbus TCP or EtherNet/IP, as determined by the native protocols of the PLC System provided.

C. Hardware Requirements:

1. 24 VDC powered
2. 0-50 degrees C
3. Din Rail Mounted

D. Configuration Software Requirements:

1. Built-in emulator to test user interface, data logging, and web server
2. C-type syntax programming environment to use advanced math, local variables, pass parameters, calls, and return values
3. Direct access to the gateway hardware, such as read/write to the SD card, manage serial ports, create TCP/IP connections to extract data, or create custom interfaces to unique products

E. Manufacturer:

1. Red Lion
2. Moxa
3. ProSoft
4. Equal

2.05 CONTROL PANEL MOUNTED INDUSTRIAL MANAGED ETHERNET SWITCH

A. General

1. This specification applies to Ethernet switches required within PLC enclosures (except within the PLC-FPB enclosure), RIO panels, and network enclosures at substations.
2. Provide an industrial managed Ethernet switch for connection to the control network as shown in the Drawings and specified herein.

B. Physical Features

1. Minimum fiber uplinks (only required where drawings indicate fiber optic connections to the Ethernet switch): 2 x 100/1000 SFP ports
2. Minimum fiber Ports (only required where drawings indicate fiber optic connections to the Ethernet switch): Two (2) Gigabit Ethernet ports shall be hot pluggable into the SFP uplink. Ports shall be duplex LCE and operate at a wavelength of 850 nm over multimode cable.
3. Minimum copper ports: 8 x 10/100 TX RJ45 ports. The final quantity of copper ports shall be based on the equipment connected to each switch and must include a minimum of 3 ports designated for spare.
 - a. For the managed Ethernet switch at the Cedar Creek WPCP Main Substation, a minimum of 4 copper ports shall support 802.3af (PoE).
4. Operating temperature: 0 to 130 °F
5. Power:
 - a. Switches not requiring PoE shall be 24 VDC redundant power supply inputs
 - b. The Cedar Creek WPCP Main Substation shall be powered by 120VAC or 48VDC in order to support PoE requirements. If the switch operates at 48VDC, a separate power supply shall be provided.
6. Enclosure: Metal case, DIN-rail mountable

C. Network Features

1. Full duplex on all port
2. Auto negotiation and manual configurable speed and duplex

3. Wire speed switching fabric
4. IEEE 802.1w Rapid Spanning Tree Protocol
5. IGMP snooping
6. IGMP filtering
7. Configuration password protected
8. Configuration backup capability required
9. SNMP V3
10. 802.1Q VLAN
11. Port-Based VLAN
12. Lock port function for blocking unauthorized access based on MAC address.

D. Manufacturers

1. Moxa
2. Phoenix Contact
3. Hirschmann
4. Or equal

2.06 FIBER OPTIC TERMINATION PATCH PANELS

A. General

1. Fiber optic patch panels (FOPPs) shall be provided as indicated on the Contract Drawings.
2. Patch panels shall be suitable for rack or enclosure/panel mounting, comprised of internal mounting plate, cable holders, slack cable take up/organizer blocks, patch adapter panels with connectors, and ground lugs as indicated. Panels shall be NEMA 12 for indoor use. Patch panels shall be compatible with the connector type used on the project. The patch panels shall be sized to handle the number of fibers as required. All fibers shall be terminated in the patch panel.
3. Where shown on the plans or in the related specification sections, the fiber optic cable shall terminate on a termination patch panel inside a fiber optic communication enclosure (FOCE) or within a programmable logic controller (PLC) enclosure.
4. All fiber cables within the exposed buffer tube shall be terminated at patch panels with fan-out kits with pre-connected pigtails. The patch panel shall have a fiber capacity equal to the total number of fibers (connected and spare) for all cables to be connected.

5. Patch panels shall be designed for either rack mounting on a standard equipment rack or housed in an enclosure for direct rack mounting. All unused couplings shall have protective dust covers.
6. The termination patch panel shall be equipped with a suitable means for routing and securing of cables, and shall provide a suitable means of protection for the mounted fiber connectors to prevent damage to fibers and connectors during all regular operation and maintenance functions. All cables shall be provided with strain relief. Bend diameters on cable fibers and jumpers must be greater than four inches at all times to ensure optical and mechanical integrity of the optical fibers.
7. Termination panels shall be equipped with splice trays (where applicable) and holders for pigtail and through fiber splicing.

B. Rack-Mount Fiber Optic Patch Panel

1. Fiber Optic Communication Enclosures (FOCEs) shall house 19" rack-mountable fiber optic patch panels (FOPPs) capable of 12 snap-in adapter panels. Each FOPP interior shall include cable ties and spool rings to hold and store cable. The FOPP shall include an inner tray that pulls out for access to the adapter panels. The FOPP shall include a removable rear cover for accessing patch cords and pigtails; and lockable plastic front cover to protect and view connections.
2. Adapter panels shall be provided to connect fiber to/from the panel or enclosure to patch cords required to interface to fiber networking equipment. Each fiber pair entering the enclosure shall be terminated within the FOPP. Adapter panels shall support 6 LC pairs each. Provide adapter panels required to a minimum of 50 percent expansion. Blank adapter panels may be provided for unused adapter slots.
3. The FOPP shall provide backbone and intermediate connects and cable strain relief for a maximum of five fiber cable systems. The front shall be swing open construction with keyed latch mechanism.
4. Panels shall be as manufactured by Black Box, Corning Cable Systems, or equal.

C. Panel-Mount Fiber Optic Patch Panel for 6 Strands or Less

1. Panel-mount fiber optic patch panels (FOPPs) shall be supplied within a control panel enclosure to terminate fiber optic cable of 6 strands or less. Each fiber optic patch panel shall support a minimum of two snap-in adapter panels.
2. Adapter panels shall be provided to connect fiber to/from the FOPP to patch cords required to interface to fiber networking equipment. Each fiber pair entering the enclosure shall be terminated within the FOPP. Adapter panels shall support 6 LC pairs each. Provide two adapter panels in each panel-mounted FOPP.
3. Patch panels shall be as manufactured by Black Box, Corning Cable Systems, Belden, or Equal.

2.07 19" SWINGING WALL MOUNT FIBER OPTIC COMMUNICATIONS ENCLOSURE

A. General:

1. The 19" network rack shall be wall-mounted and constructed to swing open for component cabling access. The center section shall pivot for either left or right opening.
2. The contractor shall furnish and install any and all appurtenances required for a fully functional network rack. The network rack shall have a 26U capacity minimum.
3. The Contractor is responsible for sizing the rack to ensure that it has sufficient capacity to accommodate the equipment being furnished. Minimum and maximum dimensions are included in Appendix A and Appendix B.

B. Features/Performance:

1. All FOCEs of this type, including those that are not being provided with an Ethernet switch, shall be furnished with the following appurtenances, unless otherwise noted:
 - a. Vent Panels
 - b. Lock and key door switch.
 - c. Mounting rail brush strip(s).
 - d. Cable management rings(s).
 - e. Horizontal cable organizer
 - f. 19" Rack mountable 48 Port-CAT6 patch panel
 - g. 19" Rack mountable Fiber Optic Patch Panel as specified herein.
 - h. Rack-mounted Ethernet switch as specified herein (Only if required by drawings).
 - i. Rack-mounted Uninterruptible Power Supply as specified in Section 13335 (Only if required by drawings).
 - j. Power supply as specified in 13330 for powering network switches requiring 24VDC (Only include if necessary to power the Ethernet switch).
 - k. Furnish and install a protected power (UPS) distribution unit (PDU) in the network rack for all FOCEs, including those without Ethernet switches. This PDU shall be fed from the UPS mounted in the rack enclosure (if applicable) and shall provide UPS power to all of the electronic devices in the FOCE.
2. Maximum load capacity of 250lb.
3. Refer to the drawings for rack layout requirements.
4. Hardware necessary for wall mounting.

C. Manufacturer:

1. Middle Atlantic CWR Series
2. Great Lakes WM Series
3. Tripp Lite SRW Series
4. Or equal.

2.08 19" FLOOR-MOUNTED FIBER OPTIC COMMUNICATIONS ENCLOSURE

A. General:

1. The 19" network rack shall be floor-mounted with front and rear access for component cabling access.
2. The contractor shall furnish and install any and all appurtenances required for a fully functional network rack. The network rack shall have a 26U capacity minimum.
3. The Contractor is responsible for sizing the rack to ensure that it has sufficient capacity to accommodate the equipment being furnished. Minimum and maximum dimensions are included in Appendices A and B.

B. Features/Performance:

1. All FOCES of this type, including those that are not being provided with an Ethernet switch, shall be furnished with the following appurtenances, unless otherwise noted:
 - a. Removable side panels
 - b. Lock and key door switch.
 - c. Mounting rail brush strip(s).
 - d. Cable management rings(s).
 - e. Horizontal cable organizer
 - f. Heavy-duty casters and leveling feet
 - g. 19" Rack mountable 48 Port-CAT6 patch panel
 - h. 19" Rack mountable Fiber Optic Patch Panel as specified herein.
 - i. Furnish and install a protected power (UPS) distribution unit (PDU) in the network rack.
2. Maximum load capacity of 250lb.
3. Refer to the drawings for rack layout requirements.
4. Hardware necessary for floor mounting and leveling.

C. Manufacturer:

1. Middle Atlantic RCS Series
2. Great Lakes E Series
3. Tripp Lite SR Series
4. Or equal.

2.09 19" OPEN-FRAME FIBER OPTIC COMMUNICATION RACK

A. General:

1. The 19" network rack shall be an open-frame design, to be mounted within a separate PLC or RIO enclosure.

2. The contractor shall furnish and install any and all appurtenances required for a fully functional network rack. The network rack shall have a 21U capacity minimum.
3. The Contractor is responsible for sizing the rack to ensure that it has sufficient capacity to accommodate the equipment being furnished. Minimum and maximum dimensions are included in Appendix A and Appendix B.

B. Features/Performance:

1. Network rack shall be furnished with the following appurtenances:
 - a. Mounting rail brush strip(s).
 - b. Cable management rings(s).
 - c. Horizontal cable organizer
 - d. 19" Rack mountable 48 Port-CAT6 patch panel
 - e. 19" Rack mountable Fiber Optic Patch Panel as specified herein.
 - f. Rack-mounted Ethernet switch as specified herein.
 - g. Rack-mounted Uninterruptible Power Supply as specified in Section 13335.
 - h. Power supply as specified in 13330 for powering network switches requiring 24VDC (Only include if necessary to power the Ethernet switch).
 - i. Furnish and install a protected power (UPS) distribution unit (PDU) in the network rack for all FOCEs, including those without Ethernet switches. This PDU shall be fed from the UPS mounted in the rack enclosure (if applicable) and shall provide UPS power to all of the electronic devices in the FOCE.
2. Maximum load capacity of 200lb.
3. Hardware necessary for subpanel mounting.
4. Refer to the drawings for rack layout requirements.

C. Manufacturer:

1. Chatsworth
2. Or equal.

2.10 19" FIXED WALL MOUNT FIBER OPTIC COMMUNICATIONS ENCLOSURE

A. General:

1. The 19" network rack shall be wall-mounted in a fixed enclosure that allows for front and side access.
2. The contractor shall furnish and install any and all appurtenances required for a fully functional network rack. The network rack shall have a 22U capacity minimum.
3. The Contractor is responsible for sizing the rack to ensure that it has sufficient capacity to accommodate the equipment being furnished. Minimum and maximum dimensions are included in Appendix A.

B. Features/Performance:

1. Network rack shall be furnished with the following appurtenances:
 - a. Vent Panels
 - b. Lock and key door switch.
 - c. Mounting rail brush strip(s).
 - d. Cable management rings(s).
 - e. Horizontal cable organizer
 - f. 19" Rack mountable 48 Port-CAT6 patch panel
 - g. 19" Rack mountable Fiber Optic Patch Panel as specified herein.
 - h. Rack-mounted Ethernet switch as specified herein.
 - i. Rack-mounted Uninterruptible Power Supply as specified in Section 13335.
 - j. Power supply as specified in 13330 for powering network switches requiring 24VDC (Only include if necessary to power the Ethernet switch).
 - k. Furnish and install a protected power (UPS) distribution unit (PDU) in the network rack for all FOCEs, including those without Ethernet switches. This PDU shall be fed from the UPS mounted in the rack enclosure (if applicable) and shall provide UPS power to all of the electronic devices in the FOCE.
2. Maximum load capacity of 250lb.
3. Refer to the drawings for rack layout requirements.
4. Hardware necessary for wall mounting.

C. Manufacturer:

1. Kendall Howard LINIER Series
2. Or equal.

2.11 19" SERVER RACK ENCLOSURE

A. General:

1. The 19" network rack shall be enclosed on all four sides with door access in the front and rear and removable panels on each side. Contractor shall provide appurtenances required for a fully functional network rack. The network rack shall have a 42U capacity.

B. Features/Performance:

1. Network rack shall be provided with the following appurtenances:
 - a. Roof fans and tray.
 - b. Lock and key door switch.
 - c. Mounting rail brush strip(s).
 - d. Cable ring set(s) (number as required).
 - e. Cable management rings (s) (number and size as required).
 - f. Horizontal cable organizer (number as required).
 - g. 19" Rack mountable 48 Port-CAT6 patch panel
 - h. 19" Rack mountable 48 Port-Fiber Optic patch panel for use with multimode fiber optic cabling with LC-style connectors.

2. Contractor shall coordinate the location of all devices in the rack with the Owner/Engineer at the time of installation.
3. Furnish and install a power distribution unit (PDU) in the network rack. The PDU shall be fed from a dedicated 20A raw power feeder (not on UPS) and shall be provided for miscellaneous equipment for which UPS power is not required.
4. Furnish and install a protected power (UPS) distribution unit (PDU) in the network rack. The PDU shall be fed from a dedicated 20A UPS power and shall be provided for all computer and networking equipment located in the server rack. This PDU shall be fed from the UPS mounted in the rack enclosure.

C. Manufacturer:

1. Dell.
2. Tripp Lite
3. Rittal.
4. Hoffman.
5. Or equal.

2.12 WIRELESS ETHERNET BRIDGE

A. General

1. Provide two wireless Ethernet bridges to connect the Main Switchgear to the plant SCADA network.

B. Network Security Requirements

1. Submit a plan for configuration of the wireless bridge that demonstrates the PCSS's approach to minimizing the risk associated with the wireless communications network
2. The following security must be implemented as a minimum:
 - a. The two radios must be configured in bridge mode only, such that the two radios can communicate point-to-point.
 - b. All traffic must be encrypted using AES
 - c. The radios shall not serve as an access point.
 - 1) The SSID shall not be broadcasted.
 - d. MAC address filtering shall be utilized to ensure that the two Ethernet bridges can communicate, but no other devices can communicate with either of the bridges.

C. Physical Features

1. Dual Radios (2.4GHz/5GHz concurrent)
2. Ethernet ports: 1 x 10/100 TX RJ45 ports
3. Antenna: Two external antenna. Shall support MIMO, Dual 2Tx/2Rx
4. Power: Power Over Ethernet (PoE) (802.3af) 48 VDC
5. Operating Temperature -20° to 70° C
6. Enclosure Rating: IP68 Metal Enclosure

D. Network Features

1. Protocols: TCP/IP, DHCP, SNMP v1/v2, RSTP
2. WIFI Encryption:
 - a. WPA2, TKIP, AES, IEEE 802.1X/RADIUS
3. Security: MAC Address Filter, HTTPS/SSL, RADIUS, SSH, 802.11i
4. Modulation Method:
 - a. IEEE 802.11b (DSSS)
 - b. IEEE 802.11g/n (OFDM/DSSS)
5. Data Transfer Rate: 300 Mbps

E. Accessories:

1. Furnish and install a directional power antenna with each radio per the following requirements
 - a. Gain: 18 dBi at 2.4 GHz
 - b. Rating: IP65
 - c. Impedance: 50 Ohms
 - d. Power Handling: 15 Watt Max
 - e. Include mounting pole for mounting on side of building.
 - f. Manufacturer: Moxa ANT-WSB-PNF-18 or Equal.

F. Manufacturers

1. Moxa AWK-4131A
2. Or equal

2.13 WIRES AND CONNECTORS

A. Ethernet 10/100/1000 BASE-T/TX Cable.

1. The unshielded twisted pair cable shall be designed for use with a high speed (10/100/1000 Mbps) Ethernet 10/100/1000 BASE-T/TX communications network. The twisted pair cable shall have a nominal impedance 100 ohms at one MHz, a maximum attenuation of 8 dB per 1000 feet at one MHz. The twisted pair cable must have frequency tested up to 250 MHz or more. The twisted pair cable shall be plenum rated and shall have a minimum of four 23 AWG solid copper conductor pairs. All 10/100/1000 BASE-T/TX (RJ-45) terminations on the twisted pair cable shall be done in a professional and workman like manner. Terminations shall provide for proper strain relief on the cable jacket. Strain relief on the wire and/or wire insulation shall not be acceptable.

2.14 SPARE PARTS

- A. General requirements for spare parts are specified in section 13300.
- B. The following Network and Communications System spare parts shall be furnished at each the Cedar Creek WPCP and the Glen Cove WWTP:
 1. One switch of each type provided.
 2. Manufacturer's cables - one of each type installed.
 3. Five-10ft CAT 6 cables with connectors installed.
 4. Provide a minimum of 40 fiber optic patch panel dust covers.
 5. Provide a minimum of ten spare fiber optic patch panel adapter panels of each type used on the project.

PART 3 EXECUTION

3.01 ESTABLISHING COMMUNICATIONS

- A. The PCSS is responsible for establishing all plant communications, RIO communications, PLC to PLC communications, and PLC to HMI communications and all other network and communication systems shown on the Drawings.

END OF SECTION

APPENDIX 13320-A

CEDAR CREEK WPCP SCHEDULE OF 19" ENCLOSURES

APPENDIX 13320-B

GLEN COVE WWTP SCHEDULE OF 19" ENCLOSURES

The following schedules shall be used in conjunction with the specification for all 19" enclosures being furnished under this project.

Section 13320 - Appendix A
Cedar Creek WPCP
Schedule of Fiber Optic Communication Enclosures

5044-102537
March 2020

Enclosure Name/Location	Nameplates	Minimum Size	Maximum Size	Enclosure/Panel Type	Panel Rating
FOCE-AOC (Building T - Electrical Room)	Nameplate: FOCE-AOC	27U Minimum (24"W x 55"H x 24"D)	27U Maximum (24"W x 55"H x 24"D)	19" Floor-Mounted Fiber Optic Communication Enclosure	Black Powdercoated Aluminum, floor mounted, closed enclosure, front and rear access
FOCE-CMPR (Building W)	Nameplate: FOCE-CMPR	22U Minimum (24"W x 43"H x 24"D)	22U Maximum (24"W x 43"H x 24"D)	19" Fixed Wall Mount Fiber Optic Communications Enclosure	Black Powdercoated Aluminum, fixed wall mount, front and side access
FOCE-CSB (Building Cs)	Nameplate: FOCE-CSB	26U Minimum (26"W x 50"H x 22"D)	26U Maximum (26"W x 50"H x 22"D)	19" Swinging Wall Mount Fiber Optic Communications Enclosure	Black Powdercoated Aluminum, wall mounted, swing out style, front and side access
FOCE-DIG (Building J - Digester Control Room)	Nameplate: FOCE-DIG	26U Minimum (26"W x 50"H x 22"D)	26U Maximum (26"W x 50"H x 22"D)	19" Swinging Wall Mount Fiber Optic Communications Enclosure	Black Powdercoated Aluminum, wall mounted, swing out style, front and side access
FOCE-DWTR (Building S - Dewatering Control Room)	Nameplate: FOCE-DWTR	26U Minimum (26"W x 50"H x 22"D)	26U Maximum (26"W x 50"H x 22"D)	19" Swinging Wall Mount Fiber Optic Communications Enclosure	Black Powdercoated Aluminum, wall mounted, swing out style, front and side access
FOCE-EPS (Effluent Pumping and Chlorination Building)	Nameplate: FOCE-EPS	26U Minimum (26"W x 50"H x 22"D)	26U Maximum (26"W x 50"H x 22"D)	19" Swinging Wall Mount Fiber Optic Communications Enclosure	Black Powdercoated Aluminum, wall mounted, swing out style, front and side access
FOCE-EQUP (Building B - Old Control Room)	Nameplate: FOCE-EQUP	26U Minimum (26"W x 50"H x 22"D)	26U Maximum (26"W x 50"H x 22"D)	19" Swinging Wall Mount Fiber Optic Communications Enclosure	Black Powdercoated Aluminum, wall mounted, swing out style, front and side access
FOCE-FPB (Building FP)	Nameplate: FOCE-FPB	21U Minimum (23"W x 42"H x 19"D)	21U Maximum (23"W x 42"H x 19"D)	19" Open-Frame Fiber Optic Communication Rack	Black Powdercoated Aluminum, wall mounted (interior of PLC-FPB Enclosure), side and front access
FOCE-GRIT (Building F)	Nameplate: FOCE-GRIT	26U Minimum (26"W x 50"H x 22"D)	26U Maximum (26"W x 50"H x 22"D)	19" Swinging Wall Mount Fiber Optic Communications Enclosure	Black Powdercoated Aluminum, wall mounted, swing out style, front and side access
FOCE-MANT (Building D)	Nameplate: FOCE-MANT	26U Minimum (26"W x 50"H x 22"D)	26U Maximum (26"W x 50"H x 22"D)	19" Swinging Wall Mount Fiber Optic Communications Enclosure	Black Powdercoated Aluminum, wall mounted, swing out style, front and side access
FOCE-OC (Building U - Adjacent to Biofilter Control Panel)	Nameplate: FOCE-OC	26U Minimum (26"W x 50"H x 22"D)	26U Maximum (26"W x 50"H x 22"D)	19" Swinging Wall Mount Fiber Optic Communications Enclosure	Black Powdercoated Aluminum, wall mounted, swing out style, front and side access
FOCE-PST (Building G/GG)	Nameplate: FOCE-PST	26U Minimum (26"W x 50"H x 22"D)	26U Maximum (26"W x 50"H x 22"D)	19" Swinging Wall Mount Fiber Optic Communications Enclosure	Black Powdercoated Aluminum, wall mounted, swing out style, front and side access

Section 13320 - Appendix A
Cedar Creek WPCP
Schedule of Fiber Optic Communication Enclosures

5044-102537
March 2020

Enclosure Name/Location	Nameplates	Minimum Size	Maximum Size	Enclosure/Panel Type	Panel Rating
FOCE-RASN (RAS Pump Station North - Electrical Room)	Nameplate: FOCE-RASN	21U Minimum (23"W x 42"H x 19"D)	21U Maximum (23"W x 42"H x 19"D)	19" Open-Frame Fiber Optic Communication Rack	Black Powdercoated Aluminum, wall mounted (interior of ATCC-3 Enclosure), side and front access
FOCE-RASS (RAS South Pump Station - MCC Room)	Nameplate: FOCE-RASS	27U Minimum (24"W x 55"H x 24"D)	27U Maximum (24"W x 55"H x 24"D)	19" Floor-Mounted Fiber Optic Communication Enclosure	Black Powdercoated Aluminum, floor mounted, closed enclosure, front and rear access
FOCE-SEW (RAS South Pump Station - MCC Room)	Nameplate: FOCE-SEW	26U Minimum (26"W x 50"H x 22"D)	26U Maximum (26"W x 50"H x 22"D)	19" Swinging Wall Mount Fiber Optic Communications Enclosure	Black Powdercoated Aluminum, wall mounted, swing out style, front and side access
FOCE-TERT (Building R - Cubicle Area on First Floor)	Nameplate: FOCE-TERT	26U Minimum (26"W x 50"H x 22"D)	26U Maximum (26"W x 50"H x 22"D)	19" Swinging Wall Mount Fiber Optic Communications Enclosure	Black Powdercoated Aluminum, wall mounted, swing out style, front and side access
FOCE-THK (Building H)	Nameplate: FOCE-THK	26U Minimum (26"W x 50"H x 22"D)	26U Maximum (26"W x 50"H x 22"D)	19" Swinging Wall Mount Fiber Optic Communications Enclosure	Black Powdercoated Aluminum, wall mounted, swing out style, front and side access

Section 13320 - Appendix B
Glen Cove WWTP
Schedule of Fiber Optic Communication Enclosures

5044-102537
October 2020

Enclosure Name	Nameplates	Minimum Size	Maximum Size	Enclosure/Panel Type	Panel Rating
FOCE-ELEC	Nameplate: FOCE-ELEC	26U (26"W x 50"H x 22"D)	26U (26"W x 50"H x 22"D)	19" Floor-Mounted Fiber Optic Communication Enclosure	Black Powdercoated Aluminum, floor mounted, closed enclosure, front, rear, and side access
FOCE-FINAL	Nameplate: FOCE-FINAL	21U (23"W x 42"H x 19"D)	21U (23"W x 42"H x 19"D)	19" Open-Frame Fiber Optic Communication Rack	Black Powdercoated Aluminum, surface mounted (inside RIO-FINAL Enclosure), side and front access
FOCE-HW	Nameplate: FOCE-HW	21U (23"W x 42"H x 19"D)	21U (23"W x 42"H x 19"D)	19" Open-Frame Fiber Optic Communication Rack	Black Powdercoated Aluminum, surface mounted (inside RIO-IPS Enclosure), side and front access
FOCE-THK	Nameplate: FOCE-THK	26U (26"W x 50"H x 22"D)	26U (26"W x 50"H x 22"D)	19" Swinging Wall Mount Fiber Optic Communication Enclosure	Black Powdercoated Aluminum, wall mounted, swing out style, front and side access
Server Rack	Nameplate: Server Rack	42U (Approximately 26"W x 80"H x 40"D)	42U (Approximately 26"W x 80"H x 40"D)	19" Floor-Mounted Server Rack	Black Powder coated Aluminum, floor mounted, closed enclosure, front, rear, and side access

SECTION 13321
FIBER OPTIC CABLING AND EQUIPMENT

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. The Work of this Section includes furnishing and installing a fiber optic communications infrastructure including, but not limited to, fiber optic cable (FOC), conduit, pull boxes, patch panels, terminations, testing, and implementation.
- B. The Work includes terminating and testing individual fiber cables installed under this Contract and testing a completed fiber optic communications network.
- C. Each 12-pair (24-strand) OM4 fiber optic cable shall have a pair of fiber reserved for each of the following networks:
 - 1. SCADA
 - 2. Fire (reserved for future)
 - 3. Security (reserved for future)
 - 4. Business (reserved for future)
 - 5. HVAC (reserved for future)
 - 6. Seven unused fiber pairs shall be considered spare for future use.

The future networks and the seven spare pairs shall be terminated and tested for future use.

CEDAR CREEK WPCP:

- D. Refer to drawings E-1, I-1, and the system architecture drawings I-2 through I-6 for a depiction of the fiber optic network design.
- E. A new OM4 multimode fiber optic ring shall serve as the network backbone throughout the plant. The network shall provide gigabit (minimum) fault tolerant communications between the Fiber Optic Communication Enclosures (FOCEs) located at the various plant facilities as indicated on the drawings. The fiber optic ring shall consist of the following 12-Pair (24 strand) gigabit communication segments:
 - 1. OM4 Fiber between Administration Building (Building A) and Grit Building (Building F)
 - 2. OM4 Fiber between Grit Building (Building F) and Digester Building (Building J)
 - 3. OM4 Fiber between Digester Building (Building J) and Sludge Thickening Building (Building H)
 - 4. OM4 Fiber between Sludge Thickening Building (Building H) and Primary Tanks Building (Building G/GG)
 - 5. OM4 Fiber between Primary Tanks Building (Building G/GG) and Sludge Dewatering Building (Building S)
 - 6. OM4 Fiber between Sludge Dewatering Building (Building S) and Aeration Tanks Odor Control Building (Building T)
 - 7. OM4 Fiber between Aeration Tanks Odor Control Building (Building T) and Odor Control Building (Building U)
 - 8. OM4 Fiber between Odor Control Building (Building U) and South RAS Pump Station
 - 9. OM4 Fiber between South RAS Pump Station and the Effluent Pumping and

- Chlorination Facility (Building L)
10. OM4 Fiber between the Effluent Pumping and Chlorination Facility (Building L) and the North RAS Pump Station
 11. OM4 Fiber between the North RAS Pump Station and the Secondary Gas Compressor Building (Building W)
 12. OM4 Fiber between the Secondary Gas Compressor Building (Building W) and the Main Equipment Building (Building B)
 13. OM4 Fiber between the Main Equipment Building (Building B) and the Administration Building (Building A)
- F. A new 12-pair (24 strand), OM4 multimode fiber optic cable shall be installed from the Main Equipment Building (Building B) to the Warehouse Maintenance Building (Building D) to connect FOCE-MANT to the fiber ring. The network shall provide gigabit communications between the FOCEs.
- G. A new 12-pair (24 strand), OM4 multimode fiber optic cable shall be installed from the Warehouse Maintenance Building (Building D) to the Fire Pump Building (Building FP) to connect FOCE-FPB to the fiber ring. The network shall provide gigabit communications between the FOCEs.
- H. A new 12-pair (24 strand), OM4 multimode fiber optic cable shall be installed from the Fire Pump Building (Building FP) to the Cold Storage Building (Building CS) to connect FOCE-CSB to the fiber ring. The network shall provide gigabit communications between the FOCEs.
- I. A new 12-pair (24 strand), OM4 multimode fiber optic cable shall be installed from the Dewatering Building (Building S) to the Tertiary Treatment Building (Building R) to connect FOCE-TERT to the fiber ring. The network shall provide gigabit communications between the FOCEs.
- J. A new 3-pair (6 strand), OM4 multimode fiber optic cable shall be installed from FOCE-EFF in the Effluent Pumping and Chlorination Building (Building L) to the PLC-ATCC-1 Enclosure in the West Aeration Tank Gallery. One pair shall be used for the SCADA network and two pairs shall be reserved as spares.
- K. A new 3-pair (6 strand), OM4 multimode fiber optic cable shall be installed from FOCE-PST in the Primary Tanks Building (Building G/GG) to the PLC-ATCC-2 Enclosure in the East Aeration Tank Gallery. One pair shall be used for the SCADA network and two pairs shall be reserved as spares.
- L. A new 3-pair (6 strand), OM4 multimode fiber optic cable shall be installed from FOCE-PST in the Primary Tanks Building (Building G/GG) to the PLC-ATCC-4 Enclosure in the East Aeration Tank Gallery. One pair shall be used for the SCADA network and two pairs shall be reserved as spares.
- M. A new 12-pair (24 strand), OM4 multimode fiber optic cable shall be installed from FOCE-THK in the Sludge Thickening Building (Building G/GG) to FOCE-SEW in the Sewer Maintenance Building (Building K) to connect FOCE-SEW to the fiber ring. The network shall provide gigabit communications between the FOCEs.
- N. All fiber optic cables will be required to be terminated and tested at the new fiber optic patch panels as shown the drawings and specified herein.

- O. A new 3-pair (6 strand), OM4 multimode fiber optic cable shall be installed from FOCE-EQUIP in the Main Equipment Building (Building B) to the fiber optic patch panel in Substation T1/T2. One pair shall be used for the SCADA network and two pairs shall be reserved as spares.
- P. A new 3-pair (6 strand), OM4 multimode fiber optic cable shall be installed from FOCE-DWTR in the Dewatering Building (Building S) to the fiber optic patch panel in Substation T7. One pair shall be used for the SCADA network and two pairs shall be reserved as spares.
- Q. A new 3-pair (6 strand), OM4 multimode fiber optic cable shall be installed from the fiber optic patch panel in Substation T7 to the fiber optic patch panel in Substation T8. One pair shall be used for the SCADA network and two pairs shall be reserved as spares.

GLEN COVE WWTP:

- R. Refer to drawings E-1, GI-2, GI-3, and GI-5 for a depiction of the fiber optic network design.
- S. A new OM4 multimode fiber optic ring shall serve as the network backbone throughout the plant. The network shall provide gigabit (minimum) fault tolerant communications between the Fiber Optic Communication Enclosures (FOCEs) located at the various plant facilities as indicated on the drawings. The fiber optic ring shall consist of the following 12-Pair (24 strand) gigabit communication segments:
 - 1. OM4 Fiber between Control Building (Server Rack) and the Control Building (Electrical Room).
 - 2. OM4 Fiber between the Control Building (Electrical Room) and the Sodium Hypochlorite Building.
 - 3. OM4 Fiber between the Sodium Hypochlorite Building and the Headworks Building.
 - 4. OM4 Fiber between the Headworks Building and the Sludge Thickening Building.
 - 5. OM4 Fiber between the Sludge Thickening Building and the Control Building (Server Rack).

1.02 RELATED WORK

- A. Delivery, Storage and Handling in Section 01600.
- B. Process Instrumentation and Control System is included in Section 13300.
- C. Network equipment and fiber optic patch panels are included in Section 13320.
- D. Fiber optic communication enclosures are included in Section 13320.
- E. Electrical Conduit Systems are specified in Section 16131.
- F. Refer to the drawing package for fiber optic cable routing.

1.03 SUBMITTALS

A. Submit to the Engineer, in accordance with Section 01300, the following:

1. Catalog Data: Detailed bill of material and catalog data on fiber-optic cable, termination devices, patch panels, breakout enclosures, pigtails, and fan-outs where applicable. Product data sheets shall include the manufacturer's name and catalog number for each item, the manufacturer's descriptive literature including electrical and physical characteristics, catalog cuts, and any power supply requirements.
2. Submit a fiber optic power budget for each cable run in excess of 1000 feet. The budget shall include transmitter power, receiver sensitivity, connector losses, cable losses, and a 3dB-aging margin. Fiber optic transmission line shall maintain a minimum of 10dB safety margin.
3. Detailed fiber optic cable installation diagrams. The following drawings shall be included as a minimum:
 - a. Drawings showing the proposed point-to-point routing of all fiber optic cable. Locations of pull boxes, manholes, and wall penetrations shall be indicated. Show the proposed routing of cable by overlaying it on the plant site plan. One overview drawing shall be included as well as a minimum of four individual drawings that show a magnified view of the fiber routing at each plant area so that details of pull boxes, conduit sizes, etc. can be clearly shown.
 - b. Drawings for each fiber optic communication enclosure (FOCE) detailing the proposed fiber optic cable terminations (including patch cables) at each patch panel and network switch. The drawings shall depict the color of each strand, the port number to which it is terminated, and the function (i.e. SCADA, Fire, Security, Business, etc.)
 - c. Requirements for diagrams of the CAT6 connections within the FOCEs are detailed in Section 13320.
4. A cable pulling plan shall be submitted a minimum of 45 days prior to the planned initiation of cable pulling. The pulling plan and pull tension calculations may be prepared by using a software program such as Pull-Planner 3000 by American Polywater Corporation. The cable pulling plan must be approved a minimum of 15 days prior to pulling cable. Work plan shall include the following:
 - a. Pull tension calculations.
 - b. Detailed description of pull operation methods for all conduit runs.
 - c. Tools and equipment to be used for cable installation and testing.
 - d. Safety and manual assist cable pulling operations.
 - e. Detailed schedule for pulling and testing cables.
 - f. Copies of ETA CFOI certificates for all field technicians or resumes demonstrating a minimum of 10 years' experience with fiber optic network installations of similar size and scope.
5. Training plan for fiber optic cable termination and testing training (refer to Section 13303 for training requirements).
6. Factory, Pre and Post Installation Test reports.

7. Field Test reports as specified herein.
8. O&M manual that includes the following:
 - a. Approved fiber optic submittals, including catalog data, power budgets (if applicable), and pulling plan.
 - b. As-built fiber optic installation drawings
 - c. Post-installation test reports
 - d. Warranty information
 - e. Instructions on how to test and terminate fiber.

1.04 REFERENCE STANDARDS

- A. The materials and installation shall comply with the codes and standards of the following organizations:
 1. American National Standards Institute (ANSI).
 2. Electronic Industries Alliance (EIA).
 3. Fiber Optic Association (FOA).
 4. Institute of Electrical and Electronic Engineers (IEEE).
 5. Insulated Cable Engineers Association (ICEA).
 6. National Electrical Contractors Association (NECA).
 7. National Electrical Manufacturers Association (NEMA).
 8. National Fire Protection Association (NFPA).
 9. Telecommunications Industry Association (TIA).
 10. Underwriters Laboratories (UL).
- B. Specific codes and standards that apply include the following:
 1. ANSI/NECA/FOA 301 – Standard for Installing and Testing Fiber Optic Cables.
 2. ANSI/TIA/EIA 568 – Cabling Standards.
 3. ICEA S-83-596 – Indoor Optical Fiber Cables.
 4. ICEA S-87-640 – Optical Fiber Outside Plant Communications Cable.
 5. ICEA S-104-696 – Indoor-Outdoor Optical Fiber Cable.
 6. NFPA 262 – Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces.
 7. NFPA 70 – National Electrical Code, Article 770.

8. TIA 598 – Fiber Optic Cabling Coding.
 9. UL 1651 – Standard for Optical Fiber Cable.
 10. UL 1666 – Standard for Test for Flame Propagation Height of Electrical and Optical-Fiber Cables Installed Vertically in Shafts.
 11. UL 1685 – Standard for Vertical-Tray Fire-Propagation and Smoke-Release Test for Electrical and Optical-Fiber Cables.
 12. UL 2024 – Standard for Signaling, Optical Fiber and Communications Raceways and Cable Routing Assemblies.
- C. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.05 QUALITY ASSURANCE

- A. The cable manufacturer shall be ISO 9001 certified and registered.
- B. The fiber optic cabling system materials furnished under this Section shall be provided by Fiber Optic manufacturer who have been providing these types of materials for the past five years.
- C. The installation of fiber optic cabling system materials furnished under this Section shall be performed by an installation Contractor who has been installing these types of materials and systems for the past three years.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. The cable shall be packaged in cartons and/or wound on spools or reels. Each package shall contain only one continuous length of cable. The packaging shall be constructed so as to prevent damage to the cable during shipping and handling.
- B. Test tails shall be at least two meters long. The inner end shall be fastened so as to prevent the cable from becoming loose during shipping and installation. Reels shall be permanently marked with an identification number that can be used by the manufacturer to trace the manufacturing history of the cable and fiber.
- C. All fiber optic cables shall be attenuated tested. The attenuation of each fiber shall be provided with each cable reel by the manufacturer.

1.07 SPARE PARTS AND TEST EQUIPMENT

- A. Spare Parts
 1. Provide 20 spare connectors of each type of connector supplied.
 2. Provide a minimum of 5 spare patch cables with terminated connectors (both ends) for each length of patch cable from patch panels to termination point. Provide protective covers to each end of patch cable.

B. Test Equipment and Tools

1. One complete fiber optic connector termination tool kit. The kit shall be the CTS version with VFL, Model TKT-UNICAM-CTS by Corning Cable Systems, or equal.
2. One fiber optic power loss test kit. Optical light source and test meter shall be a combination type unit in a single handheld device.
 - a. Provide fiber trace/detection/ continuity tone.
 - b. Provide data storage: Windows-based PC software and cabling for reports, printing, viewing, and export.
 - c. Certification: Tier 1, TIA-568-C
 - d. Power source/meter shall accommodate the connector type used on the project. Meter shall have either 850/1300 nm (multimode) or 1310/1550 nm (single mode) light sources depending on the project requirement and shall include patch cords, adapters, cleaning kit, and transit case and shall be *Fluke SimpliFiber Pro*, Photonix Technologies TECHLITE series, or equal.

1.08 WARRANTY

- A. The manufacturer shall provide an extended warranty on all installed fiber optic cables for a minimum period of 3 years, commencing from the time of final acceptance by the Owner. Warranties are limited to replacement only of defective cable

1.09 DEFINITIONS

A. Types of Optical Fiber Cables / Markings:

1. OFNP – Nonconductive optical fiber plenum cable.
2. OFCP – Conductive optical fiber plenum cable.
3. OFNR – Nonconductive optical fiber riser cable.
4. OFCR – Conductive optical fiber riser cable.
5. OFNG – Nonconductive optical fiber general-purpose cable.
6. OFCG – Conductive optical fiber general-purpose cable.
7. OFN – Nonconductive optical fiber general-purpose cable.
8. OFC – Conductive optical fiber general-purpose cable.

B. Classes of Optical Fiber Types:

1. OM4: Multimode fiber type 50 μ m core; minimum modal bandwidth of 4700 MHz*km at 850 nm.

PART 2 PRODUCTS

2.01 GENERAL MATERIALS

- A. Patch Panels: Patch panels shall be provided as specified and as indicated on the contract Drawings and as specified in Section 13320
- B. Unless indicated otherwise on the drawings, the fiber optic cable type shall be loose tube fiber optic cable suitable for indoor/outdoor applications and shall be plenum-rated flame retardant for indoor applications and water and fungus resistant for outdoor applications.
- C. Optical Fiber Characteristics
 - 1. All fibers in the cable must be usable fibers and meet required specifications.
 - 2. Each optical fiber shall consist of a doped silica core surrounded by a concentric silica cladding. The fiber shall be matched clad design.
 - 3. Multi-mode: Provide graded multimode, 50µm optical glass fiber compatible with LED or laser-based transmission systems.
- D. Manufacturers
 - 1. Corning Cable Systems.
 - 2. Belden Cable.
 - 3. Black Box.
 - 4. Or equal.

2.02 LASER-OPTIMIZED 50/125 µM FIBER (OM4)

- A. The multimode fiber utilized in the optical fiber cable shall meet ANSI/TIA/EIA-568-C.3, "Optical Fiber Cabling Components Standard" and corresponds to designation OM4 (TIA 492AAAD) per ISO/IEC 11801 or ISO/IEC 24702.
- B. The fiber shall operate at wavelengths 850/1300 nm, with maximum attenuation of 3.0/1.0 dB/km at these respective wavelengths. For 1 Gb Ethernet link, performance assured to 1000/600 m at these respective wavelengths.

2.03 FIBER OPTIC CABLE TYPES

- A. Loose Tube Fiber Optic Cable (Indoor/Outdoor)
 - 1. Cable shall be flame-retardant, UV stabilized, fully water blocked with dielectric central member for use in indoor/outdoor applications. The buffer tubes shall be gel-free. Each buffer tube shall contain a water-swellaable yarn for water-blocking protection. Cable shall be suitable for installation in duct, aerial, and riser environments. Cable shall meet UL OFNR specifications and not require transition splicing upon building entry in order to meet fire codes.

2. Optical fibers shall be placed inside a buffer tube.
3. Each buffer tube shall contain 12 fibers (6-pairs).
4. In buffer tubes containing multiple fibers, the colors shall be stable across the specified storage and operating temperature range and not subject to fading or smearing onto each other or into the gel filling material. Colors shall not cause fibers to stick together.
5. Buffer tubes shall be kink-resistant within the specified minimum bend radius.
6. Fillers may be included in the cable core to lend symmetry to the cable cross-section where needed.
7. The central anti-buckling member shall consist of a glass-reinforced plastic rod. The purpose of the central member is to prevent buckling of the cable.
8. The cable core shall contain a water-blocking material. The water-blocking material shall be non-nutritive to fungus, electrically non-conductive, and homogenous. It shall also be free from dirt and foreign matter and shall be readily removable with conventional non-toxic solvents. Cable shall contain water-blocking threads between tubes.
9. The cable shall contain at least one ripcord under the sheath for easy sheath removal.
10. Tensile strength shall be provided by a combination of high tensile strength dielectric yarns.
11. The high tensile strength dielectric yarns shall be helically stranded evenly around the cable core.
12. All dielectric cables (with no armoring) shall be sheathed with medium density polyethylene (MDPE). The minimum normal jacket thickness shall be 1.4 mm. Jacketing material shall be applied directly over the tensile strength members and water-blocking material. The polyethylene shall contain carbon black to provide ultraviolet light protection and shall not promote the growth of fungus.

2.04 CABLE CONSTRUCTION

A. Plenum Cables

1. Plenum cables up to 24 fibers: The fibers shall be stranded around a dielectric member.
2. Cable shall be all dielectric and requiring no grounding or bonding.
3. Fibers shall have a 250um buffer coating

B. Cable Jacket

1. The jacket shall be continuous, free from pinholes, splits, blisters, or other imperfections. The jacket shall have a consistent, uniform thickness; jackets extruded under high pressure are not acceptable. The jacket shall be smooth, as is consistent with the best commercial practice. The jacket shall provide the cable with a tough, flexible, protective coating, able to withstand the stresses expected in normal installation and service.

2. The cable and subunit jacket color shall be orange for cables containing multimode fibers.
3. The cable and subunit jacket color shall be yellow for cables containing single-mode fibers.
4. For cables with more than two fibers, the cable jacket shall be designed for easy removal without damage to the optical fibers by incorporating a ripcord under each cable jacket. Non-toxic, non-irritant talc shall be applied to the aramid yarns to allow the yarns to be easily separated from the fibers and the jacket.
5. The nominal thickness of the cable outer jacket shall be sufficient to provide adequate cable protection while meeting the mechanical, flammability, low smoke, and environmental test requirements of this document over the life of the cable.

2.05 CABLE IDENTIFICATION

- A. The individual fibers shall be color coded for identification. The optical fiber color coding shall be in accordance with EIA/TIA-598, "Color Coding of Fiber Optic Cables." The coloring material shall be stable over the temperature range of the cable, shall not be susceptible to migration, and shall not affect the transmission characteristics of the optical fibers. Color coded buffered fibers shall not adhere to one another. When fibers are grouped into individual units, each unit shall be numbered in the unit jacket for identification. The number shall be repeated at regular intervals.
- B. The outer cable jacket shall be marked with the manufacturer's name or UL file number, date of manufacture, fiber type, flame rating, UL symbol, and sequential length markings every two feet. The markings shall be in contrasting color to the cable jacket.

2.06 FIBER CABLE TERMINATIONS, CONNECTORS, AND CABLE ASSEMBLIES

A. Buffer Tube Fan-Out Kits

1. Individual fibers within a loose tube cable with 250 μ m coated fibers shall use a fan-out kit to maintain flexibility and ease of handling fibers within a termination cabinet. Fan-out kits shall be installed in the patch panel enclosures to transition the loose tube fibers to ruggedized tight-buffered fiber pigtail cables. Optical fusion splices shall connect the loose tube fibers to the tight-buffered pigtail cables. The optical splice loss shall comply with the specifications for optical splices. Splice protection sleeves shall be employed on all splices to protect the splices.
2. The tight-buffered pigtails shall be factory-preconnectorized with connectors as specified.

B. Connectors

1. The fiber optic communications system shall utilize stainless steel LC style connectors for all fiber optic connections. ST or SC style connectors will be acceptable only if LC style connectors are not compatible with the equipment being provided. The connectors shall be designed for use with 50/125 micron cable. Each connector shall cause a maximum signal attenuation of 1.6 dB

2. Field-Installed Connectors: Connector type to match furnished type, with ceramic or polymer ferrule and strain relief boot. The connector installation shall not require the use of epoxies, adhesives or ovens. The connector shall contain a mechanical splice and have a tool kit available to aid in assembly. The installation tools used to terminate the connector shall be able to terminate other small-form-factor and single-fiber UniCam connector designs. The connector shall not require end-face polishing in the field. The connector shall have a factory polished optical fiber stub in the connector ferrule that is bonded in the ferrule micro hole. Ferrule material shall be available in ceramic or polymer. Connector specifications shall be as follows:
 - a. Insertion loss (typical): 0.3 dB.
 - b. Durability (mating cycles): 500 (minimum).
 - c. Repeatability: Less than 0.2 dB.
 - d. Operating Temperature: 0 to plus 60 degrees C.
3. After termination with connectors, the fiber ends must be visually inspected at a magnification of not less than 100 power for multimode and 200x for single mode to check for cracks or pits in the endface of the fiber.
4. Connectors shall have a maximum allowable connection loss of 0.3 dB per mated pair, as measured per EIA-455-34. No index-matching gel is to be used; dry interfaces only.
5. Each connector shall be of the industry standard LC type compatible; designed for single-mode and multimode tolerances; shall meet or exceed the applicable provisions of EIA-455-5, 455-2A, 455-34, and 568-B.3; and shall be capable of 100 repeated ratings with a maximum loss increase of 0.1 dB. Connectors shall incorporate a key-way design and shall have a Zirconia ceramic ferrule. Connector bodies and couplings shall be made of corrosion-resistant and oxidation-resistant materials such as nickel-plated zinc, designed to operate in humid environments without degradation of surface finishes. Connectors shall be capable of operating in a range of -40 to 75 degrees C.
6. Manufacturers
 - a. Corning Cable Systems.
 - b. Belden.
 - c. Black Box.
 - d. Or equal.

C. Fiber Optic Patch Cables

1. Fiber optic patch cable shall be two-fiber zipcord 50/125 core/clad micron multimode riser rated cable.
2. Installation of patch cables shall include all spares and observe the minimum fiber bend radius and strain relief.

2.07 FIBER OPTIC TERMINATION PATCH PANELS

- A. See Section 13320.

2.08 PULLING LUBRICANT

- A. Pulling lubricant shall be nontoxic, nonflammable, noncombustible and noncorrosive. The lubricant shall be water based and contain no waxes, greases, or silicones. The material shall be UL listed and compatible with the cable insulation and jacket.
- B. The pulling lubricant shall be specifically intended for fiber optic cable installations and shall be Polywater® F as manufactured by American Polywater Corporation or equal.

2.09 WARNING TAPE

- A. Metal detectable warning tape shall be installed 4"-6" below grade above any buried fiber optic cable. Tape shall be constructed of 5 mil orange polyester material, 2-in minimum width. Tape shall be capable of being detected or located by either conductive or inductive location techniques.
- B. Black lettering shall read CAUTION: BURIED FIBER OPTIC LINE BELOW.
- C. Warning tape shall be Brady Catalog #91606 or equal.

2.10 DUCT PLUGS

- A. Reusable plugs to seal around cables in conduits and ducts to make a watertight seal shall be corrosion proof and compatible with cable jacket type.
- B. Plugs shall be either blank or sized as required based on cable and duct sizes.
- C. Plugs shall be JACKMOON product line, as manufactured by Tyco Electronics or equal.

2.11 FACTORY TESTING

- A. Perform manufacturers standard production testing and inspection in accordance with applicable ICEA standards.
- B. Submit certified factory test reports as a submittal as specified herein.

PART 3 EXECUTION

3.01 GENERAL

- A. Provide all material, equipment, and labor to install and test the fiber optic cables as indicated and as specified. Installation shall comply with all codes and standards referenced in this specification.
- B. All cable terminations shall be made by a qualified fiber optic technician. Submit certification and qualifications to the Engineer prior to any work.
- C. Fiber optic cables shall be continuous from component to component and without splices between component connection points. Unless otherwise indicated on the plans, no splices may be made in the cables without prior written approval of the Engineer.

3.02 RACEWAY INSTALLATION

A. General

1. The raceway system installation including conduits, ducts, manholes, handholes, and pull boxes shall comply with Section 16020.
2. All conduits designated "fiber optic" shall be installed with inner ducts as noted on the Drawings.
3. All conduits or ducts, whether used or spare shall be sealed with duct plugs at all outdoor box locations and at the first entry box location indoors.
4. All spare conduits or ducts shall be provided with a pull string.
5. Use of manufactured bends shall be limited to an absolute minimum and shall be coordinated with the maximum bending radius of the fiber cable. Provide a minimum sweep radius of three feet.

B. Pulling Points

1. At no point shall the cable pulling tension exceed the TIA standards for the cable type. If calculated cable pulling tension exceeds TIA standards, provide additional pulling points, i.e. manholes, handholes, or pull boxes at no additional cost to the Owner.
2. Pull points shall be provided at no greater than 1,200-feet in a straight-line direction. Within the 1,200-foot distance, the Contractor shall install pulling points at locations wherever the cumulative change of direction of the raceway exceeds 270 degrees.
3. Pulling points shall be provided on at least one side of any tunneled, i.e. directional drilled, crossing. For crossings wherever the cumulative change of directions accounts exceeds 270 degrees, provide a pulling point on both sides of the crossing.

3.03 FIBER OPTIC CABLE INSTALLATION PREPARATION

- A. Verify that fiber optic cable reels have been off-loaded from truck carefully and not damaged.
- B. Submit to the Engineer all test data provided by the fiber manufacturer.
- C. Verify that the optical fibers of the cable assembly are the type and quantity as specified and as recommended by the Instrumentation System Supplier.
- D. Verify that cable construction is the type specified.
- E. Test cable on reel per field testing paragraph.

3.04 FIBER OPTIC CABLE INSTALLATION

A. General

1. The Contractor shall determine a suitable cable installation method to ensure that all cable installation requirements shall be met in all conduit/inner duct sections. All work shall be carried out in accordance and consistent with the highest standards of quality and craftsmanship in the communication industry with regard to the electrical and mechanical integrity of the connections, the finished appearance of the installation, and the accuracy and completeness of the documentation.
2. The Contractor shall make a physical survey of the project site for the purpose of establishing the exact cable routing and cutting lengths prior to the commencement of any work or committing any materials.
3. Cable installation personnel shall be familiar with the manufacturer's recommended procedures including, but not limited to, the following:
 - a. Proper attachment to the cable strength elements for pulling during installation. Depending on cable design, this will involve direct attachment to internal strength members or attaching an external "Kellums" or split mesh grip using a 600 lb. breakaway swivel.
 - b. Cable tensile limitations and tension monitoring procedures.
 - c. Cable bending radius limitations.
 - d. Cable twisting limitations.
4. All cable shall be installed in conduit.
5. Installation tools and materials shall be approved by the cable manufacturer.
6. Provide breakout kits, signal transceivers, power supplies, patch panels, pigtails and jumpers as required and as indicated to install a complete network. Patch panels shall be mounted inside panels as shown on the drawings.

B. Cable Protection

1. Precautions shall be taken during installation to prevent the cable from being kinked, crushed, or twisted. A pulling eye shall be attached to the cable end and be used to pull the cable through the duct and conduit system. As the cable is pulled off the reel and into the cable feeder guide, it shall be lubricated with a lubricant as specified in this Section.
2. Crushed or kinked cable shall be replaced with new cable.
3. Dynamometers or break-away pulling swings shall be used to ensure the pulling line tension does not exceed the installation tension values specified by the cable manufacturer. The mechanical stress placed upon the cable during installation shall not be such that the cable is twisted and stretched. Maximum allowable cable strain during installation shall be less than 0.75 percent.
4. As the cable is pulled into the conduit system, add pulling lubricant to completely coat the cable in accordance with the lubricant manufacturer's recommendation.

5. Repair of cable jacket will not be permitted. Jacket damage will require removal and re-installation of a new cable run at the Contractor's expense.
6. Installation at Pull boxes
 - a. The pulling of the cable shall be hand-assisted at each handhole or pull box. The cable shall not be crushed, kinked, or forced around a sharp corner. Sufficient slack shall be left at each end of the cable to allow proper cable termination.
 - b. The cable shall be looped in all pull boxes, as noted on the plans, to provide approximately 15 feet of extra cable in the pull box. At termination points such as at cabinets or computers, a 15-foot loop shall also be provided wherever space permits.
 - c. The fiber optic cable shall be coiled and secured with cable ties in the pull box.
 - d. The Contractor shall ensure that the minimum bending radius of the fiber optic cable is not compromised when preparing this stored cable slack.

C. Splicing

1. Splicing of fiber optic cable shall not be permitted except in emergency conditions. Fiber optic cable runs and required looping of the cable shall be provided in one continuous length. A splice is only permitted when authorized by the Engineer, splicing shall be by trained, authorized persons only. Any allowed splicing of fiber optic cable shall be by fusion splice only; no mechanical splices are permitted.
2. All fusion splicing equipment shall be in good working order, properly calibrated, and meeting all industry standards and safety regulations. Cable preparation, closure installation, and splicing shall be accomplished in accordance with accepted and approved industry standards.
3. Splices shall be made in manholes, handholes, pull boxes or other enclosures and shall use re-enterable splice closures. Make splices watertight and provide mechanical protection equal to the cable jacket, or better.
4. The average splice loss shall be 0.1 dB or less per splice. The average splice loss is defined as the summation of the loss as measured in both directions using an optical time domain reflectometer (OTDR) through the fusion splice, divided by two. No individual splice loss measured in a single direction shall exceed 0.15 dB.
5. Upon completion of the splicing operation, all waste material shall be deposited in suitable containers, removed from the job site, and disposed of in an environmentally acceptable manner.

3.05 IDENTIFICATION

- A. All cable identifiers shall be in accordance with the approved fiber optic network submittal.
- B. Tag each cable in junction boxes, manholes, and handholes. Provide permanent nylon/plastic tie-wrap type tags with waterproof markings.
- C. Label each cable, buffer tube, and fiber with permanent waterproof typewritten tags.

3.06 PHYSICAL CHECKOUT

- A. Conduct physical checkout of the fiber optic data highway network. Physical checkout shall be performed prior to functional testing.
- B. Verify identification is completed.
- C. Verify that fiber optic patch panels have been installed plumb and level at locations indicated.
- D. Verify that optical fiber connections or terminations within patch panels and splice closures are in accordance with cable manufacturer's recommendations.

3.07 FIELD TESTING

- A. General: The Contractor shall perform pre-installation and post-installation FOC tests. The Engineer shall be notified a minimum of 15 days in advance so that these tests are witnessed. All test equipment shall be traceable to NIST standards.
- B. Test equipment: The Contractor shall use the following to perform pre-installation and post-installation FOC tests:
 - 1. Optical Loss Test Set (OLTS): The OLTS shall consist of an optical fiber light source that produces wavelengths that match the type of fiber optic cable provided and a power meter to measure within +/- .25dB. OLTS shall also be able to measure the optical length of the fiber optic cable.
 - 2. Optical Time Domain Reflectometer (OTDR). The OTDR shall be laser precision, and able to test single mode or multimode systems with a visual fault locator.
 - 3. Fiber Microscope: Capable of at least 200X magnification.
 - 4. Test equipment that combines all these devices into one instrument is acceptable.
 - 5. Manufacturers of this equipment Fluke Networks, Corning, AFL (Noyes), Exfo, or equal.
- C. Pre-installation Reel Test
 - 1. The purpose of these tests is to perform acceptance tests on the cable prior to installation to verify that the cable conforms to the manufacturer's specifications; is free of defects, breaks, and damages by transportation and manufacturing processes; and to provide baseline readings in dB.
 - 2. Prior to removal of each cable from the delivery reel, all optical fibers within the cables shall be tested by the Contractor using an OTDR. The OTDR tests shall consist of end-to-end length and fiber attenuation (dB/km) measurements to ensure proper performance of the fiber optic cable. The tests shall be performed from both ends of each fiber to ensure complete fiber continuity within the cable structure.
 - 3. Pre-installation, "on-reel" test results shall be compared with the manufacturer's test report delivered with the cable. Gross dissimilarities shall be noted and remedied between the Contractor and manufacturer. In all cases, all fibers must meet the optical attenuation specifications prior to cable installation.

4. For multimode fiber: The maximum allowable attenuation is 3.5dB/km at 850nm and 1.5 dB/km at 1300nm. The Contractor shall replace any cable in which any fiber strand within that cable does not meet this requirement
 5. The Contractor shall perform tests on all reels of cable. The Engineer shall be notified a minimum of 15 days prior to any test.
 6. The Contractor shall document this test and submit the report for review and approval. Documentation shall consist of a hard copy printout of the test results along with the manufacturers test report.
 7. Cable shall not be installed until the Engineer has reviewed and approved the test report.
- D. Post-installation tests: After FOC has been installed and connectors have been added, the following tests shall be performed:
1. Visually inspect terminal connectors for out-of-round condition and surface defects such as micro-chips, cracks, and scratches using the fiber microscope. Record results on spreadsheet and replace any defective connections.
 2. ANSI Tier 1 Fiber Testing: The end-to-end link and length attenuation shall be calculated and recorded in a spreadsheet using the formulas specified by ANSI/TIA-568-C. On the same spreadsheet, the actual OLTs results shall be recorded and then compared to the acceptable power loss budget of the equipment that the fiber optic cable is connected to.
 3. ANSI Tier 2 Fiber Testing: A recording OTDR shall be used to test for end-to-end continuity and attenuation of each optical fiber in accordance with ANSI/TIA-568-C. The OTDR shall have an X-Y plotter to provide a hard copy record of each trace of each fiber. The OTDR shall be equipped with sufficient internal masking to allow the entire cable section to be tested. This may be achieved by using an optical fiber pigtail of 30 feet or more to display the required cable section.
 - a. The OTDR shall be calibrated for the correct index of refraction to provide proper length measurement for the known length of reference fiber.
 - b. A transmission test shall be performed with the use of 850 and 1300 nm stabilized light sources and 850 nm/1300 nm power meters for multimode fiber. This test shall be conducted in both directions on each fiber of each cable.
 - c. All traces shall display the entire length of cable under test, highlighting any localized loss discontinuities (installation-induced losses and/or connector losses). The trace shall display fiber length (in kilofeet), fiber loss (dB), and average fiber attenuation (in dB/km), as measured between two markers placed as near to the opposite ends of the fiber under test as is possible while still allowing an accurate reading. Care shall be taken to ensure that the markers are placed in the linear region of the trace, away from the front-end response and far-end Fresnel reflection spike. Time averaging shall be used to improve the display signal to noise ratio. The pulse width of the OTDR shall be set to a sufficient width to provide adequate injected power to measure the entire length the fiber under test.
 - d. If connectors exist in the cable under test, then two traces shall be recorded. One trace shall record the fiber loss (dB) and average attenuation (dB/km) of the entire cable segment under test, including connectors. The second trace shall display a magnified view of the connector regions, revealing the connector losses (dB). All connector losses shall be measured using the five-point splice loss measurement technique.

- e. Hard and electronic copies of test documentation shall be submitted. The OTDR trace shall also include the following information:
 - 1) The test site, including name and location
 - 2) The name of the person conducting the test
 - 3) The date and time the test results were saved in memory
 - 4) The manufacturer and model number of the device used for testing
 - 5) Fiber cable identification name, number, and type
 - 6) Fiber sub-cables (strands) identification name, number, and colors
 - 7) Length of each fiber
 - 8) Trace plot including event tables at appropriate wavelengths
 - 9) Index of refraction setting for OTDR
 - 10) dB/km loss
 - 11) Optical wavelengths used for testing
 - 12) Pulse width setting for OTDR
 - 13) Launch point connector number
 - 14) The averaging interval of the test
- E. The Contractor shall compare the pre-installation test results to the post-installation results. If a deviation of greater than one dB occurs, the Engineer shall be notified in writing by the Contractor, and the cable shall be removed and replaced at no additional cost to the Owner.
- F. Upon completion of the previous tests, all FOC coils shall be secured with ends capped to prevent intrusion of dirt and water.
- G. Certification of completion of pre- and post-fiber installation testing including test results shall be provided to the Engineer. Test results shall be submitted on paper in a binder, including results indicated in tables or a spreadsheet. Test results that exceed specification limits shall be noted. The electronic copy shall be included in the binder.

END OF SECTION

SECTION 13330
CONTROL PANEL ENCLOSURES AND PANEL EQUIPMENT

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Refer to Section 13300.
- B. Furnish and install control panels and panel mounted equipment as specified herein and shown on the Drawings.
- C. All new panels and panel components shall match existing equipment makes and models wherever possible, so that system additions can be most easily integrated with respect to operation and maintenance training, spare parts inventory, and service contracts. Even when exact matches are not possible, equipment furnished must be fully compatible with the existing system. Color, size, and material of new panels should conform to that of existing panels.
- D. Each panel shall be supplied with full sub-panels with the minimum specified dimensions regardless of the quantity of mounted components inside the panel. All panel mounted components shall be mounted on the single rear-of-panel sub-panel unless the density of devices exceeds the panel mounting space permitted by the minimum panel dimensions specified. Side panel mounted components shall only be permitted after review and approval of the Engineer.
- E. Furnish panels as indicated on the drawings and the schedule in Appendix A at the end of this section. Panel material, NEMA rating, and dimensions shall be as required in the panel schedule in Appendices A and B. Locations where new control equipment is being installed in an existing enclosure shall be provided with a new subpanel for installation in the existing enclosure. If the panel requires an air conditioner unit (as indicated on the panel schedule), the unit shall not compromise the NEMA rating of the enclosure. All panels shall be provided with an internal heater and door intrusion switch. Where indicated in Appendix A, include a strobe light, an alarm horn, a silence button, and a reset button.

1.02 RELATED WORK

- A. Refer to Section 13300 "IC - General Provisions."
- B. Refer to Section 13330 "Appendix A - Cedar Creek WPCP Schedule of Control Panels."
- C. Refer to Section 13330 "Appendix B - Glen Cove WWTP Schedule of Control Panels."

1.03 SUBMITTALS

- A. Refer to Section 13300.
- B. Descriptive literature, bulletins, catalog cuts and Drawings for the equipment specified herein.
- C. Complete bill of materials for the equipment.
- D. Spare parts list.

E. Panel Layout Drawings and Wiring Diagrams Submittal

1. Where direct hardwired interfaces exist between the PCSS control panels and vendor provided control panels furnished under other Divisions, the Contractor shall provide to the PCSS the approved submittals in order for the PCSS to provide complete wiring diagrams showing all wiring connections in the I/O system. This includes but is not limited to terminal block numbering, relay contact information, instruments, equipment, and control panel names. These drawings shall be included in the Final O&M submittal. Leaving this information blank on the Final Documentation drawings is not acceptable.
2. Panel Layout Drawings: Drawings shall be furnished for all panels, consoles, and equipment enclosures specified. Panel assembly and elevation drawings shall be drawn to scale and detail all equipment in or on the panel. Panel drawings shall be 11"x17" in size. At a minimum, the panel drawings shall include the following:
 - a. Interior and exterior panel elevation drawings to scale.
 - b. Nameplate schedule.
 - c. Conduit access locations.
 - d. Panel construction details.
 - e. Cabinet assembly and layout drawings to scale. The assembly drawing shall include a bill of material on the drawing with each panel component clearly defined. The bill of material shall be cross-referenced to the assembly drawing so that a non-technical person can readily identify all components of the assembly by manufacturer and model number.
 - f. Fabrication and painting specifications including color (or color samples).
 - g. Construction details, NEMA ratings, intrinsically safe barrier information, gas sealing recommendations, purging system details, etc. for panels located in hazardous locations or interfacing to equipment located in hazardous areas.
 - h. For every control panel, heating and cooling calculations for each panel supplied indicating conformance with cooling requirements of the supplied equipment and environmental conditions. Calculations shall include the recommended type of equipment required for both heating and cooling.
 - i. Submit evidence that all control panels shall be constructed in conformance with UL 508 and bear the UL seal confirming the construction. Specify if UL compliance and seal application shall be accomplished at the fabrication location or by field inspection by UL inspectors. All costs associated with obtaining the UL seal and any inspections shall be borne by the Contractor.
3. Panel Wiring Diagrams: Panel wiring diagrams depicting wiring within and on the panel as well as connections to external devices. If point-to-point wiring Diagrams are specified in Section 13300, equipment external to the control panel and related external connections do not need to be shown on the Panel Wiring Diagrams. Panel wiring diagrams shall include power and signal connections, UPS and normal power sources, all panel ancillary equipment, protective devices, wiring and wire numbers, and terminal blocks and numbering. Field device wiring shall include the device ISA-tag and a unique numeric identifier. The diagrams shall identify all device terminal points that the system connects to, including terminal points where I/O wiring lands on equipment not supplied by the PCSS. Wiring labeling used on the drawings shall match that shown on the Contract Documents or as developed by the PCSS and approved by the Engineer. I/O wiring shall be numbered with rack number, slot number, and point number. Two-wire and four-wire equipment shall be clearly identified, and power sources noted. Submit final wire numbering scheme. Panel drawings shall be 11" x17" in size.

1.04 COORDINATION MEETINGS

- A. Refer to Section 13300.

1.05 REFERENCE STANDARDS

- A. Refer to Section 13300.

1.06 QUALITY ASSURANCE

- A. Refer to Section 13300.

1.07 DELIVERY, STORAGE AND HANDLING

- A. Refer to Section 13300.

1.08 NOMENCLATURE AND IDENTIFICATION

- A. Refer to Section 13300.

1.09 MAINTENANCE

- A. Refer to Section 13300.
- B. Test Equipment:
 - 1. Refer to Section 13300.

1.10 WARRANTY

- A. Refer to Section 13300.

PART 2 PRODUCTS

2.01 GENERAL

- A. Refer to Section 13300

2.02 LIGHTNING/SURGE PROTECTION

- A. Refer to Section 13300.

2.03 CONTROL PANEL GENERAL REQUIREMENTS

- A. The dimensions within this Section and on the Contract Drawings are for general reference only. Ensure that final enclosure sizing and panel arrangements accommodate all required equipment for a fully integrated and operational system as specified herein and in the Contract Documents.

- B. Each control panel and terminal cabinet shall bear the UL label. The UL label shall apply to the enclosure, the specific equipment supplied with the enclosure, and the installation and wiring of the equipment within and on the enclosure. If required for UL labeling, provide ground fault protective devices, isolation transformers, fuses and any other equipment necessary to achieve compliance with UL 508 requirement. The Drawings do not detail all UL 508 requirements.
- C. All panel doors shall have a lock installed in the door handle, or a hasp and staple for padlocking. Locks for all panels provided under this Contract shall be keyed alike.
- D. The devices designated for rear-of-panel mounting shall be arranged within the panel according to respective panel drawings and in a manner to allow for ease of maintenance and adjustment. Heat generating devices such as power supplies shall be located at or near the top of the panel.
- E. The panels shall be completely fabricated, instruments and devices installed and wired at the PCSS's facility.
- F. All components shall be mounted in a manner that shall permit servicing, adjustment, testing, and removal without disconnecting, moving, or removing any other component. Components mounted on the inside of panels shall be mounted on removable plates and not directly to the enclosure. Mounting shall be rigid and stable unless shock mounting is required otherwise by the manufacturer to protect equipment from vibration. Component mounting shall be oriented in accordance with manufacturer's recommendations. The internal components shall be identified with suitable plastic or metal engraved nametags mounted adjacent to (not on) each component identifying the component in accordance with the drawing, specifications, and PCSS's data.
- G. All exterior panel mounted equipment shall be installed with suitable gaskets, faceplates, etc. required to maintain the NEMA rating of the panel.
- H. Nameplates
 - 1. All panels and panel devices shall be supplied with suitable nameplates, which identify the panel and individual devices as required. Unless otherwise indicated, each device nameplate shall include up to three lines with the first line containing the device tag number as shown on the drawings, the second line containing a functional description (e.g., Recirculation Pump No. 1), and the third line containing a functional control description (e.g., Start).
 - 2. Unless escutcheon plates are specified or unless otherwise noted on the Drawings, nameplates shall be 3/32-inch thick, black and white, Lamicoid with engraved inscriptions. The letters shall be Black [White] against a White [Black] background unless otherwise noted. Edges of the nameplates shall be beveled and smooth. Nameplates with chipped or rough edges will not be acceptable.
 - 3. Nameplate fasteners and mounting shall be epoxy adhesive or stainless steel screws for cabinet mounted nameplates
 - 4. For every panel, provide a panel nameplate with a minimum of 1-in high letters. Provide legend plates or 1-in by 3-in engraved nameplates with 1/4-in lettering for identification of door mounted control devices, pilot lights, and meters.

5. Single lamicoid nameplates with multiple legends shall be used for grouping of devices such as selector switches and pilot lights that relate to one function.

I. Mounting Elevations

1. ISA Recommended Practice RP60.3 shall be used as a guide in layout and arrangement of panels and panel mounted components. Dimensions shall account for all housekeeping pads that panels will sit on once they are installed.
2. Centerline of indicators and controllers shall be located no lower than 48-inches or higher than 66-inches above the floor on a panel face.
3. Centerline of lights, selector switches, and pushbuttons shall be located no lower than 32-inches or higher than 70-inches above the floor on a panel face.
4. Tops of annunciators shall be located no higher than 86-inches above the floor on a panel face.
5. Installation of panel components shall conform to component manufacturers' guidelines.

2.04 PANEL MATERIALS AND CONSTRUCTION

- A. Existing enclosures being reused shall have all new equipment mounted on a subpanel inside of the existing enclosure. The size of the subpanel shall not exceed the dimensions listed on the panel schedule in Appendix A at the end of this section but should be field verified to ensure that the equipment arrangement and actual subpanel size selected shall fit the existing enclosure properly. Where indicated a new swing-out door shall be provided for mounting hand switches, pilot lights, and OITs. The size and material of the door shall be field verified to match the existing swing-out door. The door shall be provided with a mechanism to prevent the door from moving when engaged. When disengaged, the door shall swing out and allow full access to the components mounted in the enclosure. The swing-out door shall be mounted appropriately such that the existing enclosure door does not interfere with any door mounted components when the enclosure door is closed. Panels that do not include a new swing-out door shall be provided with a new enclosure door of similar material, color, and enclosure rating for mounting of new hand switches, pilot lights, and OITs.

B. Structure and Enclosure

1. Panels shall be of continuous welded-steel or FRP construction as shown on the Panel Schedule. Provide angle stiffeners as required on the back of the panel face to prevent panel deflection under instrument loading or operation. Internally the panels shall be supplied with a structural framework for instrument support purposes and panel bracing. The internal framework shall permit panel lifting without racking or distortion. Provide removable lifting rings designed to facilitate simple, safe rigging, and lifting of the control panels during installation.

2. Each panel shall be provided with full height, fully gasketed access doors. Doors shall be provided with a three-point stainless steel latch and heavy-duty stainless-steel hasp and staple for use with a Master Lock. Panel access doors shall be provided with full length, continuous, piano type stainless steel hinges with stainless steel pins. Front access doors with mounted instruments or control devices shall be of sufficient width to permit door opening without interference from flush mounted instruments.
3. The panels, including component parts, shall be free from sharp edges and welding flaws. Wiring shall be free from kinks and sharp bends and shall be routed for easy access to other components for maintenance and inspection purposes.
4. The panel shall be suitable for top and bottom conduit entry as required by the Electrical Drawings. For top mounted conduit entry, the panel top shall be provided with nominal one-foot square removable access plates, which may be drilled to accommodate conduit and cable penetrations. All conduit and cable penetrations shall be provided with ground bushings, hubs, gasketed locknuts, and other accessories as required to maintain the NEMA rating of the panel and electrical rating of the conduit system.
5. All panels in indoor, dry, non-corrosive environments shall be NEMA 12 unless otherwise noted. All panels in outdoor, wet, and chemically corrosive environments shall be NEMA 4X unless otherwise noted.

C. Freestanding and Floor-Mounted Vertical Panels

1. Freestanding and floor-mounted vertical panels shall meet the NEMA classification as shown on the drawings or specified herein. The panels shall be constructed of 12-gauge sheet steel, suitably braced internally for structural rigidity and strength. All NEMA 4X rated panels shall be constructed of Type 316 stainless steel, unless FRP is specifically indicated to be provided. Front panels or panels containing instruments shall be not less than 10-gauge stretcher leveled sheet steel, reinforced to prevent warping or distortion.

D. Wall and Unistrut Mounted Panels

1. All wall and Unistrut mounted panels shall meet the NEMA classification as shown on the drawings or specified herein. The panels shall be constructed of not less than USS 14-gauge steel, suitably braced internally for structural rigidity and strength. All NEMA 4X rated wall mounted panels shall be constructed of Type 316 stainless steel, unless FRP is specifically indicated. FRP panels shall be used in chlorine areas. All FRP panels located in direct sunlight shall be provided with a protective coating and sun shield to prevent discoloration and cracking.

E. Finish Requirements

1. All sections shall be descaled, degreased, filled, ground and finished. The enclosure when fabricated of steel shall be finished with two rust resistant phosphate prime coats and two coats of enamel, polyurethane, or lacquer finish which shall be applied by either the hot air spray or conventional cold spray methods. Brushed anodized aluminum, stainless steel, and FRP panels will not require a paint finish.
2. The panels shall have edges ground smooth and shall be sandblasted and then cleaned with a solvent. Surface voids shall be filled and ground smooth.

3. Immediately after cleaning, one coat of a rust-inhibiting primer shall be applied inside and outside, followed by an exterior intermediate and top coat of a two-component type epoxy enamel. A final sand-ing shall be applied to the intermediate exterior coat before top coating.
 4. Apply a minimum of two coats of manufacturer's standard, flat light-colored lacquer, on the panel interior after priming.
 5. Unless otherwise noted, the finish exterior colors shall be ANSI 61 gray with a textured finish.
- F. Print storage pockets shall be provided on the inside of each panel. The storage pockets shall be steel, welded on to the door, and finished to match the interior panel color. The storage pocket shall be sufficient to hold all of the prints required to service the equipment, and to accommodate 8.5 inch by 11 inch documents without folding.
- G. Where specified on the Panel Schedule, a folding shelf shall be provided on the inside of the door on all free-standing and floor-mounted panels. The shelf shall be suitable for a laptop computer and shall be placed such that an open laptop computer does not interfere with any door-mounted devices. The folded shelf shall not interfere with any internal panel components when the door is closed. The folding shelf shall automatically lock in the horizontal position when raised. The folding shelf shall be approximately 18 inches wide by 12 inches deep and shall have a minimum distributed load rating of 100 pounds. All parts shall be made of heavy gauge steel and shall be painted white or finished to match the interior panel color.

2.05 ENVIRONMENTAL CONTROL

- A. All panels shall be provided with louvers, sun shields, heat sinks, forced air ventilation, or air conditioning units as required to prevent temperature buildup inside of panel. The internal temperature of all panels shall be regulated to a range of 45 Deg F to 104 Deg F under all conditions. Under no circumstances shall the panel cooling or heating equipment compromise the NEMA rating of the panel.
- B. Except for panels mounted with their backs directly adjacent to a wall, louvers shall be in the rear of the panels, top and bottom, and shall be stamped sheet metal construction.
- C. For panels mounted with their backs directly adjacent to a wall, louvers shall be on the sides.
- D. Forced air ventilation fans, where used, shall provide a positive internal pressure within the panel, and shall be provided with washable or replaceable filters. Fan motors shall operate on 120-volt, 60-Hz power.
- E. For panels with internal heat that cannot be adequately dissipated with natural convection and heat sinks, or forced air ventilation, an air conditioner shall be provided.
- F. Provide custom fabricated sun shields for all outdoor panels in accordance with the following requirements:

1. Sun shields shall be fabricated from minimum 12 gauge Type 316 stainless steel. Units shall be designed, fabricated, installed, and supported to fully cover and shade the top, sides and back of the enclosure, and to partially shade the front panel of the enclosure, from direct exposure to sunlight from sunrise to sunset.
 2. Depending on overall size, sun shields may be fabricated in single or multiple segments for attachment to the enclosure support framing or to separate free standing framing around the enclosure.
 3. Sun shields shall not be attached directly to the enclosure by drilling holes through, or welding studs to, the enclosure surfaces, and shall be designed and mounted to provide a minimum 3-inch air gap all around the enclosure for air circulation and heat dissipation.
 4. The top section of all sun shields shall be sloped at a minimum angle of 5 degrees from horizontal. For wall mounted enclosures, the top section shall slope downward away from the wall and towards the front of the enclosure. For free standing, floor mounted and frame mounted enclosures the top section shall slope downward towards the back side of the enclosure.
 5. The front edge of the top section of all sun shields shall incorporate a narrow and more steeply sloped drip shield segment which sheds water away from the front of the enclosure and prevents it from dripping or running directly onto the front panel of the enclosure.
 6. All seam welds used in sun shield fabrication shall be continuous and shall be ground smooth.
 7. All exposed corners, edges and projections shall be smooth rounded or chamfered to prevent injury.
- G. All enclosures shall be provided with an integral heater, fan, and adjustable thermostat to reduce condensation and maintain the minimum internal panel temperature. Mount the unit near the bottom of the enclosure with discharge away from heat-sensitive equipment. Heater shall be Hoffman DAH 100 Watts, 115Volt, 50/60 HZ or equal.
- H. All outdoor enclosures shall include an air conditioning unit that shall not compromise the NEMA 4X rating. Heat calculations shall be provided indicating that the selected air conditioner shall be satisfactory to maintain a maximum temperature of 104 deg F inside the enclosure.

2.06 CORROSION CONTROL

- A. Panels shall be protected from internal corrosion by the use of corrosion-inhibiting vapor capsules as manufactured by Northern Technologies International Corporation, Model Zerust VC; Hoffman Model AHCI; or equal.

2.07 CONTROL PANEL - INTERNAL CONSTRUCTION

A. Internal Electrical Wiring

1. All interconnecting wiring shall be stranded, type MTW, and shall have 600 volt insulation and be rated for not less than 90 degrees Celsius. Wiring for systems operating at voltages in excess of 120 VAC shall be segregated from other panel wiring either in a separate section of a multi-section panel or behind a removable Plexiglas or similar dielectric barrier. Panel layout shall be developed such that technicians shall have complete access to 120 VAC and lower voltage wiring systems without direct exposure to higher voltages.
2. Power distribution wiring on the line side of fuses or breakers shall be 12 AWG minimum. Control wiring on the secondary side of fuses shall be 16 AWG minimum. Electronic analog circuits shall utilize 18 AWG shielded, twisted pair, cable insulated for not less than 600 volts.
3. Power distribution blocks shall be covered with protective guards to meet “finger-safe” requirements of IP20.
4. Power and low voltage DC wiring systems shall be routed in separate wireways. Crossing of different system wires shall be at right angles. Different system wires routed parallel to each other shall be separated by at least 6-inches. Different wiring systems shall terminate on separate terminal blocks. Wiring troughs shall not be filled to more than 60 percent visible fill.
5. Terminations
 - a. All wiring shall terminate onto single tier terminal blocks, where each terminal is uniquely and sequentially numbered. Direct wiring between field equipment and panel components is not acceptable.
 - b. Multi-level terminal blocks or strips are not acceptable unless they are approved by the Engineer in advance of panel wiring diagrams. If approved, they shall be mounted on angled din rail elevated from the back panel.
 - c. Terminal blocks shall be arranged in vertical rows and separated into groups (power, AC control, DC signal). Each group of terminal blocks shall have a minimum of 25 percent spares.
 - d. Terminal blocks shall be the compression type, fused, unfused, or switched as shown on the Contract Drawings or specified elsewhere in Division 13.
 - e. Discrete inputs and outputs (DI and DO) shall have two terminals per point with adjacent terminal assignments. All active and spare PLC and controller points shall be wired to terminal blocks.
 - f. Analog inputs and outputs (AI and AO) shall have three terminals per shielded pair connection with adjacent terminal assignments for each point. The third terminal is for shielded ground connection for cable pairs. Ground the shielded signal cable at the PLC cabinet. All active and spare PLC and controller points shall be wired to terminal blocks.
 - g. Wire and tube markers shall be the sleeve type with heat impressed letters and numbers.
 - h. Only one side of a terminal block row shall be used for internal wiring. The field wiring side of the terminal shall not be within 6-inches of the side panel or adjacent terminal or within 8-inches of the bottom of free standing panels, or within 3-inches of stanchion mounted panels, or 3-inches of adjacent wireway.

- i. Circuit power from the SCADA cabinet out to field devices (switches, dry contacts etc.) that are used as discrete inputs to the PLC input cards shall be isolated with an isolating switch terminal block with flip cover that is supplied with a dummy fuse. Isolation switch block shall be an Allen Bradley Model 1492-H7 or equal. One isolating switch terminal block per loop numbered piece of equipment and one per spare I/O point is acceptable.
 - j. All PLC discrete outputs to the field shall be isolated with an isolating fuse switch terminal block with a flip cover and a neon blown fuse indicator. The single circuit fusible terminal block shall be an Allen Bradley 1492-H4 or equal.
- 6. All wiring to hand switches and other devices, which are live circuits independent of the panel's normal circuit breaker protection, shall be clearly identified as such.
- 7. All wiring shall be clearly tagged and color coded. All tag numbers and color coding shall correspond to the panel wiring diagrams and loop drawings prepared by the PCSS. All power wiring, control wiring, grounding, and DC wiring shall utilize different color insulation for each wiring system used. The color coding scheme shall be:
 - a. Incoming 120 VAC Hot - Black
 - b. 120 VAC Hot wiring downstream of panel circuit breaker – Red
 - c. 120 VAC Hot wiring derived from a UPS system – Red with Black stripe
 - d. Three phase power – Brown, Orange, Yellow, and Green ground or as specified in Division 16.
 - e. 120 VAC neutral - White
 - f. Ground - Green
 - g. DC power or control wiring – Blue
 - h. DC analog signal wiring – Black (+), White (-)
 - i. Foreign voltage – Yellow
- 8. Provide surge protectors on all incoming power supply lines at each panel per the requirements of Section 13300.
- 9. Each field instrument furnished under Division 13 and shown on the Drawings as deriving input power from the control panel(s) shall have a separate power distribution circuit with a circuit breaker or fuse and blown fuse indication. All instruments requiring 120VAC power shall be powered from the UPS source in the panel where the instrument signals lands.
- 10. Provide redundant 24 VDC power supplies to power field instruments and panel devices. Twenty-four VDC power supplies shall be as specified in this Section.
- 11. Wiring trough for supporting internal wiring shall be plastic type with snap-on covers. The side walls shall be open top type to permit wire changing without disconnecting. Trough shall be supported to the subpanel by stainless steel screws. Trough shall not be bonded to the panel with glue or adhesives.
- 12. Each panel shall have a single tube, fluorescent light fixture, 20 Watt in size, mounted internally to the ceiling of the panel. Light fixture shall be switched and shall be complete with the lamp.
- 13. Each panel shall have a specification grade duplex convenience receptacle with ground fault interrupter, mounted internally within a stamped steel device box with appropriate

cover. Convenience receptacle shall not be powered from a UPS and shall be protected by a dedicated 5A circuit breaker.

14. Each panel shall be provided with an isolated copper grounding bus for all signal and shield ground connections. Shield grounding shall be in accordance with the instrumentation manufacturer's recommendations.
15. Each panel shall be provided with a separate copper power grounding bus (safety) in accordance with the requirements of the National Electrical Code.
16. Each panel shall have control, signal, and communication line surge suppression in accordance with Section 13300.
17. All microprocessor-based electronic devices in the panel that are powered by 120VAC shall be powered by the UPS (refer to appropriate Section in Division 13).
18. Each panel shall be provided with a circuit breaker to interrupt incoming power.
19. Additional electrical components including transformers, motor starters, switches, circuit breakers, etc. shall be in compliance with the requirements of Division 16.

B. Pneumatic Tubing

1. Refer to Section 13300.
2. Pneumatic tubing shall be a minimum of 1/4-inch O.D. Type 316 stainless steel with compression fittings. All tubing shall be rigidly supported and run in horizontal or vertical planes.
3. All pneumatic equipment shall be provided with separate shut-off valves. Flexible polyethylene tubing shall be used on all devices mounted on hinged doors, etc.
4. A screened vent shall be provided on all enclosures using pneumatic instruments.
5. All pneumatic tubing shall be routed in separate bundles or wireways, and shall be separated from all electrical wiring by a minimum of 3-inches.

C. Relays not provided under Division 16 and required for properly completing the control function specified in Division 13, Division 16, or shown on the Drawings shall be provided under this Section.

D. The orientation of all devices including PLC and I/O when installed shall be per the manufacturer's recommendations. No vertical orientation of PLC racks shall be allowed unless specifically indicated by the manufacturer as an acceptable mounting alternative and also approved by the engineer.

2.08 ELECTRICAL COMPONENTS

- A. The main circuit breaker shall be a thermal-magnetic molded case breaker, by Square D Company, or equal. Provide a flange mounted main power disconnect operating handle with mechanical interlock having a bypass that will allow the panel door to open only when the switch is in the OFF position.

- B. A mechanical disconnect mechanism, with bypass, shall be installed on each motor circuit protector, capable of being locked in the "OFF" position to provide a means of disconnecting power to the motor.
- C. A switch shall be provided for each enclosure which shall be activated when the enclosure door is opened, for monitoring by the PLC for an intrusion alarm. Switch shall be Hoffman, or equal.
- D. Auxiliary contacts shall be provided for remote run indication and indication of each status and alarm condition. Additional controls shall be provided as specified herein and as required by the detailed mechanical equipment requirements, the P&IDs, the Control Wiring Schematics and as shown on the Drawings.
- E. All operating control devices and instruments shall be securely mounted on the exterior door. All controls shall be clearly labeled to indicate function and shall be in accordance with the electrical area classification indicated on the Electrical Contract Drawings.
- F. A six digit, non-resettable quartz time base elapsed time meter shall be connected to each motor starter. Meter shall be Hobbs 98000 Series, Redington Model 722, Cramer Model ETI-635 G, or equal.
- G. The control panel shall be provided with a lightning and surge protection unit on the line side of the main circuit breaker. Unit shall be 600 Volt, 3 Phase, General Electric "Tranquell" Series, or equal.
- H. Where required by Specifications, an alternator shall be provided to sequence motors. Alternator shall be Catalog No. 008-120-13SP or 009-120-23AP by Stacon; Square D, Class 9039, Type HG-21 or equal.
- I. Panel mounted timers shall be flush mounted, plug-in type, Eagle Signal Bulletin 125 cycle-flex, Idec SR6P-MO8G or equal
- J. Specific control devices, control descriptions and other data are specified under the detailed specification for the mechanical equipment with which the control panel is supplied.

2.09 PILOT TYPE INDICATING LIGHTS

- A. Type: Energy efficient Solid State LED Lamps.
- B. Functional:
 - 1. Units shall be provided with low voltage LED lamps suitable for the voltage supplied.
 - 2. Lights supplied with 120V AC power shall have integral reduced voltage transformers.
 - 3. Lamps shall be replaceable from the front of the unit.
- C. Physical:
 - 1. Lens color:
 - a. Running, on, open – Red.
 - b. Stopped, off, closed – Green.
 - c. Alarm – Amber.

- d. White - Power on
- e. Blue - All other status indications not covered by the above
- f. Lens caps shall be approximately .46-inch diameter. Provide legend faceplates engraved to indicate the required function of each device; NEMA rating - 4X.

D. Manufacturer(s):

- 1. Cutler-Hammer.
- 2. Allen Bradley.
- 3. General Electric.
- 4. Square D.
- 5. Crouse Hinds (NEMA 7).
- 6. Equal.

2.10 SELECTOR SWITCHES AND PUSHBUTTONS

A. Type:

- 1. Control devices shall be heavy-duty oil tight type with stackable contact blocks.

B. Functional:

- 1. Provide contact arrangement and switching action as required for the control system specified.

C. Physical:

- 1. For 120 VAC service provide contacts rated 10 amps at 120 VAC, for 24 VDC service provide silver sliding contacts rated 5 amps at 125 VDC, for electronic (millivolt/ milliamp) switching provide contacts rated lamp at 28 VDC.
- 2. Pushbuttons shall have flush type operators.
- 3. Selector switches shall have knob or wing lever operators; NEMA rating - 4X; Provide legend plates denoting switch/pushbutton position/ function.

D. Manufacturer(s):

- 1. Cutler-Hammer.
- 2. Allen Bradley.
- 3. General Electric.
- 4. Square D.
- 5. Crouse Hinds (NEMA 7).

6. Equal.

2.11 GENERAL PURPOSE RELAYS AND TIME DELAYS

A. Type:

1. General purpose plug-in type.

B. Functional:

1. Contact arrangement/function shall be as required to meet the specified control function; Mechanical life expectancy shall be in excess of 10 million.
2. Duty cycle shall be rated for continuous operation; Units shall be provided with integral indicating light to indicate if relay is energized.
3. Solid state time delays shall be provided with polarity protection (DC units) and transient protection.
4. Time delay units shall be adjustable and available in ranges from .1 second to 4.5 hours.

C. Physical:

1. For 120 VAC service provide contacts rated 10 amps at 120 VAC, for 24 VDC service provide contacts rated 5 amps at 28 VDC, for electronic (milliamp/millivolt) switching applicator provide gold plated contacts rated for electronic service; relays shall be provided with dust and moisture resistant covers.

D. Options/Accessories Required:

1. Provide mounting sockets with pressure type terminal blocks rated 300 volt and 10 amps.
2. Provide mounting rails/holders as required.

E. Manufacturer(s):

1. Allen Bradley.
2. Potter & Brumfield.
3. Equal.

2.12 SIGNAL RELAY SWITCHES (CURRENT TRIPS)

A. Type:

1. Solid state, ASIC technology, electronic type.

B. Functional:

1. Input: 4-20 mA.

2. Output: Isolated contact output, double pole double throw, rated 5 amps at 120 VAC.
3. Accuracy: 0.1 percent.
4. Protection: Provide RFI protection.
5. Deadband: Adjustable between 0.1 and 5.0 percent of span.
6. Set point Adjustment: Single Point alarms shall be adjustable to trip on rising or falling input signal, dual point alarms shall be adjustable to trip on rising and falling input signals.
7. Repeatability: Trip point repeatability shall be at least 0.1 percent of span.

C. Physical:

1. Mounting: DIN rail.

D. Manufacturer(s):

1. Action Instruments Slim Pak.
2. Acromag.
3. Equal.

2.13 SIGNAL ISOLATORS/BOOSTERS/CONVERTERS

A. Type:

1. Solid state, ASIC technology; electronic type.

B. Functional:

1. Accuracy: 0.15 percent.
2. Inputs: Current, voltage, frequency, temperature, or resistance as required.
3. Outputs: Current or voltage as required.
4. Isolation: There shall be complete isolation between input circuitry, output circuitry, and the power supply.
5. Adjustments: Zero and span adjustment shall be provided.
6. Protection: Provide RFI protection.

C. Physical:

1. Mounting: DIN Rail.

D. Manufacturer(s):

1. Action Instruments Slim Pak.
2. Acromag.
3. Equal.

2.14 SIGNAL SELECTORS, COMPUTATION, AND CONDITIONING RELAYS

A. Type:

1. Solid state, ASIC technology, electronic type.

B. Functional:

1. Inputs: 4-20 mA.
2. Outputs: 4-20 mA.
3. Protection: Provide RFI protection.
4. Operation: The relay shall multiply, add, subtract, select, extract the square root, or perform the specified conditioning/ computation function required. All inputs shall be able to be individually rescaled and biased as required.
5. Isolation: All inputs, outputs, and power supplies shall be completely isolated.
6. Accuracy: 0.35 percent of span.
7. Adjustments: Multi turn potentiometer for zero, span, scaling, and biasing.

C. Physical:

1. Mounting: DIN rail.

D. Manufacturer(s):

1. Action Instruments Slim Pak.
2. Acromag.
3. Equal.

2.15 INTRINSIC SAFETY BARRIERS

A. Type:

1. Barriers shall be of the solid state electronic type in which the energy level of the sensing or actuation circuit is low enough to allow safe usage in hazardous areas.
2. Provide a barrier for instrumentation and equipment transmitting analog or digital signals that originate in a hazardous area as indicated in the design documents.

B. Options Required:

1. Barriers shall match power supply provided.
2. Barriers shall be located in non-hazardous areas.

C. Manufacturer(s):

1. Siemens Water Technologies – IS1 (4-20mA) and IS6 (dry contacts)
2. Gems – 54800 (4-20mA) and 65800 (dry contacts)
3. R. Stahl - Intrinspak
4. Equal.

2.16 EMERGENCY ALARM BEACON AND AUDIBLE HORN

A. Beacon alarm light:

1. Type:
 - a. Beacon alarm light.
2. Physical:
 - a. Beacon alarm light shall be 120 VAC, flush mounted.
 - b. A 750,000-candle power xenon strobe tube and red polycarbonate lens.
3. Manufacturer(s):
 - a. Federal Signal.
 - b. Edwards.
 - c. Wheelock.
 - d. Equal.

B. Alarm Horn:

1. Type:
 - a. Alarm horn shall be vibrating type for 120 Volts, 60 Hz.

2. Manufacturer(s):
 - a. Federal Signal Corp.
 - b. Edwards Co.
 - c. Benjamin.
 - d. Equal.

2.17 INTRINSIC SAFETY BARRIERS (FOR 2-WIRE TRANSMITTER SYSTEMS)

- A. Intrinsic safety barriers shall be passive devices requiring no external voltage supply and supplied with series resistors, series fuse and shunt zener diodes to limit the transfer of energy to levels required by intrinsically safe protection between safe and hazardous locations.
- B. Unit shall be Factory Mutual approved and certified for use in accordance with National Fire Protection Association (NFPA 493).
- C. Manufacturer(s):
 1. P&F.
 2. Gems.
 3. Unitech.
 4. Equal.

2.18 24 VDC POWER SUPPLIES

- A. Provide a 24 VDC power supply in the control panel to power field instruments, panel devices, etc., as required. Equip the power supply with a power on/off circuit breaker.
- B. The 24 VDC power supply shall meet the following requirements:
 1. Input power: 115 VAC, plus or minus 10 percent, 60 Hz.
 2. Output voltage: 24 VDC.
 3. Output voltage adjustment: 5 percent.
 4. Line regulation: 0.05 percent for 10-volt line change.
 5. Load regulation: 0.15 percent no load to full load.
 6. Ripple: 3 mV RMS.
 7. Operating temperature: 32 to 140 degrees Fahrenheit.
- C. Size the 24 VDC power supply to accommodate the design load plus a minimum 25 percent spare capacity.
- D. If power supply on/off status signal is shown, provide a relay contact (internal to the power supply or external if the power supply is not so equipped) to indicate on/off status of the power supply.

- E. Provide output overvoltage and overcurrent protective devices with the power supply to protect instruments from damage due to power supply failure and to protect the power supply from damage due to external failure.
- F. Mount the 24 VDC power supply such that dissipated heat does not adversely affect other panel components.
- G. Manufacturer(s):
 - 1. Acopian.
 - 2. Lambda.
 - 3. Equal.

2.19 SPARE PARTS

- A. General requirements for spare parts are specified in section 13300.
- B. The following control panel spare parts shall be furnished:
 - 1. Timers and sockets - Two of each type installed.
 - 2. Relays and sockets - Two of each type installed.
 - 3. Fuses and circuit breakers - 10% (minimum of 10 fuses and 2 circuit breakers) of each type and size installed.
 - 4. Light bulbs - 10% (minimum of 10) of each type installed. For LED type lights, 5% (minimum of 3) of each color installed.
 - 5. Panel Mounted power supplies - one of each type installed.
 - 6. Selector switches/pushbuttons - Two of each type installed including contact blocks.
 - 7. Provide touch-up paint, of each type and color used for all cabinets, panels, and consoles supplied.

PART 3 EXECUTION

3.01 INSTALLATION

- A. The panels shall be installed at locations as shown on the Contract Drawings.
- B. Refer to Section 13300.

3.02 TESTS

- A. Refer to Section 13300.

END OF SECTION

APPENDIX 13330-A

CEDAR CREEK WPCP SCHEDULE OF CONTROL PANELS

APPENDIX 13330-B

GLEN COVE WWTP SCHEDULE OF CONTROL PANELS

The following schedules shall be used in conjunction with the specification for all control panels enclosures being furnished under this project.

Section 13330 - Appendix A
Cedar Creek WPCP
Schedule of Control Panels

5044-102537
March 2020

Enclosure Name/Location	Nameplates	Minimum Size	Maximum Size	Enclosure/Panel Type	Enclosure Rating and Additional Requirements
PLC-ATCC-1 (West Aeration Tank Gallery)	Nameplate 1: PLC-ATCC-1 Enclosure Nameplate 2: South RAS Pump Station	36"W x 72"H x 18"D	48"W x 90"H x 24"D	PLC Enclosure	NEMA Type 4X, 1 or 2-door, 304 stainless steel construction, free standing. Front Access Only. Include NEMA 4X air conditioner. Include door intrusion switch.
PLC-ATCC-2 (Aeration Tank Gallery)	Nameplate 1: PLC-ATCC-2 Enclosure Nameplate 2: Aeration Tanks 4-6	36"W x 72"H x 18"D	48"W x 90"H x 24"D	PLC Enclosure	NEMA Type 4X, 1 or 2-door, 304 stainless steel construction, free standing. Front Access Only. Include NEMA 4X air conditioner. Include door intrusion switch.
PLC-ATCC-3 (RAS North Pump Station Electrical Room)	Nameplate 1: PLC-ATCC-3 Enclosure Nameplate 2: North RAS Pump Station	72"W x 90"H x 36"D	72"W x 90"H x 36"D	PLC Enclosure	NEMA Type 12, 2-door/panel section, steel construction (painted grey), free standing. Front Access Only. Provide two new Backpanels, one shall be 32"W x 78"H painted steel to mount the PLC-ATCC-3 and associated equipment. The other shall be 32"W x 60"H painted steel to mount the new FOCE-RASN and have space above for new OIT-ATCC-3. Include door intrusion switch.
PLC-ATCC-4 (Aeration Tank Gallery)	Nameplate 1: PLC-ATCC-4 Enclosure Nameplate 2: Aeration Tanks 1-3	N/A	N/A	PLC Enclosure: Re-Use Existing NEMA 4X Stainless Steel 72"W x 90"H x 36"D Enclosure	Include Stainless Steel plate (match existing) to cover holes after removal of controllers. Re-Use existing Sidepanels. Provide two new Backpanels, one shall be 32"W x 78"H painted steel to mount the PLC-ATCC-4 and associated equipment. The other shall be 32"W x 60"H painted steel to mount the additional equipment and have space above for new OIT-ATCC-4. Add door intrusion switch to existing enclosure.
PLC-DIG (Building J)	Nameplate 1: PLC-DIG Enclosure Nameplate 2: Digesters	72"W x 72"H x 18"D	120"W x 90"H x 24"D	PLC Enclosure	NEMA Type 12, 2-doors per panel section, steel construction (painted grey), free standing. Front Access Only. Multiple panel sections shall be provided to accommodate the large number of I/O to this panel. Include alarm horn, strobe light, silence button, and reset button. Include door intrusion switch.
PLC-ECR (Building BB Engine Control Room - Replaces the New Remote Status Panel)	Nameplate 1: PLC-ECR Enclosure Nameplate 2: Engine Control Room Control Panel	36"W x 72"H x 18"D	48"W x 90"H x 24"D	PLC Enclosure	NEMA Type 12, 1 or 2-door, steel construction (painted grey), free standing. Front Access Only. Include alarm horn, strobe light, silence button, and reset button. Include door intrusion switch.
PLC-ADMIN (Administration Building Control Room)	Nameplate 1: PLC-ADMIN Enclosure Nameplate 2: Administration Control Room	24"W x 24"H x 12"D	24"W x 36"H x 12"D	PLC Enclosure	NEMA Type 12, 1-door, steel construction (painted grey), wall-mounted. Include alarm horn, strobe light, silence button, and reset button. Include door intrusion switch.

Section 13330 - Appendix A
Cedar Creek WPCP
Schedule of Control Panels

5044-102537
March 2020

Enclosure Name/Location	Nameplates	Minimum Size	Maximum Size	Enclosure/Panel Type	Enclosure Rating and Additional Requirements
PLC-FPB (Fire Pump Building)	Nameplate 1: PLC-FPB Enclosure Nameplate 2: Fire Pump Building	30"W x 72"H x 24"D	30"W x 90"H x 30"D	PLC Enclosure	NEMA Type 12, 1 door, steel construction (painted grey), free standing. Front Access Only. Include door intrusion switch.
PLC-HVAC-B (Building B - Replaces 90-70 in Boiler Control panel)	Nameplate 1: PLC-HVAC-B Enclosure Nameplate 2: HVAC System	36"W x 72"H x 18"D	48"W x 90"H x 24"D	PLC Enclosure	NEMA Type 12, 1 or 2-door, steel construction (painted grey), free standing. Front Access Only. Include door intrusion switch.
PLC-PST-1 (Building F)	Nameplate 1: PLC-PST-1 Enclosure Nameplate 2: Primary Tanks 1-6	36"W x 72"H x 18"D	48"W x 90"H x 24"D	PLC Enclosure	NEMA Type 12, 1 or 2-door, steel construction (painted grey), free standing. Front Access Only. Include door intrusion switch.
PLC-PST-2 (Building G/GG)	Nameplate 1: PLC-PST-2 Enclosure Nameplate 2: Primary Tanks 7-10	36"W x 72"H x 24"D	36"W x 90"H x 24"D	PLC Enclosure	NEMA Type 12, 1-door, steel construction (painted grey), free standing. Front Access Only. Include door intrusion switch. Include back panel and side panel.
RIO-DIG-1 (DAF Control Room)	Nameplate 1: RIO-DIG1 Enclosure Nameplate 2: DAF Control Room	24"W x 24"H x 12"D	36"W x 48"H x 12"D	Remote I/O Enclosure	NEMA Type 12, 1-door, steel construction (painted grey), wall mounted. Front Access Only. Include door intrusion switch.
RIO-HVAC-A (Building A)	Nameplate 1: RIO-HVAC-A Enclosure Nameplate 2: Building A HVAC	24"W x 36"H x 12"D	36"W x 48"H x 12"D	Remote I/O Enclosure	NEMA Type 12, 1-door, steel construction (painted grey), wall mounted. Front Access Only. Include door intrusion switch.
RIO-HVAC-C (Building C)	Nameplate 1: RIO-HVAC-C Enclosure Nameplate 2: Building C HVAC	24"W x 36"H x 12"D	36"W x 48"H x 12"D	Remote I/O Enclosure	NEMA Type 12, 1-door, steel construction (painted grey), wall mounted. Front Access Only. Include door intrusion switch.
RIO-HVAC-J (Building J)	Nameplate 1: RIO-HVAC-J Enclosure Nameplate 2: Building J HVAC	24"W x 36"H x 12"D	36"W x 48"H x 12"D	Remote I/O Enclosure	NEMA Type 12, 1-door, steel construction (painted grey), wall mounted. Front Access Only. Include door intrusion switch.
RIO-HVAC-K (Building K)	Nameplate 1: RIO-HVAC-K Enclosure Nameplate 2: Building K HVAC	24"W x 36"H x 12"D	36"W x 48"H x 12"D	Remote I/O Enclosure	NEMA Type 12, 1-door, steel construction (painted grey), wall mounted. Front Access Only. Include door intrusion switch.
RIO-HVAC-R (Building R)	Nameplate 1: RIO-HVAC-R Enclosure Nameplate 2: Building R HVAC	24"W x 36"H x 12"D	36"W x 48"H x 12"D	Remote I/O Enclosure	NEMA Type 12, 1-door, steel construction (painted grey), wall mounted. Front Access Only. Include door intrusion switch.
Main Substation Network Enclosure	Nameplate 1: Main Substation Nameplate 2: Network Enclosure	12"W x 12"H x 6"D	16"W x 16"H x 8"D	Network Enclosure to house new Ethernet Switch	NEMA Type 12, 1-door, steel construction (painted grey), wall mounted. Front Access Only.
Substation T1/T2 Network Enclosure	Nameplate 1: Substation T1/T2 Nameplate 2: Network Enclosure	16"W x 16"H x 6"D	16"W x 20"H x 8"D	Network Enclosure to house new Ethernet Switch and Fiber Optic Patch Panel	NEMA Type 12, 1-door, steel construction (painted grey), wall mounted. Front Access Only.

Section 13330 - Appendix A
Cedar Creek WPCP
Schedule of Control Panels

5044-102537
March 2020

Enclosure Name/Location	Nameplates	Minimum Size	Maximum Size	Enclosure/Panel Type	Enclosure Rating and Additional Requirements
Substation T7 Network Enclosure	Nameplate 1: Substation T7 Nameplate 2: Network Enclosure	16"W x 16"H x 6"D	16"W x 20"H x 8"D	Network Enclosure to house new Ethernet Switch and Fiber Optic Patch Panel	NEMA Type 12, 1-door, steel construction (painted grey), wall mounted. Front Access Only.
Substation T8 Network Enclosure	Nameplate 1: Substation T8 Nameplate 2: Network Enclosure	16"W x 16"H x 6"D	16"W x 20"H x 8"D	Network Enclosure to house new Ethernet Switch and Fiber Optic Patch Panel	NEMA Type 12, 1-door, steel construction (painted grey), wall mounted. Front Access Only.
Switchgear S1 Network Enclosure	Nameplate 1: Switchgear S1 Nameplate 2: Network Enclosure	12"W x 12"H x 6"D	16"W x 16"H x 8"D	Network Enclosure to house new Ethernet Switch	NEMA Type 12, 1-door, steel construction (painted grey), wall mounted. Front Access Only.

Section 13330 - Appendix B
Glen Cove WWTP
Schedule of Control Panels

5044-102537
October 2020

Enclosure Name	Nameplates	Minimum Size	Maximum Size	Enclosure/Panel Type	Enclosure Rating and Additional Requirements
Master Aeration Control Panel (MACP)	Nameplate: MACP	36"W x 72"H x 18"D	60"W x 80"H x 24"D	PLC Enclosure	NEMA Type 12, 1 or 2-door, steel construction, free standing. Front Access Only.
PLC-ELEC Enclosure	Nameplate: PLC-ELEC	36"W x 72"H x 18"D	60"W x 80"H x 24"D	PLC Enclosure	NEMA Type 12, steel construction, 1 or 2-door, free-standing. Front access only.
RIO-ADMIN Enclosure	Nameplate: RIO-ADMIN	24"W x 30"H	30"W x 36" H	Back Panel Only	N/A. Shall be mounted in existing graphic display panel enclosure.
RIO-FINAL Enclosure	Nameplate: RIO-FINAL	48"W x 72"H x 18"D	72"W x 80"H x 24"D	RIO Enclosure	NEMA Type 4X, 2-door, 316 stainless steel construction, free standing. Front Access Only. Internal panel heater.
RIO-IPS Enclosure	Nameplate: RIO-IPS	48"W x 72"H x 18"D	72"W x 80"H x 24"D	RIO Enclosure	NEMA Type 12, 2-door, steel construction, free standing. Front Access Only. Internal panel heater.

SECTION 13335
SINGLE-PHASE UNINTERRUPTIBLE POWER SUPPLY

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Labor, equipment, supervision and materials for the installation, testing, startup, and training for the uninterruptible power supply (UPS) as shown on the Drawings and as specified herein.
- B. One UPS shall be provided in each of the following control panels and areas. Refer to the table below for UPS minimum sizing. Exact sizing is the responsibility of the PCSS.

CEDAR CREEK WPCP:

UPS Schedule

UPS Designation	Minimum VA	Location, Type, and Notes
UPS-ACR	1000	Administration Building (Building A) – Administration Building Control Room; Tower Style; UPS shall derive power from office receptacle/power source and provide UPS power to the new operator workstations and monitor.
UPS-ADMIN	500	Administration Building (Building A) –Control Room; Tower Style; UPS shall derive power from panel receptacle/power source.
UPS-ATCC-1	1000	PLC-ATCC-1 Enclosure; Tower Style; UPS shall derive power from panel receptacle/power source.
UPS-ATCC-2	1000	PLC-ATCC-2 Enclosure; Tower Style; UPS shall derive power from panel receptacle/power source.
UPS-ATCC-4	1000	PLC-ATCC-4 Enclosure; Tower Style; UPS shall derive power from panel receptacle/power source.
UPS-BCR	750	Main Equipment Control Building (Building B) – Boiler Control Room; Tower Style; UPS shall derive power from office receptacle/power source and provide UPS power to the new HVAC Operator Workstation.
UPS-DIG	750	Digester Building (J) – Fiber Optic Communication Enclosure; Rackmount Style; UPS shall be hardwired from power source.
UPS-DIG-1	1500	PLC-DIG Enclosure; Tower Style; UPS shall derive power from panel receptacle/power source; UPS shall provide power to all devices within PLC-DIG Enclosure
UPS-DWTR	750	Sludge Dewatering Building (S) – Fiber Optic Communication Enclosure; Rackmount Style; UPS shall be hardwired from power source.
UPS-ECR	1000	PLC-ECR Enclosure; Tower Style; UPS shall derive

UPS Designation	Minimum VA	Location, Type, and Notes
		power from panel receptacle/power source.
UPS-FPB	750	Fire Pump Building (FPB) – PLC-FPB Enclosure; Rackmount Style; UPS shall be hardwired from power source.
UPS-GRIT	750	Grit Building (F) – Fiber Optic Communication Enclosure; Rackmount Style; UPS shall be hardwired from power source.
UPS-EFF	750	Effluent Pumping and Chlorination Building(L) – Fiber Optic Communication Enclosure; Rackmount Style; UPS shall be hardwired from power source.
UPS-EQUP	750	Main Equipment Building (B) – Fiber Optic Communication Enclosure; Rackmount Style; UPS shall be hardwired from power source.
UPS-HVAC-B	1000	PLC-HVAC-B Enclosure; Tower Style; UPS shall derive power from panel receptacle/power source.
UPS-OC	750	Odor Control Building (U) – Fiber Optic Communication Enclosure; Rackmount Style; UPS shall be hardwired from power source.
UPS-PST-1	1000	PLC-PST-1 Enclosure; Tower Style; UPS shall derive power from panel receptacle/power source.
UPS-PST-2	1000	PLC-PST-2 Enclosure; Tower Style; UPS shall derive power from panel receptacle/power source.
UPS-PST-3	750	Primary Tanks Building (G/GG) – Fiber Optic Communication Enclosure; Rackmount Style; UPS shall be hardwired from power source.
UPS-RASN	1000	North RAS Pump Station (Building V) – Fiber Optic Communication Enclosure; Rackmount Style; UPS shall be hardwired from power source.
UPS-TERT	750	Tertiary Treatment Building (R) – Fiber Optic Communication Enclosure; Rackmount Style; UPS shall be hardwired from power source.
UPS-THK	750	Sludge Thickening Building (H) – Fiber Optic Communication Enclosure; Rackmount Style; UPS shall be hardwired from power source.

GLEN COVE WWTP:

UPS Schedule

UPS Designation	Minimum VA	Location, Type, and Notes
UPS-SV-GC	2500	Glen Cove Server Rack; Rackmount Style; UPS shall be hardwired from power source. UPS shall power all equipment mounted in the server rack.
UPS-WS-GC	1500	Control Building - Office #2 Control Desk; Tower Style UPS; UPS shall derive power from office receptacle/power source and provide UPS power to the new operator workstations and monitor
UPS-ADMIN	500	Control Building-Existing Graphic Display Panel; Control Enclosure UPS; UPS shall provide power to all devices mounted within the control enclosure
UPS-ELEC	1000	Control Building – PLC-ELEC Enclosure; UPS shall derive power from panel receptacle/power source; UPS shall provide power to all devices mounted within the control enclosure
UPS-FOCE-ELEC	750	Admin Building Electrical Room – Fiber Optic Communication Enclosure; Rackmount Style; UPS shall be hardwired from power source. UPS shall power all devices mounted in the FOCE.
UPS-FINAL	1000	Sodium Hypochlorite Building - RIO-FINAL Enclosure; UPS shall derive power from panel receptacle/power source; UPS shall provide power to all devices mounted within the enclosure, including the FOCE.
UPS-IPS	1000	Headworks Building – RIO-IPS Enclosure; UPS shall derive power from panel receptacle/power source; UPS shall provide power to all devices mounted within the enclosure, including the FOCE.
UPS-MACP	1000	Control Building - Blower Room Master Aeration Control Panel Control Enclosure UPS; UPS shall provide power to all 120VAC powered devices mounted within the control enclosure excluding
UPS-FOCE-THK	750	Sludge Thickening Building – Fiber Optic Communication Enclosure; Rackmount Style; UPS shall be hardwired from power source. UPS shall power all devices mounted in the FOCE.

1.02 RELATED WORK

- A. Section 16000 – Electrical – General Provisions.
- B. Section 16141 – Wiring Devices.
- C. Section 16950 – Electrical Acceptance Tests.

1.03 SUBMITTALS

- A. Submittals shall be in accordance with Sections 01330 and 13300. Submittals shall include shop drawings and product data, for the following:
 - 1. Product brochure.
 - 2. Bill of materials listing all components provided.
 - 3. Deviation list indicating all proposed exceptions.
 - 4. Power single line and control schematics drawings. All external connection details and their terminal block locations shall be fully detailed. All internal wiring shall include terminal numbers and color coding.
 - 5. UPS performance specifications:
 - a. kVA rating.
 - b. Input and output voltage and phase.
 - c. Run time at full and half load.
 - d. Voltage (output regulation, input tolerance, unbalance, transfer/retransfer voltage, etc.).
 - e. Heat rejection.
 - 6. Operating Instruction manuals and recommended replacement parts.
 - 7. Name, address, and telephone number of the nearest service facility.
 - 8. Battery specifications and warranty.
 - 9. UPS Loading and battery sizing calculations to support runtimes as specified herein.

1.04 REFERENCE STANDARDS

- A. ANSI C62.41/IEEE 587 - Standards for Surge Withstandability.
- B. FCC (Federal Communications Commission) Rules and Regulations, Part 15, Subpart B, Class A certified compliance.
- C. UL (Underwriters Laboratories) 1778 Listed (Rev. Jan 5, 2000), UL497A.
- D. CSA 22.2, No. 107.1 M95 AND 107.2.
- E. IEC 62040-2 Emission and Immunity.
- F. IEC 62040-3 (Uninterruptible Power Systems, Part 3).
- G. EN 60529 Equipment Protection.
- H. National Electric Code (NFPA-70).
- I. ISO 9001.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Provide delivery, storage and handling in accordance with Section 01600 and per the following:
 - 1. Store the equipment indoors in a clean, dry, heated storage facility until ready for installation. Do not install the equipment in its final location until the facilities are permanently weather tight. Furnish, install and wire temporary electric space heaters in the equipment until the permanent heating equipment is operational. Protect the equipment at all times from exposure to moisture and chemicals.

1.06 QUALITY ASSURANCE

- A. UPS systems shall utilize a field proven design. The UPS manufacturer shall demonstrate at least ten years of continuous field operating experience with equipment of similar size and design.
- B. A factory authorized service and parts organization shall be located within 100 miles of the project location. Submit the name and address of the factory authorized service and parts organization. The manufacturer shall have a complete selection of service options that may include onsite service by factory-employed service engineers and factory depot quick-return service plan options.
- C. Equipment shall be UL or ETL labeled.
- D. The UPS manufacturer shall have ISO 9001 certification.
- E. The UPS system shall meet or exceed the theoretical Mean-Time-Between-Failures (MTBF) for a single module UPS operation (represents UPS module operation only) of 140,000 MTBF hours.

1.07 WARRANTY

- A. Refer to Section 01740.
- B. UPS: In addition to the basic warranty, the UPS manufacturer shall provide a standard warranty for the UPS for a period of one (1) year from the date of purchase. The Contractor shall provide an additional one (1) year extended warranty to cover delays associated with equipment startup or date of receipt by end user, whichever occurs first.
- C. Battery: In addition to the basic warranty, the UPS manufacturer shall provide a standard warranty for the batteries for a period of one (1) year from the date of purchase. The Contractor shall provide an additional one (1) year extended warranty to cover delays associated with equipment startup or date of receipt by end user, whichever occurs first.

PART 2 PRODUCTS

2.01 CONTROL ENCLOSURE UPS

A. System Description

1. Provide a continuous-duty, on-line, solid state, dual conversion, single-phase input, single-phase 120VAC true sinewave output uninterruptible power system.
2. Refer to UPS Schedule in the Section for notes on the requirements of each UPS.
3. The UPS shall be a tower form factor.
4. The UPS shall provide power conditioning and power backup for computer, communication, and other critical electronic loads as indicated on the Drawings.
5. The UPS system shall consist of the following major components:
 - a. Rectifier and battery charger.
 - b. Inverter.
 - c. Batteries and battery disconnect switch.
 - d. Automatic static bypass switch.
 - e. External maintenance bypass switch.
 - f. Integral control and monitoring panel.
 - g. Other features as described in this specification and as indicated on the Drawings.
6. The UPS shall be manufactured by one of the following:
 - a. Schneider Electric APC.
 - b. Tripp Lite.
 - c. Eaton Powerware.

B. General Requirements

1. External Battery Enclosure: A separate enclosure shall be provided for housing additional batteries if required to provide the minimum run time as specified herein. The battery enclosure shall match the main UPS enclosure in style and color.
2. All cabling required to interconnect all components of the UPS system shall be provided by the UPS manufacturer.
3. Battery protection shall be provided an internal circuit breaker disconnect. Battery cabinets shall be protected by an internal circuit breaker.
4. Current limiting circuitry shall protect the inverter output under any load condition. High speed semiconductor fusing shall protect the static bypass in the event of an output short circuit.
5. The AC output neutral shall be electrically isolated from the UPS chassis. The UPS chassis shall have an equipment ground terminal. Provisions for installation of a bonding connector shall be provided.
6. The UPS shall be suitable for installation at the location as shown on the Drawings.

C. Performance Requirements - Ratings

1. Battery runtime: Provide batteries to support 100% of calculated load for a minimum of 15 minutes for control panels. Provide additional batteries in separate enclosure as required to meet the runtime requirement.
2. Output power: Provide a minimum kVA rating of 125% of the anticipated kVA rating in order to supply the control panels and ancillary equipment shown on the Control System Architecture Diagram and the P&IDs. Confirm UPS ratings per UPS submitted load calculations, spare capacity, and runtime requirements as specified herein.

D. Performance Requirements -Environment:

1. Ambient temperature: 0 to 40 degrees C.
2. Elevation: Project site elevation.
3. Relative humidity: 0 to 95 percent non-condensing.

E. Electrical Requirements:

1. System Input – Primary source:
 - a. Single input: Nominal Input Voltage: Single-phase as shown in the UPS schedule.
 - b. Frequency: 60 Hertz plus or minus 5 percent.
 - c. Input Power Factor: 0.96 lag minimum, 50 to 100 percent load.
 - d. Input Current Total Harmonic Distortion (THD) : <33 percent.
 - e. Input Surge Withstandability: Per IEEE 587/ANSI C62.41. Category A and B, (6 kV).
 - f. Input Connection: Coordinate with electrical contractor.
2. System Output:
 - a. Nominal Output Voltage: 120 VAC.
 - b. Frequency: 60 Hertz plus or minus 3 Hertz.
 - c. 100 percent load with 3:1 Crest Ratio.
 - d. Frequency Slew Rate: 1 Hz/second. (Adjustable at startup).
 - e. Output Connections: (6) NEMA 5-15R receptacles.
3. AC to AC Efficiency: (100 percent load @ rated PF): 91 percent.
4. Acoustical Noise: Noise generated by the UPS under normal operation shall not exceed 65 dBA (60 dBA typical) at one meter from any surface, measured at 25 degrees C (77 degrees F) and full load.
5. EMI Suppression: The UPS shall meet FCC Rules and Regulation 47, Part 15, Subpart B, for Class A devices.

F. Modes of Operation

1. Normal Mode: The UPS shall be a continuous online unit. Power to the critical loads shall be continuously generated by the inverter during normal AC line power. In the event of AC line power failure, power to inverter is supplied by the batteries. Under normal operation, the batteries shall be charged in a manner that optimizes battery life. Simple "trickle charge" of the batteries shall not be acceptable.
2. Bypass Mode: The automatic bypass shall transfer the critical load to the commercial AC source, bypassing the UPS' inverter/rectifier, in the case of an overload, load fault, or internal failure.
3. Maintenance Mode: The external service bypass switch shall be operated to transfer the load to the alternate source when the UPS is taken out of service for maintenance or repair. This transfer shall occur without interruption.

G. Controls

1. Microprocessor-controlled circuitry: Fully automatic operation of the UPS shall be provided through the use of a microprocessor-based controller. All operating and protection parameters shall be firmware-controlled. The logic shall include system test capability to facilitate maintenance and troubleshooting. Startup, battery charging, and transfers shall be automatic functions.
2. Graphical Display: The UPS control panel shall utilize an LED graphical display for all UPS control, monitoring, alarming, configuration and diagnostic functions. The following operational controls and indicators shall be provided on the UPS control panel per the following KVA ranges:
 - a. UPS On/Alarm Silence/Manual Battery Test control.
 - b. Standby/Manual Bypass control.
3. Network Communications
 - a. Each UPS shall be equipped with a network management card to facilitate Ethernet communications over the network. The network card shall include environmental monitoring including humidity and temperature.
 - b. Protocols: The following network protocols shall be supported:
 - 1) HTTP, HTTPS.
 - 2) IPv4, IPv6.
 - 3) NTP.
 - 4) SNMP.
 - 5) TCP/IP.
 - c. Network Interface Connection: RJ-45 10/100 Base-T.

H. Rectifier/Charger

1. The term rectifier/charger shall denote the solid-state equipment and controls necessary to convert incoming AC power to regulated DC power for input to the inverter and for battery charging. The rectifier/charger shall be a solid-state SCR/IGBT power transistor type with constant voltage/current limiting control circuitry.

I. Inverter

1. The inverter shall include all solid-state equipment and controls to convert DC power from the rectifier/charger or battery to a regulated AC power for powering the critical load. The inverter shall use Insulated Gate Bipolar Transistors (IGBTs) in a phase-controlled, pulse width modulated (PWM) design capable of providing the specified AC output.
2. The inverter shall be capable of supplying current and voltage for overloads exceeding 100 percent. The inverter is to provide 150 percent of full load for 30 seconds and 125 percent of full load for 2 minutes. A status indicator and audible alarm shall indicate overload operation. The UPS shall transfer the load to bypass when overload capacity is exceeded.
3. The output voltage shall be maintained to within plus or minus 4 percent.
4. The output voltage total harmonic distortion (THD) shall not be greater than 5 percent for all loads. For 100 percent rated load of 3:1 crest factor nonlinear loads, the output voltage total harmonic distortion shall not be greater than 4 percent. The output rating shall not be derated in kVA or kW due to the 100 percent nonlinear load with 3:1 crest factor.
5. The inverter shall use software control to adjust the output voltage from plus or minus 5 percent of the nominal value.

J. Batteries

1. The batteries shall be VRLA (valve-regulated lead-acid), sealed, maintenance-free, high-rate discharge, lead-acid cells suitable for use indoors with no offgassing or water addition requirements. Batteries shall not require special ventilation. The battery shall consist of one or more battery banks with the number of cells required to meet the requirements of the rest of these specifications.
2. Battery Design Life: 5 years.
3. Run time operation of the UPS shall be accomplished using batteries mounted within the UPS enclosure and supplemented as required with an external battery enclosure to provide the battery runtime specified.

K. Service Bypass Panel

1. Each UPS shall be provided with a "two-position" external bypass switch system to permits the UPS to be removed for repair or maintenance without causing power disruption to the connected power loads. The external bypass switch shall be snap-action type with switching speed approximately 10ms or less and independent of operator action. External bypass switch positions shall be labeled BYPASS and UPS.
2. The service bypass panel shall be mounted inside the control panel.
3. Input:
 - a. Single input: Nominal Input Voltage: 120 VAC.
 - b. Input Connections: NEMA 5-15P.

4. Output:
 - a. Nominal Output Voltage: 120 VAC.
 - b. Maximum Total Current Draw per Phase: 15 A.
 - c. Output Connections: NEMA 5-15R.
 - d. Always on Outlets: 8.
5. The service bypass panel shall be APC SBP2200RM or equal.

2.02 RACK MOUNTABLE UPS

A. System Description

1. Provide a rack mounted, continuous-duty, on-line, solid state, line interactive, single-phase uninterruptible power system.
2. Refer to UPS Schedule in the Section for notes on the requirements of each UPS.
3. The UPS shall being supplied with all support rails and equipment to facilitate mounting within the FCE.
4. The UPS shall provide power conditioning and power backup for the Ethernet switches and other electronic loads located within the FCE.
5. The UPS system shall consist of the following major components:
 - a. Rectifier and battery charger.
 - b. Inverter.
 - c. Batteries.
 - d. Automatic static bypass switch.
 - e. External service bypass switch
 - f. Other features as described in this specification and as indicated on the Drawings.
6. The UPS shall be an APC Smart-UPS or approved equal.

B. General Requirements

1. Battery protection shall be provided an internal circuit breaker disconnect.
2. Current limiting circuitry shall protect the inverter output under any load condition.
3. The AC output neutral shall be electrically isolated from the UPS chassis. The UPS chassis shall have an equipment ground terminal. Provisions for installation of a bonding connector shall be provided.
4. The UPS shall be suitable for installation in a UL508A listed panel.
5. The UPS shall be rack mountable.
6. UL recognized components for industrial applications in accordance with UL508 without derating.

C. Performance Requirements - Ratings

1. Battery runtime: Provide batteries to support 125% of calculated load for a minimum of 30 minutes.
2. Output power: Provide a minimum kVA rating of 125% of the anticipated kVA rating in order to supply the control panels and ancillary equipment shown on the Control System Architecture Diagram and the P&IDs. Confirm UPS ratings per UPS submitted load calculations, spare capacity, and runtime requirements as specified herein.

D. Performance Requirements – Environmental

1. Operating temperature: 0 to 40 degrees C.
2. Operating relative humidity: 0 to 95 percent non-condensing.
3. Operating elevation: 0 to 10000 feet above mean sea level.
4. Storage temperature: -15 to 45 degrees C.
5. Storage relative humidity: 0 to 95 percent non-condensing.
6. Storage elevation: 0 to 50000 feet above mean sea level.

E. Electrical Requirements

1. Input:
 - a. Single input: Nominal Input Voltage: 120 VAC.
 - b. Frequency: 50 to 60 Hertz plus or minus 3 Hertz.
 - c. Input Connections: NEMA 5-15P.
2. Output:
 - a. Nominal Output Voltage: 120 VAC.
 - b. Frequency: 57 to 63 Hertz plus or minus 3 Hertz.
 - c. Crest Factor: up to 5:1.
 - d. Output Connections: NEMA 5-15R
3. Acoustical Noise: Noise generated by the UPS under normal operation shall not exceed 45 dBA at one meter from surface of unit.
4. EMI Suppression: The UPS shall meet FCC Rules and Regulation 47, Part 15, Subpart J, for Class A devices.

F. Modes of Operation

1. Normal Mode: The UPS shall be a continuous online unit. Power to the critical loads shall be continuously generated by the inverter during normal AC line power. In the event of AC line power failure, power to inverter is supplied by the batteries. Under normal operation, the batteries shall be charged in a manner that optimizes battery life. Simple "trickle charge" of the batteries shall not be acceptable.

2. Bypass Mode: The automatic bypass shall transfer the critical load to the commercial AC source, bypassing the UPS' inverter/rectifier, in the case of an overload, load fault, or internal failure.
3. Maintenance Mode: The external service bypass switch shall be operated to transfer the load to the alternate source when the UPS is taken out of service for maintenance or repair. This transfer shall occur without interruption.

G. Controls

1. Microprocessor-controlled circuitry: Fully automatic operation of the UPS shall be provided through the use of a microprocessor-based controller. All operating and protection parameters shall be firmware-controlled. The logic shall include system test capability to facilitate maintenance and troubleshooting. Startup, battery charging, and transfers shall be automatic functions.
2. The UPS shall be equipped with a front panel display interface with that is menu driven through the use of up and down push buttons. A master power on/off button shall also be provided.
3. Front Indicators: As a minimum, the following indicators shall be provided on the UPS control panel:
 - a. On-line (UPS is using utility power to power the load).
 - b. On battery.
 - c. Fault.
 - d. Replace battery / battery disconnected.

H. Network Communications

1. Each UPS shall be equipped with a network management card to facilitate Ethernet communications over the network. The network card shall include environmental monitoring including humidity and temperature.
2. Protocols: The following network protocols shall be supported:
 - a. HTTP, HTTPS.
 - b. IPv4, IPv6.
 - c. NTP.
 - d. SNMP.
 - e. TCP/IP.
3. Network Interface Connection: RJ-45 10/100 Base-T.

I. Rectifier/Charger

1. The term rectifier/charger shall denote the solid-state equipment and controls necessary to convert incoming AC power to regulated DC power for input to the inverter and for battery charging. The rectifier/charger shall be a solid-state SCR/IGBT power transistor type with constant voltage/current limiting control circuitry.

J. Inverter

1. The inverter shall include all solid-state equipment and controls to convert DC power from the rectifier/charger or battery to a regulated AC power for powering the critical load. The inverter shall use Insulated Gate Bipolar Transistors (IGBTs) in a phase-controlled, pulse width modulated (PWM) design capable of providing the specified AC output.
2. The inverter shall be capable of supplying current and voltage for overloads exceeding 100 percent. The inverter is to provide 150 percent of full load for 30 seconds and 125 percent of full load for 2 minutes. A status indicator and audible alarm shall indicate overload operation.
3. The output voltage shall be maintained to within plus or minus 5 percent.
4. The output voltage total harmonic distortion (THD) shall not be greater than 5 percent at full load.

K. Batteries

1. The batteries shall be high temperature sealed, maintenance-free, high-rate discharge, lead-acid cells suitable for use indoors with no off gassing, or water addition requirements. Batteries shall not require special ventilation.
2. Battery Design Life: 3-5 years.

L. Service Bypass Panel

1. Each UPS shall be provided with a "two-position" external bypass switch system to permits the UPS to be removed for repair or maintenance without causing power disruption to the connected power loads. The external bypass switch shall be snap-action type with switching speed approximately 10ms or less and independent of operator action. External bypass switch positions shall be labeled BYPASS and UPS.
2. The service bypass panel shall be rack mountable.
3. The service bypass panel shall being supplied with all support rails and equipment to facilitate mounting within the FCE.
4. Input:
 - a. Single input: Nominal Input Voltage: 120 VAC.
 - b. Input Connections: NEMA 5-15P.
5. Output:
 - a. Nominal Output Voltage: 120 VAC.
 - b. Maximum Total Current Draw per Phase: 15 A.
 - c. Output Connections: NEMA 5-15R.
 - d. Always on Outlets: 8.
6. The service bypass panel shall be APC Service Bypass PDU, Part SBP1500RM or equal.

2.03 TOWER STYLE UPS (FOR OPERATOR WORKSTATIONS)

A. System Description:

1. Tower style battery backup with surge protection for electronics and computers.
2. Refer to the UPS Schedule in this Section for notes on each UPS.
3. Output power: Provide a minimum kVA rating of 125% of the anticipated kVA rating in order to supply the control panels and ancillary equipment shown on the Control System Architecture Diagram and the P&IDs. Confirm UPS ratings per UPS submitted load calculations, spare capacity, and runtime requirements as specified herein.

B. Operation:

1. To provide uninterrupted 120 V power to the output upon loss of input power.
2. When the 120 V supply voltage is applied, the internal battery is charged.
3. In the event of a supply voltage failure, the battery module is connected to the output, and the stored power ensures that all connected devices continue to operate without interruption.

C. Functional:

1. Nominal input voltage: 120 V.
2. Input connections: NEMA 5-15P.
3. Nominal Output voltage: 120 V.
4. Output connections: (5) NEMA 5-15R (Battery Backup), (5) NEMA 5-15R (Surge Protection).
5. Data line protection for telephone, fax or Ethernet.

D. Control Panel

1. LED status display:
 - a. On line.
 - b. On battery.
 - c. Replace battery.
 - d. Building wire fault.

E. Network Communications

1. Each UPS shall be equipped with a network management card to facilitate Ethernet communications over the network. The network card shall include environmental monitoring including humidity and temperature.
2. Protocols: The following network protocols shall be supported:
 - a. HTTP, HTTPS.

- b. IPv4, IPv6.
 - c. NTP.
 - d. SNMP.
 - e. TCP/IP.
- 3. Network Interface Connection: RJ-45 10/100 Base-T.
- F. Environmental:
 - 1. Operating temperature range: 0-40 C.
 - 2. Operating relative humidity: 5 to 95 percent.
- G. Manufacturer(s):
 - 1. Schneider Electric APC.
 - 2. Tripp Lite.
 - 3. Eaton Powerware.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install and connect the equipment in accordance with the manufacturer's instructions.
- B. Remove temporary lifting angles, lugs and shipping braces.
- C. Touch up damaged paint finishes.

3.02 FACTORY TESTING

- A. Prior to shipment, the complete UPS system shall undergo the manufacturer's standard factory test.

3.03 FIELD TESTING

- A. Perform the following minimum test and checks:
 - 1. Verify that all connections are completed in accordance with shop drawings.
 - 2. Verify supply voltage and phase sequence are correct.
 - 3. Check mechanical interlocks for proper operation.
 - 4. Test ground connections for continuity and resistance.
 - 5. Check control circuit interlocking and continuity.
- B. Submit the test plan for review and approval.

- C. For UPSs rated 3-6kVA, the manufacturer's field service technician shall perform startup and adjustment of the UPS in accordance with the manufacturer's written instructions. Submit a copy of the field report containing verification of all startup tests and adjustments performed.
- D. The Contractor shall include testing of battery runtime under full load with loss of AC power. Testing shall occur prior to system start-up.
- E. Perform all additional tests required by Section 16950 Electrical Acceptance Testing.
- F. In the event of an equipment fault, notify the Construction Manager immediately. After the cause of the fault has been identified and corrected, a joint inspection of the equipment shall be conducted by the Contractor, the Construction Administrator and the equipment manufacturer's factory service technician. Repair or replace the equipment as directed by the Construction Administrator.

3.04 ADJUSTMENT

- A. Make all UPS adjustments necessary for manual and automatic operation of the entire system.

3.05 CLEANING

- A. Remove all rubbish and debris from inside and around the equipment. Remove dirt, dust, or concrete spatter from the interior and exterior of the equipment using brushes, vacuum cleaner, or clean, lint free rags. Do not use compressed air.

3.06 TRAINING

- A. Provide training of staff in accordance with Section 01820 and Section 13303.

END OF SECTION

SECTION 13340 INSTRUMENTS

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. This Section covers the furnishing, installation, and services for instruments.

1.02 RELATED WORK

- A. Refer to Section 13300 "I & C - General Provisions."
- B. Sections 13341 through Section 13345.

1.03 SUBMITTALS

- A. Submit complete documentation of all field instruments using ISA-TR20.00.01-2001 (updated in 2004-2006) data sheet formats. Submit a complete Bill of Materials (BOM) or Index that lists all instrumentation equipment. The list shall be sorted by Loop Number.
- B. Submit separate data sheets for each instrument including:
 - 1. Plant Equipment Number and ISA tag number per the Drawings.
 - 2. Product (item) name used herein and on the Drawings.
 - 3. Manufacturer's complete model number.
 - 4. Location of the device.
 - 5. Input - output characteristics.
 - 6. Range, size, and graduations in engineering units.
 - 7. Physical size with dimensions, enclosure NEMA classification and mounting details in sufficient detail to determine compliance with requirements.
 - 8. Materials of construction for enclosure and wetted parts.
 - 9. Instrument or control device sizing calculations where applicable.
 - 10. Certified calibration data for all flow metering devices.
 - 11. Two-wire or four-wire device type as applicable.
- C. Submit catalog cuts for all instruments. Submit descriptive literature for each hardware component, which fully describes the units being provided.
- D. Submit index and data sheets in electronic format as well as hard copies on 8-1/2" x 11" formats. Electronic format shall be in Microsoft Excel or Word. Submit electronic copy on CD-ROM or DVD disk.

1.04 MAINTENANCE

- A. Refer to Section 13300.

1.05 INSTRUMENT TAGS

- A. A permanent stainless steel or other non-corrosive material tag firmly attached and permanently and indelibly marked with the instrument tag number, as indicated in the Drawings, shall be provided on each piece of equipment supplied under this Section and related sections. Equipment shall be tagged before shipping to the site.
- B. Provide 1/8-in by 3/8-in, Type 316 stainless steel button head machine screws.
- C. All supplied instrument transmitters and instrument transmitter elements shall have a stainless steel identification tag attached to each transmitter and element prior to shipment. Tag shall be attached via stainless steel chain or stainless steel wire (24 gauge min) to a non-removable part of the device. The tag size shall be a minimum of 1.5 square inches. Tag shall include the ISA alphanumeric instrument number as indicated in the P&ID, loop, and detail drawings. The alphanumeric instrument number shall be stamped into the tag and shall have a minimum of 3/16-in high alphanumeric characters.

1.06 APPROVALS/CERTIFICATIONS

- A. Instruments for hazardous locations shall have Factory Mutual (FM), Canadian Standards Association (CSA), and CENELEC approvals and certifications as specified herein and as indicated on the Drawings or in the Instrument Device Schedule. The instrument specifications in Part 2 state the Class, Division, and gas groups for FM/CSA approval, followed in parenthesis by the CENELEC certification; however, instruments provided are only required to have the approval/certification stated above. The instrument shall have a stainless steel tag identifying the relevant approval or certification.

1.07 MANUFACTURERS' START-UP AND TRAINING SERVICES

- A. If indicated in the individual instrumentation paragraphs, the instrument manufacturer or manufacturer's certified service representative shall provide start-up and training services. This work shall not be done by the PCSS.
- B. The start-up services shall be to calibrate, oversee the installations of the sensor, and start-up the sensor/transmitter in order to provide reliable measurement at the instrument and to a remote system. The vendor shall work with the PCSS to verify the transmitter sends correct information to the remote system (i.e., that the scaling and units are the same at the instrument and on the remote operator interface).
- C. While the instrument manufacturer or manufacturer's certified service representative is starting up the instrumentation, training shall be provided to the Owner's instrumentation technicians. The training shall be in how to calibrate, install, troubleshoot, read the diagnostics, and maintain the sensor and transmitter.

PART 2 PRODUCTS

2.01 SPARE PARTS AND ACCESSORIES

- A. Submit a list of spare parts, expendables, and test equipment recommended by the manufacturer for all instruments.
- B. Furnish following field Instrument related Spare Parts:
 - 1. One level indicating sensor and remote transmitter for each type of level element provided.
 - 2. One gas sensor and remote transmitter for each type provided.
 - 3. One flow transmitter for each type of flow element provided.
 - 4. One pressure transmitter for each type provided.
 - 5. One temperature transmitter for each type provided.
- C. Furnish following Accessories:
 - 1. All mounting hardware required for pipe stand, surface, or other mounting.
 - 2. Each instrument shall be provided with a manufacturer installed stainless steel tag identifying the instrument tag number.

PART 3 EXECUTION

3.01 GENERAL

- A. See execution requirements in Section 13300.
- B. Unless specifically indicated, direct reading or electrical transmitting instrumentation shall not be mounted on process piping. Instrumentation shall be mounted on instrument racks or stands. All instrumentation connections shall be provided with shutoff and drain valves. For differential pressure transmitters, 5-valve manifolds for calibration, testing and blow down service shall also be provided. For chemical or corrosive fluids, diaphragm seals with flushing connections shall be provided.

END OF SECTION

SECTION 13341
FLOW DEVICES

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. This Section covers the furnishing, installation, and services for flow related instruments as detailed on the Drawings.

1.02 RELATED WORK

- A. Refer to Section 13300 "I & C - General Provisions."

1.03 SUBMITTALS

- A. Refer to Sections 13300 and 13340.

1.04 REFERENCE STANDARDS

- A. Refer to Section 13300.

1.05 SYSTEM DESCRIPTION

- A. N/A

1.06 DELIVERY, STORAGE AND HANDLING

- A. Refer to Section 13300.

1.07 COORDINATION MEETINGS

- A. Refer to Section 13300.

1.08 QUALITY ASSURANCE

- A. Refer to Section 13300.

1.09 NOMENCLATURE AND IDENTIFICATION.

- A. Refer to Section 13300.

1.10 MAINTENANCE

- A. Refer to Section 13300.

- B. Test Equipment:

1.11 SPARE PARTS AND ACCESSORIES

- A. See Section 13340 for spare parts requirements.

- B. All mounting hardware required for pipe stand, surface, or other mounting shall be provided.
- C. Each instrument shall be provided with a manufacturer installed stainless steel tag identifying the instrument tag number.

1.12 APPROVALS/CERTIFICATIONS

- A. Instruments specified herein shall meet at a minimum, the National Electrical Manufacturers Association (NEMA) rating for non-hazardous locations listed with each instrument. Those instruments that are submerged in a liquid or are located in submersible area shall also meet NEMA 6 ratings approval. All instruments that are located in hazardous areas as indicated on the Electrical Classification Drawings or in the Instrument Device Schedule shall meet the Factory Mutual (FM), Canadian Standards Association (CSA), and CENELEC Class, Division and Group approvals and certifications listed for that area. The instrument shall have a stainless steel tag identifying the relevant approval or certification

PART 2 PRODUCTS

2.01 DIFFERENTIAL PRESSURE FOR FLOW ELEMENTS

- A. Type:
 - 1. Microprocessor based, intelligent type to be used with existing Venturi tubes.
- B. Function/Performance:
 - 1. Range: Range of the transmitter shall be the standard range of the manufacturer closest to the differential pressure range to be metered.
 - 2. Accuracy: 0.075 percent of span (linear output).
 - 3. Operating Temperature: -4 to 176 degrees F.
 - 4. Temperature Effect: Combined temperature effects shall be less than 0.2 percent of maximum span per 28 degrees C temperature change.
 - 5. Static Pressure Effect: Effect on accuracy due to static pressure changes shall be negligible.
 - 6. Output: 4-20 mA DC adjustable over the instrument range, with HART protocol. The output shall be proportional to the square root of the input differential pressure.
 - 7. Stability: 0.05 percent of upper range limit for 1 year.
 - 8. Display:
 - a. Digital indicator displaying flow in the engineering units indicated in the Instrument Device Schedule.

9. Diagnostics:
 - a. Self-diagnostics with transmitter failure driving output to above or below out of range limits.
 - b. Simulation capability for inputs and loop outputs.
 - c. Test terminals available to ease connection for test equipment without opening the loop.
 - d. Registers to record minimum and maximum pressure and temperatures transmitter has been exposed to shall be available.
 10. Over Range Protection: Provide positive over range protection to 150 percent of the maximum pressure of the system being monitored by the instrument.
- C. Physical:
1. Enclosure: NEMA 4X (IP66), explosion proof, approved for Class I, Division 1, Groups C and D (EEx d IIC T5).
 2. Process Wetted Parts: Isolating diaphragm and other wetted metal parts shall be Type 316L stainless steel, unless otherwise indicated in the device schedule. Gaskets and O-rings shall be Teflon.
 3. Power Supply: 24 VDC loop power.
 4. Sensor Fill Fluid: Silicone.
- D. Power Requirements:
1. 24 VDC loop powered instrument.
- E. Accessories Required:
1. Provide span and zero adjustment at each transmitter and through the handheld programming unit.
 2. For air and clean water processes, provide a five valve manifold with each transmitter. The manifold shall be Type 316 stainless steel. Manifolds may be mounted directly to the instrument or separately mounted. Manifolds shall be by the instrument manufacturer or by D/A Manufacturing or Anderson Greenwood.
 3. For dirty water or sludge applications, each transmitter shall be provided with integral remote armored capillary seals. The seal connection shall match the connection provided at the meter. The fluid in the seal shall meet the temperature requirements of the meter location.
- F. Manufacturers:
1. ABB 264DS
 2. Rosemount 3051.
 3. Foxboro IDP10.

4. Siemens Sitrans P DS III
5. Endress & Hauser Deltabar PMD75

PART 3 EXECUTION

3.01 GENERAL

- A. See execution requirements in Section 13300.

END OF SECTION

SECTION 13342
LEVEL DEVICES

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. This Section covers the furnishing, installation, and services for level related instruments as detailed on the Drawings.
- B. Refer to Section 13300.

1.02 RELATED WORK

- A. Refer to Section 13300 "I & C General Provisions."
- B. Refer to Section 13340 "Instruments."

1.03 SUBMITTALS

- A. Refer to Sections 13300 and 13340.

1.04 REFERENCE STANDARDS

- A. Refer to Section 13300.

1.05 SYSTEM DESCRIPTION

- A. N/A

1.06 DELIVERY, STORAGE AND HANDLING

- A. Refer to Section 13300.

1.07 COORDINATION MEETINGS

- A. Refer to Section 13300.

1.08 QUALITY ASSURANCE

- A. Refer to Section 13300.

1.09 NOMENCLATURE AND IDENTIFICATION.

- A. Refer to Section 13300.

1.10 MAINTENANCE

- A. Refer to Section 13300.
- B. Test Equipment:

1.11 SPARES AND ACCESSORIES

- A. See Section 13340 for spare parts requirements.
- B. All mounting hardware required for pipe stand, surface, or other mounting shall be provided.
- C. Each instrument shall be provided with a manufacturer installed stainless steel tag identifying the instrument tag number.

1.12 APPROVALS/CERTIFICATIONS

- A. Instruments for hazardous locations shall have Factory Mutual (FM), Canadian Standards Association (CSA), and CENELEC approvals and certifications as specified herein and as indicated on the Drawings or in the Instrument Device Schedule. The instrument specifications in Part 2 state the Class, Division, and gas groups for FM/CSA approval, followed in parenthesis by the CENELEC certification; however, instruments provided are only required to have the approval/certification stated above. The instrument shall have a stainless steel tag identifying the relevant approval or certification.

1.13 MANUFACTURER START-UP AND TRAINING SERVICES

- A. If indicated in the instrumentation paragraphs below, the instrument manufacturer or manufacturer's certified service representative shall provide start-up and training services. This work shall not be done by the PCSS contractor.
- B. The start-up services shall be to calibrate, oversee the installations of the sensor, and start-up the sensor/transmitter in order to provide reliable measurement at the instrument and to the control system. The vendor shall work with the PCSS to verify the transmitter sends correct information to the remote system (i.e., that the scaling and units are the same at the instrument and on the remote operator interface). Vendor to submit an instrument calibration report in order to document the calibration procedure of the instruments.
- C. While starting up the analyzers, the manufacturer shall provide training to the Owner's instrumentation technicians. The training shall be in how to calibrate, install, troubleshoot, read the diagnostics, and maintain the analyzer and transmitter.

PART 2 PRODUCTS

2.01 NON-CONTACT RADAR LEVEL METER

- A. Sensor
 - 1. Non-contact, microwave type level meter.
 - 2. Function/Performance
 - a. Radar Frequency: 26GHz for continuous measurement.
 - b. Measuring Range: Range shall be suitable for the installation indicated,
 - c. Accuracy: Plus or minus 0.32 inches (8 mm)
 - d. Operating Temperature: -40 to 80 degrees C.
 - e. Output: Isolated 4-20 mA output.
 - f. Diagnostics: On-screen instructions and display of self-diagnostics.

3. Physical
 - a. Antenna shall be PVDF, Horn style, Type 316 stainless steel
 - b. Instrument shall be provided with a minimum Class 150 pound (DN 80, PN16) mounting flange to match material and class of mounting bracket.
 - c. Housing shall be NEMA 4X (IP66). Where the instrument is installed in a hazardous area, the housing shall be explosion-proof, approved for Class I, Division 1, Groups C and D (EEx d IIB T4) installation. The instrument shall be certified for installation of the antenna in a Class I, Division 1, Groups C and D (Zone 0) environment.
 - d. Power Requirements: 24 VDC Loop powered
4. Accessories Required
 - a. All mounting hardware required for pipe stand, surface, or other mounting shall be provided.
 - b. A manufacturer furnished reflector shall be provided and installed parallel to the instrument.
 - c. Where required for calibration/programming, a hand-held programmer shall be provided.
5. Manufacturer Start-up and Training services
 - a. Provide two days of manufacturer's start-up and training services as specified in the start-up and training services paragraph.

B. Transmitter

1. Type
 - a. Remotely mounted, intelligent transmitter compatible with sensor provided.
2. Function/Performance
 - a. Operating Temperature: -20 to 70 degrees C
 - b. Output: 4-20 mA DC linear. Transmitter shall also communicate using HART protocol.
 - c. Display: Digital indicator displaying level in engineering units remotely mounted on side of tank.
 - d. Diagnostics: Self diagnostics with transmitter failure driving output to above or below out of range limits.
 - e. LED indication of transmitter faults.
 - f. Simulation capability for inputs and loop outputs.
3. Physical:
 - a. Housing shall be NEMA 4X (IP66). Where the instrument is installed in a hazardous area, the housing shall be explosion-proof, approved for Class I, Division 1, Groups C and D (EEx d IIB T4) installation. The instrument shall be certified for installation of the antenna in a Class I, Division 1, Groups C and D (Zone 0) environment.
 - b. Transmitter shall be suitable for surface or pipe stand mounting.
 - c. Power Supply shall be 24 VDC loop powered.
4. Manufacturer (s):
 - a. Endress & Hauser Micropilot FMR51 with FHX50 display
 - b. Or Equal.

2.02 RF ADMITTANCE/CAPCITANCE TYPE POINT LEVEL SWITCH

A. Sensor:

1. Type:
 - a. Rigid probe.
2. Function/Performance:
 - a. Range: Range and trip points shall be as indicated in the instrument device schedule.
 - b. Operating Temperature: -40 to 60 degrees C.
3. Physical:
 - a. Probe diameters shall be 0.375 inches (9.5 mm) minimum. The probe diameter shall be as recommended by the supplier for the conditions of installation, i.e., probe length and degree of agitation in the tank.
 - b. Probes shall be completely insulated. For corrosive applications, the insulating material shall be resistant to corrosion by the medium being metered. Insulating material shall be bonded to the probe.
 - c. In corrosive applications, other parts exposed to the process shall also be coated for protection against corrosion.
 - d. Probe assembly shall include an integral ground reference element where installed in concrete structures or non-metallic tanks. Ground reference elements shall be coated with or manufactured from materials resistant to corrosion by the medium being metered.
 - e. Probe mounting shall be a four-inch (100 mm), 150-pound, Type 316 stainless steel flange for non-corrosive applications. Flanges for corrosive applications shall be of materials resistant to corrosion by the medium being metered, or shall be protected by corrosion-resistant coatings and facings.
 - f. Where required for installation in hazardous areas, probes shall be intrinsically safe, approved for installation in Class I, Division 1, Groups C and D (Zone 0).
4. Manufacturers:
 - a. Ametek Drexelbrook.
 - b. Magnetrol.
 - c. Or equal.

B. Converter/Relays:

1. Type:
 - a. Integrally mounted electronic converter and relays.
2. Functional/Performance:
 - a. System Accuracy: Plus or minus one percent of span.
 - b. Operating Temperature: -40 to 60 degrees C.
 - c. Output: 5 A, 120 VAC contacts for the number of switching points indicated on the Drawings.
 - d. Coating Effects: The electronics shall include circuitry to render the sensing element unaffected by coatings, foam, or other materials that may build up on the probe.
 - e. Electronics shall be immune to RFI/EMI noise.

3. Physical:
 - a. Housing (including indicator): NEMA 4 (IP65) for non-hazardous locations and explosion-proof, approved for Class I, Division 1, Groups C and D service (EEx d IIC) where indicated on the Drawings to be installed in a hazardous area.
 - b. Power supply will be as specified in Section 13300.
4. Manufacturers:
 - a. Ametek Drexelbrook Multipoint II.
 - b. Magnetrol Kotron Sentinel Series.
 - c. Siemens Pointek CLS Series.
 - d. Or equal.

PART 3 EXECUTION

3.01 GENERAL

- A. See execution requirements in Section 13300.

END OF SECTION

SECTION 13343
PRESSURE DEVICES

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. This Section covers the furnishing, installation, and services for pressure related instruments as detailed on the Drawings.
- B. Refer to Section 13300.

1.02 RELATED WORK

- A. Refer to Section 13300 "I & C - Provisions."

1.03 SUBMITTALS

- A. Refer to Sections 13300 and 13340.

1.04 REFERENCE STANDARDS

- A. Refer to Section 13300.

1.05 SYSTEM DESCRIPTION

- A. N/A

1.06 DELIVERY, STORAGE AND HANDLING

- A. Refer to Section 13300.

1.07 COORDINATION MEETINGS

- A. Refer to Section 13300.

1.08 QUALITY ASSURANCE

- A. Refer to Section 13300.

1.09 NOMENCLATURE AND IDENTIFICATION.

- A. Refer to Section 13300.

1.10 MAINTENANCE

- A. Refer to Section 13300.
- B. Test Equipment:

1.11 SPARES AND ACCESSORIES

- A. See Section 13340 for spare parts requirements.
- B. All mounting hardware required for pipe stand, surface, or other mounting shall be provided.
- C. Each instrument shall be provided with a manufacturer installed stainless steel tag identifying the instrument tag number.

PART 2 PRODUCTS

2.01 GAUGE PRESSURE TRANSMITTERS

- A. Type:
 - 1. Microprocessor based, intelligent type.
- B. Function/Performance:
 - 1. Range: Range of the transmitter shall be the standard range of the manufacturer closest to the pressure range to be metered.
 - 2. Accuracy: 0.075 percent of span.
 - 3. Operating Temperature: -20 to 80 degrees C.
 - 4. Temperature Effect: Combined temperature effects shall be less than 0.2 percent of maximum span per 28 degrees C temperature change.
 - 5. Output: 4-20 mA DC linear with pressure, with HART protocol. Zero adjustable over the range of the instrument provided calibrated span is greater than the minimum calibrated span.
 - 6. Stability: 0.05 percent of upper range limit for 1 year.
 - 7. Display: Digital indicator displaying pressure in the engineering units indicated in the Instrument Device Schedule.
 - 8. Diagnostics:
 - a. Self-diagnostics with transmitter failure driving output to above or below out of range limits.
 - b. Simulation capability for inputs and loop outputs.
 - c. Test terminals available to ease connection for test equipment without opening the loop.
 - d. Registers to record minimum and maximum pressure and temperatures transmitter has been exposed to shall be available.
 - e. Run-time clock available to determine usage for warranty purposes. 5-year warranty on this clock reading is included.
 - 9. Over Range Protection: Provide positive over range protection to 150 percent of the maximum pressure of the system being monitored by the instrument.

10. If required to meet the range or suppression/elevation requirements, a differential pressure transmitter shall be provided.

C. Physical:

1. Enclosure: NEMA 4X (IP66), explosion proof, approved for Class I, Division 1, Groups C and D (EEx d IIC T5).
2. Process Wetted Parts: Isolating diaphragm and other wetted metal parts shall be Type 316L stainless steel, unless otherwise indicated in the device schedule. Gaskets and O rings shall be Teflon.
3. Power Supply: 24 VDC loop power.
4. Sensor Fill Fluid: Silicone.

D. Accessories Required:

1. Provide span and zero adjustment at each transmitter and through the handheld programming unit.
 - a. Configuration of the transmitter may be accomplished using the local display and pushbuttons without the use of an external programming device.

E. Manufacturers:

1. Smar
2. ABB
3. Rosemount
4. Foxboro
5. Siemens Sitrans
6. Or equal.

PART 3 EXECUTION

3.01 GENERAL

- A. See execution requirements in Section 13300.

END OF SECTION

SECTION 13344
TEMPERATURE DEVICES

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. This Section covers the furnishing, installation, and services for temperature related instruments as detailed on the Drawings.
- B. Refer to Section 13300.

1.02 RELATED WORK

- A. Refer to Section 13300 "I & C - General Provisions."

1.03 SUBMITTALS

- A. Refer to Sections 13300 and 13340.

1.04 REFERENCE STANDARDS

- A. Refer to Section 13300.

1.05 SYSTEM DESCRIPTION

- A. N/A

1.06 DELIVERY, STORAGE AND HANDLING

- A. Refer to Section 13300.

1.07 COORDINATION MEETINGS

- A. Refer to Section 13300.

1.08 QUALITY ASSURANCE

- A. Refer to Section 13300.

1.09 NOMENCLATURE AND IDENTIFICATION

- A. Refer to Section 13300.

1.10 MAINTENANCE

- A. Refer to Section 13300.

1.11 SPARES AND ACCESSORIES

- A. See Section 13340 for spare parts requirements.
- B. All mounting hardware required for surface or other mounting shall be provided.
- C. Each instrument shall be provided with a manufacturer installed stainless steel tag identifying the instrument tag number.

PART 2 PRODUCTS

2.01 TEMPERATURE ELEMENT/TRANSMITTER

- A. Sensor:
 - 1. Type:
 - a. Three wire platinum RTD.
 - 2. Function/Performance:
 - a. Range: As required by the measuring range indicated in the Instrument List.
 - b. Accuracy: Resistance versus temperature shall meet performance requirements of IEC 751 Tolerance Class B.
 - c. Maximum Thermal Response Time: 9 seconds to reach 50 percent sensor response when tested in flowing water according to IEC 751.
 - d. Temperature Coefficient: 100 ohms at 0 degrees C, with temperature coefficient of 0.00385 ohms/ohm/degree C.
 - e. Self-Heating: Maximum self-heating factor of 0.15 degrees K/mW when measured as defined in DIN EN 60751.
 - 3. Physical:
 - a. Type 316 stainless steel sheath.
 - b. Spring loaded sensor assembly.
 - c. Sensor shall penetrate into the pipe where it is installed, by 1/3 to 1/2 of the pipe diameter.
 - d. Sensor shall be provided with covered connection head. Sensor and connection head shall be NEMA 4X (IP66). Where indicated on the drawings to be installed in a hazardous location, the sensor assembly shall be explosion proof approved for Class I, Division 1, Groups C and D (EEx d IIC).
 - 4. Accessories Required:
 - a. Sensors shall be installed in Type 316L stainless steel thermowells. Thermowells shall be threaded.
 - 5. Manufacturers:
 - a. Smar.
 - b. Rosemount.
 - c. Foxboro.
 - d. Siemens.
 - e. Or equal.

B. Transmitter:

1. Type:
 - a. Remotely mounted, intelligent transmitter compatible with sensor provided.
2. Function/Performance:
 - a. Digital Accuracy: plus or minus 0.2 degrees C.
 - b. Stability: plus or minus 0.1 percent or 0.1 degrees C, whichever is greater, for 24 months.
 - c. Operating Temperature: -40 to 85 degrees C.
 - d. Output: 4-20 mA DC linear with temperature. Transmitter shall also communicate using HART protocol.
 - e. Output may be set as difference or average of two measured temperatures.
 - f. Output may be configured for custom curves including Callendar-Van Dusen correction.
 - g. Display: Digital indicator displaying temperature in engineering units.
 - h. Diagnostics:
 - i. Self-diagnostics with transmitter failure driving output to above or below out of range limits.
 - j. LED indication of transmitter faults.
 - k. Simulation capability for inputs and loop outputs.
 - l. Test terminals available to ease connection for test equipment without opening the loop.
3. Physical:
 - a. Enclosure shall be NEMA 4X (IP66). Where indicated on the drawings to be installed in hazardous locations, the transmitter shall be explosion proof approved for Class I, Division 1, Groups C and D (EEx d IIC).
 - b. Power supply shall be 24 VDC loop power.
4. Manufacturers:
 - a. Smar TT301.
 - b. ABB TTF300.
 - c. Rosemount 3144P.
 - d. Foxboro RTT20.
 - e. Siemens SITRANS TF.
 - f. Or equal.

2.02 THERMOWELL

A. Type:

1. Lagged, threaded, and tapered.
2. Insertion length to suit application.

B. Function/Performance:

1. Purpose: To separate the temperature measuring sensitive portion of a filled thermal system, thermocouple, or resistance temperature detector from potentially corrosive or damaging process media, and/or provide isolation for removal.

2. Connection: Pipe tap threaded well, drilled construction.
3. Flange tap: Flanged well, drilled and welded construction.
4. Hydrostatically pressure tested at 17 MPa (2500 psi) at 24 degrees C (75 degrees F).

C. Physical:

1. Material: Stainless steel Type 316. Titanium for use with raised face, flanged wells.
2. Tip Length: 90mm (3.5-in) minimum.
3. Lagging Extension: 75mm (3-in) minimum.

PART 3 EXECUTION

3.01 GENERAL

- A. See execution requirements in Section 13300.

END OF SECTION

SECTION 13345
ANALYTICAL DEVICES

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. This Section covers the furnishing, installation, and services for analytical related instruments as detailed on the Drawings.
- B. Refer to Section 13300.

1.02 RELATED WORK

- A. Refer to Section 13300 "I & C - General Provisions."

1.03 SUBMITTALS

- A. Refer to Sections 13300 and 13340.

1.04 REFERENCE STANDARDS

- A. Refer to Section 13300.

1.05 SYSTEM DESCRIPTION

- A. N/A

1.06 DELIVERY, STORAGE AND HANDLING

- A. Refer to Section 13300.

1.07 COORDINATION MEETINGS

- A. Refer to Section 13300.

1.08 QUALITY ASSURANCE

- A. Refer to Section 13300.

1.09 NOMENCLATURE AND IDENTIFICATION

- A. Refer to Section 13300.

1.10 MAINTENANCE

- A. Refer to Section 13300.

1.11 SPARES AND ACCESSORIES

- A. See Section 13340 for spare part requirements.

- B. All mounting hardware required for pipe stand, surface, or other mounting shall be provided.
- C. Each instrument shall be provided with a manufacturer installed stainless steel tag identifying the instrument tag number.

1.12 MANUFACTURER START-UP AND TRAINING SERVICES

- A. If indicated in the instrumentation paragraphs below, the instrument manufacturer or manufacturer's certified service representative shall provide start-up and training services. This work shall not be done by the PCSS contractor.
- B. The start-up services shall be to calibrate, oversee the installations of the sensor, and start-up the sensor/transmitter in order to provide reliable measurement at the instrument and to the control system. The vendor shall work with the PCSS to verify the transmitter sends correct information to the remote system (i.e., that the scaling and units are the same at the instrument and on the remote operator interface). Vendor to submit an instrument calibration report in order to document the calibration procedure of the instruments.
- C. While starting up the analyzers, the manufacturer shall provide training to the Owner's instrumentation technicians. The training shall be in how to calibrate, install, troubleshoot, read the diagnostics, and maintain the analyzer and transmitter.

1.13 NETWORKED INSTRUMENTS

- A. Where indicated on the Drawings provide intelligently networked instruments. Provide all components necessary to form a complete and functional instrument network.
- B. Instrumentation communicating via digital pathways (Ethernet TCP/IP, Modbus, Profibus, Profinet, etc.) shall be supported by the SCADA/HMI system. The PCSS to provide all additional drivers necessary to establish communication.

PART 2 PRODUCTS

2.01 GAS SENSOR CONTROLLER

- A. Controller:
 - 1. Type:
 - a. Wall Mounted Controller
 - 2. Function/Performance:
 - a. Power: 100-240 VAC
 - b. Temperature: -20 to 50°C
 - c. Inputs: Availability for up to six (6) I/O modules installed on backplane. Quantity of I/O modules provided shall be as required to accommodate the sensors shown on the drawings.
 - d. Output Relays: Alarm relay output modules shall be provided with a minimum of 10 isolated SPST relay contacts per module. Configurable relay contacts shall be provided to initiate a horn and fault.
 - e. Alarms: A minimum of 4 alarm levels shall be provided for each input channel, including high and low limits, and rate of change alarms.

- f. Data Storage: Internal non-volatile compact flash memory up to 2GB.
 - g. Communication: Communication shall be via Modbus TCP/IP or EtherNet/IP, and shall be natively compatible with the PLC hardware required in Section 13311.
 - h. AT CEDAR CREEK WPCP:
The controller shall be configured to energize the existing strobe lights in the digester area when combustible gas level exceeds the programmed alarm level. The following existing strobes in the Digester Building shall be tied into the controllers:
 - 1) Two (2) strobes wired to Pull Box 14 (PB #14)
 - 2) One (1) strobe wired to Pull Box 15 (PB #15)
 - 3) Three (3) strobes wired to Pull Box 19 (PB #19)
 - 4) Two (2) strobes wired to Pull Box 20 (PB #20)
 - 5) Four (4) strobes wired to Pull Box 22 (PB #22)
 - 6) One (1) strobe wired to Pull Box 25 (PB #25)
- 3. Physical:
 - a. Enclosure: 24"x24" wall mountable NEMA 4X fiberglass enclosure.
 - 4. Accessories Required:
 - a. DIN rail mountable 240W power supply for powering field devices. Power supply shall accept 100-240VAC, 50/60Hz input and shall provide 24VDC power to field devices.
 - b. 10.4" LED Panel with resistive touchscreen display
 - c. Two (2) push buttons mounted on the enclosure for horn silence and alarm acknowledgement.
 - d. Terminal blocks shall be provided for signal and power wiring for sensors/transmitters.
- B. Manufacturers:
- a. MSA GasGard 100
 - b. Or equal.

2.02 COMBUSTIBLE GAS/LEL DETECTOR

- A. Sensor:
- 1. Type:
 - a. Combustible gas sensors shall utilize infrared technology.
 - 2. Functional/performance:
 - a. Continuously measure, indicate and transmit % LEL in air.
 - b. The speed of response to a step change in gas concentration shall be less than 5 seconds to 90 percent of final reading.
 - c. Accuracy: plus or minus 3 percent up to 50 percent LEL, plus or minus 5 percent for greater than 50 percent LEL.
 - d. Range: 0 to 100 percent LEL.
 - e. Environmental Conditions: -25 to 60 degrees C; 0 to 95 percent relative humidity.
 - 3. Physical:
 - a. The sensor shall be compact and of rugged construction to minimize accidental damage of materials and to resist corrosive atmospheres and poisoning of the sensor.

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- b. It shall have positive flame arresting protection and be suitable for installation in atmospheres falling under NEC Class I, Division I, Group D classifications.
 - c. The sensor shall be remotely mounted from the transmitter.
 - d. Transmitter shall be of explosion proof construction.
 - e. The sensor shall be mounted to prevent moisture accumulation.
 - f. The following requirements are specific to the Cedar Creek WPCP:
 - 1) The existing calibration tubing at the Cedar Creek WPCP shall remain and be reattach to the new sensor.
 - 2) New gas detection sensors shall be installed in-place of the existing gas detection sensors at the Cedar Creek WPCP, and the existing wiring and conduit shall be reused. Additional wiring shall be provided as necessary to terminate each sensor in the new PLC-DIG Enclosure.
4. Expendables:
- a. The sensor shall have a useful life of 2 years under normal operating conditions.
5. Accessories Required:
- a. Sufficient cable up to 100 ft (30 m) of the type recommended by the manufacturer, shall be provided for installation between sensor and transmitter.
 - b. Mounting brackets for mounting as indicated on the drawings.
 - c. Enclosures shall be explosion proof, approved for Class 1, Division 1, Groups C and D (EEx d IIC T4) areas.

B. Indicating Transmitter/Controller

- 1. Type:
 - a. Electronic, microprocessor based transmitter compatible with sensor provided.
 - b. Single or dual channel as indicated on the Drawings or in the Instrument Device Schedule.
- 2. Function/Performance:
 - a. Continuously measure, indicate and transmit % LEL in air
 - b. Linearity: plus or minus 2 percent of full scale.
 - c. Response Time: Less than 2 seconds to 90 percent of final reading.
 - d. Range: 0 to 100% LEL.
 - e. Accuracy: plus or minus 3 percent up to 50 percent LEL, plus or minus 5 percent for greater than 50 percent LEL.
 - f. Range: 0 to 100 percent LEL.
 - g. Environmental Conditions: -40 to 60 degrees C and 0 to 95 percent relative humidity.
 - h. Output: One 4-20 mA output proportional to calibrated range. Three relay contacts for alarm and one fault relay contact.
 - i. Digital display indicating the gas level, alarm or fault messages, and diagnostic information.
- 3. Physical:
 - a. NEMA 4X (IP65) enclosure approved for Class 1, Division 1, Groups C and D (EEx d IIC T4).
 - b. Suitable for surface mounting.
- 4. Accessories Required:
 - a. One year supply of calibration and test gas for detectors.

- b. Calibrator, fittings, and other devices require for calibration of detectors. Additional hoses for calibration shall be furnished as needed.
 - c. Calibration Kit: The sensor module shall come equipped with one calibration kit for each type of gas detected. Only one kit is needed for each gas detected.
 - d. Handheld programming unit for setup and calibration.
 - e. Furnish with manufacturer supplied 120VAC to 24VDC internal power supply.
5. Manufacturers:
- a. Ultima XIR Series Gas Monitor by MSA Instrument Co.
 - b. Or Equal.

2.03 AMBIENT OXYGEN DETECTOR

A. Sensor:

- 1. Type:
 - a. Electrochemical type sensor.
- 2. Function/Performance:
 - a. Response Time: Less than 30 seconds to 50% of final reading.
 - b. Environmental Conditions: -40 to 60°C, 0-95% relative humidity.
 - c. Sensor Life: 1 year minimum.
- 3. Physical:
 - a. Suitable for remote wall or ceiling mounting, or directly fitted to transmitter as indicated on the Drawings.
 - b. In non-hazardous areas, remote sensor enclosures shall be NEMA 4X (IP65). Where indicated in the Instrument Device Schedule or on the Drawings to be installed in hazardous areas, enclosures shall be explosion proof, approved for Class 1, Division 1, Groups C and D (EEx d IIC T4) areas.
- 4. Accessories Required:
 - a. Sufficient cable up to 100 ft. (30 m) of the type recommended by the manufacturer shall be provided for installation between sensor and transmitter as required by the installation indicated on the Drawings.
 - b. Mounting brackets for mounting as indicated on the Drawings.

B. Remote Indicating Transmitter/Controller:

- 1. Type:
 - a. Electronic, microprocessor-based single channel transmitter compatible with sensor provided.
- 2. Function/Performance:
 - a. Linearity: ± 2 percent of full scale.
 - b. Repeatability: ± 1 percent of full scale.
 - c. Range: 0 to 25 percent oxygen by volume.
 - d. Environmental Conditions: -40 to 60 °C and 0 to 95 percent relative humidity.
 - e. Output: One 4-20 mA output proportional to calibrated range. Three relay contacts for alarming.

- f. Display: Digital display indicating the gas level, alarm or fault messages, and diagnostic information.
- 3. Physical:
 - a. NEMA 4X (IP65) enclosure. Where indicated in the Instrument Device Schedule or on the Drawings to be installed in hazardous areas, transmitters shall be approved for Class 1, Division 1, Groups C and D (EEx d IIC T4).
 - b. Suitable for surface mounting.
- 4. Accessories Required:
 - a. One year's supply of calibration and test gas for detectors indicated in the Instrument Device Schedule or on the Drawings.
 - b. Calibrator, fittings, hoses, and other devices require for calibration of detectors.
- C. Manufacturers:
 - a. MSA Ultima Series.
 - b. Or equal.

2.04 HYDROGEN SULFIDE DETECTOR

- A. Sensor:
 - 1. Type:
 - a. Integral hydrogen sulfide gas sensors shall be the continuous diffusion type, which change resistance when exposed to hydrogen sulfide.
 - 2. Functional/performance:
 - a. Continuously measure, indicate, and transmit ppm concentration of hydrogen sulfide in air. The speed of response to a step change in gas concentration shall be less than 10 seconds to 90 percent of final reading.
 - 3. Physical:
 - a. The sensor shall be compact and of rugged construction to minimize accidental damage of materials and to resist corrosive atmospheres and poisoning of the sensor.
 - b. It shall have positive flame arresting protection and be suitable for installation in atmospheres falling under NEC Class I, Division I, Group D classifications.
 - c. The sensor shall be integral with the transmitter and be of explosion proof construction.
 - d. The sensor shall be mounted to prevent moisture accumulation.
 - e. The sensor shall be mounted approximately 1 ft. above the floor.
 - 4. Expendables:
 - a. The sensor shall have a useful life of 2 years under normal operating conditions.
 - 5. Accessories Required:
 - a. Sufficient cable up to 100 ft (30 m) of the type recommended by the manufacturer shall be provided for installation between sensor and transmitter as required by the installation indicated on the Drawings.
 - b. Mounting brackets for mounting as indicated on the Drawings.
 - c. In non-hazardous areas, remote sensor enclosures shall be NEMA 4X (IP65). Where indicated in the Instrument Device Schedule or on the Drawings to be installed in

hazardous areas, enclosures shall be explosion proof, approved for Class 1, Division 1, Groups C and D (EEx d IIC T4) areas.

B. Remote Indicating Transmitter/Controller:

1. Type:
 - a. Electronic, microprocessor based single channel transmitter compatible with sensor provided.
2. Function/Performance:
 - a. Linearity: ± 1 percent of full scale.
 - b. Repeatability: ± 1 percent of full scale.
 - c. Range: 0 to 50 PPM.
 - d. Environmental Conditions: -40 to 60 °C and 0 to 95 percent relative humidity.
 - e. Output: One 4-20 mA output proportional to calibrated range. Three relay contacts for alarming.
 - f. Digital display indicating the gas level, alarm or fault messages, and diagnostic information.
3. Physical:
 - a. NEMA 4X (IP65) enclosure approved for Class 1, Division 1, Groups C and D (EEx d IIC T4).
 - b. Suitable for surface mounting.
4. Accessories Required:
 - a. One year supply of calibration and test gas for detectors indicated in the Instrument Device Schedule or on the Drawings.
 - b. Calibrator, fittings, hoses, and other devices require for calibration of detectors.

C. Manufacturers:

1. MSA Ultima Series.
2. Or equal.

2.05 CARBON MONOXIDE DETECTOR

A. Sensor:

1. Type:
 - a. Intrinsically safe.
 - b. Metal oxide sensing element.
2. Function/Performance:
 - a. Accuracy: ± 5 percent full scale at 50 percent relative humidity.
 - b. Environmental Conditions: -40 to 60°C, 0-95% relative humidity.
3. Physical:
 - a. Suitable for remote wall or ceiling mounting, or directly fitted to transmitter as indicated on the Drawings.

4. Accessories Required:
 - a. Sufficient cable up to 100 ft. (30 m) of the type recommended by the manufacturer; shall be provided for installation between sensor and transmitter as required by the installation indicated on the Drawings.
 - b. For convenient calibration, sensors that are inaccessible to an individual standing on the floor, shall be fitted with calibration cups with connected stainless steel tubing running to a point adjacent to the transmitter. Tubing installation shall conform to tubing installation requirements specified elsewhere.
 - c. Remote sensor enclosures shall be approved for the specified areas as shown on the Drawings.

B. Remote Indicating Transmitter/Controller:

1. Type:
 - a. Electronic, microprocessor based single channel transmitter compatible with sensor provided.
2. Function/Performance:
 - a. Range: 0 to 100 ppm.
 - b. Environmental Conditions: 0 to 40 °C; 0 to 95 percent relative humidity.
 - c. Output: One 4-20 mA output proportional to calibrated range. Programmable relay contacts for warning, alarm, and/or fault.
 - d. Display: Digital display indicating the gas level, alarm or fault messages, and diagnostic information.
3. Physical:
 - a. Compatible to the environment specified in the drawings.
 - b. Suitable for surface mounting.

C. Manufacturers:

- a. MSA Z Gard Series.
- b. Or equal.

2.06 DISSOLVED OXYGEN ANALYZER (OPTICAL TYPE SENSOR)

A. Electrode Cartridge/Sensor Assembly:

1. Type: Continuous monitoring of dissolved oxygen by an optical sensor using either luminescence excited with blue light pulses technology or fluorescence quenching principle.
2. Function/Performance:
 - a. Accuracy: ± 0.1 ppm (DO<1 ppm); ± 0.2 ppm.
 - b. Repeatability: ± 0.01 ppm.
 - c. Measuring Range: 0 to 20 ppm.
 - d. Sensitivity: ± 0.05 percent of span.
 - e. Measuring Range: 0 to 50 °C.
 - f. Materials on Construction: Noryl, polybutyl methacrolate, epoxy, polyurethane or PVC depending upon manufacturer.
 - g. Warranties: Probe, 3 years; Sensor, 1 year.

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information is being sent to the PLC system (i.e. that the scaling and units are the same at the instrument and on the remote operator interface). The manufacturer shall submit a calibration report in order to document the calibration procedure of the dissolved oxygen analyzer system. Provide a minimum of four (4) days of startup services.

3. When starting up the system, the manufacturer shall provide training to the Owner's instrumentation technicians. The training shall be on how to calibration, install, troubleshoot, read the diagnostics, and maintain the system. Provide a minimum of eight (8) hours of training services.

PART 3 EXECUTION

3.01 GENERAL

- A. See execution requirements in Section 13300.

END OF SECTION

SECTION 15100
VALVES

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Furnish all labor, materials, equipment and incidentals required and install complete and ready for operation and test all non-buried valves as shown on the Drawings and as specified herein.
- B. The equipment shall include, but not be limited to, the following; however not all items specified herein may be included in this project.
 - 1. General Requirements
 - 2. Valve Actuators (Hydraulic Cylinder Operator)
 - 3. Butterfly Valves (as required)

1.02 RELATED WORK

- A. Instrumentation, not specified herein, is included in Division 13.
- B. Electrical work is included in Division 16.
- C. Certain items similar to those specified in this Section may be specified to be furnished and installed with individual equipment or systems. In case of a conflict, those individual equipment or system requirements shall govern.
- D. Electric valve operators of all types, rate of flow controllers (including modulating valves and operators) and other types of valves which are part of the automated instrumentation (such as some solenoid valves) if not included herein are included in Division 13.

1.03 SUBMITTALS

- A. Submit to Engineer, in accordance with Section 01300, materials required to establish compliance with this Section. First submittal shall be valve schedule described in Paragraph 1.09. Approval of valve schedule submittal is required prior to Contractor submitting any of equipment in this specification. Subsequent Equipment Submittals shall include at least the following:
 - 1. Valve tag number.
 - 2. Manufacturer and supplier.
 - 3. Address at which equipment will be fabricated or assembled.
 - 4. Drawings showing assembly details, materials of construction and dimensions.
 - 5. Descriptive literature, bulletins and/or catalogs of the equipment.
 - 6. Total weight of each item.

7. A complete bill of materials.
8. Additional submittal data, where noted with individual pieces of equipment.
9. Individual electrical control schematics and wiring diagrams for each valve operator with external interfaces, identified exactly as detailed on Electrical and Instrumentation Drawings. Standard catalogue cut sheets that show typical wiring diagrams only are not acceptable. Valve actuators shall be coordinated with electrical requirements shown on Drawings and valves as specified herein.

B. Test Reports:

1. Provide certified hydrostatic test data, per manufacturer's standard procedure or MSS-SP-61 for valves.

C. Certificates:

1. For each valve specified to be manufactured, tested and/or installed in accordance with AWWA and other standards, submit an affidavit of compliance with appropriate standards, including certified results of required tests and certification of proper installation.

D. Manufacturer's Installation and Application Data.

E. Operating and Maintenance Data.

1. Operating and maintenance instructions shall be furnished to Engineer as provided in Section 01730. Instructions shall be prepared specifically for this installation and shall include required cuts, drawings, equipment lists, descriptions and other information required to instruct operating and maintenance personnel unfamiliar with such equipment.

1.04 REFERENCE STANDARDS

A. ASTM International:

1. ASTM A48 - Standard Specification for Gray Iron Castings.
2. ASTM A126 - Standard Specification for Gray Iron Castings for Valves, Flanges and Pipe Fittings.
3. ASTM A240 - Standard Specification for Heat-Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet and Strip for Pressure Vessels.
4. ASTM A276 - Standard Specification for Stainless Steel Bars and Shapes.
5. ASTM A436 - Standard Specification for Austenitic Gray Iron Castings.
6. ASTM A536 - Standard Specification for Ductile Iron Castings.
7. ASTM B30 - Standard Specification for Copper-Base Alloys in Ingot Form.
8. ASTM B62 - Standard Specification for Composition Bronze or Ounce Metal Castings.

B. American Water Works Association (AWWA):

1. AWWA C111 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
2. AWWA C500 - Metal-Seated Gate Valves Supply Service.
3. AWWA C504 - Rubber-Seated Butterfly Valves.
4. AWWA C507 - Ball Valves, 6-in through 48-in (150mm through 1200mm).
5. AWWA C508 - Swing-Check Valves for Waterworks Service, 2-in (50mm through 24-in (600mm) NPS.
6. AWWA C509 - Resilient-Seated Gate Valves for Water Supply Service.
7. AWWA C511 - Reduced-Pressure Principle Backflow-Prevention Assembly.
8. AWWA C540 - Power-Actuating Devices for Valves and Sluice Gates.
9. AWWA C541 - Hydraulic and Pneumatic Cylinder and Vane Type Actuators for Valves and Slide Gates.
10. AWWA C550 - Protective Epoxy Interior Coatings for Valves and Hydrants.
11. AWWA C800 - Underground Service Line Valves and Fittings.

C. American National Standards Institute (ANSI):

1. ANSI B1.20.1 - Specifications, Dimensions, Gauging for Taper and Straight Pipe Threads (except dry seals).
2. ANSI B16.1 - Cast Iron Pipe Flanges and Flanged Fittings.
3. ANSI B16.10 - Face-to-Face and End-to-End Dimensions of Valves.
4. ANSI B16.104 - Butterfly Valves.

D. American Iron and Steel Institute (AISI).

E. Manufacturer's Standardization Society of the Valve and Fittings Industry (MSS):

1. MSS-SP-61 - Pressure Testing of Steel Valves.
2. MSS-SP-67 - Butterfly Valves.
3. MSS-SP-70 - Cast Iron Gate Valves, Flanged and Threaded Ends.
4. MSS-SP-71 - Cast Iron Swing Check Valves, Flanges and Threaded Ends.
5. MSS-SP-72 - Ball Valves with Flanged or Butt-Welding Ends for General Services.
6. MSS-SP-78 - Cast Iron Plug Valves, Flanged and Threaded Ends.

7. MSS-SP-80 - Bronze Gate, Globe, Angle and Check Valves.
 8. MSS-SP-82 - Valve Pressure Testing Methods.
 9. MSS-SP-98 - Protective Coatings for the Interior of Valves, Hydrants and Fittings.
- F. National Electrical Manufacturers Association (NEMA).
- G. Underwriters Laboratories (UL).
- H. Factory Mutual (FM).
- I. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.05 QUALITY ASSURANCE

A. Qualifications:

1. Valves and appurtenances shall be products of well-established firms who are fully experienced, minimum ten years, reputable and qualified in manufacture of particular equipment to be furnished.
2. Equipment shall be designed, constructed and installed in accordance with best practices and methods and shall comply with this Section as applicable.
3. Units of the same type shall be the product of one manufacturer.

B. Certifications:

1. Manufacturers shall furnish an affidavit of compliance with Standards referred to herein as specified in Paragraph 1.03C above. Refer to Part 3 for testing required for certain items in addition to that required by referenced standards.

C. Provide services of a qualified and factory-trained service representative of manufacturer to provide operational and maintenance instruction, for a one day, eight hour period for each type of the following equipment:

1. Electro-pneumatic hydraulic cylinder actuators.

D. Inspection of units may also be made by Engineer or other representative of Owner after delivery. Equipment shall be subject to rejection at any time due to failure to meet any of specified requirements, even though submittal data may have been accepted previously. Equipment rejected after delivery shall be marked for identification and shall be removed from job site at once.

1.06 SYSTEM DESCRIPTION

- A. Equipment and materials specified herein are intended to be standard for use in controlling flow of wastewater, and sludge as noted on Drawings.

- B. Valves, appurtenances and miscellaneous items shall be installed as shown on Drawings and as specified, so as to form complete workable systems.

1.07 DELIVERY, STORAGE AND HANDLING

- A. Reference is made to Section 01600 for additional information.
- B. Packing and Shipping:
 - 1. Care shall be taken in loading, transporting and unloading to prevent injury to the valves, appurtenances, or coatings. Equipment shall not be dropped. Valves and appurtenances shall be examined before installation and no piece shall be installed which is found to be defective. Damage to the coatings shall be repaired as acceptable to Engineer.
 - 2. Prior to shipping, ends of valves shall be acceptably covered to prevent entry of foreign material. Covers shall remain in place until after installation and connecting piping is completed.
 - a. Valves 3-in and larger shall be shipped and stored on site until time of use with wood or plywood covers on each valve end.
 - b. Valves smaller than 3-in shall be shipped and stored as above except that heavy cardboard covers may be used on the openings.
 - c. Rising stems and exposed stem valves shall be coated with a protective oil film which shall be maintained until the valve is installed and put into use.
 - d. Corrosion in evidence at the time of acceptance by the Owner shall be removed, or the valve shall be removed and replaced.
- C. Storage and Protection:
 - 1. Special care shall be taken to prevent plastic and similar brittle items from being directly exposed to the sun, or exposed to extremes in temperature, to prevent deformation. See the individual piping sections and manufacturer's information for further requirements.

1.08 MAINTENANCE

- A. Special tools and the manufacturer's standard spare parts, if required for normal operation and maintenance, shall be supplied with the equipment in accordance with Section 01730 and where noted, as specified herein. Tools shall be packaged in a steel case, clearly and indelibly marked on the exterior to indicate equipment for which tools are intended.
- B. Provide one operations and maintenance manual for each type of valve and operator supplied under this specification in accordance with Section 01730.
- C. Included within operations and maintenance manuals, provide a list of all spare and replacement parts with individual prices and location where they are available.

1.09 VALVE DESIGNATIONS AND SCHEDULE

- A. Valves shall be identified by a unique valve tag as identified in valve schedule prepared by Contractor. Specific type of valve to be used will be identified by symbol and/or call out on Drawings. Contractor shall identify each valve by its assigned tag number on shop drawings and equipment submittals.

- B. Contractor shall refer to the P&IDs and mechanical plans for type of each valve called out by abbreviation or drawing symbol. Prior to first valve submittal, Contractor shall submit a detailed valve schedule listing process valves to be furnished along with Contract Drawing P&IDs edited electronically which shall include valve tag numbers prepared by Contractor identifying each valve. Valve schedule shall include: valve tag number; valve designation; valve size; end connections and operator type. Valve tag convention shall be four digits long, numbering shall be linked to the P&ID Sheet on which it is shown. Identical valves in same position in parallel processes (EX. Pump inlet/outlet isolation valves where there are three parallel pumps of same type) shall have same tag number followed by a hyphen and quantifier -1, 2, 3 etc. Where electric, hydraulic or pneumatic actuators are supplied their type shall be so noted with an E, H or P. Modulating duty actuators shall be noted with an M following the actuator type notation. An excerpt of an EXAMPLE schedule is as follows:

Valve Tag.	Designation	Size	Ends	Operator	Notes
1000-1	BFV1	8-in	Flanged	Gear/Handwheel	Extra description as necessary
1000-2	BFV1	8-in	Flanged	Gear/Handwheel	
1005	PV1	6-in	Flanged	EM	

PART 2 PRODUCTS

2.01 MATERIALS AND EQUIPMENT - GENERAL

- A. Reference is made to Division 1 for additional requirements, including nameplates, provisions for temporary pressure gauges, protection against electrolysis and anchor bolts.
- B. Use of a manufacturer's name and/or model or catalog number is for purpose of establishing standard of quality and general configuration desired.
- C. Valves and appurtenances shall be of size shown on the Drawings or as noted and as far as possible equipment of same type shall be identical and from one manufacturer.
- D. Valves and appurtenances shall have name of maker, nominal size, flow directional arrows, working pressure for which they are designed and standard referenced, cast in raised letters or via riveted stainless steel nameplate upon some appropriate part of the body.
- E. Unless otherwise noted, items shall have a minimum working pressure of 150 psi or be of same working pressure as pipe they connect to, whichever is higher and suitable for pressures noted where they are installed.
- F. Joints, size and material - unless otherwise noted or required by Engineer:
- Except where noted, joints referred to herein shall be of same type, nominal diameter, material and with a minimum rating equal to pipe or fittings they are connected to.
 - Valves and appurtenances shall be of same nominal diameter as pipe or fittings they are connected to.
 - Valves exposed to view, or in vaults:
 - Plastic valves in chemical service - solvent cement, or flanged ends.

- b. 3-in and smaller - threaded ends- unless noted otherwise herein or on Drawings.
 - c. 4-in and larger - flanged ends.
- G. Provide special adaptors as required to ensure compatibility between valves, appurtenances, and adjacent pipe.
- H. No alternative materials will be considered for approval unless complete documentation is provided regarding their satisfactory long-term use in similar conditions; in addition, the consideration of any substitution will be considered only if superiority of proposed materials is the intent of substitution, and only if sufficient evidence is provided to document that superiority.

2.02 VALVE ACTUATORS – HYDRAULIC CYLINDER OPERATOR

A. General:

- 1. Actuators shall conform to AWWA Standard C540, insofar as applicable and as herein specified. Actuators shall be O-ring sealed, watertight to standard NEMA 4X/6, submersion to 6 feet for 30 minutes.
- 2. Valve service/operation shall be as indicated on the P&IDs and as specified in the Process Control Strategies in Section 13305.
- 3. Modulating actuators shall contain proportional control unit and be capable of 1200 starts per hour, open-closed valve actuators shall not require a proportional control unit, and be capable of 60 starts per hour.
- 4. Actuators shall have a digital control module, to allow valves or gates to be positioned remotely via a 2-wire 4-20mA signal. The actuators shall have the following inputs and outputs for interfacing with the plant SCADA system:
 - a. 4-20mA input for position control
 - b. 4-20mA output for position feedback
 - c. Dry contact output for monitoring that actuator is in Remote Control mode.
 - d. Dry contact output for monitoring that the valve is fully opened.
 - e. Dry contact output for monitoring that the valve is fully closed.
- 5. Each actuator shall be provided with supply air regulator, supply air filter and pressure gages. The pressure gages shall be provided with a range of 0-160psi. The regulators with 3/8NPT connections, max inlet pressure 250 psi and max output pressure of 100 psi. The inline coalescing filters with a grade DX filter that is 93% efficient at 0.1 micron and designed for a max inlet pressure of 250psi.

B. VALVE ACTUATORS – Hydraulic Cylinder Operator:

- 1. Cylinders: Hydraulic Cylinder Operators for rubber seated flow control valves shall move valve to any position from full open to full closed where a minimum pressure of 50 PSI is applied to cylinder. Wetted parts of cylinder shall be corrosion resistant and cylinder rods shall be corrosion resistant stainless steel. Rod seals shall be of non-adjustable wear compensating type. Cylinder actuators shall be Pratt MDT Type with Dura-Cyl Cylinder. Four limit switches shall be provided on cylinder operator.

2.03 BUTTERFLY VALVES (AS REQUIRED)

A. Energy Efficient Process Duty Butterfly Valves: Tag Type BFV4.

1. Valves shall be high flow, concentric disc, bi-directional seal, hard backed cartridge seat, wafer style, except for dead end service, where fully lugged valves shall be used. Valves shall be 50 PSI pressure rated for low pressure air service, 150 PSI rated for fluid service. Air service valves shall be fitted with trim capable of continuous 250 degree F. service, intermittent 300 degree F. service.
2. Body shall be one piece cast iron for wafer style, ductile iron for lug style. Body class shall be ASME 150.
3. Disc shall be undercut type if employed for air service, material shall be ASTM B 148 C954 or 955 aluminum bronze or CF8M stainless steel. Valve discs shall employ a positive machined drive utilizing a rectangular drive connection, or shall be attached using Type 416 stainless steel taper pins or bolts with locking nuts.
4. Valves shall have dry stem journals with no leakage to stems at rated pressure. Stem packing shall not be required. Valves shall be constructed with separate upper and lower stems or single through stems. Separate stems shall be positively retained by tangential pins. Stems shall be 17-4 PH or Type 416 stainless steel. Through stem design shall be supported by a minimum of two upper bearings and one lower bearing.
5. Seats shall be hard backed cartridge type consisting of a resilient EPDM liner molded to a rigid non-metallic backing ring. Viton liners shall be utilized for high temperature or corrosive duty service. Valve seats shall be field replaceable with hand tools.
6. Upper stem shall be guided by two self-lubricating bronze or PTFE bearings, lower stem for single piece stem designs shall be guided by one self-lubricating bronze or PTFE bearing.
7. Valves shall be Crane Centerline Series 200; Apollo Series 141; Demco NE-C (2" to 12"), or NF-C (14" to 24"), manufactured by Cameron Valves & Measurement, or equal.

2.04 SURFACE PREPARATION AND SHOP COATINGS

- A. Notwithstanding any of these specified requirements, coatings and lubricants in contact with potable water shall be certified as acceptable for use with that fluid.
- B. If manufacturer's requirement is not to require finished coating on interior surfaces, then manufacturer shall so state and no interior finish coating will be required, if acceptable to Engineer.
- C. Exterior surface of various parts of valves, operators, floor-stands and miscellaneous piping shall be thoroughly cleaned of all scale, dirt, grease or other foreign matter and thereafter one shop coat of an approved rust-inhibitive primer such as Inertol Primer No. 621 shall be applied in accordance with instructions of paint manufacturer or other primer compatible with finish coat provided.

- D. Unless otherwise noted, interior ferrous surfaces of valves shall be given a shop finish of an asphalt varnish conforming to AWWA C509, (except mounting faces/surfaces) or epoxy conforming to AWWA C550 with a minimum thickness of 6 mils.
- E. Ferrous surfaces obviously not to be painted shall be given a shop coat of grease or other suitable rust-resistant coating. Mounting surfaces shall be especially coated with a rust preventative.
- F. Special care shall be taken to protect uncoated items and plastic items, especially from environmental damage.

2.05 FACTORY INSPECTION AND TESTING

- A. Factory inspection, testing and correction of deficiencies shall be done in accordance with the referenced standards and as noted herein.
- B. See Division 1 for additional requirements. Also refer to Part 1, especially for required submission of test data to Engineer.
- C. In addition to tests required by referenced standards, the following shall also be factory tested:
 - 1. Butterfly valves shall be factory tested to demonstrate drop tight closure at specified conditions.

PART 3 EXECUTION

3.01 INSTALLATION - GENERAL

- A. Valves and appurtenances shall be installed per manufacturer's instructions in locations shown, true to alignment and rigidly supported. Damage to above items shall be repaired to satisfaction of Engineer before they are installed.
- B. Install brackets, extension rods, guides, various types of operators and appurtenances as shown on Drawings, or otherwise required. Before setting these items, check Drawings and figures which have a direct bearing on their location. Contractor shall be responsible for proper location of valves and appurtenances during construction of the work.
- C. Materials shall be carefully inspected for defects in construction and materials. Debris and foreign material shall be cleaned out of openings, etc. Valve flange covers shall remain in place until connected piping is in place. Operating mechanisms shall be operated to check their proper functioning and nuts and bolts checked for tightness. Valves and other equipment which do not operate easily, or are otherwise defective, shall be repaired or replaced at no additional cost to Owner.
- D. Where installation is covered by a referenced standard, installation shall be in accordance with that standard, except as herein modified, and Contractor shall certify such. Also note additional requirements in other parts of this Section.
- E. Unless otherwise noted, joints for valves and appurtenances shall be made up utilizing same procedures as specified under applicable type connecting pipe joint and valves and other items

shall be installed in proper position as recommended by manufacturer. Contractor shall be responsible for verifying manufacturers' torquing requirements for all valves.

3.02 INSTALLATION OF MANUAL OPERATIONAL DEVICES

- A. Unless otherwise noted, operational devices shall be installed with units of factory, as shown on Drawings or as acceptable to Engineer to allow accessibility to operate and maintain item and to prevent interference with other piping, valves, and appurtenances.

3.03 INSPECTION, TESTING AND CORRECTION OF DEFICIENCIES

- A. See also Division 1. Take care not to over pressurize valves or appurtenances during pipe testing. If unit proves to be defective, it shall be replaced or repaired to satisfaction of Engineer.
- B. Functional Test: Prior to plant startup, items shall be inspected for proper alignment, quiet operation, proper connection and satisfactory performance. After installation, manual valves shall be opened and closed in presence of Engineer to show valve operates smoothly from full open to full close and without leakage. Valves equipped with electric, pneumatic or hydraulic actuators shall be cycled five times from full open to full closed in presence of Engineer without vibration, jamming, leakage, or overheating. Pressure control and pressure relief valves shall be operated in presence of Engineer to show they perform their specified function at some time prior to placing piping system in operation and as agreed during construction coordination meetings
- C. Various pipe lines in which valves and appurtenances are to be installed are specified to be field tested. During these tests any defective valve or appurtenance shall be adjusted, removed, and replaced, or otherwise made acceptable to Engineer.
- D. Various regulating valves, strainers, or other appurtenances shall be tested to demonstrate their conformance with specified operational capabilities and deficiencies shall be corrected or device replaced or otherwise made acceptable to Engineer.

3.04 CLEANING

- A. Items including valve interiors shall be inspected before line closure, for presence of debris. At option of Engineer, internal inspection of valve and appurtenances may be required any time that likelihood of debris is a possibility. Pipes and valves shall be cleaned prior to installation, testing disinfection and final acceptance.

3.05 BUTTERFLY VALVE REPLACEMENT

- A. Upon completion of the functional testing of the actuators, as described in Section 3.03-B, should it be found that the valve(s) is inoperable the Engineer and Owner will provide a list of the valves to be replaced.
- B. The line item cost to replace a resilient seat 24" settled wastewater, 30" settled wastewater and/or a 14" return sludge valve as defined in the measurement and payment items shall be covered under the Butterfly Valve Repair Allowance.

END OF SECTION

SECTION 15101
ELECTRIC MOTOR VALVE ACTUATORS

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Furnish all labor, materials, equipment and incidentals required and install electric valve actuators on the existing outdoor aeration valves at the Glen Cove WWTP, complete and ready for testing and operation as shown on the Drawings and as specified herein.

1.02 RELATED WORK

- A. Surface preparation and painting is included in Division 9.
- B. Instrumentation, not specified herein, is included in Division 13.
- C. Electrical work is included in Division 16.

1.03 SUBMITTALS

- A. Submit to the Engineer, in accordance with Section 01300, materials required to establish compliance with this Section. The first submittal shall be the valve schedule described in Paragraph 1.09. Approval of the valve actuator schedule submittal is required prior to Contractor submitting any of the equipment in this specification. Subsequent Equipment Submittals shall include at least the following:
 - 1. Valve tag number.
 - 2. The manufacturer and supplier.
 - 3. The address at which equipment will be fabricated or assembled.
 - 4. Drawings showing assembly details, materials of construction and dimensions.
 - 5. Descriptive literature, bulletins and/or catalogs of the equipment.
 - 6. The total weight of each item.
 - 7. A complete bill of materials.
 - 8. Additional submittal data, where noted with individual pieces of equipment.
 - 9. Individual electrical control schematics and wiring diagrams for each valve operator with external interfaces, identified exactly as detailed on the Electrical and Instrumentation Drawings. Standard catalogue cut sheets that show typical wiring diagrams only are not acceptable. Valve actuators shall be coordinated with electrical requirements shown on the Drawings and valves as specified herein.

B. Manufacturer's Installation and Application Data

C. Operating and Maintenance Data

1. Operating and maintenance instructions shall be furnished to the Engineer as specified in Division 1, Section 01730. The instructions shall be prepared specifically for this installation and shall include required cuts, drawings, equipment lists, descriptions and other information required to instruct operating and maintenance personnel unfamiliar with such equipment.

1.04 REFERENCE STANDARDS

A. ASTM International

1. ASTM A48 - Standard Specification for Gray Iron Castings.
2. ASTM A126 - Standard Specification for Gray Iron Castings for Valves, Flanges and Pipe Fittings.
3. ASTM A240 - Standard Specification for Heat-Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet and Strip for Pressure Vessels.
4. ASTM A276 - Standard Specification for Stainless Steel Bars and Shapes.
5. ASTM A436 - Standard Specification for Austenitic Gray Iron Castings.
6. ASTM A536 - Standard Specification for Ductile Iron Castings.
7. ASTM B30 - Standard Specification for Copper-Base Alloys in Ingot Form.
8. ASTM B62 - Standard Specification for Composition Bronze or Ounce Metal Castings

B. American Water Works Association (AWWA)

1. AWWA C111 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
2. AWWA C500 - Metal-Seated Gate Valves Supply Service
3. AWWA C504 - Rubber-Seated Butterfly Valves
4. AWWA C507 - Ball Valves, 6-in through 48-in (150mm through 1200mm)
5. AWWA C508 - Swing-Check Valves for Waterworks Service, 2-in (50mm through 24-in (600mm) NPS
6. AWWA C509 - Resilient-Seated Gate Valves for Water Supply Service
7. AWWA C511 - Reduced-Pressure Principle Backflow-Prevention Assembly
8. AWWA C540 - Power-Actuating Devices for Valves and Sluice Gates
9. AWWA C550 - Protective Epoxy Interior Coatings for Valves and Hydrants

10. AWWA C800 - Underground Service Line Valves and Fittings

C. American National Standards Institute (ANSI)

1. ANSI B1.20.1 - Specifications, Dimensions, Gauging for Taper and Straight Pipe Threads (except dry seals).
2. ANSI B16.1 - Cast Iron Pipe Flanges and Flanged Fittings
3. ANSI B16.10 - Face-to-Face and End-to-End Dimensions of Valves
4. ANSI B16.104 - Butterfly Valves

D. American Iron and Steel Institute (AISI)

E. Manufacturer's Standardization Society of the Valve and Fittings Industry (MSS)

1. MSS-SP-61 - Pressure Testing of Steel Valves.
2. MSS-SP-67 - Butterfly Valves.
3. MSS-SP-70 - Cast Iron Gate Valves, Flanged and Threaded Ends.
4. MSS-SP-71 - Cast Iron Swing Check Valves, Flanges and Threaded Ends.
5. MSS-SP-72 - Ball Valves with Flanged or Butt-Welding Ends for General Services.
6. MSS-SP-78 - Cast Iron Plug Valves, Flanged and Threaded Ends.
7. MSS-SP-80 - Bronze Gate, Globe, Angle and Check Valves.
8. MSS-SP-82 - Valve Pressure Testing Methods
9. MSS-SP-98 - Protective Coatings for the Interior of Valves, Hydrants and Fittings.

F. National Electrical Manufacturers Association (NEMA)

G. Underwriters Laboratories (UL)

H. Factory Mutual (FM)

- I. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.05 QUALITY ASSURANCE

A. Qualifications

1. The equipment shall be designed, constructed and installed in accordance with the best practices and methods and shall comply with this Section as applicable.
2. Units of the same type shall be the product of one manufacturer.

3. Motor actuators shall be 480 volt, 3 Phase, 60 Hz. and shall be the product of one manufacturer. This requirement shall be coordinated with the existing valves.

B. Certifications

1. The manufacturers shall furnish an affidavit of compliance with Standards referred to herein as specified in Paragraph 1.03C above. Refer to PART 3 for testing required for certain items in addition to that required by referenced standards.

C. Provide the services of a qualified and factory-trained service representative of the manufacturer to provide operational and maintenance instruction, for a 1 day, 8 hour period for each type of the following equipment:

1. Valve motor operators.

D. Inspection of the units may also be made by the Engineer or other representative of the Owner after delivery. The equipment shall be subject to rejection at any time due to failure to meet any of the specified requirements, even though submittal data may have been accepted previously. Equipment rejected after delivery shall be marked for identification and shall be removed from the job site at once.

1.06 SYSTEM DESCRIPTION

- A. The equipment and materials specified herein are intended to be standard for use in controlling the flow of air, as noted on the Drawings.
- B. Valves, appurtenances and miscellaneous items shall be installed as shown on the Drawings and as specified, to form complete workable systems.

1.07 DELIVERY, STORAGE AND HANDLING

- A. Reference is made to Section 01600 for additional information.
- B. Packing and Shipping
 1. Care shall be taken in loading, transporting and unloading to prevent injury to the valve operators, appurtenances, or coatings. Equipment shall not be dropped. Valves and appurtenances shall be examined before installation and no piece shall be installed which is found to be defective. Any damage to the coatings shall be repaired as acceptable to the Engineer.
- C. Storage and Protection
 1. Special care shall be taken to prevent plastic and similar brittle items from being directly exposed to the sun, or exposed to extremes in temperature, to prevent deformation..

1.08 MAINTENANCE

- A. Special tools and the manufacturer's standard spare parts, if required for normal operation and maintenance, shall be supplied with the equipment in accordance with Section 01730 and where noted, as specified herein. Tools shall be packaged in a steel case, clearly and indelibly marked on the exterior to indicate equipment for which tools are intended.
- B. Provide one Operations and Maintenance manual for the valve operator supplied under this specification in accordance with Section 01730.
- C. Included within the Operations and Maintenance manuals, provide a list of spare and replacement parts with individual prices and location where they are available.

1.09 VALVE DESIGNATIONS AND SCHEDULE

- A. Valves shall be identified by a unique valve tag as identified in the valve schedule prepared by the Contractor. The specific type of valve to be used will be identified by the symbol and/or call out on the Drawings. Identify each valve by its assigned tag number on shop drawings and equipment submittals.
- B. Refer to the P&IDs and Mechanical Plans for type of each valve called out by abbreviation or drawing symbol. Provide valve operators for the following valves:

Valve Tag.	Designation	Size	Ends	Operator	Notes
2150-1	Butterfly (BFV)	8-in	Flanged	EM	New operator installed on existing BFV
2150-2	Butterfly (BFV)	8-in	Flanged	EM	New operator installed on existing BFV
2150-3	Butterfly (BFV)	8-in	Flanged	EM	New operator installed on existing BFV
2150-4	Butterfly (BFV)	8-in	Flanged	EM	New operator installed on existing BFV
2150-5	Butterfly (BFV)	8-in	Flanged	EM	New operator installed on existing BFV
2150-6	Butterfly (BFV)	8-in	Flanged	EM	New operator installed on existing BFV
2150-7	Butterfly (BFV)	8-in	Flanged	EM	New operator installed on existing BFV
2150-8	Butterfly (BFV)	8-in	Flanged	EM	New operator installed on existing BFV

PART 2 PRODUCTS

2.01 MATERIALS AND EQUIPMENT - GENERAL

- A. The use of a manufacturer's name and/or model or catalog number is for the purpose of establishing the standard of quality and general configuration desired.
- B. Provide special adaptors as required to ensure compatibility between valves and operators.

- C. No alternative materials will be considered for approval unless complete documentation is provided regarding their satisfactory long-term use in similar conditions; in addition, the consideration of any substitution will be considered only if the superiority of the proposed materials is the intent of the substitution, and only if sufficient evidence is provided to document that superiority.

2.02 VALVE ACTUATORS – POWERED

A. General

1. The actuators shall conform to AWWA Standard C540, insofar as applicable and as herein specified. Actuators shall be O-ring sealed, watertight to standard NEMA 4X/6, submersion to 6 feet for 30 minutes.
2. Valve service/operation shall be as indicated on the P&IDs and as specified in the Process Control Strategies in Section 13305.
3. 480 Volt powered actuators shall be Limitorque MX; Rotork IQ/IQM; EIM TEK 2000; AUMA SA/SAR, or Equal. Actuators shall be configured as required to provide for part turn or multi-turn and be coupled with gearboxes as required to obtain the speed and operating torque as required for the valve it controls.
4. Modulating actuators shall contain proportional control unit and be capable of 1200 starts per hour.

B. 480 Volt Powered Actuators for Multi-Turn Valve Operation

1. Operation
 - a. Capabilities shall be provided to position the valve (or gate) locally via the Local/Off/Remote selector switch and Open/Stop/Close push buttons.
 - b. Operators shall provide modulating service, when in remote the actuator shall accept a 4-20mADC position control signal, and shall position the valve 0-90 degrees in proportion to the control signal.
 - c. Valves shall rotate from stop to stop in 25 seconds.
2. Functional
 - a. The motor operated valve controller shall include the motor, operator unit gearing, limit switch gearing, limit switches, control power transformer, position transmitter (when required), torque switches, bored and key-wayed drive sleeve for non-rising stem valves, declutch lever and auxiliary handwheel as a self-contained unit. Valve contacts shall be capable of handling the current equivalent of a NEMA 1 size starter.
 - b. Reversing starters shall be integral with the actuator, and shall be solid-state starters for modulating service. Electro-mechanical reversing starters shall be acceptable for open-close service and shall be mechanically and electrically interlocked.

- c. Limit switches and gearing shall be an integral part of the valve control. The limit switch gearing shall be made of bronze or stainless steel and shall be fully lubricated, intermittent type and totally enclosed to prevent dirt and foreign matter from entering the gear train. Limit switches shall be of the adjustable type capable of being adjusted to trip at any point between fully opened valve and fully closed valve. Limit and torque switches shall be provided for stopping valve in both directions. Set position shall not be lost if over travel occurs in either manual or electric modes of operation.
 - d. The valve position transmitter shall be a gear actuated, two-wire device, producing 4-20 mADC signal proportional to 0-90 degree valve position or to 0-100% of valve travel. The transmitter shall be provided with easily accessible zero and span adjustment potentiometers. The valve actuator shall be provided with a local digital or mechanical indicator integral with the operator with a 0-100 percent scale. The DC power supply shall be provided integral with the operator and powered from the 110 volt AC internal transformer. The positioner board shall provide repeatable accuracy to 0.25% of span. There shall be separate trim pots on the positioner board for zero, span and dead band adjustment.
 - e. The speed of the actuator shall be the responsibility of the system supplier with regards to hydraulic requirements and response compatibility with other components within the control loop. Each valve controller shall be provided with a minimum of two limit switch functions, one for opening and one for closing. Each limit switch will have two normally open and two normally closed contacts. Gear limit switches must be geared to driving mechanism and in step at all times whether in motor or manual operation. Provision shall be made for two extra sets of limit switches as described above, each to have two normally open and two normally closed contacts. Each valve controller shall be equipped with a double torque switch. The torque switch shall be adjustable and will be responsive to load encountered in either direction of travel. The limit and torque switch contacts shall be silver inlay type.
 - f. Each actuator shall include monitor relays to remotely indicate fault signal for indication of power failure, phase failure, thermal switch tripped, torque switch tripped between travel stops and Local-Off-Remote selector switch position.
3. Control/Monitoring:
- a. The following dry contacts shall be provided for monitoring by the PLC/SCADA system
 - 1) Remote Status Indication
 - 2) Fault
 - 3) Full Opened Limit Reached
 - 4) Full Closed Limit Reached
 - b. The following analog (4-20mA) signals shall be provided
 - 1) Valve position feedback (0-100% of position)
 - 2) Valve position control (0-100% position command) for use when the valve is placed in the "Remote" mode.
4. Physical
- a. The operator shall be equipped with open-stop-close push-buttons, a local-off-remote selector switch and indicating lights all mounted on the operator. Where operator will not be situated between 2-ft-0-in and 7-ft-0-in above the operator platform, and where shown on the Drawings provide a separate remote valve operating station.

- b. The motor shall operate on 460 volt, 60 hertz, 3 phase power and shall be sized by the actuator manufacturer to provide the required output torque for the service intended. The motor shall have Class F insulation, with a duty rating of at least 15 minutes at 40 degrees C ambient temperature. The motor shall be specifically designed and built by the actuator manufacturer for electric actuator service. Commercially available motors shall not be acceptable. The actuator shall include a device to ensure that the motor runs with the correct rotation for the required direction of valve travel regardless of the connection sequence of the power supply.
 - c. Operators utilizing multiple reduction power gearing shall consist of spur, helical, or bevel gearing and worm of hardened alloy steel, and the worm gear shall be alloy bronze. Operators utilizing single-stage reduction shall be single-stage worm gear totally enclosed in a fully lubricated gearcase, with filling and drain plugs. Non-metallic, aluminum, or cast gearing shall not be allowed. The output shaft shall incorporate thrust bearings of the ball or roller type at the base of the actuator.
 - d. An operating wheel shall be provided for manual and/or emergency operation, engaged when the motor is declutched by a lever or similar means, the drive being restored to power automatically by starting the motor. The operating wheel drive must be mechanically independent of the motor drive, and any gearing shall be such as to permit emergency manual operation, using a 40 pound force in a reasonable time. Clockwise operation of the handwheel shall give closing movement of the valve unless otherwise stated.
 - e. Each actuator shall be supplied with a start-up kit including installation instructions, wiring diagrams, and spare cover screws and seals to provide for losses during commissioning.
 - f. Continuous mechanical dial indication of valve and position shall be provided. The mechanical dial position indicator shall be in step with the actuator at all times in both the hand wheel and motor operation. For modulating applications, the mechanical dial position indicator shall include graduations of 0-100 percent scale.
5. Wiring and Terminals
- a. Internal wiring shall be of tropical grade PVC insulated stranded cable of 5 amp minimum rating for control circuits and of appropriate size for the motor 3 phase power. Each wire shall be clearly identified at each end.
 - b. The terminals shall be of the stud type embedded in a terminal block of high tracking-resistance compound. The 3-phase power terminals shall be shrouded from the control terminals by means of an insulating cover.
 - c. The terminal compartment shall be separated from the inner electrical components of the actuator by means of a watertight seal. The terminal compartment of the actuator shall be provided with three threaded cable entries.
 - d. Each actuator shall be provided with a commissioning kit consisting of a wiring diagram and installation and operation manual. A separate wiring diagram shall be provided inside the terminal cover. No special tools, devices or parts shall be required for commissioning.
 - e. Actuators shall have separately sealed motor and control compartments. Operators shall have space heaters in their limit switch, motor, and control compartments.
6. Performance Test
- a. Each actuator shall be shop performance tested, and individual test certificates shall be supplied without additional charge to the Owner. Test certificates shall be submitted prior to shipment of valve actuators. The test equipment shall simulate a typical valve load, and the following parameters shall be recorded:

- 1) No load current
- 2) Current at maximum torque setting
- 3) Stall current
- 4) Torque at maximum torque setting
- 5) Stall torque
- 6) Test voltage and frequency
- 7) Flash test voltage
- 8) Actuator output speed

2.03 SURFACE PREPARATION AND SHOP COATINGS

- A. The exterior surface of various parts of valves, operators, floor-stands and miscellaneous piping shall be thoroughly cleaned of scale, dirt, grease or other foreign matter and thereafter one shop coat of an approved rust-inhibitive primer such as Inertol Primer No. 621 shall be applied in accordance with the instructions of the paint manufacturer or other primer compatible with the finish coat provided.
- B. Unless otherwise noted, interior ferrous surfaces of valves shall be given a shop finish of an asphalt varnish conforming to AWWA C509, (except mounting faces/surfaces) or epoxy conforming to AWWA C550 with a minimum thickness of 6 mils.
- C. Ferrous surfaces obviously not to be painted shall be given a shop coat of grease or other suitable rust-resistant coating. Mounting surfaces shall be especially coated with a rust preventative.
- D. Special care shall be taken to protect uncoated items and plastic items, especially from environmental damage.

2.04 FACTORY INSPECTION AND TESTING

- A. Factory inspection, testing and correction of deficiencies shall be done in accordance with the referenced standards and as noted herein.
- B. See Division 1 for additional requirements. Also refer to PART 1, especially for required submission of test data to the Engineer.

PART 3 EXECUTION

3.01 INSTALLATION - GENERAL

- A. Valve actuators and appurtenances shall be installed per the manufacturer's instructions in the locations shown, true to alignment and rigidly supported. Damage to the above items shall be repaired to the satisfaction of the Engineer before they are installed.
- B. Install brackets, extension rods, guides, the various types of operators and appurtenances as shown on the Drawings, or otherwise required. Before setting these items, check Drawings and figures which have a direct bearing on their location to insure that valves, actuators and appurtenances are properly located during the construction of the work.

- C. Materials shall be carefully inspected for defects in construction and materials. Debris and foreign material shall be cleaned out of openings, etc. Operating mechanisms shall be operated to check their proper functioning and nuts and bolts checked for tightness. Valve operators which do not operate easily, or are otherwise defective, shall be repaired or replaced at no additional cost to the Owner.
- D. Where installation is covered by a referenced standard, installation shall be in accordance with that standard, except as herein modified. Also note additional requirements in other parts of this Section.

3.02 INSPECTION, TESTING AND CORRECTION OF DEFICIENCIES

- A. See also Division 1. Take care not to over pressure valves or appurtenances during pipe testing. If any unit proves to be defective, it shall be replaced or repaired to the satisfaction of the Engineer.
- B. Functional Test: Prior to plant startup, items shall be inspected for proper alignment, quiet operation, proper connection and satisfactory performance. After installation, manual valves shall be opened and closed in the presence of the Engineer to show the valve operates smoothly from full open to full close and without leakage. Valves equipped with electric, pneumatic or hydraulic actuators shall be cycled five times from full open to full closed in the presence of the Engineer without vibration, jamming, leakage, or overheating. Pressure control and pressure relief valves shall be operated in the presence of the Engineer to show they perform their specified function at some time prior to placing the piping system in operation and as agreed during construction coordination meetings

END OF SECTION

SECTION 16010
GENERAL ELECTRICAL REQUIREMENTS

1.01 SECTION INCLUDES

- A. General electrical requirements shall be provided in accordance with the requirements specified under this section, the Specifications and the Contract Drawings.
- B. The Contractor shall provide all labor, materials and equipment required to perform the work as specified in the Specifications and as shown on the Contract Drawings. The work shall also include the following:
 - 1. Inserts and other electrical items which shall be installed embedded in concrete, or built into walls, partitions, ceilings or panels.
 - 2. Keep informed of the construction so the electrical work shall be installed within such time periods as will not delay the work of the other Subcontractors.
 - 3. Notify other Subcontractors in advance of the installation of the work included, so they shall have sufficient time for coordination and installation of interrelated items that are included in their contracts and that must be installed in conjunction with the work included under this Contract.
- C. All existing plants will be maintained in continuous operation during the entire construction period of all contracts. Work under each contract shall be so scheduled and conducted by each Contractor that such work will not impede any process, or cause odor or other nuisance. In performing the work shown and specified, the Contractor shall plan and schedule his work to meet the plant operating requirements.
- D. The Contractor has the option of providing additional temporary facilities that can eliminate a constraint, provided it is done at no additional cost and provided that all requirements of these specifications are fulfilled. No plant personnel will be available to supervise, operate or maintain any temporary facilities. Work not specifically covered in the following paragraphs may, in general, be done at any time during the contract period, subject to the operating requirements outlined hereinafter. All references to days in this section are to consecutive calendar days, except where noted. All references to schedule completion dates shall mean the date noted in the latest revision of the CPM schedule.
- E. It shall be the responsibility of the Contractor to move all equipment, desks, stored materials, etc. from one building to another. All moves shall be scheduled and coordinated with the Engineer.

1.2 RELATED SPECIFICATIONS

- A. Specification 09900 – Painting.
- B. Specification 16036 – Testing

1.3 PAYMENT

- A. Payment for general electrical requirements shall be made as provided for in the Specifications.

1.4 REFERENCES

- A. General electrical requirements shall comply with the latest applicable provisions and recommendations of the following:
 - 1. NFPA 70, National Electrical Code.
 - 2. NEMA, National Electrical Manufacturers Association.
 - 3. UL, Underwriters Laboratories Incorporated.

1.5 SUBMITTALS

- A. Contractor shall submit working drawings, shop drawings and material specifications for the approval of the Engineer in accordance with the requirements of the specifications.
- B. Working Drawings:
 - 1. Point-to-point field wiring diagrams.
 - 2. Qualifications of proposed wiring coordinator who shall prepare the point-to-point field wiring diagrams.
- C. Reports: Demonstration of equipment report shall be submitted.

1.6 QUALITY ASSURANCE

- A. General:
 - 1. All equipment and devices shall be properly connected and interconnected with other equipment and devices so as to render the installations complete for successful operation, regardless of whether all the connections and interconnections are specifically mentioned in the Specifications or shown on the Contract Drawings.
 - 2. Similar products shall be by the same manufacturer for uniformity on the Contract.
 - 3. Electrical material and equipment shall be new and shall bear the label of UL, or other Engineer Approved nationally recognized, independent testing laboratory, wherever standards have been established and label service regularly applies.
 - 4. Where execution of the work under this Contract requires certain systems and equipment to be modified, the Contractor shall perform the work with due regard to maintenance of operations and construction staging in accordance with the Specifications.
 - 5. The modification work shall be coordinated in advance with the plant superintendent and existing conditions. Contractor shall field determine and make such investigations as required to determine the functionality of each circuit and identify circuit terminations as required for the modifications intended to ensure the proper interface of all components for a complete functional system.
 - 6. The Contractor shall retain the services of a wiring coordinator, to prepare the point-to-point field wiring diagrams. The wiring coordinator shall have experience in the development of the diagrams of the type specified and shall have served in a similar role on a project of similar size and complexity.

B. Area Classifications:

1. Materials and equipment for all indoor areas shall conform to the area classifications shown on the Contract Drawings or stated in the Specifications.
2. Materials and equipment for all outdoor areas shall conform to corrosive requirements, unless shown otherwise on the Contract Drawings or stated in the Specifications.
3. The locations and requirements shall be in accordance with the following:
 - a. Materials, equipment and incidentals installed in corrosive areas shall meet NEC and NEMA requirements for corrosive locations. Enclosures installed in corrosive locations shall meet NEMA 4X requirements. For this Contract NEMA 4X areas include but are not limited to the Headworks Building, the Sludge Thickening Building, the below grade tunnels, and all exterior locations.
 - b. Materials, equipment and incidentals installed in hazardous locations, shall meet NEC requirements for the Class and Division designated. Enclosures installed in hazardous locations shall be provided with stainless steel hardware and watertight gasketing. For this Contract, hazardous areas include but are not limited to the influent wet well area within the Headworks Building.
 - c. Materials, equipment and incidentals installed in non-corrosive and non-hazardous areas shall meet NEC and NEMA 12 requirements. For this Contract NEMA 12 areas include but are not limited to the Control Building.

1.7 GENERAL CONSTRAINTS

- A. General: Under Paragraph 1.09, Sequence of Construction and Operation, herein, the sequence for units which are to be taken out of service for renovation and remedial work is outlined for each area. The operational status of completed or existing units other than the designated units shall not be interrupted by the Contractor. New units may only be used after the specified testing and acceptance of the units.
- B. Accidental Shutdown: In the event of accidental shutdown of plant equipment the Contractor shall notify plant personnel immediately to allow for an orderly restart of affected equipment.
- C. Personnel Access: Treatment plant personnel must have access to all areas which remain in operation throughout the construction period. The construction work must be phased, and access for plant workers must be maintained during construction.
- D. Power, Light and Communication Systems: Electric power, lighting service and communications systems shall be maintained in uninterrupted operation in all areas which remain in operation. Individual units may be disconnected as required for replacement.
- E. Sump Pumps and Sumps: All existing pumps shall be maintained in an operable condition with either existing pumps or temporary pumps. Interim piping, power and controls shall be provided as required by the staged construction sequence.
- F. Service Interruptions:
 1. When a construction task requires a suspension of normal operations of a plant utility system for a period of less than twenty-four (24) continuous hours, the suspension shall be considered a service interruption.

2. The contractor shall compile an inventory of the labor and materials required to perform the tasks, an estimate of the time required and a written description of the steps required to complete the task resulting in a service interruption. The inventory, time estimate and written procedure shall be submitted to the Engineer for review thirty (30) days prior to the start date of the task as defined in the CPM schedule. If the proposed procedure submitted by the Contractor is acceptable, the Engineer shall authorize in writing, the service interruption pending the verification of materials and labor and the final notification specified therein.
3. No service interruption shall be initiated until the list of materials and labor is verified by the Engineer as on site at least one week prior to the proposed start date. After verification of the list of materials and labor, the Contractor shall notify the Engineer of the exact date that he wishes to perform the work in writing two (2) normal working days, excluding Saturdays, Sundays and holidays, prior to the proposed date.
4. When the normal operations of a plant utility system unit are suspended longer than twenty-four (24) hours, then the procedures for a shutdown, specified hereinafter, shall be enforced.

1.8 PRIOR, CURRENT AND FUTURE CONSTRUCTION CONTRACTS

- A. Refer to Specification 01010 – Summary Work

1.9 SEQUENCE OF CONSTRUCTION AND OPERATION

- A. In order to maintain continuous plant operation during construction, a phased removal, construction and operational sequence will be required as described herein. The order in which the principal structures or work areas are presented herein is for convenience of presentation and is not intended as a sequence of work or a listing of priorities.
- B. Refer to Specification 01310 – Maintenance of Plant Operations.

1.10 TEMPORARY FACILITIES

- A. Temporary facilities shall be provided in accordance with the requirements of Paragraph 1.9, Sequence of Construction and Operation.
- B. Temporary facilities shall be any equipment, materials, controls, services and accessories temporarily needed for access to and for protection of all existing structures and equipment, and to maintain an operating system, all in accordance with the provisions of these Specifications.
- C. The size or capacity of the temporary facility shall generally be equal to the size or capacity of the facility replaced, unless otherwise directed by the Engineer.

1.11 INTERIM AND TEMPORARY MATERIAL AND EQUIPMENT

- A. The Contractor shall furnish, install and remove the interim material and equipment in accordance with the Contract Documents.
- B. The Contractor is responsible for the removal from the site of all interim material and equipment and disposal thereof in accordance with the Specifications.

- C. Temporary material and equipment is material and equipment which must be furnished by the Contractor based on his method of construction for maintaining a treatment process for a specific period, or the utility or service systems during the installation or connection of new equipment or material.

1.12 ADDITIONAL PROVISIONS

A. Shutdowns:

1. Before commencing work on any of the existing equipment which requires a shutdown or suspension of normal operations, the Contractor shall request permission from the Engineer, in writing, at least thirty (30) days in advance of the date he proposes to commence such work. A date in a CPM schedule shall not constitute proper notification. In the request, the Contractor shall explain what construction procedures shall be used during the shutdown.
2. The Contractor is prohibited from shutting down any treatment units or equipment before obtaining written authorization from the Engineer to proceed with such operations; such authorization shall, however, not be construed as a waiver of the requirements for the uninterrupted operation of the plant. A final notification in writing shall be submitted by the Contractor two (2) normal working days excluding Saturdays, Sundays and holidays, in advance of the actual shutdown.

- B. Protection of Underground and Covered Facilities: The location and extent of these facilities are not guaranteed, and the Contractor is cautioned to proceed with care, in the construction of new work in order to prevent damage to any existing structures, piping, or facilities. Protection and support for all underground facilities shall be provided to insure that the service provided for all existing facilities will not be interrupted. Any rerouting of the existing facilities to facilitate construction operation shall be only with written permission of the Engineer and then in the manner and at the time approved by the Engineer. The rerouting shall be made at no additional cost. Contractor shall pay for all damage to existing underground facilities that he causes and compensate the County for any service interruption caused by such damages.

C. Special Protection of Machinery and Equipment:

1. The Contractor shall take all protective measures to the satisfaction of the Engineer necessary to insure that inclement weather or dust and debris from demolition does not enter any of the mechanical or electrical equipment enclosures. Enclosures shall be provided where necessary to prevent contamination of the air. All protective measures shall be furnished, installed, lighted, ventilated, maintained and removed at the Contractor's own cost. The Contractor shall pay for all damage to machinery and equipment caused by his failure to adequately protect it.
2. Interior dustproof covers shall be a heavy reinforced polyethylene film curtain, minimum thickness 6 mils, supported by wood framing. All seams and penetrations shall be sealed with duct tape on two sides. Junctions with existing walls, floors and ceilings shall be made with a double fold secured with a backing strip anchored to the existing wall, floor and ceiling.
3. Exterior weather tight enclosures shall be provided whenever a section of a roof or exterior wall on an existing building is removed or equipment is installed in a new building.

- D. Site Visits: The Contractor, before submitting his proposal, shall visit the sites and shall be responsible for having ascertained local conditions, such as location, accessibility and general character of the sites, the character and extent of any existing work within or adjacent to the sites, and any other work being performed on the sites at the time of submitting his proposal. The Contractor shall fully examine all the drawings relating to the work and shall become completely informed as to the extent and character of the work required and prevailing existing condition. No allowances will be made for the Contractor's failure to avail himself of such information.
- E. Existing Cables and Conduits
1. When working with existing equipment or wiring systems, care shall be taken to avoid damage, and shutdown of process equipment. Prior to working in an area, Contractor shall examine existing conditions and file an inspection report with the Engineer. Any additional defects which result from the Contractor's work, will result in the Contractor being held liable for damage to existing equipment.
 2. Where new construction involves connecting to or using existing equipment, the Contractor shall include in his bid price, all cost, work and materials required to adapt, extend or rework the prevailing existing "As Is" condition, to the new work. Should an existing condition prove to be grossly deteriorated or inadequate for modification, such condition shall be reported to the Engineer for a remedy.
 3. Where existing empty conduits are to be used for new wiring systems, they shall be assumed to be in poor condition requiring prior "make ready" work before using. A wire brush reamer shall be pulled through prior to wiring and, if necessary, water accumulations shall be pumped or blown out.
 4. Contractor shall trace and tag all wires before these are relocated and reconnected from the equipment. Contractor shall coordinate removal of wires with the Field Engineer.
 5. The Contractor's attention is directed to the requirement that he shall work on an existing Sewage Plant which shall remain in operation.
 6. As indicated on the plans, certain equipment and/or wiring systems are being taken out of active service permanently and the Contractor shall perform all work required to remove or safely abandon existing systems.
 7. The following describes the intended work scope for removals:
 - a. The Contractor shall arrange for the safe de-energization of all electrical equipment.
 - b. Feeder and branch wiring, conduits and boxes routed exposed shall be removed in their entirety by the Contractor.
 - c. Feeder and branch wiring and conduits in earth, concrete slabs or masonry shall be abandoned in place, except that wiring ends shall be cut off (or removed) at the conduit mouth by the Contractor. When feeder and branch wiring and conduits interfere with the installation of any new project work they shall be removed in their entirety by the Contractor. Conduits which exit floor slabs, and walls, shall be cut or hammered down, flush with floor level or wall and filled with epoxy concrete by the Contractor.
 8. Generally all equipment, boxes, fixtures, etc. shall be removed from the site and disposed of at Contractor's expense, or delivered to an on-site storage area when the Engineer directs.
 9. The Contractor shall be responsible for all damage to existing structures, equipment, and facilities caused by his construction operations and must repair all such damage when and as ordered at no additional cost.

- F. Emergency Repair Crews: In case the Contractor's operations disrupt the process at any of the, at any time, he shall at his own cost immediately make all repairs or replacements and do all work necessary to restore the plant to operation to the satisfaction of the Engineer. Such work shall progress continuously to completion on a 24-hour day, seven work-day week basis. The Contractor shall provide the services of emergency repair crews, available on call 24 hours per day.

PART 2 - PRODUCTS

2.1 POINT-TO-POINT FIELD WIRING DIAGRAMS

- A. The Contractor shall provide point-to-point field wiring diagrams for all equipment, including equipment provided by other Contractors. Refer to Specification 13300 – Instrumentation and Controls – General Provisions for detailed requirements.

2.2 SHOP FINISHES

- A. Electrical equipment shall be shop painted.
- B. Exposed ferrous metal surfaces except aluminum, bronze, brass and stainless steel components shall be cleaned with a commercial blast and primed with one coat of rust inhibitive primer.
- C. Manufactured assemblies such as switchgear, substations, motor control centers, panelboards and motor controllers shall be shop painted.
- D. Other equipment shall be painted with the manufacturer's best grade finish paint system compatible with the finish coatings specified.

PART 3 - EXECUTION

3.1 MAINTENANCE OF OPERATIONS

- A. Where execution of the work under this Contract requires certain equipment to be taken out of service, the Contractor shall perform the work with due regard to maintenance of operations and construction staging in accordance with Paragraph 1.09 of this specification.
- B. The Contractor shall schedule the work in advance with the Engineer so as not to affect proper plant operations. When the work is scheduled, the Engineer shall be notified 48 hours prior to proceeding with the work to allow time for the plant superintendent to perform load switching and alternation of equipment.
- C. To the maximum extent possible at the end of the workday, all equipment shall be back in place and ready for its normal service use should a plant emergency arise. In addition, should an emergency condition occur during execution of the work, at the request of the plant engineer, the equipment shall be placed back in service immediately and turned over to plant personnel.
- D. In the event of accidental shutdown of plant equipment the Contractor shall notify plant personnel immediately to allow for an orderly restart of affected equipment.

3.2 DEMONSTRATION OF EQUIPMENT

- A. The Contractor shall demonstrate, in the presence of the Engineer that all electrical systems and electrically operated equipment operates as specified, designed and as required.
- B. The demonstration of equipment shall include the following:
 - 1. All power circuits shall be operated to verify proper connection to equipment.
 - 2. All pushbuttons, indicating lights and similar devices shall be operated to verify proper connection and function. All devices, such as pressure and flow switches and similar devices shall be operated to verify that shut-downs and control sequences operate as required.
 - 3. The Contractor, with coordination of the other Subcontractors, shall operate the systems to verify wiring and adjust the controls, as required, to achieve proper operation. This shall include wiring, timing and switching functions.
 - 4. All instrumentation systems shall be operated to verify that wiring and data transmission is correct.

3.03 RESTORATION

- A. The Contractor shall field paint after installation marred or scratched surfaces. All scratches, abrasions and other damage to equipment shall be touch-up painted.

+ + END OF SECTION +

SECTION 16035 DEMOLITION ELECTRICAL

1.1 SECTION INCLUDES

- A. Requirements for providing demolition work. This section also includes equipment relocation. The demolition and relocation work shall be performed in accordance with the requirements specified under this Section, the Specifications and the Contract Drawings.
- B. The Contractor shall remove and dispose of all electrical equipment and items as a result of the demolition Work. Where demolished equipment is so identified, it shall become the property of the County and disposal shall not occur.
- C. The Contractor shall also relocate electrical equipment. The extent of the demolition and relocation work is shown on the Contract Drawings.

1.2 PAYMENT

- A. Payment for demolition work shall be made as provided for in the Specifications.

1.3 REFERENCES

- A. Demolition work shall comply with the latest applicable provisions and recommendations of the following:
 - 1. NFPA 70, National Electrical Code.
 - 2. Local Codes and Ordinances

1.4 SUBMITTALS

- A. Contractor shall submit working drawings, shop drawings and material specifications for the approval of the Engineer.
- B. Working Drawings:
 - 1. Techniques and details proposed to accomplish the demolition work.

1.5 QUALITY ASSURANCE

- A. All demolition and removal work shall be in accordance with the Nassau County Building Code and NFPA 70 National Electrical Code.
- B. In performance of the demolition work, the Contractor shall provide protection of adjacent plant areas, existing equipment and on-going construction. No electrical equipment shall be disposed off-site without the written approval of the County and Engineer.

- C. The Contractor shall execute the work in a careful and safe manner with the least possible disturbance to the public and to the operation of the facility. All work shall be performed with due regard to sequence of construction and operations and construction staging in accordance with the Specifications.
- D. Demolition and removal work shall be executed with care and performed by competent experienced workmen for the various types of demolition and removal work. All patching, replacing and refinishing of work shall be done by skilled workmen. The work shall be carried out through to completion with due regard to the safety of County employees, workmen on site and the public.
- E. The Contractor shall make such investigations, explorations and probes as are necessary to ascertain any required protective measures before proceeding with demolition and removal. The Contractor shall give particular attention to shoring, bracing and shielding requirements so as to prevent any damage to new or existing construction. The Contractor shall be responsible for any damage which may be caused by demolition and removal work to any part or parts of existing structures or equipment designated for reuse or to remain.
- F. All demolished equipment becomes the property of the Contractor, except where identified by the County. All equipment marked by the County to remain shall be carefully removed by the Contractor, so as not to be damaged, cleaned and stored on or adjacent to the site in a protected place or loaded onto trucks provided by the County.
- G. The Contractor shall coordinate with other Prime Contractors to disconnect or remove sources of power to equipment being removed or relocated under other Contracts.

1.6 SITE CONDITIONS

- A. The County assumes no responsibility for the actual condition of structures to be demolished and removed. Conditions existing at the time of inspection for bidding purposes shall be noted by the Contractor and shall be used by him in preparing his bid.
- B. The Contractor shall perform the work with due regard that certain equipment, tanks, and piping contain gases which are potentially hazardous and may be toxic, contain insufficient oxygen for human survival and are combustible in the presence of oxygen. All work regarding hazardous materials shall be performed in accordance with the Specifications.
- C. The Contractor shall perform the work with due regard that in some areas only certain systems and equipment shall be demolished while other systems and equipment shall remain operational. Contractor shall field determine and make such investigations as required to determine the source and function of each circuit, to allow for the disconnection and removal each circuit not required as result of the demolition and to retain all active circuits for areas unaffected by the demolition work.

1.7 SCHEDULING

- A. The Contractor shall proceed with the demolition and removal of equipment in a sequence designed to maintain the existing facility in operation. The Contractor shall notify the Engineer 48 hours before proceeding and meet with plant personnel to review removals and demolition work. Work shall begin only after approval of the County and Engineer.
- B. Any equipment and appurtenances removed without proper authorization, which are necessary for the operation of the existing facility, shall be replaced to the satisfaction of the Engineer at no cost to the County.
- C. The Contractor shall familiarize himself with the work of all contracts and coordinate and schedule demolition activities with the other Prime Contractors for proper sequencing of the work and the removal of equipment.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 PREPARATION

- A. The Contractor shall provide protection and restoration of structures in accordance with the Specifications. Catch platforms, lights, barriers, weather protection, warning signs and other items shall be provided as required for proper protection of the public, occupants of the building, workmen engaged in demolition operations, and adjacent construction.
- B. The Contractor shall provide weather protection at exterior openings so as to fully protect the interior premises against damage from the elements until such openings are closed by new construction.
- C. The Contractor shall provide temporary protection of the existing structure designated to remain where demolition, removal and new work is being done, connections made, materials handled or equipment moved.
- D. The Contractor shall provide dustproof partitions to prevent dust from rising by wetting demolished masonry, concrete, plaster and similar debris. Unaltered portions of the existing equipment affected by the demolition shall be protected. Such enclosures will be required in areas of major demolition work and for protection of existing equipment and personnel. Insulating barriers shall also be provided where necessary for protection.
 - 1. Dust proof partitions shall be constructed of wood studs with plywood on both sides. Partitions shall extend from floor to ceiling with a closure plate at the floor and ceiling and a dust- tight door in each enclosure complete with hardware, attached and keyed.
 - 2. Insulation barriers shall be provided to cover exposed, energized terminals, wires and busses.
 - 3. Adequate ventilation shall be provided for a safe working environment.

- E. The Contractor shall provide adequate fire protection during demolition in accordance with Local Fire Department requirements.
- F. The Contractor shall not close or obstruct roadways, walkways, passageways, or stairways and shall not store or place materials in passageways, stairs or other means of egress. The Contractor shall conduct operations with minimum traffic interference.
- G. The Contractor shall repair any damage to the existing structure or contents by reason of the insufficiency of protection provided.

3.2 REMOVALS

- A. The Contractor shall demolish or relocate electrical equipment as shown on the Contract Drawings.
- B. All wiring shall be removed, salvaged and stored. Direct burial cable shall be abandoned, but disconnected at both ends, insulated and identified. Where cable enters a structure, the cable shall be cut back to the point of entrance.
- C. All exposed conduits shall be removed and disposed. Conduits underground or concealed shall be abandoned. Abandoned conduits shall be cut flush with the slab or wall at the point of entrance and plugged.
- D. Recessed equipment to be demolished shall be abandoned, unless otherwise noted on the Contract Drawings. Demolished recessed panelboards and boxes enclosure fronts and internals shall be completely removed. The enclosure fronts shall be covered with new blank cover plates.
- E. Wherever cable and conduit are to be removed for disposition, the circuit shall be de-energized by the Contractor and adjacent circuits that are to remain in service shall be blanked off and then isolated.
- F. All supports, pedestals and anchors for conduits, lighting fixtures and other equipment shall be removed with the equipment unless otherwise noted on the Contract Drawings. Concrete bases, anchor bolts and other supports shall be removed to approximately one inch below the surrounding finished area and the recesses shall be patched to match the adjacent areas.
- G. The Contractor shall dispose of all demolition equipment, debris and other items, not marked by the County to remain, off the site and in conformance with all applicable codes and regulations.
- H. The Contractor shall perform patching, restoration, finishing and new work in accordance with the Specifications. All openings in structures as a result of the work, shall be patched and exterior openings made watertight. Where alterations occur, or new and old work join, the Contractor shall cut, remove, redrill or refinish the adjacent surfaces to the extent required by the conditions, so to leave the altered work in a condition as existed prior to the start of the work.
- I. Superstructure wall and roof openings shall be closed, and damaged surfaces shall be restored to match the adjacent areas. Wall sleeves and castings shall be plugged or blanked off, all conduit openings in equipment shall be closed.

- J. Where equipment is indicated to be removed, relocated and reused, the equipment shall be operated in the presence of representatives of the Contractor, and the Engineer. Such items shall be removed or relocated with care to prevent unnecessary damage, under the supervision of the trade responsible for reinstallation and protected and stored until required. Material or items damaged during removal shall be replaced with similar new material or items.

3.3 CLEANING AND MAINTENANCE

- A. The Contractor shall maintain the existing electrical power system to operate without interruption. Any interruption of electrical power to the existing facility and equipment shall be with the approval and permission of the County and the Engineer.
- B. The Contractor shall maintain all protection facilities installed in preparation of the demolition work.
- C. The Contractor shall provide on-site dump containers for collection of waste materials, debris and rubbish.
- D. All existing surfaces shall be cleaned of dirt, grease, loose paint before refinishing.
- E. The Contractor shall clean the site and properties of dust, dirt and debris caused by the demolition and removal work in accordance with the Specifications. Waste materials, debris and rubbish shall be disposed of and the areas shall be returned to conditions prior to start of the work.

++ END OF SECTION ++

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SECTION 16036 TESTING

1.1 SECTION INCLUDES

- A. The Contractor shall perform all tests as specified in these specifications, and as required.
- B. Individual testing requirements are detailed in the individual equipment specifications.

1.2 RELATED SPECIFICATIONS

- A. Specification 16292 - Power Distribution System Coordination

1.3 REFERENCES

- A. NETA - International Electrical Testing Association.
- B. IEEE - Institute of Electrical and Electronics Engineers.
- C. ANSI - American National Standards Institute.

1.4 DESIGN REQUIREMENTS

- A. General
 - 1. The Contractor shall furnish all instruments and qualified personnel for all tests.
 - 2. Written notice of all tests shall be given to the Engineer at least two (2) weeks in advance.
 - 3. Unless waived in writing by the Engineer, all tests shall be made in the presence of a duly authorized representative of the Engineer. When the presence of such representative is so waived, sworn statements, in duplicate, of the tests made and the results thereof, shall be furnished to the Engineer by the Contractor.
 - 4. Necessary adjustments and testing shall be made in cooperation with the respective manufacturers and other Contractors when necessary.
 - 5. The Contractor shall make available, the electrical system and personnel when required by other Contractors to test their respective equipment. The Contractor shall coordinate their resources with the other Contractors.
- B. Factory and witness shop testing requirements shall be as detailed in the individual equipment specifications.

C. Field Testing: All electrical equipment furnished, installed or modified under this Contract shall be field tested by this Contractor as detailed in the individual equipment specifications.

D. Schedules and Plant Operations

1. When testing requires that certain pieces of equipment be taken out of service, all testing procedures and schedules must be submitted to the County's engineer for review and approval one month prior to any work beginning. When testing has been scheduled as above, the plant must be notified 48 hours prior to any work to allow time for load switching and/or alternation of equipment. In addition, all testing that requires temporary shutdown of plant equipment must be coordinated with plant personnel so as not to affect proper plant operations.
2. At the end of the workday, all equipment shall be back in place and ready for immediate use should a plant emergency arise. In addition, should an emergency condition occur during testing, at the request of the plant engineer, the equipment shall be placed back in service immediately and turned over to plant personnel.
3. In the event of accidental shutdown of plant equipment the contractor shall notify plant personnel immediately to allow for an orderly restart of affected equipment.

F. Final Field Testing

1. The Contractor shall complete the installation and testing of the electrical installation at least two (2) months prior to the start-up and testing of all other contracts. During the period between the completion of electrical installation and the start-up and testing of all other contracts, the Contractor shall make all components of the Electrical Work available to the other contractors as it is completed for their use in performing Preliminary and Final Field Tests.
2. Before each test commences, the Contractor shall submit a detailed test procedure, and also provide manpower and scheduling for the approval of the Engineer. In addition the Contractor shall furnish detailed test procedures for any of his equipment required as part of the field tests of systems by other contractors.

1.5 SUBMITTALS

- A. Submit the following in accordance with Article GC-14 of the General Conditions and Division 1.
- B. Certificate of Compliance
 1. Qualifications of independent testing firm and technicians.

C. Reports

1. Proposed testing methods and schedules.
2. All field test reports.

1.06 QUALITY ASSURANCE AND QUALIFICATIONS

- A. As detailed above, the independent testing firm shall be a qualified firm employing NETA certified technicians.

+ + END OF SECTION + +

NO TEXT ON THIS PAGE

SECTION 16061 GROUNDING

1.1 SECTION INCLUDES

- A. Requirements for providing grounding. Grounding shall be provided in accordance with the requirements specified under this section, the Specifications and the Contract Drawings.
- B. The grounding work shall be a complete system for the electrical and instrumentation systems, structures and equipment. The work shall include grounding of all electrical equipment, transformer neutrals, equipment enclosures and grounding electrodes.

1.2 RELATED SPECIFICATIONS

- A. Specification 16121 - Electric Wires and Cables
- B. Specification 16131 - Electric Conduit System

1.3 PAYMENT

- A. Payment for grounding shall be made as provided for in the Specifications.

1.4 REFERENCES

- A. GROUNDING SHALL COMPLY WITH THE LATEST APPLICABLE PROVISIONS AND RECOMMENDATIONS OF THE FOLLOWING:
 - 1. NFPA 70, National Electrical Code.
 - 2. PSEG Long Island.
 - 3. UL Standard No. 467, Electrical Grounding and Bonding Equipment.

1.5 SUBMITTALS

- A. Contractor shall submit working drawings, shop drawings and material specifications for the approval of the Engineer in accordance with the requirements of the General Conditions, Article GC-14 – Contractor Submissions; and as specified under Division 1 of the Specifications.

B. Working Drawings:

1. Prior to equipment submission, submit a list of proposed manufacturers with the products they produce proposed for the contract.
2. Manufacturer's catalog cuts for the grounding materials proposed for use.
3. Scaled working drawings showing proposed routing and layout of the grounding system.

C. Field test report shall be submitted.

1.6 QUALITY ASSURANCE

- A. The grounding system maximum resistance shall not exceed 5 ohms under normally dry conditions. All structures and metal equipment containing electrical apparatus shall be connected to ground.

1.7 DELIVERY, STORAGE AND HANDLING

- A. The grounding equipment shall be delivered, stored and handled in accordance with the Specifications and the manufacturer's recommendations.

PART 2 - PRODUCTS

2.1 GROUND CABLE

- A. The ground cable shall be soft drawn bare stranded copper conforming to ASTM B8 and B189. Size shall be as shown on the Contract Drawings.
- B. The insulated cable for equipment grounding shall conform to the requirements of Specification 16121 - Electric Wires and Cables.
- C. Ground cable shall be General Cable Corporation, Okonite Cable Company, Southwire, or equal to be approved by the Engineer.

2.2 GROUND RODS

- A. Ground rods shall be copper-clad steel, 5/8-inch diameter and 10 feet long.
- B. Ground rods shall have a drive point at the lower ends. The upper end of each rod shall be equipped with bronze, clamp type connectors with not less than four bolts.
- C. Ground rods shall be Heary Brothers Lightning Protection Company, Fushi Copperweld, or equal to be approved by the Engineer.

2.3 GROUNDING CONNECTORS

- A. Compression connectors shall be heavy duty copper. Bolted connectors shall be copper alloy castings, designed specifically for the items to be connected, and assembled with Durium or silicone bronze bolts, nuts and washers.
- B. Welded connections shall be by exothermic process utilizing molds, cartridges and hardware designed specifically for the connection to be made.
- C. Bolted or compression grounding connectors shall be Burndy, Thomas and Betts or equal to be approved by the Engineer. Welded grounding connections shall be Cadwell or equal to be approved by the Engineer.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. A complete ground grid system shall be installed as shown on the Contract Drawings.
- B. Ground cable shall be installed around perimeter of structures at a minimum of 2 feet-6-inches below grade.
- C. Ground rods shall be installed 2 feet below grade, 2 feet from foundation walls and shall extend 10 feet vertically into the earth.
- D. Test points shall be installed at locations and in accordance with the details shown on the Contract Drawings.
- E. Equipment shall be connected in accordance with the details shown on the Contract Drawings. All steel column and underground connections shall be welded except for test points.
- F. Metal casings or supporting frames of electrical equipment, such as transformers, panel boards, control panels, unit substations, and individual motor controllers shall be grounded. The equipment shall be thoroughly grounded to the facility grounding system. All metal conduits leaving all electrical equipment shall be grounded. Grounding type fittings shall be installed on flexible conduits.
- G. An insulated cable for equipment grounding shall be installed with the phase conductors within the conduit for the nominal 120 volt and higher power, lighting and control circuits.

3.2 FIELD TESTING

- A. After installation, the completed ground system shall be field tested for operation and conformance. The field tests shall be witnessed by the Engineer and certified by the Contractor. The Contractor shall provide testing consisting of the following:

1. Resistance testing shall be made using a Biddle, Null Balance Earth Tester or Associated Research Vibro-ground, not less than 48 hours after rainfall. Resistance shall be no more than 5 ohms. If resistance is greater than 5 ohms, the Contractor shall continue to drive ground rods in accordance with NEC up to a maximum of three to reduce the resistance to 5 ohms. Resistance values above 5 ohms after three ground rods have been driven in the same area shall be brought to the Engineer's attention.
 2. Grounded cables and metal parts shall be continuity tested. The conduit system shall be ground tested in accordance with the requirements of Specification 16131 - Electric Conduit System.
- B. The Contractor shall provide a Field Test Report, the report shall identify the testing performed and the results obtained.

+ + END OF SECTION + +

SECTION 16071 SUPPORTING DEVICES

1.1 SECTION INCLUDES

- A. Requirements for providing supporting devices. Supporting devices shall be provided in accordance with the requirements specified under this section, the Specifications and the Contract Drawings.
- B. The supporting devices shall be a complete system for the equipment. The work shall include providing all required support devices to properly mount and secure all equipment furnished under.
- C. This section also includes equipment anchorage and restraints suitable to meet the specified seismic requirements.

1.2 RELATED SPECIFICATIONS

- A. Specification 16131 - Electric Conduit System

1.3 PAYMENT

- A. Payment for supporting devices shall be made as provided for in the Specifications.

1.4 REFERENCES

- A. Supporting devices shall comply with the latest applicable provisions and recommendations of the following:
 - 1. ASTM A569, Specification for Steel, Carbon, Hot-Rolled Sheet and Strip Commercial Quality.
 - 2. ASTM A570, Specification for Steel, Sheet and Strip, Carbon, Hot-Rolled, Structural Quality.
 - 3. ASTM B633, Specification for Electrodeposited Coatings of Zinc on Iron and Steel.
 - 4. AISI, Standard for Stainless Steel.
 - 5. MFMA-1, Standard Publication for Metal Framing.

1.5 SUBMITTALS

- A. Contractor shall submit working drawings, shop drawings and material specifications for the approval of the Engineer in accordance with the requirements of the General Conditions, Article GC-14 – Contractor Submissions; and as specified under Division 1 of the Specifications.
- B. Working Drawings:
 - 1. Manufacturer's catalog cuts for the supporting devices proposed for use with specifications and other data required to demonstrate compliance with the specified requirements.
 - 2. Scaled working drawings showing dimensions and locations of all items and clearance requirements.
 - 3. Support design details and equipment seismic anchorage and restraint details, stamped by a licensed Engineer as required.

1.6 QUALITY ASSURANCE

- A. General:
 - 1. All channels, fittings and hardware used in the supporting system shall be in accordance with MFMA-1, Standard Publication.
 - 2. The design of the support system shall be the responsibility of the Contractor. The Contractor shall provide the proper sized rods, channels, fittings, brackets and appurtenances necessary to adequately support the equipment.
 - 3. The Contractor shall retain the services of a Licensed Engineer, registered in the State of New York, to prepare and stamp support details for equipment exceeding 50 pounds in weight.
- B. Seismic Requirements:
 - 1. Equipment assemblies such as secondary unit substations, switchgear, motor control centers and panelboards shall be certified to meet seismic requirements in accordance with the requirements specified in the applicable sections of the Specifications.
 - 2. The Contractor shall provide equipment anchorage details for all equipment certified to meet seismic requirements. The details shall be coordinated with the manufacturer's equipment mounting provisions.
 - 3. Electric conduit shall include seismic restraints in accordance with the requirements of Specification 16131 - Electric Conduit System.
 - 4. The Contractor shall retain the services of a Licensed Engineer, registered in the State of New York, to prepare the seismic anchorage and restraint details. The Engineer shall stamp the seismic anchorage and restraint details.

1.7 DELIVERY, STORAGE AND HANDLING

- A. The supporting devices shall be delivered, stored and handled in accordance with the Specifications and the manufacturer's recommendations.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Supporting devices shall be by B-Line (Eaton), Kindorf (Thomas & Betts/ ABB Group), or equal to be approved by the Engineer.

202 CHANNELS, FITTINGS AND BRACKETS

- A. The Contractor shall provide channels, fittings, brackets and related hardware for mounting and supporting the electrical equipment. Anchor bolts, concrete inserts and related hardware for proper support of equipment shall also be provided. All equipment necessary to meet the seismic requirements specified shall be provided.
- B. Channels shall conform to ASTM A569 or A570. Channels shall have a minimum thickness of 12 gauge. The cross sectional width dimension shall be 1-1/2 inch minimum. The depth shall be as required to satisfy load requirements.
- C. Attachment holes, when required, shall be factory punched on hole centers approximately equal to the cross sectional width and shall be 9/16 inch diameter.
- D. Fittings and brackets shall have 9/16 inch diameter holes on centers identical to the channel or as required to align with the channel holes. Fittings and brackets shall have the same width as the channel and shall be 1/4 inch thick minimum. Fittings and brackets shall mate properly with the channel.
- E. All channels, fittings, brackets and related hardware shall be steel and have an electro-plated zinc finish according to ASTM B633.
- F. In corrosive areas, channels, fittings, brackets and related hardware shall be type 316 stainless steel or PVC coated.

2.3 CONDUIT HANGERS, SUPPORTS AND INSERTS

- A. The Contractor shall provide channels, rods, straps, anchors and related hardware for support of the exposed electric conduit system.
- B. The Contractor shall also provide anchor bolts, concrete inserts and related hardware for proper support of equipment. All equipment necessary to meet the seismic requirements specified shall be provided.
- C. Conduit hangers, supports and inserts shall be in accordance with Specification 16131 - Electric Conduit System.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. All supporting devices shall be installed level, parallel and perpendicular to building walls and floors, such that the support system is installed in a neat and professional manner.
- B. All holes in hung ceilings for support rods and other equipment shall be made adjacent to bars where possible, to facilitate removal of ceiling panels.
- C. The channels, fittings and brackets shall be rigidly bolted together and braced to make a substantial supporting framework support system.
- D. Where motor control centers, switchgear, unit substations and other electrical equipment is being installed on concrete pads, the Contractor shall furnish leveling channels. The Contractor shall install the leveling channel in the concrete pads. Seismic certified equipment shall be anchored in accordance with the seismic anchorage details.
- E. All equipment fastenings to steel columns, beams and trusses shall be by beam clamps. In lieu of beam clamps, equipment may be welded to steel structures, subject to Engineer approval.
- F. No holes shall be drilled in any steel columns, beams and trusses.
- G. Hanger rod supports shall be installed such that threaded rod is parallel and perpendicular to building walls and floors.

+ + END OF SECTION +

SECTION 16076
LABELING AND IDENTIFICATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Requirements for providing labeling and identification. Labeling and identification shall be provided in accordance with the requirements specified under this section, the Specifications and the Contract Drawings.
- B. The labeling and identification shall be provided for the identification of equipment. The work shall include providing all high voltage signs, equipment nameplates, markers and tags for all equipment furnished under this Contract.
- C. The Contractor is advised that the equipment identification shown on the Contract Drawings is temporary and will be finalized during construction.
- D. Temporary identification will be required as to information specified, but only final identification needs to conform to materials and mounting methods specified herein.

1.2 RELATED SPECIFICATIONS

- A. Specification 16121 - Electric Wire and Cable
- B. Specification 16131 - Electric Conduit System

1.3 PAYMENT

- A. Payment for labeling and identification shall be made as provided for in Division 1 of the Specifications.

1.4 REFERENCES

- A. Labeling and identification shall comply with the latest applicable provisions and recommendations of the following:
 - 1. NFPA 70, National Electrical Code.
 - 2. OSHA, Occupational Safety and Health Act.

1.5 SUBMITTALS

- A. Contractor shall submit working drawings, shop drawings and material specifications for the approval of the Engineer in accordance with the requirements of the General Conditions, Article GC-14 – Contractor Submissions; and as specified under Division 1 of the Specifications.

- B. Working Drawings:
 - 1. Prior to equipment submission, submit a list of proposed manufacturers with the products they produce proposed for the contract.
 - 2. Submit signs, nameplates and other labeling and identification devices proposed for use with specifications and other data required to demonstrate compliance with the specified requirements.

1.6 QUALITY ASSURANCE

- A. All labeling and identification signs and nameplates shall be provided in accordance with the NFPA 70 and OSHA.

1.7 DELIVERY, STORAGE AND HANDLING

- A. The labeling and identification devices shall be delivered, stored and handled in accordance with the Specifications and the manufacturer's recommendations.

PART 2 - PRODUCTS

2.1 HIGH VOLTAGE SIGNS

- A. High voltage signs shall be provided for equipment operating over 600 volts.
- B. High voltage signs shall be fiberglass reinforced polyester, rigid acrylic or aluminum plate 1/16-inch thick. Finish shall be industry standard of red, white and black graphics. Signs shall be 10 inches by 14 inches with the following exceptions:
 - 1. Use 7-inch by 10-inch signs where this is the largest size that can be applied.
 - 2. Use 14-inch by 20-inch signs where needed for adequate vision.
- C. High voltage signs shall read; "DANGER - HIGH VOLTAGE KEEP OUT".
- D. High voltage sign mounting screws shall be 3/16 inch diameter, round head, stainless steel, self-tapping type.

2.2 EQUIPMENT NAMEPLATES

- A. Equipment nameplates shall be provided in addition to the manufacturer's nameplate, to identify the equipment number and the item's function and the equipment to which it serves.
- B. Equipment nameplates shall be laminated plastic with black letters on a white background. Nameplates for equipment identification shall have 1/2-inch high letter engravings. Nameplates for pilot device identification shall have 1/4-inch high letter engravings.
- C. Nameplates for distribution equipment shall have the following information:
 - 1. Equipment name and number.
 - 2. Voltage.
 - 3. Phases and number of wires.

- D. Pullboxes, junction boxes and control stations shall have a nameplate identifying the equipment name and number.
- E. All feeders and branch circuit devices shall have nameplates identifying the served equipment name and number. Where execution of the work under this Contract requires certain feeders and branch circuit devices to be modified, the Contractor shall provide new nameplates reflecting the modifications. The nameplates shall identify the served equipment name and number.
- F. All control and indicating devices shall have individual nameplates identifying device function.
- G. Nameplate mounting screws shall be 3/16 inch diameter, round-head, stainless steel self-tapping type. Adhesives shall not be used.

2.3 CONDUIT MARKERS AND TAGS

- A. Conduit markers and tags shall be provided for the identification of the electric conduit system.
- B. Conduit markers and tags shall be in accordance with Specification 16131 - Electric Conduit System.

2.4 CABLE AND WIRE MARKERS

- A. Cable and wire markers shall be provided for the identification of the electric wire and cable.
- B. Cable and wire markers shall be fiberglass based. Teflon coated stainless steel line/wire shall be used to attach the markers to the cables.
- C. Cable and wire markers shall be in accordance with Specification 16121 - Electric Wire and Cable.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. All signs, nameplates and tags shall be installed neatly, properly and as recommended by the manufacturers.
- B. Signs and nameplates shall be mounted with screws. Where mounting of signs or nameplates with screws is impractical, the Contractor shall alert the Engineer.
- C. High voltage signs shall be installed on equipment operating at over 600 volts. High voltage signs shall also be installed on sides of fences or walls which enclose outdoor equipment operating at over 600 volts.
- D. Control, signal and status wire and cable shall be identified by a unique number. The numbering system shall reflect the actual identification used in the work and shall be documented on the point-to-point wiring diagrams.

++ END OF SECTION ++

NO TEXT ON THIS PAGE

SECTION 16121
ELECTRIC WIRES AND CABLES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Requirements for providing electric wires and cables. Electric wires and cables shall be provided in accordance with the requirements specified under this section, the Specifications and the Contract Drawings.
- B. The electric wires and cables to be provided shall include all accessories.
- C. The following index of this Specification is presented for convenience.

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- D. The cables and wires proposed for all instrumentation cables and wires shall be approved by the Contractor before Engineer approval can be given. The Contractor shall submit the approvals from the Contractor along with the cable and wire shop drawings for Engineer approval.

1.2 PAYMENT

- A. Payment for electric wires and cables shall be made as provided for in Division 1 of the Specifications.

1.3 REFERENCES

- A. Electric wires and cables shall comply with the latest applicable provisions and recommendations of the following:
1. NFPA 70, National Electrical Code.
 2. National Electrical Safety Code.
 3. ASTM B5, High Conductivity Tough-Pitch Copper Refinery Shapes.
 4. ASTM B8, Concentric-Lay-Stranded Copper Conductors, Hard, Medium-hard or Soft.
 5. ASTM B33, Tin Coated Conductors.
 6. ASTM D69, Test Methods for Friction Tape
 7. ICEA S-66-524 Cross-linked-thermosetting - polyethylene-insulated Wire and Cable for the Transmission and Distribution of Electrical energy.
 8. ICEA S-68-516, Ethylene-Propylene-Rubber-Insulated Wire and Cable for Transmission and Distribution of Electrical Energy.
 9. UL Standard No. 44, Wires and Cables, Rubber-Insulated.
 10. UL Standard No. 83, Wires and Cables, Thermoplastic-Insulated.
 11. UL Standard 486A - Wire Connectors and Soldering Lugs for Use With Copper Conductors.
 12. UL 1072, Medium Voltage Power Cables.
 13. AEIC CS6-87, Ethylene-Propylene-Rubber-Insulated Shielded Power Cable.
 14. NETA, International Electrical Testing Association.
 15. IEEE 48, Test Procedures and Requirements for High Voltage Alternating-Current Cable Terminations.

1.4 SUBMITTALS

- A. Contractor shall submit working drawings, shop drawings and material specifications for the approval of the Engineer in accordance with the requirements of the General Conditions, Article GC-14 – Contractor Submissions; and as specified under Division 1 of the Specifications.
- B. Working Drawings:
1. Prior to equipment submission, a list of proposed manufacturers shall be submitted with the products they produce proposed for the contract.
 2. Manufacturer's Literature, specifications and engineering data for the electric wires and cables and accessories.
 3. Description of shop and field testing methods, procedures and apparatus with calibration dates shall be submitted. Testing methods and procedures shall be submitted at least 45 days in advance prior to conformation of witness testing dates and actual testing.
 4. Qualifications of proposed testing firm to perform acceptance testing shall be submitted. Submit firm experience records at least 45 days in advance to actual testing, five recent references with phone numbers shall be submitted.
- C. Reports:
1. Shop and field test reports shall be submitted.
 2. Acceptance testing report shall be submitted.
- D. MATERIAL SAFETY DATA SHEETS
1. Material Safety and Data Sheets (MSDS) shall be submitted for all cables and wires supplied. MSDS shall be submitted with the equipment shop drawings.

1.5 QUALITY ASSURANCE

A. General:

1. All cables and wires shall be made by an approved manufacturer, and in their construction shall be employed the most improved commercial materials and processes of manufacture.
2. Only electrical wiring manufactured under high standards of production and meeting the approval of the Engineer shall be used. Friction tape shall be in accordance with ASTM Des. D69.
3. The wire and cable manufacturer shall use a shop test facility that has recently calibrated testing apparatus and qualified, experienced technicians, for all shop tests. Calibration of testing apparatus shall be within one year.
4. All test equipment and instrument calibration shall be in accordance with the latest edition of the accuracy standard of the U.S. National Institute of Standards and Technology and the NETA acceptance testing specification.

B. Field Tests:

1. Electric wires and cables shall be field tested. Field testing for 600 volt and below wires and cables shall be in accordance with the requirements specified under Article 3.4.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Electric wires and cables shall be delivered, stored and handled in accordance with the Specifications and the manufacturer's instructions.

PART 2 - PRODUCTS

2.1 300 VOLT INSULATED CABLE

- A. 300 volt insulated cable shall be used for all instrumentation and communication circuits. The size and quantity of 300 volt insulated cable shall be as indicated in the conduit and cable schedule.
- B. Instrumentation cable shall be in accordance with the following:
1. Conductors shall be stranded, tinned coated copper, No. 16 AWG minimum size. All conductors shall be polyethylene insulated and twisted in pairs with an aluminum-mylar shield overlapped.
 2. The cable shall include an outer jacket. Jacketing shall be neoprene, chlorosulfonated polyethylene (hypalon), chlorinated polyethylene or flame retardant 105 degree C polyvinyl chloride.
 3. Instrumentation cable shall be by Okonite Company, General Cable Corporation, Belden Company or equal to be approved by the Engineer.
- C. Communication and Fire Alarm Cable shall be in accordance with the following:
1. Conductors shall be stranded, tinned coated copper, No. 18 AWG minimum size for fire alarm cable and No. 24 AWG for communication cable. Insulation shall be polyethylene. Where specifically shown on the Contract Drawings or stated in the Specifications, communication system conductors shall be twisted shielded cable.

2. The cable shall include an outer jacket. Jacketing shall be neoprene, chlorosulfonated polyethylene (hypalon), chlorinated polyethylene or flame retardant 105 degree C or polyvinyl chloride.
3. Fire Alarm Cable shall be UL listed, made of Teflon and approved by the East Rockaway Building Department, Material and Equipment Acceptance Division.
4. Communication and Fire Alarm Cable shall be by General Cable Corporation, Belden Company with Beldfoil shielding or equal to be approved by the Engineer.

2.2 600 VOLT INSULATED WIRE AND CABLE

- A. 600 volt insulated wire and cable shall be used for all 600 volt and below power, lighting, control and alarm circuits. The size and quantity of 600 volt insulated wire and cable shall be as indicated in the conduit and cable schedule. The conductor jacket shall be in accordance with color identification requirements specified under Article 3.03.
- B. 600 volt single conductor wire and cable for installation in conduit shall be in accordance with the following:
 1. Conductors shall be stranded, tinned coated copper, single conductor cable conforming to ASTM B8, and B33, No. 12 AWG minimum size.
 2. Insulation shall be flame-retardant EPR (FREP), moisture and heat resistant thermoset rated 90 degrees C in dry locations and 90 degrees C in wet locations and listed by UL as type XHHW-2 or RHW-2.
 3. XHHW-2 shall be used for all indoor circuits and RHW-2 for all underground and outdoor circuits.
 4. 600 volt insulated wire and cable for installation in conduit shall be by Okonite Company, General Cable Corporation, Southwire, or equal to be approved by the Engineer.
- C. When identified on the Contract drawings 600 volt multiple conductor cable shall be used for control and alarm circuits in the quantities indicated. 600 volt multiple conductor control cable for installation in conduit shall be in accordance with the following:
 1. Conductors shall be stranded, tinned coated copper conforming to ASTM B8 and B33, No. 12 AWG minimum size.
 2. Insulation shall be moisture and flame resistant cross-linked polyethylene rated 90 degrees C in wet and dry locations and listed by UL as type XHHW-2.
 3. Cable conductors shall be assembled together with flame and moisture resistant filters and tape to make round.
 4. Cable shall include an overall protective jacket of polyethylene compound, 45 mils minimum thickness.
 5. 600 volt multiple conductor control cable shall be Okonite Company, General Cable Corporation or equal to be approved by the Engineer.
- D. Security system cables shall be 600 Volt insulated. Minimum size conductors for the security system shall be No.22 AWG. Where specifically shown on the Contract Drawings or stated in the Specifications, security system shall use twisted shielded cable or coaxial type cable.

2.3 600 VOLT AND BELOW WIRE AND CABLE ACCESSORIES

- A. Cable connectors shall be provided for terminating 600 volt and lower voltage wire and cable. Connectors for wire and cable up to 600 volt shall be solder less type and properly sized to fit fastening device and wire size. Connectors shall be in accordance with the following:
1. For wire sizes up to and including No. 6 AWG, compression type with UL 486A listing shall be used. All cable terminations for conductors No. 10 AWG and smaller shall be terminated using UL listed ring tongue type, nylon insulated connectors, at each terminal board.
 2. For wire sizes No. 4 AWG and above, either compression type or bolted type with tin-plated contact faces shall be used.
 3. For wire sizes No. 250 kcmil and larger, connectors with at least 2 cable clamping elements or compression indents and provision for at least 2 bolts for joining to apparatus terminal shall be used.
 4. Compression connectors shall be Power-Connect, ring tongue shall be Series 83 as manufactured by Ideal Industries. Connectors shall also be by Thomas and Betts, Burndy or equal approved by the Engineer.
- B. Cable splicing for 600 volt and below wire and cable shall be performed when terminals are not provided. Splicing shall be in accordance with the following:
1. For wire sizes No. 8 AWG and larger, splices shall be made up with compression type copper splice fittings with UL 486A listing. Splices shall be taped and covered with materials recommended by the cable manufacturers, to provide insulation equal to that on the conductors.
 2. For wire sizes No. 10 AWG and smaller, splices shall be made up with pre-insulated spring connectors. Connectors shall be flame retardant with UL listing.
 3. For wet locations, splices shall be submersible rated for underwater use. Underwater splices shall be rated for 10,000 psig. The splices shall be precision precast polyurethane compression dams, waterblock solder pins and an amber polyurethane overmold to prevent all water from entering the cable and keeping seawater outside the cable from passing through the splice to the electrical connection. Underwater splices shall be UL listed. All underwater splices shall be manufactured by PMI Industries or approved equal.
 4. Compression splices shall be by Ideal Industries, Thomas and Betts, Burndy, or equal to be approved by the Engineer. Waterproof compression splices shall be thermo-shrink as manufactured by Ideal Industries. Waterproof compression splices shall also be by Thomas and Betts, Burndy, Buchanan or equal approved by the Engineer.
 5. Spring connector splices shall be Twister type and Twister DB type for waterproof, as manufactured by Ideal Industries. Spring connectors shall also be by Thomas and Betts, Burndy, or equal approved by the Engineer.
- C. Cable markers shall be provided for the identification of 600 volt and below wire and cable. Markers for 600 volt and below wire and cable shall be in accordance with the following:
1. Markers shall be vinyl type, moisture, heat and abrasion resistant with adhesive back. Cable identification shall be clearly marked.
 2. Markers shall be by Ideal Industries, Thomas and Betts or equal to be approved by the Engineer.
- D. Pulling compound shall be provided to facilitate wire pulling. Pulling compound shall be in accordance with the following:

1. Pulling compound shall be waxed based, with a .17 average coefficient of friction and a temperature range of 30 to 190 degrees F. The compound shall be compatible with all cable types.
2. Pulling compound shall be Ideal Industries, Greenlee or equal to be approved by the Engineer.

2.4 SHOP TESTS

A. Certified Shop Tests:

1. Shop testing shall be performed on the wire and cable at the manufacturer's plant prior to shipment. Shop test shall be in accordance with the latest revisions of ICEA and UL and shall demonstrate that the wire and cable tested conforms to the requirements specified.
2. The Contractor shall provide a shop test report. The report shall identify the tests performed and the results obtained.
3. All low voltage wire and cable shall be shop tested in accordance with the requirements of Underwriters' Laboratories.

B. Witnessed Shop Tests:

1. The Contractor shall perform witnessed shop tests in accordance with the Specifications.
2. The Engineer shall have access during working hours for inspection purposes to all parts of the works where material and cable are being manufactured, and all reasonable inspection and testing facilities shall be provided to him without increase in price. The Engineer may request that dielectric strength tests and measurements be made to verify the cable data furnished by the Contractor. For this purpose the Contractor shall furnish without increase in price, a length of cable, not to exceed 3 feet for each size to be cut from one or more reels as directed by the Engineer. Each sample shall be marked with a tag bearing full description of cable insulation and number of reel from which it is cut.

2.5 ARMORED METAL-CLAD CABLE

A. When identified in the cable and conduit schedule, armored metal-clad cable shall be used for all temporary power circuits. The armored metal-clad cable shall be in accordance with the following:

1. Conductors shall be stranded, tinned, copper cable conforming to ASTM B8 and B33, No. 12 AWG minimum wire size.
2. Insulation shall be flame-retardant EPR (FREP), moisture and heat resistant, thermoset, rated 90 degrees C in dry or wet locations and be listed by UL as Type MC-HL, Type XHHW-2 or Type RHW-2.
3. Cable shall be assembled together with flame and moisture resistant fillers and tape.
4. Cable shall include an impervious, continuous, welded, corrugated aluminum sheath, which shall be resistant to gases, moisture, and liquids.
5. Cable shall include a bare stranded copper grounding conductor meeting the requirements of NFPA 70 and UL 1569.
6. XHHW-2 shall be used for all indoor circuits and RHW-2 for all underground circuits.
7. The cable shall be provided with all fittings and hardware necessary for proper installation.
8. The armored metal-clad cable shall be as manufactured by Okonite Company, BICC Cable Company or Rockbestos Cable Company.

2.6 FIBER OPTIC CABLES

- A. Fiber optic cable shall be installed for inter-building and inter-panel communication as shown on drawings. These cables shall meet the following:
 - 1. Cable shall be suitable for installation as both trunk cable and riser cable.
 - 2. Cable shall be rated for indoor/outdoor use.
 - 3. Cable shall be 62.5/125 micrometer (core/clad) multimode fiber optic cable.
 - 4. Cable shall utilize a multi-fiber per tube (MFPT) design consisting of 24 fibers contained in tight buffer tubes.
 - 5. Cable shall utilize a 900 um diameter tight buffer coating on each optical fiber.
 - 6. Cable shall be riser rated distribution cable.
 - 7. Cable shall have a ripcord(s) to assist in jacket removal.
 - 8. Cable shall be suitable for direct termination with standard connectors.
 - 9. Manufacturer:
 - a. Optical Cable Corporation, DX Series
 - b. Belden, Lan Lite Series
 - c. Approved equal
- B. Fiber Optic Patch Cables
 - 1. Patch cables shall be 62.5/125 micrometer (core/clad) multimode fiber optic cable.
 - 2. Patch cables shall be terminated with connectors as scheduled.
 - 3. Manufacturer:
 - a. Optical Cable Corporation
 - b. Siecor
 - c. Approved equal

PART 3 - EXECUTION

3.1 GENERAL

- A. All cables and wires shall be installed within the raceways as shown on the Contract Drawings. They shall be carefully handled so as to avoid twists or kinks in the conductors or damage to the insulation.
- B. The Contractor shall ensure that the manufacturer's recommended cable bending radii and pulling are not exceeded and that the number of conductors permitted in a conduit are in accordance with the latest applicable section of NFPA 70 National Electrical Code.
- C. No splices shall be permitted between terminals except at approved (in writing) junction or terminal boxes. Boxes shall be provided as shown on the Contract Drawings or as required by Code for the pull lengths. No more than two terminations shall be made at each terminal point. Cable and wire runs shall be looped through pull boxes without cutting and splicing where possible. All splices below grade, in manholes, hand holes and wet locations shall be water proofed.
- D. No splicing of instrument wiring shall be permitted. Instrument wiring shall be extended by use of field termination boxes employing labeled terminal strips. Shield continuity shall be maintained. Ultimate shield termination (ground) shall be at one end only.

3.2 INSTALLATION OF WIRING

- A. Cables shall be installed complete with proper terminations at both ends. For each motor circuit, Contractor shall ensure proper phase sequence and motor rotation.
- B. Wire and cable contained within a single conduit shall be pulled simultaneously using insulating pulling compounds containing no mineral oil.
- C. Cables shall be installed with maximum slack at all terminal points, boxes, handholes and manholes.

3.3 CONDUCTOR IDENTIFICATION

- A. Each wire shall be labeled at each termination points and all splice locations. Carry individual conductor or circuit identification throughout, with circuit numbers or other identification stamped on terminal boards when provided or the cable so it is visible around the cable's circumference.
- B. Each wire shall be identified in junction boxes, cabinets, and terminal boxes. Where no termination is made, use a plastic-coated, self-adhesive, wire marker. Where termination is made, use a plastic, pre-printed sleeve wire marker. Paper, self-adhesive wire markers shall not be used.
- C. In manholes and handholes, each power wire shall be identified by a laminated plastic tag located so that it can be seen from center of manhole without moving adjoining wires. Bundle and mark control wires as listed in conduit and cable schedule.
- D. Multi-conductor control cables shall be color coded in accordance with ICEA S-61-402, Method 1, Table K.
- E. The following identification scheme shall be used for all 600 volt and below power circuits:

System Voltage	Neutral	Phase A	Phase B	Phase C	Ground
208/120V	White	Black	Red	Light Blue	Green
240/120V	White-Gray Strip	Black-Blue Strip	Red-Blue Strip	None	Green
480/277V	Gray	Brown	Orange	Yellow	Green

3.4 600 VOLT AND BELOW WIRE AND CABLE FIELD TESTING

- A. After installation, all 600 volt and below wire and cable shall be field tested. The field tests shall be performed by the Contractor who shall furnish all testing equipment. The field tests shall be witnessed by the Engineer and certified by the Contractor. The Contractor shall provide a report identifying the tests performed and the results obtained.

- B. Each electrical circuit shall be tested after permanent cables are in place to demonstrate that the circuit and equipment are connected properly and will perform satisfactorily and that they are free from improper grounds and short circuits. The tests shall consist of the following:
1. 600 volt wire and cable mechanical connections shall be individually tested after installation and before they are put in service with a calibrated torque wrench. Values shall be in accordance with manufacturer's recommendations.
 2. 600 volt and below wire and cables shall be individually tested for insulation resistance between phase and from each phase to ground. Test cables after they are installed and before they are put in service with a Megger for one minute at a voltage rating recommended by the cable manufacturer or in accordance with NEMA and ICEA standards.
 3. The insulation resistance for any given conductor shall not be less than the value recommended by the cable manufacturer or in accordance with NEMA and ICEA standards. Any cable not meeting the recommended value or which fails when tested under full load conditions shall be replaced with a new cable for the full length.
 4. Shielded instrumentation cable shields shall be tested with an ohmmeter for continuity along the full length of the cable and for shield continuity to ground.
 5. Shielded instrumentation cables shall be connected to a calibrated 4-20 milliamp DC signal transmitter and receiver. Test at 4, 12, and 20 milliamp transmitter settings.

+ + END OF SECTION + +

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SECTION 16131 ELECTRIC CONDUIT SYSTEM

1.1 SECTION INCLUDES

- A. Requirements for providing conduit system. The conduit system shall be provided in accordance with the requirements specified under this section, the Specifications and the Contract Drawings.
- B. The conduit system required shall be provided with all rigid and flexible conduits, boxes, fittings, supports, hangers and inserts and other conduit accessories as required for the installation of the electric wire and cable.
- C. The following index of this Specification is presented for convenience.

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- D. The conduit system proposed for all circuits shall be approved by the General Contractor before Engineer approval can be given. The Contractor shall submit the approvals from the General Contractor along with the conduit layout submittals for Engineer approval.

- E. All PVC coated conduit installed shall be the same uniform gray color. No other color variations will be accepted. All RGS conduit shall be painted to match the same uniform gray color of the PVC coated conduit delivered to the site.
- F. Every conduit shall be tagged to define its system served: power, process/mechanical, instrumentation, telephone, fire alarm, communications and lighting.
- G. Where conduit enters and exits pull boxes, junction boxes, terminal boxes, etc. the labels for conduit tags shall be placed on the interior of the box on the conduit bushings.

1.2 RELATED SPECIFICATIONS

- A. Specification 09900 - Painting.
- B. Specification 16071 – Supporting Devices.

1.3 PAYMENT

- A. Payment for Electric Conduit System shall be made as provided in Division 1 of the Specifications.

1.4 REFERENCES

- A. Electric conduit system shall comply with the latest applicable provisions and recommendations of the following:
 - 1. NFPA 70, National Electrical Code.
 - 2. IEEE 142, Recommended Practice for Grounding of Industrial and Commercial Power Systems.
 - 3. UL Standard No. 6, Rigid Metal Electrical Conduit.
 - 4. UL Standard No. 50, Electrical Cabinets and Boxes.
 - 5. UL Standard No. 360, Liquid-Tight Flexible Steel Conduit.
 - 6. UL Standard No. 514A, Metallic Outlet Boxes.
 - 7. UL Standard No. 514B, Fittings for Conduit and Outlet Boxes.
 - 8. UL Standard No. 886, Electrical Outlet Boxes and Fittings for Use in Hazardous Locations.
 - 9. ANSI C80.1, Specification for Zinc Coated Rigid Steel Conduit.
 - 10. ANSI C80.4, Specification for Fittings for Rigid Metal Conduit and Electrical Metallic Tubing.
 - 11. NEMA Standard No. RN-1, PVC Externally Coated Galvanized Rigid Steel Conduit.

1.5 SUBMITTALS

- A. Contractor shall submit working drawings, shop drawings and material specifications for the approval of the Engineer.
- B. Working Drawings:
 - 1. Prior to equipment submission, submit a list of proposed manufacturers with the products they produce proposed for the contract.
 - 2. Manufacturer's catalog cuts for the conduit, boxes, fittings and supports proposed for use.
 - 3. Construction details of conduit racks and other conduit support systems with seismic restraint details and calculations signed by a licensed Engineer.

4. Scaled working drawings showing proposed routing of all conduits, inclusive of conduits embedded in structural concrete and conduits directly buried in earth. Drawings shall show locations of pull and junction boxes and all penetrations in walls and floor slabs.

C. Field test report shall be submitted.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Electric conduit system shall be delivered, stored and handled in accordance with the Specifications, the manufacturer's instructions and the following:
 1. Conduit shall be delivered to the work in standard bundles having each length suitably marked with the manufacturer's name or trademark and bearing the label of the Underwriters' Laboratories, Incorporated, inspection service.

PART 2 - PRODUCTS

2.1 PVC COATED RIGID STEEL CONDUIT

- A. The Contractor shall provide PVC coated rigid steel conduit in the locations listed below, unless otherwise noted on drawings, with the exception of where flexible metallic conduit is required to permit movement of connected devices. All steel conduit shall comply with the requirements of ANSI C80.1, and the Underwriters' Laboratories, Incorporated, Standard for No. 6.
 - a. Cedar Creek:
 - i. All interior and exterior locations.
 - b. Glen Cove:
 - i. All interior locations south of the control building, beginning at the intersection of the underground tunnel (tunnel from the control building to the headworks building) and the south wall of the basement of the control room.
 - ii. All exterior locations.
- B. Both the inside and outside surfaces of the rigid steel conduit shall be protected against corrosion by a coating of zinc applied by the hot-dip galvanizing process.
- C. Conduits, elbows and couplings shall be rigid, heavy wall, mild steel, hot dip galvanized. Conduits, elbows and couplings shall have a smooth interior with tapered threads and carefully reamed ends. Conduit size shall be 3/4-inch minimum and shall conform to UL-6.
- D. Conduits, elbows and couplings shall include a PVC coating for all areas.
- E. PVC coated conduit shall be factory applied and shall include a smooth 2 mil thick urethane interior coating and 40 mil thick polyvinyl chloride exterior coating. The exterior PVC coating color shall be gray. The threads of conduits that have been cut to size shall have the same PVC coating applied in the field. PVC coated conduit shall conform to NEMA Standard RN-1.

2.2 RIGID STEEL CONDUIT

- A. The Contractor shall provide rigid steel conduit in the locations listed below, unless noted otherwise on drawings. All steel conduit shall comply with the requirements of ANSI C80.1, and the Underwriters' Laboratories, Incorporated, Standard for No. 6.

- a. Cedar Creek:
 - i. Rigid Steel Conduit will not be acceptable. All interior and exterior conduit shall be PVC Coated Rigid Steel Conduit.
- b. Glen Cove:
 - i. All interior locations north of the intersection of the underground tunnel (tunnel from the control building to the headworks building) and the south wall of the basement of the control building, including areas within the control building.
- B. Both the inside and outside surfaces of the rigid steel conduit shall be protected against corrosion by a coating of zinc applied by the hot-dip galvanizing process.
- C. Conduits, elbows and couplings shall be rigid, heavy wall, mild steel, hot dip galvanized. Conduits, elbows and couplings shall have a smooth interior with tapered threads and carefully reamed ends. Conduit size shall be 3/4-inch minimum and shall conform to UL-6.
- D. Rigid steel conduit shall be by Allied Tube and Conduit Corporation, Wheatland Tube Company or approved equal.

2.3 HANGERS, SUPPORTS AND INSERTS

- A. The Contractor shall provide hangers, supports and inserts for support of the electric conduit system. The supports shall securely attach the electric conduit system to the channel and structure.
- B. The electric conduit system shall be designed, constructed and installed suitable for earthquake regulations in accordance with the seismic requirements of the Nassau County Building Code and the Uniform Building Code for Zone 2A application.
- C. Transverse and longitudinal bracing shall be provided as required to brace the electric conduit for the seismic requirements specified.
- D. All drilled in type concrete inserts shall be expansion shields or anchors conforming to 16071 – Supporting Devices. In corrosive locations, concrete inserts shall be 316 stainless steel.
- E. Hangers and supports shall be in accordance with the requirements of Specification 16071 – Supporting Devices except beam clamps, hanger rods and hardware shall be steel with electro-plated zinc finish. This shall also include bolts, nuts and washers. In corrosive locations, hangers and support hardware shall be type 316 stainless steel or factory applied 40 mil thick PVC coated.
- F. Hangers, Supports and Inserts shall be by B-Line, Kindorf or equal to be approved by the Engineer.

2.4 FLEXIBLE METALLIC CONDUIT

- A. The Contractor shall provide flexible metallic conduit only where required to permit movement of connected devices and where it is impracticable to complete runs with rigid conduit.
- B. Liquid-tight flexible metallic conduit shall be used for all indoor non-hazardous areas.

- C. Liquid-tight flexible metallic conduit shall be used for all outdoor non-hazardous areas.
- D. For hazardous areas flexible conduit shall include a brass inner core with a bronze outer braid and protective neoprene plastic coating. End fittings shall be steel, brass or bronze.
- E. Flexible conduit shall be by Anaconda American Brass Company, Electric-Flex Company or approved equal. Hazardous area flexible conduit shall be by Crouse Hinds Company, Appleton Electric Company or equal to be approved by the Engineer.

2.5 OUTLET BOXES AND FITTINGS

- A. The Contractor shall provide outlet boxes and fittings for rigid and flexible conduit. The outlet boxes and fittings required for the work which constitutes a part of the conduit system, shall be of approved types.
- B. For outdoor, wet and corrosive areas, conduit fittings and outlet bodies shall be cast gray iron alloy, cast malleable iron bodies and covers. All units shall be gasketed, watertight, and threaded with five full threads and shall have rust-proofing in accordance with the requirements of Article 2.06. Fittings and bodies installed on PVC coated conduits shall also include interior and exterior coatings equivalent to the conduit.
- E. Threaded cast ferrous metal, hub type outlet boxes shall be used throughout. Cast iron or alloy outlet boxes of the proper size and depths for the application, complete with watertight gaskets and covers secured by brass screws, shall be furnished and installed as indicated on the Contract Drawings or as required by the conduit run. Outlet boxes, furnished and installed for the installation of lighting fixtures, switches and receptacles in a future contract, shall be furnished with watertight gaskets and blank covers.
- D. For non-hazardous, indoor dry dusty areas pressed steel boxes of the proper size and depths for the application shall be provided. Boxes shall be rated NEMA 12, not less than No. 14 U.S. Standard Gauge (0.078 inch). The conduit openings shall be provided with oil-resistant gaskets. Conduits shall be fastened to these boxes with locknuts and bushings, and all unused outlets or holes shall be left sealed.
- E. All outlet boxes intended for fixtures shall be provided with approved fixture studs.
- F. For concealed conduit runs in outside walls and all exposed conduit work, connections to boxes and fittings shall be made through threaded holes, unless otherwise approved by the Engineer. For concealed conduit work in non-hazardous areas in other than outside walls, connections between conduit and boxes may be made with drilled holes, using locknuts and bushings. Where necessary unions may be used. Unions in hazardous locations shall be Crouse Hinds type UNF, UNL, UNY conduit fittings or equal to be approved by the Engineer. Unions in non-hazardous areas shall be Universal or Erickson conduit couplings or equal to be approved by the Engineer.
- G. All boxes installed for concealed conduit, shall be provided with extension rings or plaster rings and covers as required. For non-hazardous, dry indoor areas stainless 302/304, satin beveled steel cover and device plates for surface mounted boxes shall be used. For corrosive locations, galvanized ferrous and galvanized cast ferrous metal cover and device plates with neoprene gaskets shall be used.

- H. Outlet boxes and fittings installed on PVC coated conduit shall also include interior and exterior coatings equivalent to the conduit.
- I. For receptacle, switch, fixture, and other device outlet boxes recessed in walls, or exposed within hung ceiling spaces, in non-hazardous, indoor, dry areas above grade, standard galvanized pressed steel outlet boxes with partially pre-punched conduit connection cutouts, of the proper size and depth for the application, shall be provided. Conduits shall be fastened to these boxes with locknuts and bushings. Similar pressed steel boxes with blank covers may be used for junction and pull boxes in conduit runs where pressed steel device boxes are permitted.

2.6 CONDUIT ACCESSORIES

- A. The Contractor shall provide conduit accessories for use with the conduit system. The conduit accessories shall be of approved types.
- B. Expansion and Deflection Fittings:
 - 1. Expansion and deflection fittings shall be made up of non-corrodible parts and shall provide for ample longitudinal and lateral movement. A suitable bond shall provide a low resistance, continuous longitudinal path for ground currents.
 - 2. Expansion and deflection fittings shall be watertight cast iron, malleable iron or hot dipped galvanized. Fittings shall be corrosion-resistant, UL listed and compatible with the conduit system.
 - 3. Expansion /deflection fittings shall provide both expansion and deflection in a single fitting in accordance with the following:
 - a. Axial expansion or contraction up to 3/4-inch.
 - b. Angular misalignment up to 30 degrees.
 - c. Parallel misalignment up to 3/4-inch.
 - 4. Expansion fittings shall provide expansion /contraction with eight inch total movement.
 - 5. Expansion and deflection fittings shall be by Crouse Hinds, Appleton Electric or equal to be approved by the Engineer.
- C. Sealing Fittings:
 - 1. Sealing fittings shall be cast gray iron alloy or cast malleable iron or copper free aluminum with zinc electroplate and lacquer or enamel finish.
 - 2. Sealing fittings shall have an ample opening with threaded closure for access to conduit hub for making dam. Sealing fiber and compound shall be suitable for use with the fitting and shall be the products of the fitting manufacturer.
 - 3. For where PVC conduit is installed, seal fittings shall include interior and exterior coatings equivalent to the PVC conduit coating specified under Article 2.1.
 - 4. Sealing fittings shall be by Crouse Hinds, Appleton Electric or equal to be approved by the Engineer.
- D. Drain Fittings:
 - 1. Drain fittings shall be a combination device designed to provide ventilation to minimize condensation and drains accumulated condensate.
 - 2. The combination drain/breather fitting shall be 3/8 inch male thread size with stainless steel body.
 - 3. Drain fittings shall be by Crouse Hinds, Appleton Electric or equal to be approved by the Engineer.

- E. Conduit Hubs:
 - 1. Conduit hubs shall be threaded, insulated throat type with bonding screw locknut.
 - 2. The conduit hub and locknut shall be malleable iron or zinc and shall include a 90 degree C insulating surface and a sealing ring for a water tight and dust tight connection.
 - 3. Conduit hubs shall be by O-Z Gedney, Thomas and Betts or equal to be approved by Engineer.
- F. Conduit Bushings:
 - 1. Conduit bushings shall be insulated, grounding type with lay-in-lug connection. Two locknuts shall be provided for each bushing.
 - 2. The conduit bushing and locknuts shall be steel, malleable iron or zinc. The bushing shall include a 90 degree C insulating surface.
 - 3. Conduit bushings and locknuts shall be by O-Z Gedney, Thomas and Betts or equal to be approved by the Engineer.
- G. Duct Seal:
 - 1. Duct seal shall be a soft, fibrous non-hardening sealing compound for sealing between cables and conduits.
 - 2. Duct seal shall be by O-Z Gedney, Ideal Industries or equal to be approved by the Engineer.
- H. Thruwall Seals and Bushings:
 - 1. Thruwall seals and bushings shall be in accordance with the following:
 - a. For conduits passing through exterior block walls or installed in existing construction passing through exterior subsurface walls, exterior concrete walls, floor slabs and roof slabs for use in core bit-drilled holes sealing bushings shall be used. Sealing bushings shall be Type CSMI at the inside of the structure and Type CSMC at the outside of the structure, within the same core drilled hole. Sealing bushings shall be manufactured by O-Z/Gedney or equal to be approved by the Engineer.
 - b. For conduits passing through existing interior concrete walls or floors and interior block walls sealing bushings shall also be used. Sealing bushings shall be CSMC or CSMI type as manufactured by O-Z/Gedney or equal to be approved by the Engineer.
 - c. For conduits passing through fire rated floors and walls fire stop fittings shall be used. Fire stop fittings shall be CFS and/or CFSI type as manufactured by O-Z/ Gedney or equal to be approved by the Engineer.
 - d. For multiple conduit runs passing through interior or exterior and fire rated walls thru-wall barriers shall be used. Thru-wall barriers shall be TW series by Crouse-Hinds or equal to be approved by the Engineer.
- I. Conduit Tags:
 - 1. Conduit tags shall be Setmark snap around conduit markers which shall be secured to the conduit with annealed brass wire.
 - 2. Conduit tags shall be by Seton Nameplate Corporation or equal to be approved by the Engineer.
- J. Conduit Markers:
 - 1. Conduit identification markers shall be self-sticking color-coded tape. Identification tape shall be two inches wide and colored in accordance with the color banding specified under this section.
 - 2. Conduit markers shall be by Thomas and Betts or equal to be approved by the Engineer.

2.7 TERMINAL, JUNCTION AND PULL BOXES

- A. The Contractor shall provide terminal, junction and pull boxes as shown on the Contract Drawings and where otherwise required, or as directed by the Engineer.
- B. Boxes in all areas shall be minimum NEMA Type 4X. Boxes shall be constructed of 316 stainless steel material with sealed seams.
- C. For hazardous locations boxes shall be explosion proof NEMA Type 7. Boxes shall be constructed of cast iron and shall include threaded connections and ground joint surfaces.
- D. Pull and junction boxes shall be provided with covers held in place by brass screws. Terminal boxes shall be provided with terminal block supports and approved hinged covers fitted tightly against a gasket and secured by lug bolts and wing nuts. Hinges, lug bolts, wing nuts and other fittings shall be made of an approved, non-ferrous, non-corrodible metal. All boxes shall be provided with rabbeted gaskets or flange gaskets securely held in place.
- E. Tapping for threaded connections to outlet boxes, junction boxes, pull boxes and conduit fittings in non-explosion proof construction shall conform to the following:
 - 1. All threads shall be tapered.
 - 2. If threads for connection of conduit are tapped all the way through a hole in an enclosure, or if an equivalent construction is employed, there shall be not less than 3-1/2 threads in the metal and the construction of the enclosure shall be such that a suitable conduit bushing can be properly attached.
 - 3. If threads for connections of conduit are not all the way through a hole in a boxwall, conduit hub or the like, there shall be not less than five full threads in the metal and there shall be a smooth, well rounded inlet hole for the conductors, which shall afford protection to the conductors equivalent to that provided by a standard conduit bushing and which shall have an internal diameter approximately the same as that of the corresponding trade size of rigid conduit. The threaded hole shall be provided with a conduit end stop.
 - 4. Tapping for threaded connections for explosion proof construction shall conform to the requirements of the National Electrical Code for construction in Class I, Division 1, hazardous locations.
- F. Cast iron or cast ferrous alloy outlet boxes, junction boxes, pull boxes, conduit fittings and conduit accessories such as box covers shall be rust-proofed by zinc coating applied by the "hot-dip" process or shall be given a rust protective coating applied by either of the following methods:
 - 1. Method A:
 - a. Castings shall be given a mechanical and chemical cleaning.
 - b. Castings shall be given a phosphoric acid type dip.
 - c. Then a coating of zinc chromate primer shall be applied, and finally
 - d. A coating of baked enamel finish shall be applied over the outside and inside surfaces of the castings.
 - 2. Method B:
 - a. Castings shall be given a mechanical and chemical cleaning.
 - b. Then a coating of cadmium shall be deposited electrolytic ally.
 - c. Then a coating of zinc shall be applied by electroplating.
 - d. Then a vinyl resin base aluminum lacquer shall be applied.

- G. Stamped steel outlet boxes, junction boxes and box covers shall be rust-proofed by a zinc coating applied by an electro-galvanizing or sherardizing process. Fabricated sheet steel boxes shall be formed from galvanized sheet steel. Welded joints shall be touched up with aluminum lacquer and boxes and covers shall be given a shop priming coat of zinc chromate rust inhibiting paint.
- H. Terminal blocks shall be used within terminal boxes for termination of prepared conductors No. 10 AWG and smaller. Terminal blocks shall be in accordance with the following:
 - 1. Terminal blocks shall be high density, screw terminal type suitable for rail mounting with quantities sufficient for the conductors to be terminated plus 20 percent spare.
 - 2. Terminal blocks shall be NEMA rated, 600 volt, 35 ampere suitable for 85 degrees C.
 - 3. Terminal block components shall have stainless steel and tin plated copper alloy components, backed out captive screws and marking surface.
 - 4. Terminal blocks shall be Allen-Bradley Company, General Electric Company or equal to be approved by the Engineer.

PART 3 - EXECUTION

3.1 GENERAL

- A. All conduits shall be installed in accordance with the requirements specified under this section and in conformity with the sizes stated in the Specifications or shown on the Contract Drawings. They shall be installed complete with all accessories, fittings and boxes, in an approved and workmanlike manner so as to provide proper raceways for electrical conductors.
- B. The Contractor's attention is called to the fact that all conduit runs indicated on the Contract Drawings are shown diagrammatically for the purpose of outlining the general method of routing the conduits to avoid interference. Where conduit runs are not shown, it shall be the responsibility of the Contractor to establish the runs required based upon the various systems shown on the Contract Drawings.
- C. Should any structural difficulties prevent the setting of cabinets, boxes, conduits, etc., at points shown on the plans, deviations therefrom as determined by the Engineer will be permitted and shall be made without additional cost.
- D. All exposed steel conduits, fittings, boxes, straps, racks and hangers shall be painted in conformity with Specifications 09900 - Painting. PVC coated conduit systems shall not be painted. Paint shall match the gray color of the PVC coated conduits.
- E. Conduits shall be tagged using conduit tags. Conduit tags shall be installed where conduits terminate in equipment and enclosures.
- F. Exposed conduits shall be color banded using conduit markers. Markers shall also include operating voltage when over 600 volts. Conduit markers shall be installed 360 degrees, double wrap around conduit exterior. Conduit markers shall be installed where conduits enter equipment, boxes, within each room, at wall penetrations and 50 feet on centers in each area. When exposed conduits are to be painted, markers shall be installed after the conduits are painted. Color banding shall be in accordance with the following:
 - 1. 120/208 volt AC: Gray.
 - 2. 277/480 volt or 480 volt AC: Sand.
 - 3. 2400 volt or 4160 volt AC: Silver.

4. 13800 volt AC: Brown.
5. Fire Detection and Alarm: Red.
6. Telephone: Blue.
7. Intercommunication: Yellow.
8. Security System: Rust.
9. Low Voltage Switching, Instrumentation and Controls System: Black.

3.2 INSTALLATION OF RACEWAYS

- A. The Contractor shall install all exposed raceways parallel or at right angles to walls and ceiling beams. Changes in directions shall be made with bends, elbows and pull boxes. All parallel runs shall be spaced uniformly throughout and secured in place with hangers and fasteners. Brace raceways to satisfy the specified seismic requirements in accordance with the restraint details.
- B. Conduits, where exposed, shall in all cases be substantially supported in an approved manner, but they shall not be fastened to or come in contact with any other pipes, ducts or other work of a similar nature. In all exposed work, approved channel or angle iron hangers, racks, one-hole straps or a combination thereof shall be provided to support the conduits. Where conduits are supported with one-hole straps, spacers shall be used to provide 1/4-inch minimum clearance between the conduits and walls or ceilings.
- C. Hanger rods for trapeze type hangers shall not be less than 5/8 inch diameter. Conduit supports shall be located at intervals not exceeding 8 feet. Conduits shall be securely fastened to each support with U-bolts, straps or clamps. All hanger types (trapeze and others) shall be furnished and installed in accordance with Specification 16071 – Supporting Devices. All items that are hung and supported shall be submitted as a separate shop drawing complete with licensed structural engineer P.E. seal.
- D. All concealed conduits shall be placed in walls, floors, ceilings or slabs at the proper time in accordance with the progress of the structural work. The Contractor shall cooperate in every respect in meeting schedules and shall not delay the structural work unnecessarily.
- E. Conduits embedded in concrete shall be blocked and braced in place by use of adequate conduit separators to prevent displacement during the pouring of concrete. The Contractor will be held responsible for proper position of conduits and shall rearrange any conduit that may be displaced while concrete is poured, without additional cost.
- F. Where conduit runs are to be concealed and the Contractor fails to place such conduit in sufficient time to be included in the structures and the structures are completed without such conduit, the Contractor shall install such runs either concealed or exposed as directed by the Engineer, with no extra payment for additional work or for more conduit than the original lengths.
- G. Embedded conduit shall be run in structural concrete in the center of slabs and walls and above waterstops. Conduit connections shall be made watertight. Contractor shall confirm that concrete thickness is sufficient for embedding the quantity of conduits intended. Unless specifically shown otherwise on the Contract Drawings or stated in the Specifications, embedded conduits shall be in accordance with the following criteria:
 1. Minimum concrete thickness shall be as follows:
 - a. For concrete 16 inches thick and less, the minimum concrete thickness shall be 11.5 inches plus the depth of the largest conduit assembly. The conduit assembly depth shall be from the top of the uppermost conduit to the bottom of the lowest conduit.

- b. For concrete greater than 16 inches thick, the minimum concrete thickness shall be 13.5 inches plus the depth of the largest conduit assembly.
 - c. For concrete at foundation slabs, an additional inch shall be added to the minimum concrete thicknesses previously stated.
 - 2. Conduit spacing shall be as follows:
 - a. Conduits shall be separated three times outer diameter of larger conduit center to center.
 - b. For multiple conduit layer assemblies, conduits shall be separated vertically three times outer diameter of larger conduit center to center.
 - c. When conduits cross at a given point, the conduits may be in direct contact and the angle of cross shall be 45 degrees or greater. Conduits may also cross within the vertical spacing of a multi-conduit layer assembly.
 - d. When conduits cross a structural expansion joint, conduits shall be separated three times outer diameter of larger conduit fitting center to center.
- H. A run of conduit between outlet and outlet, between fitting and fitting or between outlet and fitting shall not contain more than the equivalent of three quarter bends, including those bends located immediately at the outlet or fitting. The equivalent number of 90° bends in a single conduit run are limited to the following:

1. Runs in excess of 300 feet	0
2. Runs of 300 feet to 201 feet	1
3. Runs of 200 feet to 101 feet	2
4. Runs of 100 feet and less	3
- Factory bent elbows or field bent elbows with approved tools may be used. Heating of conduit to facilitate bending is prohibited.
- I. Factory-made conduit bends or elbows shall be used wherever possible in making necessary changes in direction. Field bends shall be carefully made so as to prevent conduit damage or reduction in the internal areas. The radius shall not be less than six times the nominal diameters for the conduit with carefully matched bends on parallel runs so as to present a neat appearance.
- J. All conduits, where cut, shall be carefully reamed to remove burrs. No running threads will be permitted. All screw joints shall be watertight. Conduits shall be fitted in an approved manner to all devices and boxes. The ends of all conduits shall be equipped with suitable approved conduit fittings. The ends of all empty conduits shall stub up six inches above the slab and shall be capped.
- K. All conduits shall be carefully cleaned before and after installation and all inside surfaces shall be free from all imperfections likely to injure the cable. Conduits shall be cleaned in accordance with the following:
 - 1. After erection of complete conduit runs, conduits shall be snaked with a suitable swap to which shall be attached an approved tube cleaner equipped with an approved cylindrical mandrel of a diameter not less than 85 percent of the nominal diameter of the conduit.
 - 2. All conduits through which the mandrel will not pass shall be removed and replaced by the Contractor at his own expense. After snaking, the ends of the dead-ended conduits shall be protected with standard malleable iron caps to prevent the entrance of water or other foreign matter.
 - 3. Conduit ends shall be protected after cleaning with caps to prevent entrance of water, concrete, debris or other foreign substance.

- L. As far as practicable, conduits shall be pitched to drain to outlet boxes or otherwise so installed as to avoid trapping moisture. Trapped conduits in concealed construction shall be provided with outlet boxes for drainage. Where necessary drainage in outlet boxes or where dips are unavoidable in exposed conduits, a drain fitting shall be installed at the low point.
- M. Thruwall type seals and conduit sealing bushings shall be installed for all conduits passing through concrete slabs, floors, walls or block walls.
- N. Conduit runs shall be installed so as to avoid flues, heat sources, steam or hot water pipes. A minimum separation of 12 inches shall be maintained where conduit crosses or parallels hot water, steam pipes or heat sources.
- O. Where conduit enter or leave equipment located within electrical and control rooms the conduit shall be sealed and packed with duct seal compound.
- P. A 250 pound tested polyethylene pull tape shall be provided in all empty conduits, with a minimum 8 inch of slack, double backed into the conduit. Conduit shall be protected immediately after installation by installing flat non-corrosive metallic discs and steel bushings designed for this purpose at each end. Discs shall not be removed until it is necessary to clean the conduit.
- Q. All conduit that is cut on the job shall be cut square and taper reamed to remove burrs before installation. Where steel conduit is cut and threaded on the site, it shall be coated before and after making connections.
- R. Conduits embedded in concrete shall stub up 6 inches above the slab. A three inch high curb extending three inches from the outer surface of the conduit penetrating the floor shall be provided to prevent corrosion. Conduit stub-ups shall be terminated in couplings, slightly above the finished concrete curb.

3.3 CONDUIT CONNECTIONS TO EQUIPMENT

- A. At each motor, limit switch, solenoid valve, electrical control device or other electrically controlled or operated equipment, the Contractor shall install a complete conduit connection between the conduit system and the terminal box of the motor or the conduit connection point of the equipment.
- B. Conduits installed in the conduit system shall be terminated in such locations as to permit direct connections to motors, devices or equipment.
- C. Connections shall be made with rigid conduit if equipment is fixed and not subject to adjustment, mechanical movement or vibration. Rigid connections shall be provided with union fittings to permit removal of equipment without cutting, breaking or burning conduit.
- D. Motors, transformers and equipment subject to adjustment, mechanical movement or vibration shall be connected with flexible metallic conduit.
- E. Devices such as solenoid valves, small limit switches, etc., shall be connected with flexible metallic conduit arranged to prevent strain and distortion.

- F. Flexible conduit connections shall be watertight unless the area of installation requires explosion-proof construction.

3.4 INSTALLATION OF BOXES AND FITTINGS

- A. All concealed outlet boxes shall be set in such a manner that they will be plumb and flush with the finished surface.
- B. Boxes shall be installed rigidly and securely to the structure. Independent supports shall be provided where no walls or other structural surface exists.
- C. Expansion and expansion/deflection fittings shall be installed where conduits cross structural expansion joints and at locations shown on the Contract Drawings. Fittings shall be installed on each conduit and incorporated into the expansion joints of structures, at right angles to the joint, to insure their proper functioning and preservation.
- D. Expansion fittings shall be installed on exposed conduit runs exceeding 200 feet. Unless specifically shown otherwise on the Contract Drawings or stated in the Specifications, when crossing structural expansion joints larger than one inch, an expansion fitting shall also be installed together with an expansion/deflection fitting. The fittings shall be installed on each conduit run in accordance with manufacturer's recommendations to provide the additional movement necessary.
- E. All conduit connections shall be made watertight and shall terminate at enclosures with approved conduit hubs.
- F. At pull and junction boxes having any box dimension in excess of 18 inches, jumper type grounding bushings shall be installed on conduit ends and jumper wires shall be installed to bond all conduits and to bond conduits to boxes.
- G. All insulated grounding bushings shall be bonded together and to the structure of the enclosure by a continuous, copper bonding wire.
- H. Removable, flame-retardant, insulating cable supports shall be provided in all boxes with any dimension exceeding 3 feet.
- I. Scratched PVC boxes damaged as a result of installation shall be touched up by field applying PVC. All touch up work shall be in strict conformance with manufacturer's recommendations.

3.5 INSTALLATION WITHIN HAZARDOUS AREAS

- A. Explosion-proof boxes and fittings shall be of a type approved by the Engineer. Boxes and fittings shall be of cast iron with finish as specified hereinbefore or of an aluminum alloy specially developed for use in hazardous areas.
- B. Explosion-proof boxes shall be suitable for the installation of explosion-proof switches, receptacles, lighting fixtures or other devices as indicated. All conduit connections to such boxes shall be made with threaded fittings. Bushings and locknut connections shall not be used.

- C. Conduits terminating at explosion-proof boxes, enclosing circuit opening equipment, shall be sealed at the entrance to the box with an approved compound-filled sealing fitting to prevent passage of explosive or combustible gases through the conduit. Where construction prevents the use of sealing fittings, the ends of the conduits shall be properly sealed with sealing compound.
- D. Sealing fittings shall be installed to seal each conduit leading from or entering into hazardous locations. Exposed conduits passing through hazardous locations shall be sealed at point of exit and entrance.
- F. The installation of explosion-proof boxes, fittings and all conduits in connection therewith shall conform to the requirements of the National Electrical Code for Class I, Division 1 Group D hazardous location unless specifically noted otherwise.

3.6 FIELD TESTS

- A. After installation, the electric conduit system shall be field tested. The field tests shall be witnessed by the Engineer and certified by the Contractor. The Contractor shall provide testing consisting of the following:
 - 1. Each conduit shall be tested by pulling through a cylindrical mandrel as specified under paragraph 3.2 K. Maintain a record of all conduits testing clear.
 - 2. Conduit systems shall be ground tested in the presence of the Engineer, who will inspect all enclosures, pull and junction boxes for bonding to the safety green conductor pulled with the nominal 120 volt and higher power and control circuits, and for bonding of the conduit grounding bushing to this safety ground.
 - 3. The separation of above safety grounding system from the instrumentation signal grounding shall be verified.
- B. The Contractor shall provide a Field Test Report. The Report shall identify the testing performed and the results obtained.

+ + END OF SECTION + +

SECTION 16441
PANELBOARDS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Requirements for providing panelboards. Panelboards shall be provided in accordance with the requirements specified under this section, the Specifications and the Contract Drawings.
- B. The panelboards shall include all power distribution, lighting, appliance and instrument panels.

1.2 RELATED SPECIFICATIONS

- A. Specification 16076 - Labeling and Identification

1.3 PAYMENT

- A. Payment for panelboards shall be made as provided for in the Specifications.

1.4 REFERENCES

- A. Panelboards shall comply with the latest applicable provisions and recommendations of the following:
 - 1. NFPA 70, National Electrical Code.
 - 2. UL Standard No. 50, Enclosures for Electrical Equipment.
 - 3. UL Standard No. 67, Panelboards.
 - 4. UL Standard No. 489, Molded Case Circuit Breakers.
 - 5. UL Standard No. 943, Ground Fault Circuit Interrupters.
 - 6. NEMA PB1, Panelboards.
 - 7. NEMA AB1, Molded Case Circuit Breakers.

1.5 SUBMITTALS

- A. Contractor shall submit working drawings, shop drawings and material specifications for the approval of the Engineer in accordance with the requirements of the General Conditions, Article GC-14 – Contractor Submissions; and as specified under Division 1 of the Specifications.
- B. Working Drawings:
 - 1. Manufacturer's technical information for the panelboards proposed for use including all components.
 - 2. A listing of the panelboards with the number and size of circuit breakers and/or fuses identified.
 - 3. Dimensional drawings showing panelboard enclosure details.
 - 4. Panelboard anchorage details with design calculations signed by licensed Engineer.
- C. Certificates of Compliance: Seismic qualification certification from the manufacturer including mounting recommendations.
- D. Reports: Shop test reports shall be submitted.

- E. Operations and Maintenance Manuals shall be submitted in accordance with the Specifications.

1.6 QUALITY ASSURANCE

A. General:

1. All panelboards shall conform to the applicable NEMA and UL Standards and shall be built by one approved manufacturer who shall use only best commercial materials and processes of manufacture.
2. All panelboards shall be UL listed.
3. The panelboards manufacturer shall use a shop test facility that has recently calibrated testing apparatus and qualified, experienced technicians, for all shop tests. Calibration of testing apparatus shall be within one year.
4. All test equipment and instrument calibration shall be in accordance with the latest edition of the accuracy standard of the U.S. National Institute of Standards and Technology.

- B. The panelboards shall be designed, constructed and installed suitable for earthquake regulations in accordance with the seismic requirements of the Nassau County Building Code and the Uniform Building Code for zone 2A application.

1.7 DELIVERY, STORAGE AND HANDLING

- A. Panelboards shall be delivered, stored and handled in accordance with the Specifications and the manufacturer's recommendations.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Fusible Panelboards shall be Eaton's Bussmann series Quik-Spec™ Coordination Panelboards type QSCP, or equal.

2.2 PANELBOARD RATINGS

- A. Panelboards shall be labeled with a short-circuit current rating equal to or greater than that indicated on the associated schedules or drawings.
- B. Non-service entrance rated panelboards shall be UL and cULus Listed. Service entrance rated panelboards shall be UL Listed.
- C. Panelboards shall be rated \geq system voltages up to 600Vac/125Vdc and have a current rating as indicated on the associated schedules or drawings.
- D. Panelboard overcurrent protective device interrupting ratings shall be fully rated for the maximum available fault current and have a UL Listed interrupting rating of 300kA and CSA Certified interrupting rating of 200kA.

- E. Current ratings, configuration of poles and number of circuits shall be indicated on associated schedules or drawings.

2.3 CONSTRUCTION

- A. Panelboard circuits 100A and less shall incorporate overcurrent protection and branch-circuit rated disconnecting means into a single integrated component.
- B. Interiors shall be factory assembled.
- C. Panelboard shall be equipped with a six-space spare fuse compartment for storing replacement branch circuit fuses. Spare fuse compartment shall be located behind locking panel door. Provide 20% spare fuses, minimum of 12 spare fuses.
- D. Bus bars shall be tin-plated copper with sufficient cross sectional area to meet UL 67 temperature rise requirements.
- E. 200A/400A rated neutrals shall be standard, 400A or 800A rated neutral shall be provided where indicated in the associated schedules or drawings.
- F. Bonded neutral shall be provided where specified in associated drawings.
- G. Isolated or non-isolated equipment ground bar shall be provided as indicated in the associated schedules or drawings.
- H. Where a service-entrance rated panelboard is indicated in associated schedules or drawings, a bonded neutral and non-isolated equipment ground bar shall be provided by the manufacturer.
- I. Main lug conductor terminations:
 - 1. MLO terminations shall be rated for 60/75°C, Cu-Al
 - 2. Main disconnect terminations shall be rated for 75°C, Cu Only
- J. NEMA 1 panelboards shall be field convertible for top or bottom incoming feed. NEMA 3R panelboards are bottom feed only.

2.4 MAIN DISCONNECT

- A. Permanently installed lockout means shall be provided on the main disconnect for lockout tagout procedures.
- B. Main disconnect shall be quick-make, quick-break type.

2.5 BRANCH FUSED DISCONNECTS

- A. Device shall have visible circuit ON/OFF indication with colored and international symbol markings.

- B. Device shall provide open fuse indication via permanently installed indicating light.
- C. Device shall be UL and cUL Listed 600Vac/200kA or 125Vdc/100kA voltage/short-circuit current rating, load-break disconnect with amp ratings and number of poles as indicated on the panelboard schedule.
- D. Fuse and disconnect assembly shall be a finger-safe component with trim installed.
- E. Fuse and disconnect shall be mechanically interlocked so as not to allow fuse removal while fuse terminals are energized.
- F. No special tools shall be required for fuse removal.
- G. Devices shall have bolt-on style bus connectors.
- H. Device housing shall be clearly marked with device amperage.
- I. Permanently installed lockout means shall be provided on the device for lockout tagout procedures. Permanently installed means for locking device in the ON position shall also be available.
- J. Device shall provide fuse amp rating rejection at the following ampacities to ensure continued circuit protection at the specified circuit rating: 15A, 20A, 30A, 40A, 50A, 60A, 70A, 90A & 100A.

2.6 MAIN & BRANCH OVERCURRENT PROTECTION

- A. All overcurrent protective devices shall have a minimum UL Listed interrupting rating of 300kA and CSA Certified interrupting rating of 200kA.
- B. Branch circuit overcurrent protection shall be 600Vac UL Listed minimum 300kA IR and CSA Certified minimum 200kA IR finger-safe fuse with Class CF (equivalent to Class J) performance characteristics.
- C. Main overcurrent protective devices shall be 600Vac UL Listed minimum 300kA IR and CSA Certified minimum 200kA IR Class J fuses or Class CF (equivalent to Class J) performance fuses.
- D. Where panelboard main fuses are installed, fuses in panelboard branch circuits shall selectively coordinate with main fuses for all over-currents up to 200kA.

2.7 ENCLOSURE

- A. NEMA 1 enclosures shall be surface or flush mount as indicated in associated schedules or drawings. NEMA 3R enclosures shall be surface mount only.
- B. Boxes shall be a nominal 20 inches wide and 5-¾ inches deep (NEMA 1) or 6.3" (NEMA 3R) with wire bending space per the National Electrical Code®.

- C. Panelboard trim shall be supplied with lockable door covering all disconnect handles.
- D. Panelboard trim shall be dead-front construction covering all energized parts.
- E. Enclosures shall be NEMA Type 1 or Type 3R as indicated in associated schedules or drawings.
- F. Door-in-door type trim shall be provided for NEMA 1 enclosures where it is specified in the associated schedules or drawings.
- G. Front trim shall be lockable. All lock assemblies shall be keyed alike with like NEMA rated enclosures.

2.8 PAINTING

- A. All metal surfaces of the panelboard enclosures shall be thoroughly cleaned and given one coat of zinc chromate primer. All interior surfaces shall then be given one shop finishing coat of a nitro-cellulose enamel lacquer.
- B. All exterior surfaces shall be given three coats of the same lacquer. The color of finishing coats shall be light gray ANSI No. 61.

2.9 SHOP TESTS

- A. Shop tests shall be performed at the panelboard's manufacturer's plant prior to shipment. Shop tests shall demonstrate that the equipment tested conforms to the requirements specified.
- B. Each panelboard shall be given a 60 Hertz, AC, Hi-Pot test, phase to phase and phase to ground, at twice rated voltage plus 1000 volts for one minute, 1500 volts minimum.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Panelboard shall be mounted rigidly and securely to the building structure or to supporting devices which are rigidly and securely supported to the building structure. Anchor panelboards to satisfy seismic requirements in accordance with the anchorage details.
- B. Panelboards shall be fastened with bolts and expansion shields on concrete or brick, with toggle bolts on hollow masonry units, and with machine screws or welded studs on metal.
- C. Mount all panelboards parallel or perpendicular to walls, such that panelboards are installed in a neat and professional manner.
- D. All wiring shall be neat within the panelboards. Wires shall be run vertically in the wire gutter and then terminate horizontally at a breaker.
- E. The Contractor shall install blanking devices within panelboard spaces so bus bars are not exposed.

- F. Install panelboard nameplates for identification of equipment.
- G. Panelboard circuits shall be installed so to balance the loads on each of the panelboards.

++ END OF SECTION ++

SECTION 16511
LIGHTING FIXTURES AND DEVICES

1.1 SECTION INCLUDES

- A. Requirements for providing lighting fixtures and devices. Lighting fixtures and devices shall be provided in accordance with the requirements specified under this section, the Specifications and the Contract Drawings.
- B. The lighting system shall be complete and include all luminaires, devices and accessories as required for the installation of the lighting fixtures and devices.
- C. The following index of this Specification is presented for convenience.

1.2 RELATED SPECIFICATIONS

- A. Specification 16076 - Labeling and Identification
- B. Specification 16131 - Electric Conduit System

1.3 PAYMENT

- A. Payment for lighting fixtures and devices shall be made as provided for in the Specifications.

1.4 REFERENCES

- A. Lighting fixtures and devices shall comply with the latest applicable provisions and recommendations of the following:
 - 1. NFPA 70, National Electric Code.
 - 2. UL Standard No. 20, General Use Snap Switches.
 - 3. UL Standard No. 844, Electric Lighting Fixtures for Use in Hazardous Locations.
 - 4. UL Standard No. 894, Switches for Use in Hazardous Locations.
 - 5. UL Standard No. 924, Emergency Lighting and Power Equipment.
 - 6. UL Standard No. 935, Fluorescent Lamp Ballasts.
 - 7. UL Standard No. 1010, Electrical Receptacle - Plug Combinations for Use in Hazardous Locations.
 - 8. UL Standard No. 1029, High Intensity Discharge Lamp Ballasts.
 - 9. UL Standard No. 1570, Fluorescent Lighting Fixtures.
 - 10. UL Standard No. 1571, Incandescent Lighting Fixtures.
 - 11. UL Standard No. 1572, High Intensity Discharge Lighting Fixtures.
 - 12. American National Standard Institute, ANSI.
 - 13. Certified Ballast Manufacturers, CBM.

1.5 SUBMITTALS

- A. Contractor shall submit working drawings, shop drawings and material specifications for the approval of the Engineer in accordance with the requirements of the General Conditions, Article GC-14 – Contractor Submissions; and as specified under Division 1 of the Specifications.

B. Working Drawings:

1. Prior to equipment submission, submit a list of proposed manufacturers with the products they produce proposed for the contract.
2. Manufacturer's catalog cuts and drawings showing all technical information, and construction details for lighting fixtures, including dimensions, type of wiring, weight, size, installation methods and provisions for relamping lighting fixtures from the ground.
3. Photometric data, fixture IES lighting classification, and isolux diagram developed for each fixture type.
4. Lamp type and technical information.
5. Ballast type and technical information including power factor, input watts and ballast factor.
6. Scaled working drawings showing the locations of all fixtures and devices. The Drawings shall include the proposed routing of the branch circuits.
7. Point-to-point photometric layout drawings detailing the footcandle levels at one foot intervals, six inches above the finished floor. For exterior areas, the footcandle levels shall be detailed at one foot intervals, six inches above grade. For stairways, the footcandle levels shall be detailed at one foot intervals, six inches above each step.
8. Bills of material.

C. Reports:

1. Field test reports shall be submitted.
2. Manufacturer's site visit report shall be submitted.

D. Operations and Maintenance Manuals shall be submitted in accordance with the Specifications.

1.6 QUALITY ASSURANCE

A. General:

1. Lighting fixtures shall be UL listed. The lighting fixture types are noted within the fixture schedule. The descriptions and catalog numbers serve to establish the quality, appearance and performance of the specified lighting fixtures.
2. All lighting fixtures shall be the products of lighting equipment manufacturers who have previously demonstrated, by performance and reputation, the ability to manufacture products of the quality specified. Such manufacturers must maintain an organization and manufacturing facility capable of actually manufacturing the specified lighting fixtures. For the purpose of inspection, Contractor shall assure the Engineer, free and easy access to the manufacturing facilities and inventories of any manufacturer whose equipment the Contractor proposes to supply.
3. The Contractor shall be responsible to assure that the exact inscription for exit and stairway signs required by local code is checked against that specified, prior to providing same. The Engineer shall be advised of any changes required to conform to local codes before such changes are effected.

4. The Contractor shall be responsible for reviewing all drawings of each Contract and coordinating with all trades the installation of lighting fixtures and devices. The lighting fixture and device finishes and construction shall be compatible with the wall and ceiling types based upon the Contractor's review of all drawings of each Contract.
5. All industrial fixtures shall be of the highest quality material and construction for their respective types.
6. Lamps for all lighting fixtures shall be in accordance with the Federal Energy Legislation for reduced energy consumption.
7. Fixtures shall be suitable for connection to concealed or exposed conduit runs as required in each particular location and shall be of sizes suitable for lamp sizes indicated on the Contract Drawings.
8. Fittings and other materials for special fixtures not definitely shown or specified shall be of approved material, make and quality and shall have a finish that will harmonize with other parts of the fixtures. Where suitable standard materials are not available such parts of the fixtures shall be specially manufactured.

B. Field Testing:

1. The lighting fixtures shall be field tested. The field testing shall be performed in accordance with the requirements specified under Article 3.03.

1.7 DELIVERY, STORAGE AND HANDLING

- A. Lighting fixtures and devices shall be delivered, stored and handled in accordance with the Specifications and the manufacturer's instructions.

1.8 SPARE PARTS

- A. The Contractor shall furnish and deliver to the Engineer, at that part of the site and at such time as the Engineer may direct, spare parts for the lighting fixtures in accordance with the Specifications.
- B. The spare parts shall be listed in an index and packed in containers suitable for long term storage, bearing labels clearly designating the manufacturer's part number with complete information for use and reordering.
- C. The following spare parts shall be furnished:
1. 10 percent lamps shall be provided of each wattage of each type of HID lamp, but not less than the requirement for two fixtures.
 2. 5 percent ballasts shall be provided of each type of HID type ballast, but not less than two.
 3. 10 percent lamps shall be provided of each wattage of each type of fluorescent lamps, but not less than the requirement for two fixtures.
 4. 5 percent ballasts shall be provided of each type of fluorescent type ballast, but not less than two.
 5. 200 percent lamps shall be provided of each wattage of each type incandescent lamp.

6. 10 percent lamps shall be provided of each type of LED fixture, but not less than the requirement for five fixtures.
7. 10 percent fuses shall be provided of each size and type, but not less than two.

PART 2 - PRODUCTS

2.1 LIGHT FIXTURES

- A. A lighting fixture shall be provided for each fixture symbol shown on the Contract Drawings. Light fixtures shall be provided in accordance with the lighting fixture schedule shown on the Contract Drawings.
- B. Light fixtures shall be provided with all necessary hangers, supports, conduit adaptors, reducers, hooks, brackets and other support hardware. All hardware shall have a protective, non-corrosive finish.
- C. Recessed fixtures shall be provided with trim moldings and frames suitable for the types of ceilings.
- D. Pendent fixtures shall be suspended by means of an enclosed and gasketed cushion type hanger. The hanger shall be suitable to be mounted directly to the fixture outlet box and shall provide a minimum of 8 degrees swing from the vertical. Fixture stems shall be threaded rigid metal conduit, 1/2 inch minimum size. In corrosive areas stems shall be PVC coated.
- E. Where fixtures are subjected to moisture, or assembled of dissimilar metals, gaskets of approved material and thickness shall be provided.
- F. Explosion-proof type fixtures shall comply with the requirements of the National Electric Code for the hazardous locations indicated on the Contract Drawings.
- G. Fixtures shall be completely wired except where they will be directly connected to branch circuit wiring. The conductors shall be not less than No. 12 gauge, stranded, with approved heat resistant covering.
- H. Mounting heights of all fixtures shall be as shown on the Contract Drawings. For special types, the height shall be determined at the time of installation.
- I. Metal halide fixtures shall be screw-in type. The only wiring required shall be attaching of two (2) wires to a connection block in the mounting hood. Wiring to the ballast shall not be required.

- J. Metal halide fixtures shall be constructed of copper free aluminum (4/10 of 1% maximum copper content) for the mounting hoods, ballast bodies and guards. Mounting hoods, ballast bodies and guards shall have an epoxy-clad finish. Finish shall be two (2) coat baked, electrostatically applied for complete uniform surface protection. Reflectors shall be polyester. Globes and refractors shall be heat-resistant prismatic glass.

2.2 LAMPS

- A. LED Lamps shall have voltage ratings suitable for the voltages shown on the Contract Drawings.
- B. Fluorescent lamps shall be cool white, energy efficient rapid start type. Unless specifically indicated otherwise, fluorescent lamps shall be 32 watt T8, suitable for operation in ambient temperature above 50 degrees F. For operation outdoors, at 50 degrees and below, standard lamps shall be provided.
- C. High pressure sodium lamps shall be clear with medium or mogul base and wattage as indicated in the fixture schedule.
- D. Metal halide lamps shall be standard-line phosphor coated with wattage as indicated in the fixture schedule.
- E. Incandescent lamps shall be energy efficient type, inside frosted with wattage as indicated in the fixture schedule.
- F. Lamps shall be by General Electric Company, Sylvania Company or approved equal.

2.3 BALLASTS

- A. General:
 - 1. Ballasts shall be matched for proper operation of lamps and shall meet the requirements for fixture light output, reliable starting and operation.
 - 2. Ballasts shall be UL listed and certified by Electrical Testing Laboratories and shall conform to certified ballast manufacturer's specifications.
 - 3. Ballasts shall be by Advance Transformer, Magnetek or approved equal.
- B. Fluorescent Ballasts:
 - 1. Fluorescent ballasts shall be high power factor, energy efficient type. Ballasts shall be Class P protected with a Class A sound rating. Ballast used with fixtures outdoors shall be cold weather type.
 - 2. Ballasts for use with 32 watt T8 lamps shall be electronic type, with total harmonic distortion less than 10 percent total. The ballast factor shall be .85 or greater with total of less than 61 watts input.
 - 3. Controllable electronic ballasts shall continuously dim between 20 and 100 percent of light output. The dimming circuitry shall be UL Class 2 fully isolated and shall provide a 0-10 VDC control signal between ballast and control element.

C. High Intensity Discharge Ballasts:

1. Ballasts shall have a power factor of not less than 90 percent for 70 watt lamps and above.
2. Ballasts shall be (lag-type) magnetic regulator type for lamps 70 to 400 watts. High power factor reactor ballasts shall be provided for lamps below 70 watts.
3. In non-air conditioned spaces, ballasts shall be rated for operation in 40 degrees C temperature environment. Ballasts shall be capable of starting lamps with a lamp wall temperature of 0 degrees C or lower.
4. Ballasts, including the starter aid, shall protect itself against normal lamp failure modes and shall be capable of operation with the lamp in an open or short circuit condition for six months without accelerated loss of ballast life.
5. Ballast primary current during starting shall not exceed normal operating current.
6. Ballasts shall be capable of sustaining lamp operation with a line voltage dip or sag of 50 percent for up to 4 seconds when operating a nominal voltage lamp, with nominal line voltage applied to the ballast primary, as defined in ANSI 82.6.
7. The line power factor of the lamp/ballast system shall not drop below 90 percent for plus or minus 10 percent line voltage variations at any lamp voltage, from nominal through rated end-of-life lamp voltage, as described in ANSI 82.6.

2.4 RECEPTACLES AND SWITCHES

A. General:

1. Receptacles and switches shall be provided in accordance as shown on the Contract Drawings. The receptacles and switches shall be complete and shall include all accessories for proper installation.
2. Outlet boxes for receptacles and switches shall be in accordance with Specification 16131 - Electric Conduit System.
3. Unless specifically shown otherwise or stated in the Specifications explosion proof devices in hazardous locations shall comply with the requirements of the National Electric Code for Class I, Division 1, Group D locations.

B. Receptacles:

1. Receptacles shall be duplex grounding type, two pole, three wire, 125 volt AC, 15 ampere. Where shown on the Contract Drawings, other special receptacles with number of poles, voltage and current rating shall be provided. Matching plugs shall be provided for each special receptacle.
2. Receptacles for indoor dry, dusty locations shall be heavy duty, straight blade type, with reinforced polyester base and impact resistant nylon face.
3. Receptacles for wet and corrosive locations shall be marine duty, straight blade type, with heat resistance melamine body. Special receptacles in wet and corrosive locations shall be Type 316 stainless steel.
4. Receptacles for hazardous locations shall be factory sealed. Receptacles for hazardous locations shall be in accordance with the following:
 - a. Explosion-proof type receptacles shall be of the delayed action type requiring the turning of a plug shell on withdrawal to allow time for extinction of arcs.

- b. Surface mounted explosion-proof receptacles shall be provided with cast iron or cast aluminum angle type covers with hinged flaps.
 - c. Flush mounted explosion-proof receptacles shall be provided with brass, chromium plated, flush plates with double hinged flaps.
 - d. Plugs shall be provided where required for each type of explosion-proof receptacle. Plugs shall be of explosion-proof construction, and shall have steel bodies with corrosion resistant finish. Plugs shall be fitted with aluminum alloy cable clamps and chloroprene cable bushings.
 - 5. Receptacles for installation in floors shall be in accordance with the following:
 - a. Floor receptacles shall comprise a watertight unit consisting of a cast iron box with an adjustable top, permitting permanent angular and vertical adjustment, brass cover plate and 3/4 inch brass floor extension. The extension shall be of an approved height and shall be surmounted with a brass head arranged for a duplex receptacle. Exposed metal parts shall be finished to match adjacent metal finish.
 - b. For low voltage signal and telephone work, floor outlets shall be equal to those specified above for floor installation, except that the interiors shall be designed for cable extension as approved.
 - 6. Fan or clock outlets shall be single receptacles with molded composition or bakelite bodies. Rating shall be 15 amperes, 125 volts. Fan outlets shall be furnished with stud supports. Clock outlets shall be of the recessed type and shall be furnished with yokes for clock support.
 - 7. 480 volt receptacles in non-hazardous areas shall be a mechanically interlocked type with circuit breaker disconnect. The circuit breaker disconnect cannot be closed until the plug is fully inserted and the plug cannot be withdrawn or inserted unless the switch is open. The receptacle enclosure shall be copper - free aluminum with stainless steel parts. Rating shall be 600 volt, three phase, 60 amperes.
 - 8. Receptacles shall be by Hubbell Incorporated, Arrow-Hart Incorporated or approved equal. Hazardous located receptacles and 480 volt receptacles shall be by Crouse-Hinds Company, Appleton Electric Company, or approved equal.
- C. Switches:
- 1. Switches shall be industrial-heavy duty, AC toggle, quiet type. Switches shall be rated 120/277 volt, 20 ampere. Poles and switching shall be as shown on the Contract Drawings.
 - 2. Switches for hazardous locations shall be factory sealed tumbler type. The switch body and cover shall be cast gray iron alloy or cast malleable iron with zinc electroplate finish.
 - 3. Switches shall be by Hubbell Incorporated, Arrow-Hart Incorporated or approved equal. Hazardous located receptacles shall be by Crouse-Hinds Company, Appleton Electric Company, or approved equal.
- D. Plates and Covers:
- 1. Stainless steel plates shall be furnished for devices in indoor dry, dusty locations. They shall have beveled edges and shall be made of Type 302/304, stainless steel.
 - 2. Plates shall have satin finish. Attachment screws shall have matching head finish.

3. For wet and corrosive locations neoprene gasketed covers shall be used. Covers shall be galvanized ferrous or cast ferrous metal. Covers shall be PVC-coated in corrosive locations. Covers shall be equipped with gasketed spring doors for receptacles and an external operating mechanism for switches.
4. Plates shall be by Hubbell Incorporated, Arrow-Hart Incorporated or approved equal. Covers shall be by Crouse-Hinds Company, Appleton Electric Company, or approved equal.

PART 3 - EXECUTION

3.1 INSTALLATION OF LUMINAIRES

- A. Luminaires shall be installed at locations shown on the Contract Drawings. Luminaire locations shall be adjusted where necessary to clear conflicts and obstructions.
- B. All luminaires shall be installed complete with all hardware, and supporting devices necessary to make a safe, complete and fully operational installation. The Contractor shall obtain from the manufacturer for each lighting fixture, diagrams, illustrations and other installation instructions. The Contractor shall install in strict conformance with such instructions and the requirements of NFPA 70 National Electrical Code.
- C. LED fixtures shall be installed in conformance with manufacturer's recommendations and to suit the architectural details of the area involved. Independent supports from structural members of the building shall be provided. Unless otherwise shown on the Contract Drawings or stated in the Specifications, every fluorescent fixture shall have at least two supports, and continuous lines of LED fixtures shall be supported at 4 foot intervals,.
- D. Pendant mounted fixtures shall be installed with pendants 1/2 inch for stems up to 5 feet and 3/4 inch for longer lengths.
- E. All pendant stem hangers shall be furnished with suitable aligner canopies or outlet box covers so that the lighting fixtures hang vertical to the finished floor irrespective of the angle of the surface from which they are suspended. When lighting fixtures or hanger canopies are mounted flush to the ceiling or wall, and where raceways and outlet boxes serving the lighting fixtures are surface mounted to the ceiling or wall, finishing rings shall be provided to conceal the outlet box. All visible hanging devices and appurtenances shall have the same finish as the lighting fixture.
- F. Reflectors, lenses, diffusers, louvers and decorative elements of lighting fixtures shall not be installed until completion of plastering, ceiling tile work, painting, and general clean-up in the area.

3.2 INSTALLATION OF DEVICES

- A. Receptacles and Switches:
 - 1. Receptacles and switches shall be installed within outlet boxes at locations indicated on the Contract Drawings and in accordance with code requirements.
 - 2. Receptacles shall be mounted 2 feet above the finished floor, except in hazardous locations where receptacles shall be mounted 4 feet-6 inches above the finished floor.
 - 3. Switches shall be mounted 4 feet 6 inches above the finished floor.
 - 4. Where devices are grouped they shall be mounted under a common plate. Where directed or where space conditions limit gang mounting, tandem or tandem gang arrangement shall be provided.
 - 5. Where four or more switches controlling fixtures that are not visible from the switch location are grouped, the switch plate shall be engraved and filled with colored material or otherwise suitably marked to designate the control of each switch.

3.3 FIELD TESTS

- A. After installation, the completed lighting system and receptacle devices shall be field tested for operation and conformance. The field tests shall be witnessed by the Engineer and certified by the Contractor. The Contractor shall provide testing consisting of the following:
 - 1. Wiring continuity test shall be performed.
 - 2. Branch circuit load balance test shall be performed.
 - 3. Fixture and control operation test shall be performed.
 - 4. Receptacle polarity and grounding.
- B. The Contractor shall provide a field test report. The report shall identify the test performed and the results obtained.

3.4 MANUFACTURER'S FIELD SERVICES

- A. The Contractor shall provide equipment start-up services and training in accordance with the Specifications.
- B. The Contractor shall provide a field report from the manufacturer's representative for each visit to the site. The report shall include complete information on time, schedule, tasks performed, persons contacted, problems corrected, tests results, training instruction and all other pertinent information.
- C. The service representative shall sign in with the Engineer on each day they are at the site.

3.5 CLEANING OF LUMINAIRES

- A. Luminaires shall be cleaned inside and out to remove construction dust prior to substantial completion.
- B. Fixtures shall be re-lamped prior to substantial completion.

+ + END OF SECTION + +