

SECTION 00100 - ADVERTISEMENT FOR BIDS

TOWN OF CANTON
WATER POLLUTION CONTROL AUTHORITY
CANTON, CONNECTICUT
ADVERTISEMENT FOR BIDS

The Town of Canton, Connecticut, acting by and through the Water Pollution Control Authority invites sealed Bids for the proposed "Town Bridge Road Pump Station Generator Replacement, Water Pollution Control Authority, Town of Canton, Connecticut, August 2014". Sealed Bids will be received at the Canton Town Hall, Office of the Chief Administrative Officer, 4 Market Street, Collinsville, Connecticut 06022 at **10:00 a.m. on Friday, August 29, 2014** at which time all bids will be opened and publicly read aloud. Sealed bids must have outer envelope marked as "Town Bridge Road Pump Station Generator Replacement Project, Town of Canton, Connecticut, August 2014, Bid Enclosed".

The work for the Town Bridge Pump Station Generator Replacement Project consists of:

1. Removal of existing generator and transport to the Town of Canton DPW Garage on Old River Road, Canton.
2. Demolition and disposal of all components of the existing generator system not claimed by the Town of Canton.
3. Furnishing, unloading, placing, installing and testing all associated mechanical and electrical equipment, fittings, anchors, wire and conduit to provide a complete and functional propane fired standby generator system), as included in the Contract Documents.

Bidding Documents may be examined and/or obtained at the office of Woodard & Curran, Inc., 1699 King Street, Suite 406, Enfield, CT 06082 between the hours of 8:30 a.m. and 4:30 p.m., Monday through Friday, legal holidays excluded. Bidding Documents may also be obtained via the Town of Canton's website at:

<http://www.townofcantonct.org/content/19184/20465/default.aspx>.

A mandatory pre-bid meeting will be held at the Canton Water Pollution Control Facility (50 Old River Road, Collinsville, CT 06022) on **Wednesday, August 27, 2014 at 10:00 a.m.**

No Bid may be withdrawn within sixty (60) days after the date of the opening of bids, excluding weekends and legal holidays. Owner reserves the right to waive any informality in or to reject any or all Bids, or to accept any Bid which in their opinion, is in the public interest to do so. This bid may be subject to the Town of Canton Local Bidder Preference Policy.

The Town of Canton is an equal opportunity/affirmative action employer. Consulting Engineer:

Woodard & Curran, Inc.
Paul Dombrowski, PE, BCEE
1699 King Street, Suite 406
Enfield, CT 06082
(203) 605-1297

*** END OF SECTION ***

PROJECT MANUAL

**WATER POLLUTION CONTROL AUTHORITY
CANTON, CONNECTICUT**

**Town Bridge Road Pump Station
Generator Replacement
Canton, Connecticut**



AUGUST 2014

Bid Set No. _____



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**TOWN OF CANTON
WATER POLLUTION CONTROL AUTHORITY
CANTON, CONNECTICUT**

**TOWN BRIDGE ROAD PUMP STATION
GENERATOR REPLACEMENT**



Consulting Engineers
1699 King Street, Suite 406
Enfield, CT 06082
Tel: (203) 605-1297

Project No. 222479.47
August 2014

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**TOWN OF CANTON, CT
WATER POLLUTION CONTROL FACILITY**

**TOWN BRIDGE ROAD PUMP STATION
GENERATOR REPLACEMENT**

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*** END OF SECTION ***

SECTION 00410 - FORM FOR GENERAL BID

PROJECT IDENTIFICATION:

Solids Handling Building – Process and Mechanical Upgrades

THIS BID IS SUBMITTED TO:

Water Pollution Control Authority, Town of Canton, Connecticut

- 1.01 The undersigned Bidder proposes and agrees, if this Bid is accepted, to agree to the terms of a Purchase Order that will be issued by the OWNER to perform all Work as specified and described in the Summary of Work and indicated in the Bidding Documents for the prices and within the times indicated in this Bid and in accordance with the other terms and conditions of the Bidding Documents.
- 2.01 In submitting this Bid, Bidder represents, as set forth in the Purchase Order, that:
 - A. Bidder has examined and carefully studied the Bidding Documents, the other related data identified in the Bidding Documents and the Addenda, receipt of all which is hereby acknowledged.
 - B. Bidder has visited the Site and become familiar with and is satisfied as to the general, local and Site conditions that may affect cost, progress, and performance of the Work.
 - C. Bidder is familiar with and is satisfied as to all federal, state and local Laws and Regulations that may affect cost, progress and performance of the Work.
 - D. Bidder has obtained and carefully studied (or assumes responsibility for having done so) all additional or supplementary examinations, investigations, explorations, tests, studies and data concerning conditions (surface, subsurface and Underground Utilities) at or contiguous to the Site which may affect cost, progress, or performance of the Work or which relate to any aspect of the means, methods, techniques, sequences, and procedures of construction to be employed by Bidder, including applying the specific means, methods, techniques, sequences, and procedures of construction expressly required by the Bidding Documents to be employed by Bidder, and safety precautions and programs incident thereto.
 - E. Bidder does not consider that any further examinations, investigations, explorations, tests, studies, or data are necessary for the determination of this Bid for performance of the Work at the price(s) bid and within the times and in accordance with the other terms and conditions of the Bidding Documents.
 - F. Bidder is aware of the general nature of work to be performed by OWNER and others at the Site that relates to the Work as indicated in the Bidding Documents.
 - G. Bidder has correlated the information known to Bidder, information and observations obtained from visits to the Site, reports and drawings identified in the Bidding Documents, and all additional examinations, investigations, explorations, tests, studies, and data with the Bidding Documents.
 - H. Bidder has given ENGINEER written notice of all conflicts, errors, ambiguities, or discrepancies that Bidder has discovered in the Bidding Documents, and the written resolution thereof by ENGINEER is acceptable to Bidder.
 - I. The Bidding Documents are generally sufficient to indicate and convey understanding of all terms and conditions for the performance of the Work for which this Bid is submitted.
- 3.01 Bidder proposes to furnish all labor and materials required to complete the Work shown on the Contract Documents.
- 3.02 Bidder proposes to furnish all labor and materials required to complete this work in accordance with the Contract Documents for the prices as bid for the designated items of payable work as presented below.

4.03 The Contractor agrees to comply with all provisions of the Civil Rights Act of 1964, the Equal Opportunity Act of 1972, Executive Orders 11246, 11375, 11478, and if applicable, the Connecticut Fair Employment Practice Law and any and all similar State or Federal legislation, and any amendments thereof.

Date _____, 201_____

(Print Name of Firm Submitting a General Bid)

(Signature of Authorized Representative)

(Print Name of Person Signing Bid and Title)

Social Security Number
Or Federal Identification Number:

(Business Address)

(City, State and Zip Code)

Phone #: _____

Fax #: _____

STATEMENT OF BIDDER'S QUALIFICATIONS

All questions shall be answered and information given shall be clear and comprehensive. If additional room is required to answer questions attach additional sheets with the supplemental information. The Bidder's name shall appear on the top of the supplemental sheets to avoid confusion. The Bidder may submit additional information as he deems necessary to enable the Owner to fairly judge his ability to perform the proposed Work.

1. Name of Bidder: _____
2. Permanent Main Office Address: _____
3. Contact Person for this Contract: _____
4. Phone Number and email address where the Contact Person may be reached during normal business hours: _____
5. Date of organization of the business: _____
6. Date of Incorporation, if applicable: _____
7. If a corporation, list officers; if a partnership, list partners; if a sole proprietorship, list individual:

8. How many years have you been engaged in business under your present firm or trade name: _____
9. Contracts on hand (dollar value, anticipated completion date): _____
10. General character or type of Work performed by your business: _____
11. Have you ever failed to complete any Work awarded to the business? If the answer is YES, explain in detail the circumstances. _____

12. Have you ever defaulted on a Contract? If the answer is YES, explain in detail the circumstances.

13. List Contracts of a similar nature (size, type, and complexity) completed successfully by your business within the last five (5) years. List Owner, value of Contract, and Year Completed.

<u>Owner</u>	<u>Value of Contract</u>	<u>Year Completed</u>
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

14. How many years of experience does the business have in Work of similar importance to this proposed Contract? _____

15. Bank or other financial institution, contact person, Phone number, address, and available credit:

16. List the number of permanent employees. _____

17. Percentage of work to be performed under this contract directly by the business. _____

The undersigned hereby authorizes and requests any person, firm, institution, and/or corporation to furnish any information requested by the Owner, for verification of the information and statements comprising this Statement of Bidder's Qualifications.

Dated at _____ this ____ day of _____ 201 ____

Name of Bidder: _____

By: _____ Title: _____

State of _____

SECTION 01110 - SUMMARY OF WORK – GENERATOR REPLACEMENT

PART 1 – GENERAL

1.01 SUMMARY

- A. The Work of this Contract is described in Drawings and Specifications entitled:

Canton Water Pollution Control Authority
Town Bridge Road Pump Station
Generator Replacement
Canton, Connecticut
August 2014
Woodard & Curran, Inc.
Enfield, Connecticut

- B. Obtain all local permits and licenses necessary for the contemplated Work. The Town of Canton will waive the fees for the permits; however, they must be obtained as a condition of this project.
- C. Comply with the requirements of all permits issued for all portions of the Work under this Contract. Copies of permits, etc. appended to the document shall become part of this Contract.
- D. The Owner requires continued operation of the Town Bridge Road Pump Station during performance of this work to maintain plant operations. The Contractor shall coordinate all construction with the Owner to minimize conflict and to facilitate Owner usage.
- E. Other projects will be active during the performance of this Contract. The Contractor shall coordinate his work to minimize the disruption of others at the site.
- F. All Work shall be completed by December 2, 2014.
- G. The period during which the pump station is not functional under utility power shall be limited to 60 consecutive minutes.
- H. The period during which standby power is not available shall be limited to no more than 24 consecutive hours.

1.02 PROJECT SCOPE

- A. The project consists of Work associated with Town Bridge Road Pump Station Generator Replacement as shown on the Contract Drawings and described in the Specifications. The Work included in this Contract includes all aspects of the Contract Drawings and Specifications.
- B. A general description of work to be performed under this Contract includes, but is not limited to the following:
1. Apply for and secure any permits required by local, state and federal agencies having jurisdiction over Work to be performed under this Contract. The Town of Canton will waive all local permit fees for this project.
 2. Provide submittal package of generator, automatic transfer switch and all ancillary items for review by Engineer prior to installation.

3. Disconnect and remove existing generator and automatic transfer switch (ATS). Relocate to DPW Facility on Old River Road.
4. Provide temporary standby power for unattended pump station operation during construction as needed to maintain operation during loss of utility power in order to comply with SECTION 01310 – COORDINATION. CONTRACTOR shall provide all components to provide a temporary standby power system including system installation, connection to the existing pump station electrical system, fuel and ancillary equipment.
5. Provide (furnish and install) a new 30 KW, 120/240 volt, 3-phase propane fired generator and automatic transfer switch (ATS) and all necessary appurtenances for a complete and operating system.
6. Generator and ATS will generally have the following features provided:
 - A. 100 amp mainline circuit breaker
 - B. Electronic voltage regulation and electronic governor of power output
 - C. Lubrication, oil and antifreeze for initial operation
 - D. Factory and installed testing of generator system, startup services and O&M manuals
 - E. Connection of propane fuel lines, including new flexible lines, second stage regulator, shutoff and black iron fittings.
 - F. Engine starting batteries, battery rack and cables, alternator and 3-stage float type battery charger
 - G. Critical exhaust silencer, exhaust piping, stainless steel flexible connection and thimble (UL listed). Provide thermal insulation on all pipe and tubing operating at more than 30°F over ambient room temperature situated less than 90 inches above finished floor.
 - H. Engine mounted radiator
 - I. Engine jacket water heater (block heater)
 - J. Integrated generator control system (Cummins PowerCommand I.1 or equivalent) that includes operator display, at least eight engine protection shutdowns and remote control functions (start, stop, cool down, exercise, cyclic cranking plus configurable inputs (2) and outputs (2))
7. Electrical improvements associated with generator installation shall include all labor and materials to provide a complete and functional system, including, but are not limited to, the following:
 - A. Power wiring between the Automatic Transfer Switch and Generator sized in accordance with the amperage of the main circuit breaker of the new generator.
 - B. One (1) 120 volt, 20 amp circuit from the existing electrical panel to the generator for the generator battery charger.
 - C. One (1) 120 volt, 20 amp circuit from the existing electrical panel to the generator for the jacket water heater (block heater - reuse existing 120 volt circuit)
 - D. Four (4) #14 THWN conductors from the Automatic Transfer Switch to the Generator (Start Ckt.)
 - E. Eight (8) #18 THWN conductors from the new Generator to the Existing SCADA Control Panel.
 - F. One (1) #18/4 Twisted Shielded Pair Cable from the new Generator to the New Automatic Transfer Switch.
 - G. Six (6) #14 THWN conductors from the new Automatic Transfer Switch to the Existing SCADA Control Panel.

H. One (1) 120 volt, 20 amp circuit with wire and conduit from the existing electrical panel to the two (2) new Motorized Louvers – interconnect Louvers with Generator start circuit.

I. All groups of conductors shall be in separate conduits.

8. Coordination and scheduling with the Owner and Engineer is part of the work and shall be the responsibility of the Contractor.

9. Coordination of equipment start-up and training with the Owner, Engineering, Manufacturer and all trades associated with the equipment start-up and training shall be the responsibility of the Contractor.

10. As-built drawings of final generator installation.

1.03 PROJECT SCHEDULE

A. Refer to SPECIFICATION SECTION 01325 SCHEDULING OF CONSTRUCTION for additional information related to the construction schedule.

*** END OF SECTION ***

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SECTION 01310 - COORDINATION

PART 1 -GENERAL

1.01 SUMMARY

A. Section Includes:

1. Coordination of the Work while minimizing the interference with operation of the existing facility.

B. Related Sections:

1. Section 01110 – Summary of Work
2. Section 01325 — Scheduling of Construction

C. Related Work Not Included:

1. Operation of existing facilities will be performed by the OWNER unless otherwise specified. The OWNER will assist in arranging operation of any existing facilities or equipment required by the CONTRACTOR to connect to existing facilities, and no existing equipment shall be operated without the OWNER's knowledge.

1.02 SUBMITTALS

- A. Submit to the OWNER and ENGINEER all requests for temporary shutdowns of facilities or interruption of operations at least 7 days prior to the beginning of any shutdown. No shutdown shall occur without the approval of the OWNER.

1.03 OPERATION OF EXISTING FACILITIES

- A. OWNER will perform all operations of existing electrical, instrumentation, and process equipment including but not limited to operation of all pumps, valves, circuit breakers, etc. No existing equipment shall be operated without OWNER's knowledge and prior approval.
- B. To the extent possible, perform all construction activities so as to avoid interference with the existing facilities. Conduct work to maintain existing facilities in operation at all times unless otherwise specifically permitted in the Specifications or approved by the OWNER.
- C. OWNER shall be kept fully informed at least two weeks before the beginning of all work by CONTRACTOR which may affect OWNER's operations.
- D. The OWNER shall have the authority to order work stopped or prohibited, which would in his opinion, unreasonably result in interference with the necessary functions of the wastewater treatment operations. Any costs and/or delays associated with OWNER authorized work stoppages due to the CONTRACTOR's operation shall be borne by the CONTRACTOR.
- E. The CONTRACTOR's access to the site shall be limited to the hours of 7:00 a.m. to 3:30 p.m., Monday through Friday, no holidays, unless by prior arrangement with the OWNER and ENGINEER.

1.04 SEQUENCE OF CONSTRUCTION

- A. Construction of the proposed improvements, while maintaining existing operations, will require a

specific sequence of construction during portions of this project. The CONTRACTOR will be allowed as much flexibility as possible in scheduling the details of the project. The CONTRACTOR shall provide a detailed schedule as required in Section 01325

- B. The CONTRACTOR shall incorporate the following project scheduling requirements into development of the schedule submitted as required in Section 01325.
1. All components of the existing facility must remain in operation throughout construction unless otherwise specified herein.
 2. The period during which the pump station is not functional under utility power shall be limited to 60 consecutive minutes.
 3. The period during which standby power is not available at the pump station shall be limited to no more than 24 consecutive hours.

PART 2 - PRODUCTS (not applicable)

PART 3 - EXECUTION (not applicable)

*** END OF SECTION ***

SECTION 01325 - SCHEDULING OF CONSTRUCTION

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Preparation
2. Periodic reports
3. Constraints on sequence of operations

B. Related Sections:

1. Section 01310 – Coordination

1.02 REFERENCES

- A. Associated General Contractors of America – The Use of CPM in Construction

1.03 SUBMITTALS

- A. Submit for approval within 3 calendar days after the effective date of the Purchase Order and at least 20 days prior to submitting the first application for a progress payment a sequence of construction.
- B. Periodic reports - On the first working day of each month submit an updated sequence of construction.
- C. Rate of Expenditure Schedule — Before starting any work on site, the CONTRACTOR shall submit an estimate of the rate of contract payments for the project on a monthly basis. If, in the opinion of the ENGINEER, the CONTRACTOR has deviated significantly from this projection during the course of the project, the CONTRACTOR shall submit a revised rate of expenditure schedule.

1.04 QUALITY ASSURANCE

- A. The CONTRACTOR shall take the following into consideration in the preparation of the schedule network analysis:
 1. Shop drawing submittal and approval time;
 2. Delivery times of equipment and materials;
 3. Subcontractors' work, availability and abilities of workmen;
 4. Weather conditions;
 5. Seasonal constraints resulting from stormwater flows;
 6. Restrictions in operations at the work site;
 7. All other items that may affect completion of the Work.

PART 2 – PRODUCTS (not applicable)

PART 3 – EXECUTION

3.01 PREPARATION

- A. Prior to all work of this Section, thoroughly study the referenced standard as well as pertinent portions of the Contract Documents.
- B. In the preparation of the schedule, the CONTRACTOR shall take into consideration Shop Drawing submittal and approval time, the delivery times of equipment and materials, Subcontractors' work, availability and abilities of workmen, weather conditions, any restrictions in operations at the Work site, and all other items that may affect completion of the Work within the time requirements of the Contract Documents.

3.02 SEQUENCE OF OPERATIONS

- A. The sequence of operations is subject to the following constraints:
 - 1. CONTRACTOR shall achieve final completion as specified in SPECIFICATION SECTION 01110 – SUMMARY OF WORK.
 - 2. Refer to SPECIFICATION SECTION 01310 - COORDINATION for additional requirements.

3.03 ADHERENCE TO SCHEDULE

- A. Whenever in the opinion of the ENGINEER the Work is not proceeding in accordance with the construction progress schedule, the CONTRACTOR shall promptly take such measures as are necessary to return the Work to its progress schedule, as directed by, and at no cost, to the OWNER. Such measures shall include but not be limited to, employing additional or different personnel, equipment or construction methods, employing additional shifts, or working overtime. Such measures shall be continued until compliance with the progress schedule has been achieved.

*** END OF SECTION ***

SECTION 01770A - SITE WORK CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Documentation for Completed Work
2. Final Clean-up

B. Related Sections:

1. Section 01110 – Summary of Work

1.02 SUBMITTALS

A. Closeout Submittals:

1. The closeout submittals include but are not necessarily limited to
 - a. Evidence of payment and release of liens.

1.03 SEQUENCING

A. Substantial Completion:

1. Prior to requesting final inspection and project close-out, the Contractor shall assure that the work is completed in accordance with the specified requirements and is ready for the requested inspection.
2. Within a reasonable period of time after receipt of the request, the Engineer will inspect the work to review compliance, completeness, and issue a listing of unsatisfactory work. The Contractor shall remedy the deficiencies and the work will be reinspected.

B. Completion:

1. The Contract shall be considered complete and final payment made, only when:
 - a. All provisions of the Contract Documents have been strictly adhered to.
 - b. The project and premises have been left in good order, including removal of all temporary construction, Contractor-owned and extraneous materials as required.

PART 2 - PRODUCTS (not applicable)

PART 3 - EXECUTION

3.01 CLEANING

- ##### A.
- Where material or debris has washed, flowed or has been placed in existing watercourses, ditches, gutters, drains, pipe, or structures, for work done under the Contract work limits or elsewhere

during the course of the Contractor's operations, such material or debris shall be entirely removed and satisfactorily disposed of during the progress of the Work, and the ditches, channels, drains, pipes, structures, and watercourses shall, upon completion of the Work, be left in a clean and neat condition.

- B. Restore or replace, when and as directed, any public or private property damaged or removed by his work, equipment, or employees, to a condition at least equal to that existing immediately prior to the beginning of operations. To this end, complete as required all necessary highway or driveway, walk, and landscaping work. Suitable materials, equipment and methods shall be used for such restoration. The restoration of existing property, signs or structures shall be done as promptly as practicable, as work progresses, and shall not be left until the end of the contract period.

*** END OF SECTION ***

SECTION 01770B - EQUIPMENT CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Documentation required for the transfer of the completed work to the Owner.

1.02 SUBSTANTIAL COMPLETION

A. Procedure:

1. Prior to requesting final inspection and project close-out, the Contractor shall ensure that the Work is completed in accordance with the specified requirements and is ready for the requested inspection.
2. Within a reasonable period of time after receipt of the request, the Owner, Contractor, and Engineer will inspect the Work to determine the status of completion. If Engineer does not consider the Work substantially complete, the Contractor shall remedy any deficiencies to be corrected or completed and the Work will be re-inspected.

Upon determination of the Work being substantially complete, the Engineer will:

- a. Prepare a "Certificate of Substantial Completion" which will accompany the list of remaining items to be completed or corrected. The Engineer will submit the certificate to the Owner and Contractor.

1.03 FINAL COMPLETION AND PROJECT CLOSEOUT DOCUMENTS

- A. As-built Drawings - Submit as-built drawings to the Engineer for review, approval, or comment. The drawings shall show any and all deviations from the original drawings. The drawings shall depict the location of all conduit and devices exterior from the motor control centers, the location of valves, small diameter piping, relocated devices and all field changes. All underground work shall be actively tied in a minimum of two horizontal directions with vertical control. All fittings, bends, valves and other appurtenances shall be shown. Locate all utilities and appurtenances concealed in construction. Provide detail not shown on Contract Documents. Colored pencils or felt tipped pens shall be used to record all revisions to the record set of Drawings. Use the following color code unless otherwise approved by the Engineer:

- | | |
|--------------------------|--------|
| 1. Process & Mechanical: | Red |
| 2. Architectural: | Blue |
| 3. Structural: | Purple |
| 4. Plumbing: | Brown |
| 5. HVAC: | Green |
| 6. Electrical: | Orange |
| 7. Other: | Black |

- B. Operation and Maintenance manuals for items listed in pertinent other sections of these Specifications and for other items when directed by the Engineer. Manuals (6 sets submitted to Owner) shall include:

1. The O&M's shall be submitted in three ring binder notebooks. And shall provide the following as a minimum.
 - a. A comprehensive index broken down into sections and sub-sections, etc.
 - b. A complete list of the equipment supplied, including serial numbers, ranges, and pertinent data.
 - c. Full specifications on each item.
 - d. Detailed service, maintenance and operation instructions for each item supplied.
 - e. System schematic drawings "as Constructed", illustrating all components, piping and electrical connections of the systems supplied under Division 16.
 - f. Special maintenance requirements particular to this system shall be clearly defined, along with special calibration and test procedures.
 - g. The operating instructions shall also incorporate a functional description of the entire system, with references to the systems schematic drawings and instructions.
 - h. Complete parts lists with stock numbers and name, address, and telephone number of the local supplier.
 - i. A complete "As Constructed" set of approved shop drawings.
 - j. The format of the O&M manual shall meet the following general requirements:
 - i. First will be the complete, comprehensive index.
 - ii. Next will be a section with the operating instructions including complete overview of the system.
 - iii. Next will be a section with a complete parts list as described above.
 - iv. Next will be a section that includes all schematic diagrams, wiring diagrams etc. of the "As Constructed System".
 - v. Next will be product information.
 - k. Section and sub-section, etc. dividers shall be provided for easy reference.
 - l. Each product shall have a separate divider for easy reference.
 - m. Each instrument section shall have data sheets indicating the Tag names (as used on the Drawings), manufacturer, complete model number, complete specifications, and a parameter setup sheet, per tag name. Following the parameter setup sheets will be the manufacturers O&M manual in its entirety.
2. Final documentation shall be written specifically for this project, but may include standard and modified standard documentation. Modifications to existing hardware or software manuals shall be made on the respective pages or inserted adjacent to the modified pages. All standard documentation furnished shall have all portions that apply clearly indicated. All portions that do not apply shall be lined out.

3. The manuals shall contain all illustrations, detailed drawings, wiring diagrams, and instructions necessary for installing, operating, and maintaining the equipment. The illustrated parts shall be numbered for identification. All information contained therein shall apply specifically to the equipment furnished and shall only include instructions that are applicable. All such illustrations shall be incorporated within the printing of the page to form a durable and permanent reference book.
4. The requirements for final documentation include the following:
 - a. As-Built documentation shall include all previous submittals, as described in this Specification, updated to reflect the as-built system.
 - b. The maintenance documentation shall describe the detailed preventative and corrective procedures required to keep the System in good operating condition. All hardware maintenance manuals shall make reference to appropriate diagnostics, where applicable, and all necessary timing diagrams shall be included. A maintenance manual or a set of manuals shall be furnished for all delivered hardware, including peripherals. The hardware maintenance documentation shall include, as a minimum, the following information.
 - i. Operation information - This information shall include a detailed description of how the equipment operates and a block diagram illustrating each major assembly in the equipment.
 - ii. Preventative-maintenance instructions -These instructions shall include all applicable visual examinations, hardware testing and diagnostics routines, and the adjustments necessary for periodic preventative maintenance of the system.
 - iii. Corrective-maintenance instructions - These instructions shall include guides for locating malfunctions down to the card-replacement level. These guides shall include adequate details for quickly and efficiently locating the cause of an equipment malfunction and shall state the probable source(s) of trouble, the symptoms, probable cause, and instructions for remedying the malfunction.
 - iv. Parts information - This information shall include the identification of each replaceable or field-repairable module. All parts shall be identified on a list in a drawing; the identification shall be of a level of detail sufficient for procuring any repairable or replaceable part. Cross-references between the Contractor's part number and manufacturer's part numbers shall be provided. All PC boards shall be identified by; manufacturer and model number, slot number, part name and configuration (if applicable).
- C. Warranties and bonds for items so listed in pertinent other sections of the Contract Documents.
- D. Keys and keying schedule, where applicable.
- E. Evidence of compliance with requirements of governmental agencies having jurisdiction including, but not necessarily limited to:
 1. Certificates of Inspection
 2. Certificates of Occupancy

- F. Evidence of payment and release of liens.
- G. List of subcontractors, service organizations, and principal vendors, including names, addresses, and telephone numbers where they can be reached for emergency service at all times including nights, weekends, and holidays.
- H. Equipment start-up reports shall be submitted in duplicate to the Engineer for each piece of equipment installed. The report shall include detailed descriptions of the points inspected, tests, and adjustments made, quantitative results obtained and maintenance suggestions. The report shall certify that the equipment (1) has been satisfactorily installed and conforms to the Contract requirements; (2) is in accurate alignment and free from undue stress; (3) has been operated under full load and operates satisfactorily; and (4) nothing in the installation will render the manufacturer's warranty null and void
- I. Color charts, legends, instructions, special tools and other requirements specifically requested in Sections of the Specification

1.04 INSTRUCTION OF OWNER'S PERSONNEL

- A. Provide instruction by qualified manufacturers' representatives in the proper operation, maintenance, adjustment and the safety aspects of the equipment and materials furnished. Specific instruction requirements may be included within the Sections of the Specification.

1.05 FINAL CLEANING & REPAIRS

- A. Complete cleaning prior to final inspection. Cleaning shall include all interior and exterior glass and surfaces exposed to view; remove temporary labels, stains and foreign substances, polish transparent and glossy surfaces. Thoroughly wipe clean all ductwork, piping, equipment, devices, and exposed surfaces. Clean debris from lawns, roofs, downspouts and gutters. Sweep paved surfaces and rake lawns and landscaped areas.
- B. Use only cleaning materials that will not create hazards to health or property.
- C. Where material or debris has washed or flowed into or has been placed in existing watercourses, ditches, gutters, drains, pipes, structures, for Work done under the Contract work limits or elsewhere during the course of the Contractor's operations, such material or debris shall be entirely removed and satisfactorily disposed during the progress of the Work, and the ditches, channels, drains, pipes, structures, and work, shall, upon completion of the Work, be left in a clean and neat condition.
- D. On or before the completion of the Work, tear down and remove all temporary buildings and structures, remove all temporary works, tools, and machinery or other construction equipment, remove all rubbish from any grounds which has been occupied and leave the roads and all parts of the premises and adjacent property in a neat and satisfactory condition.
- E. Restore or replace, when and as directed, any public or private property damaged by equipment or employees, to a condition at least equal to that existing immediately prior to the beginning of operations. To this end the Contractor shall do as required necessary highway or driveway, walk, and landscaping work. Suitable materials, equipment and methods shall be used for such restoration. The restoration of existing property or structures shall be done as promptly as practicable, as Work progresses, and shall not be left until the end of the contract period.

1.06 COMPLETION

- A. The Contract shall be considered complete and final payment made, only when:
1. All provisions of the Contract Documents have been strictly adhered to.
 2. All damage to adjoining areas caused by the Work has been repaired.
 3. The project and premises have been left in good order, including removal of all temporary construction, Contractor-owned and extraneous materials as required.
 4. All warranties, Operation and Maintenance Manuals, maintenance instructions, releases, and permits called for in the Contract have been submitted to the Owner and Engineer as applicable.
 5. All as-built Drawings as required by the Contract Documents have been submitted to the Owner.
 6. All monies owed the Owner for services performed for the Contractor by Owner's forces in connection with the Contract have been paid.

PART 2 - PRODUCTS (not applicable)

PART 3 - EXECUTION (not applicable)

*** END OF SECTION ***

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SECTION 02070 - SELECTIVE DEMOLITION

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

- A. Demolition includes modification, removal, relocation, and/or disposal of the following:
Removal of building components, standby generator, automatic transfer switch, electrical components, and incidentals as indicated on drawings and as required to accommodate new construction.

1.02 JOB CONDITIONS

- A. Occupancy: Conduct selective demolition work in manner that will minimize need for disruption of Owner's normal operations. Weatherproof all structural openings. Maintain continuous treatment capacity at all times unless shutdown is specifically provided elsewhere in these documents. Contractor shall provide temporary piping and pumping as required to reroute flows around work areas.
- B. Condition of Structures: The Owner assumes no responsibility for actual condition of structures to be demolished.
 - 1. Conditions existing at time of inspection for bidding purposes will be maintained by Owner in so far as practicable. However, variations within structure may occur by Owner's removal and salvage operations prior to start of demolition work.
- C. Partial Removal: Items must be removed from structure as work progresses. Salvaged items must be transported from site as they are removed. Note that the Contractor shall take care when removing items that are to be salvaged so they are not damaged.
 - 1. Items property of Owner: Coordinate with Owner before removing any items. Owner reserves right to retain demolished items or portions thereof at designated location within the Town of Canton. Allow Owner to remove components from demolished items. Items Owner does not retain become property of Contractor and must be removed and disposed of properly.
- D. Explosives: Use of explosives will not be permitted.
- E. Traffic: Conduct demolition operations and removal of debris to ensure no interference with roads, streets, walks, and other adjacent occupied or used facilities.
 - 1. Do not close or obstruct streets, walks or other occupied or used facilities without permission from authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways.
- F. Protections: Ensure safe passage of persons around area of demolition. Conduct operations to prevent injury to adjacent buildings, structures, other facilities, and persons.

1. Provide interior and exterior shoring, bracing, or support to prevent movement, settlement or collapse of adjacent facilities to remain.
- G. Damages: Promptly repair damages caused to adjacent facilities by demolition operations at no cost to Owner.
- H. Utility Services: Maintain existing utilities indicated to remain in service and protect against damage during demolition operations.

PART 2 - PRODUCTS - Not applicable.

PART 3 - EXECUTION

3.01 DEMOLITION

- A. Pollution Controls: Use water sprinkling, temporary enclosures, and other suitable methods to limit dust and dirt rising and scattering in air to lowest practical level. Comply with governing regulations, permits, laws, ordinances, etc. pertaining to environmental protection.
 1. Clean adjacent structures and improvements of dust, dirt, and debris caused by demolition operations. Return adjacent areas to condition existing prior to the start of work. Reform adjacent concrete areas and repair to previous condition.

3.02 DISPOSAL OF DEMOLISHED MATERIALS

- A. General: Do not remove from site debris, rubbish, and other materials resulting from demolition operations without prior permission by Owner. Store all demolished materials that Owner wishes to retain at on-site location designated by Owner.
 1. Burning removed materials from demolished structures will not be permitted on site.
 2. Dispose demolition debris in a lawful manner.

*** END OF SECTION ***

SECTION 16050 BASIC ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.01 SCOPE

- A. The work included under this section shall include all electrical work associated with the Generator Replacement at the Town Bridge Road Pump Station for the Canton Water Pollution Control Authority in Canton, Connecticut.
- B. The Electrical Contractor shall provide the labor, tools, equipment, and materials necessary to furnish and install all electrical work in accordance with the Drawings and as specified herein. Work shall include installation and termination of all control and signal wiring for instrumentation and process control equipment as indicated in the Contract Documents and Specifications.
- C. In general, electrical Work shall include but not be limited to the following:
 - 1. All Generator and Automatic Transfer Switch wiring.
 - 2. Power distribution equipment.
 - 3. Equipment connections.
 - 4. Control and Scada wiring.
 - 5. Equipment grounding system.
 - 6. All support material and hardware for raceway and electrical equipment.
 - 7. Branch circuit wiring.
 - 8. Termination & labeling of all cable and wire unless otherwise noted. This includes, but is not limited to, final termination of all control and instrumentation wiring in PLC/SCADA control panels and consoles.
 - 9. Building wall, floor and roof penetrations for raceways.
 - 10. Start up, acceptance testing test reports and instruction of systems operation to the Owner.

1.02 REQUIREMENTS OF REGULATORY AGENCIES

- A. Codes and Standards:
 - 1. Electrical equipment, materials, installation and workmanship shall comply with all state and local building codes, safety and fire law regulations at the location of the Work and shall conform to the latest edition of the applicable codes and standards of the organizations listed:
 - a. National Electrical Code (NEC).
 - b. Connecticut Electrical Code (CEC).
 - c. Underwriters' Laboratories (UL).
 - d. Institute of Electrical and Electronics Engineers (IEEE C2).
 - e. American National Standards Institute, Inc. (ANSI).
 - f. National Fire Protection Association (NFPA).
 - g. National Electrical Manufacturers Association (NEMA).
 - h. Insulated Power Cable Engineers Association (IPCEA).
 - i. Association of Edison Illuminating Companies (AEIC).
 - j. Occupational Safety Health Act (OSHA).
 - k. Americans with Disabilities Act (ADA).
 - 2. Where the Contract requires the Work or any part of the same, to be above the standards required by applicable laws, ordinances, rules and regulations and other statutory provisions pertaining to the Work, such Work shall be performed and completed in accordance with the Contract requirements.

3. Should any changes in the specifications and Drawings be necessary to conform to the requirements of any of the above mentioned codes or standards, the Contractor shall so notify the Engineer.
- B. Drawings required by governing authorities: Prepare any detailed diagrams or Drawings which may be required by the governing authorities.
- C. Permits, Certificates, Inspections, Fees and Utility Costs:
1. The Contractor shall obtain and make payments for all permits, licenses, and certificates which are required for the associated Work.
 2. Following completion of the Work, the Contractor shall obtain certificates of approval from the responsible agencies concerned with the Work.
 3. Arrange for timely inspections required for Work under this section.
 4. All utility company and municipal back charges shall be the responsibility of the Owner. Cost of electricity shall be borne by the Contractor until substantial completion as determined by the Owner.

1.03 COORDINATION OF WORK

- A. The electrical work shall be coordinated with the work of other trades to prevent interferences and so that the progress in construction of the building will in no way be retarded.
- B. Refer to other sections of these specifications and Drawings for related work which may affect the work of this section.
- C. Where lighting fixtures and other electrical items are shown in conflict with locations of structural members and mechanical or other equipment, furnish and install all required supports and wiring to clear the encroachment for a complete installation.
- D. Any Work installed contrary to or without acceptance by the Engineer shall be subject to change as directed by the Engineer, and no extra compensation will be allowed to the Contractor for making these changes.

1.04 DRAWINGS

- A. All electrical equipment such as junction and pull boxes, panelboards, switches, controls and such other apparatus as may require maintenance and operation from time to time shall be made easily accessible and properly labeled.
- B. The Contractor shall examine all contracts and reference Drawings, and verify and properly coordinate the placement of outlets. Contractor shall also check all Drawings including mechanical Drawings and shop drawings for apparatus for which he must rough-in and to which he must connect.

1.05 SUBMITTALS

- A. Furnish manufacturer's product data, test reports, and materials certifications as required.
- B. Follow the procedures specified in the Project Specifications, the Contractor shall also prepare and submit a complete submittal list to the Engineer. The submittal list shall include all submittal items covered in the Division 16 specification sections.

- C. Shop Drawings shall be submitted to the General Contractor who shall review and approve them prior to submittal to the Engineer for approval. Shop Drawings shall identify the specific equipment and material being supplied; the quantity being supplied; and all accessories, dimensions, descriptions, mounting and connection details, wiring diagrams, elementary control diagrams, equipment interface diagrams and any other information necessary to determine compliance with the plans and specifications. Fabrication and installation shall be in accordance with the approved Shop Drawings.
- D. As-built copies of all Shop Drawings shall be submitted to the Engineer.
- E. Permits and Easements. Submit copies of reports, permits, and easements necessary for installation, use, and operation.
- F. Test Reports. Submit copies of reports of tests, inspections, and meter readings as specified.

1.06 RECORD DRAWINGS

- A. The Contractor shall maintain a complete and separate set of prints of Contract Drawings and specifications at job Site for duration of the contract. The Contractor shall record Work completed and all changes from original Contract. Drawings shall clearly and accurately include Work installed as a modification or as an addition to the original design.
- B. At completion of Work and prior to final request for payment, the Contractor shall submit a complete set of reproducible Record Drawings showing all systems as actually installed.

1.07 JOB CONDITIONS

A. Existing Conditions

1. Prior to all Work of this section, carefully inspect the installed Work of all other trades and verify that all such Work is complete to the point where this installation may properly commence.
2. Verify that the electrical installation may be made in complete accordance with all pertinent codes and regulations and the original design.

B. Coordination

1. Coordinate the installation of electrical items with the schedules for Work of other trades to prevent unnecessary delays in the total Work.
2. Any changes shall be done at the Contractor expense.
3. Where lighting fixtures and other electrical items are shown in conflict with locations of structural members and mechanical or other equipment, furnish and install all required supports and wiring to clear the encroachment for a complete installation.
4. Any Work installed contrary to or without acceptance by the Engineer shall be subject to change as directed by the Engineer, and no extra compensation will be allowed to the Contractor for making these changes.

C. Accuracy of Data

1. The Drawings are diagrammatic and functional only, and are not intended to show exact circuit layouts, number of fittings, components and place in satisfactory operational power, lighting, and other electrical systems shown. Install additional circuits, components and material wherever needed to conform to the specific requirements of the equipment whether or not indicated or specified.
2. Information and components called for in the specification but not shown on plans or vice versa shall apply and shall be provided as though required expressly by both.
3. The locations of equipment, fixtures, outlets and similar devices shown on the Drawings are approximate only. Field measurements shall take precedence over scaled dimensions from Drawings. Exact locations shall be as accepted by Engineer during construction. Obtain in the field all information relevant to the placing of electrical Work and, in case of any interference with other Work, proceed as directed by the Engineer and furnish all labor and materials necessary to complete the Work in an acceptable manner.
4. In case of difference between building codes, specifications, state laws, industry standards and the Contract Documents, the most stringent shall govern. Should the Contractor perform any Work that does not comply with the requirements of the applicable building codes, state laws, and industry standards, he shall bear all cost arising in correcting these deficiencies.
5. Verify size and ratings of motors and other electrically operated devices supplied by others.
6. Check with Engineer before installation of Work for outlets not specified as to location or for Work that interferes with other trades.

1.08 FLASHING, CUTTING, FIREPROOFING AND WATERPROOFING

- A. Flashing around all electrical items penetrating roof or exterior walls shall be the responsibility of the General Contractor.
- B. All cutting of surfaces, including core drilling of walls and slabs, shall be done by the Electrical Contractor.
- C. Patching shall be done by the Electrical Contractor.
- D. The Electrical Contractor shall fireproof, waterproof and seal all openings in slabs and walls.

1.09 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Protection. Use all means necessary to protect electrical system materials before, during and after installation and to protect the installed Work and materials of all other trades.
- B. Replacements. In the event of damage, immediately make all repairs and replacements necessary to the acceptance of the Engineer and at no additional cost to the Owner. If any apparatus has been subject to possible injury by water, it shall be thoroughly dried out and put through such special tests as directed by the Engineer, at the cost and expense of the Contractor, or shall be replaced by the Contractor at his own expense.
- C. Protect the Work of other trades. Restore any damage caused to other trades to the condition existing prior to damage at no additional cost to the Owner.
- D. Investigate each space in the building through which equipment must pass to reach its final location. If necessary, the manufacture shall be required to ship his material in sections sized to permit passing through such restricted areas in the building.

1.10 WORK PERFORMANCE

- A. Electrical work shall be accomplished with all affected circuits or equipment deenergized. When an electrical outage cannot be accomplished in this manner for the required work, the following requirements are mandatory:
 - 1. Electricians must use full protective equipment (i.e., certified and tested insulating material to cover exposed energized electrical components, certified and tested insulated tools, etc.) while working on energized systems in accordance with NFPA 70E.
 - 2. Electricians must wear personal protective equipment while working on energized systems in accordance with NFPA 70E.
 - 3. Before initiating any work, a job specific work plan must be developed by the Contractor and the Owner. The work plan must include procedures to be used on and near the live electrical equipment, barriers to be installed, and safety equipment to be used and exit pathways.
 - 4. Work on energized circuits or equipment cannot begin until prior written approval is obtained from the Owner.

1.11 SPECIAL WARRANTY

- A. Compile and assemble the warranties specified in Division 16 into a separate set of vinyl covered three ring binders, tabulated and indexed for easy reference.
- B. Provide complete warranty information for each item. Information to include:
 - 1. Product or equipment list.
 - 2. Date of beginning of warranty or bond.
 - 3. Duration of warranty or bond.
 - 4. Names, addresses, and telephone numbers and procedures for filing a claim and obtaining warranty services.

1.12 DEFINITIONS

- A. As used in this specification, “provide” means “furnish and install”, “furnish” means “to purchase and deliver to the project Site complete with every necessary appurtenance and support and to store in a secure area in accordance with manufacturers instructions”, and “install” means “to unload at the delivery point at the Site or retrieve from storage, move to point of installation and perform every operation necessary to establish secure mounting and correct operation at the proper location in the Project”.
- B. Finished Areas. In general, areas with carpet or tile floors, lay-in or fixed ceiling tile, special architectural ceiling treatment, or tiled, plastered, or paneled walls shall be considered finished areas.
- C. Interior. For the purposes of this specification, interior is any area within the boundaries of the foundation of any building within the superstructure or other structures not classified as a building.

1.13 TEMPORARY POWER

- A. If applicable, the Contractor shall furnish, install, maintain, and remove the temporary electrical power and lighting systems, including lamps, and pay for all labor, materials, and equipment

required therefore. All such temporary electrical Work shall meet the requirements of the National Electrical Code, the local utility company, and OSHA.

- B. The Contractor shall make all necessary arrangements with the local utility company as to where the temporary electric service can be obtained.
- C. The Contractor shall secure and pay for all required permits and back charges for Work performed by others, and other expenses incidental to the installation of the temporary electric service.

1.14 POSTED OPERATING INSTRUCTIONS

- A. Provide for each system and principal item of equipment as specified in the technical sections for use by operation and maintenance personnel. The operating instructions shall include the following:
 - 1. Wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment.
 - 2. Start up, proper adjustment, operating, lubrication, and shutdown procedures.
 - 3. Safety precautions.
 - 4. The procedure in the event of equipment failure.
 - 5. Other items of instruction as recommended by the manufacturer of each system or item of equipment.
- B. Print or engrave operating instructions and frame under glass or in approved laminated plastic. Post instructions where directed. For operating instructions exposed to the weather, provide weather-resistant materials or weatherproof enclosures. Operating instructions shall not fade when exposed to sunlight and shall be secured to prevent easy removal or peeling.

1.15 MANUFACTURER'S NAMEPLATE

- A. Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

1.16 FIELD FABRICATED NAMEPLATES

- A. Provide laminated plastic nameplates for each equipment enclosure, relay, switch, and device; as specified in the technical sections or as indicated on the Drawings. Each nameplate inscription shall identify the name of the equipment, function and, when applicable, the position. Nameplates shall be melamine plastic, 0.125 inch thick, black with white letters. Surface shall be matte finish. Corners shall be square. Accurately align lettering and engrave into the core. Minimum size of nameplates shall be one by 2.5 inches. Lettering shall be a minimum of 0.25 inch high normal block style. All electrical equipment shall be labeled with the following:
 - 1. Panel Name
 - 2. Fed from "Panel Name" & "CKT #"
 - 3. Amps
 - 4. Volts
 - 5. Phase

1.17 ARC FLASH LABEL

- A. Provide arc flash labels for all electrical equipment with operating voltages greater than 50 volt per NEC 110.16.

1.18 WARNING SIGNS

- A. Exterior warning and caution signs shall be weather resistant, nonfading, preprinted cellulose acetate butyrate signs with 20 gauge, galvanized steel backing, with colors, legend, and size appropriate to the location.
- B. Interior warning and caution signs shall be aluminum signs with preprinted baked enamel finish and punched for fasteners. Colors, legend, and size appropriate to location.

1.19 WIRE AND CABLE MARKERS

- A. Underground line marking tape shall be permanent, bright colored, continuous printed, metal backed, plastic tape compounded for direct burial service not less than 6 inches wide. Printed legend indicative of general type of underground line below.
- B. Wire labels for wires smaller than No. 4. shall be vinyl or vinyl cloth, self-adhesive, wraparound, wire markers with preprinted numbers and letters. Wire sizes No. 4 and larger and multi conductor cables shall be marked with one-piece, nylon locking marker ties equal to Panduit PLM Series.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Materials and equipment shall be listed by UL unless it can be demonstrated that no UL standards exist for a specific item or class of equipment.
- B. All other materials, not specifically described but required for a complete and operable electrical installation, shall be new, first quality of their respective kinds, specification grade or better, and as selected by the Contractor subject to the acceptance by the Engineer.
- C. All materials and equipment furnished and installed on this project shall meet the most stringent efficiency standards of the local utility to qualify for the maximum rebate.

2.02 MATERIAL AND CONSTRUCTION REQUIREMENTS

- A. Unless otherwise shown or specified, all enclosures, motors, wiring and other materials and all construction methods shall conform to the following:
 - 1. Indoor, Above Ground, Dry Areas - NEMA 1, General Purpose, with gasketing for applications where atmospheric conditions are normal. Enclosures shall be sheet steel, treated to resist corrosion, prime painted and finished with a gray baked-on enamel.

2.03 INTERCHANGEABILITY

- A. In all design and purchasing, interchangeability of items of equipment, subassemblies, parts, motors, starters, relays and other items is essential. All similar items shall be of the same manufacturer, type, model and dimensions.
- B. For ease of maintenance and parts replacement, to the maximum extent possible, use equipment of a single manufacturer.
- C. The Engineer reserves the right to reject any submittal which contains equipment from various manufacturers if suitable materials can be secured from fewer manufacturers and to require that source of materials be unified to the maximum extent possible.

PART 3 - EXECUTION

3.01 COORDINATION

- A. Prior to all Work of this section, carefully inspect the installed Work of all other trades and verify that all such Work is complete to the point where this installation may properly commence.
- B. Field verify all locations and dimensions to ensure that the equipment will be properly located, readily accessible, and installed in accordance with all pertinent codes and regulations, the Contract Documents, and the referenced standards.
- C. The Work shall be carefully laid out in advance, and where cutting, drilling, etc., of floors, walls, ceilings, or other surfaces is necessary for the proper installation, this Work shall be carefully done, and any damage to building, piping, or equipment shall be repaired by skilled mechanics of the trades involved at no additional cost to the Owner.
- D. In the event any discrepancies are discovered, immediately notify the Owner's Representative in writing. Do not proceed with installation in areas of discrepancy until all such discrepancies have been fully resolved.

3.02 INSTALLATION

- A. Install all equipment and fixtures in complete accordance with the manufacturer's recommendations and all pertinent codes and regulations.
- B. Thoroughly inspect all items of equipment and any items dented, scratched, or otherwise damaged in any manner shall be replaced or repaired and painted to match original finish. All items so repaired and refinished shall be brought to the attention of the Engineer for inspection and acceptance.
- C. Coordinate the installation of required supporting devices and sleeves to be set in poured-in-place concrete or supported from or on other structural components, as they are constructed.
- D. Sequence, coordinate, and integrate installations of electrical materials and equipment for efficient flow of the Work. Give particular attention to large equipment requiring positioning prior to closing in the building and equipment which must be placed in service before further construction can take place.
- E. Where mounting heights are not detailed or dimensioned, install systems, materials, and equipment to provide the maximum headroom possible.

- F. The final routing of raceways shall be determined by structural conditions, interferences with other trades and by terminal locations on apparatus. The Engineer reserves the right of a reasonable amount of shifting at no extra cost up until time of roughing in the Work.
- G. Where circuits are shown as "home-runs" all necessary fittings and boxes shall be provided for a complete raceway installation.
- H. In general, wiring and raceway systems for security alarm, fire alarm, telephone and intercommunications systems are not indicated on the Drawings but shall be furnished and installed under this section.
- I. Each lighting and each receptacle circuit shall have its own neutral, dedicated to that circuit. A common neutral for more than one signal phase circuit is not allowed.
- J. Surface mounted panel boxed, junction boxes, conduits, etc., shall be supported by spacers to provide a clearance between wall and equipment.
- K. Upon completion of all installation, lamping, and testing, thoroughly inspect all exposed portions of the electrical installation and completely remove all exposed labels, soils, markings and foreign material.

3.03 MARKING AND LABELING

- A. All panelboards, indoor transformers, cabinets, control panels and other specified equipment shall be labeled with engraved laminated plastic plates with engraved letters. Punch tapes with mastic backings are not acceptable.
- B. All starters disconnect switches and other specified equipment shall be marked with engraved laminated plastic plates and engraved letters. Where individual switches are circuit breakers in power or distribution panelboards do not have cardholders, they shall be marked with ½" high labels.
- C. All empty conduits shall have labels tied to the pull string at each end of each empty conduit, marked as to identification of each end. Junction boxes with circuits provided for future use shall be labeled with appropriate circuit designation.
- D. All panelboards directories shall be filled out with typewritten identification of each circuit.

3.04 WIRE AND CABLE MARKERS

- A. Tag control circuit conductors at both ends and at junction box splices using wire and cable markers with identification numbers as designated on equipment wiring diagrams. Provide typed listing to identify conductors by number and use.
- B. Identify spare conductors, individually, at both ends and at junction box splices with number between 1 and 999. Do not duplicate numbers.
- C. Identify wire numbers on terminal block marking strips.

- D. Provide permanent plastic name tag indicating load for each feeder for all junction boxes, handholes and manholes. Label all process motor wires to yard equipment in handholes and manholes.

3.05 TESTS & SETTINGS

- A. Provide the services of an independent Testing Agency to perform the specified tests for the following systems:

- 1. Ground resistance.

The Testing Company shall perform all testing in accordance with National Electrical Testing Association (NETA) standards and procedures. All testing results shall be submitted on NETA forms and the testing data shall be certified by the respective Agency. Test results shall indicate recommended action for a sub-par test results. Results shall list recommended test values that should be obtained for new installation.

- B. Provide necessary material, equipment, labor and technical supervision to perform and complete the Electrical Acceptance Tests as required.
- C. Acceptance tests as herein specified are defined as those tests and inspections required to determine that the equipment involved is acceptable as delivered to the job Site, that the equipment may be energized for final operational tests and is in accordance with the Specifications.
- D. Final acceptance of the equipment and/or workmanship will depend upon performance characteristics as determined by the subject tests, in addition to complete operation tests, on all electrical equipment to show that it will perform the functions for which it was designed.
- E. If the test and inspection data submitted should indicate deficiencies in the operation of the electrical apparatus or in the manufacturer thereof, the Contractor shall promptly implement the necessary adjustments, corrections, modifications and/or replacements necessary to be made to meet the specified requirements.
- F. Upon completion of the remedial Work, the Testing Agency shall repeat all of the tests on components previously found deficient on the first test or any additional test if they be required. It shall be the responsibility and obligation of the Contractor to have all remedial Work accomplished as may be required by second and/or additional tests.

3.06 CLEANING

- A. General. When all Work is completed and has been tested and accepted by the Owner's Representative, the Contractor shall clean all light fixtures, equipment, and exposed surfaces that have been directly affected by this Work. The Contractor, insofar as the Work is concerned, shall at all times keep the premises in a neat and orderly condition and at the completion of the Work shall properly clean up and remove from the Site any excess materials.

END OF SECTION

SECTION 16120 - WIRE AND CABLES

PART 1 – GENERAL

1.01 SCOPE

- A. The Contractor shall provide the labor, tools, equipment, and materials necessary to install wires, cables, and connectors in accordance with the plans and as specified herein.
- B. This section includes wires, cables, and connectors for power, signal, control, and related systems rated 600 volts and less.

1.02 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including all specification sections and Summary of Work shall apply to this section.
- B. Related Sections:
 - 1. Division 16: Section, "Basic Electrical Requirements".

1.03 QUALITY ASSURANCE

- A. Reference Standards:
 - 1. National Fire Protection Association (NFPA) 70 "National Electrical Code (NEC), and Connecticut Electrical Code".
 - 2. Underwriter's Laboratories, Inc. (UL) Compliance.
 - a. UL Standard 83 Thermoplastic Insulated Wires and Cables.
 - b. UL Standard 486A Wire Connectors and Soldering Lugs for Use with Copper Conductors.
 - 3. National Electrical Manufacturers Association (NEMA) Compliance.
 - a. WC-5 Thermoplastic Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.
 - b. WC-7 Cross Linked Thermosetting Polyethylene Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.
 - c. WC-8 Ethylene Propylene Rubber Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.
 - 4. Institute of Electrical and Electronic Engineers (IEEE) Compliance.
 - a. Standard 82 Test Procedure for Impulse Voltage Tests on Insulated Conductors.

1.04 SUBMITTALS

- A. Furnish manufacturer's product data, test reports, and materials certifications as required.
- B. Submit the following in accordance with Conditions of Contract and project specification sections:
 - 1. Product data for electrical wires, cables, and connectors.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver wire and cable properly packaged in factory fabricated type containers, or wound on NEMA specified type wire and cable reels.
- B. Store wire and cable in clean dry space in original containers. Protect products from weather, damaging fumes, construction debris, and traffic.

PART 2 - PRODUCTS

2.01 MATERIALS

A. General

- 1. Provide factory-fabricated wires of sizes, ampacity ratings, and materials for applications and services indicated. Where not indicated, provide proper wire selection as determined by Installer to comply with project's installation requirements, NEC and NEMA standards. Select from the following UL types those wires with construction features which fulfill project requirements:
- 2. Provide color-coding for phase identification as specified herein.
- 3. Provide factory applied nylon or polyvinyl chloride (PVC) external jackets on wires and cables for pulls in raceways over 100 feet in length, for pulls in raceways with more than three equivalent 90 degree bends, for pulls in conduits underground or under slabs on grade, and where indicated.

B. Building Wiring

- 1. 98 percent conductivity copper.
- 2. 600 volt insulation, type, THWN/THHN, or XHHW.
- 3. Stranded conductor: #14 AWG and larger.
- 4. Minimum branch circuit: #12 AWG.
- 5. Minimum #10 AWG for 120 volt circuits more than 100 feet long.
- 6. Minimum #10 AWG for 277 volt circuits more than 230 feet long.

C. Control Wiring

- 1. Control wiring for digital/discrete signal wiring, shall be 600V, minimum #14AWG, THHN/THWN, copper stranded, unless specifically indicated otherwise.
- 2. Instrument cable for analog signal wiring (4-20mA DC) shall be shielded, 2-conductor, 300 volt rated, minimum #18 AWG, Belden No. 8760, Alpha Wire, or approved equal. Provide 600 volt rated cable where cable occupies the same enclosure and/or raceway with voltages greater than 300 volt as specified below.
- 3. Single Shielded Pair Instrument Cable.
 - a. Tinned copper, XLPE insulated stranded conductors, No. 18 AWG minimum, twisted pair with overall shield, stranded tinned No. 18 AWG copper drain wire and overall PVC jacket. Rated for 600 volts minimum and conforming to UL 1581. Cables shall be rated for tray cable "TC" use where installed within a cable tray.

1. Beldon Company.
 2. Okonite Company.
 3. Dekoron Wire and Cable Company.
4. Multi-paired Shielded Instrument Cable.
- a. Tinned copper, XLPE insulated stranded conductors, No. 16 AWG minimum, twisted pairs with shield over each pair, stranded tinned No. 18 AWG copper drain wire, and overall PVC outer jacket. Rated for 600 volts minimum and conforming to UL 1581 or UL 13. Cables shall be rated for tray cable "TC" use where installed within a cable tray.
1. Beldon Company.
 2. Okonite Company.
 3. Dekoron Wire and Cable Company.

D. Splices

1. No. 10 and smaller with 600-volt pressure type insulated connector of wire-nut type, or equal; soldered and crimped type not allowed. Ideal type "wire nut" Buchanan type "B-Cap" and Minnesota Mining (3M) type "Scotchlok".
2. No. 8 and larger with solderless lugs or solderless connectors of Lock-tite or similar type properly taped with plastic insulating tape, Minnesota Mining Co. #33, or equal, then two half-lap servings of friction tape, Manson, or equal.'
3. Wire connector systems for use with underground conductors shall be UL listed specifically for such use.
4. Service entrance conductors shall be installed without splices. Electrical equipment feeders shall be spliced only where shown or specifically approved. Control and metering conductors shall be installed without splices.
5. All splices shall be made only by specific permission of the Engineer and then only in manholes or pull boxes and shall be sealed watertight with a heat-shrunk insulation.
6. Tighten electrical connectors and terminals in accordance with manufacturer's published torque tightening values. Where manufacture's torqueing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Standards 486A and 486B.
7. Use UL listed splice for all underground wires, ducts buried, in conduit and in ducts. Connectors and splices shall be waterproof.

PART 3 – EXECUTION

3.01 WIRE AND CABLE INSTALLATION

- A. All wire and cables shall be installed in conduit of size and type indicated on the drawing and specifications.

- B. Install electrical cables, wires, and connectors in compliance with NEC.
- C. Pull conductors simultaneously where more than one is being installed in same raceway. Use UL listed pulling compound or lubricant, where necessary.
- D. Use pulling means including, fish tape, cable, rope, and basket weave wire/cable grips which will not damage cables or raceways. Do not use rope hitches for pulling attachment to wire or cable.
- E. Conceal all cable in finished spaces.
- F. Install exposed cable parallel and perpendicular to surfaces or exposed structural members, and follow surface contours, where possible.
- G. Conductors shall be sized such that voltage drop does not exceed 3 percent for branch circuits or 5 percent for feeder/branch circuit combination.
- H. Provide adequate length of conductors within electrical enclosures and train the conductors to terminal points with no excess. Bundle multiple conductors, with conductors larger than No. 10 AWG cabled in individual circuits. Make terminations so there is no bare conductor at the terminal.
- I. All feeder and branch circuit wiring shall be color coded at all termination and splice locations. System neutrals shall be designated in addition to phase conductors. Equipment grounds shall be green.
- J. The number of conductors shown on the Drawings is not necessarily the correct number required. As many conductors as are required in each case shall be installed. In general, grounding conductors are not scheduled.
- K. In general, wiring for the following systems shall be installed in separate conduits. Do not mix categories in a single raceway.
 - 1. 120 volt power wiring.
 - 2. 120 volt control wiring, including, digital input and output signals.
 - 3. 24 volt DC control wiring, including, digital input and output signals.
 - 4. 24 volt DC analog control wiring (4-20mA).
 - 5. Communications wiring.
 - 6. Special & Emergency Systems
- L. Conductors 600 volts and below shall be color coded in accordance with the following:

<u>CONDUCTOR</u>	120/240V <u>COLOR</u>
Phase A	Black
Phase B	Orange (High Leg)
Phase C	Black
Neutral	White
Equipment Grounds	Green Green

3.02 FIELD QUALITY CONTROL

- A. The Contractor shall test each electrical circuit after permanent cables are in place with terminators installed, but before cable or wire is connected to equipment or devices to demonstrate that each circuit is free from improper grounds and short circuits.

END OF SECTION

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SECTION 16130 – RACEWAYS, BOXES AND SUPPORTING DEVICES

PART 1 - GENERAL

1.01 SCOPE

- A. The Contractor shall provide the labor, tools, equipment, and materials necessary to furnish and install raceways, boxes and supporting devices in accordance with the plans and as specified herein.
- B. Types of products specified in this section include:
 - 1. Conduit, Raceways & Fittings
 - 2. Supporting Devices.
 - 3. Boxes and fittings.

1.02 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including all specification sections and Summary of Work shall apply to this section.
 - 1. Division 16: Section, "Basic Electrical Requirements".
 - 2. Division 16: Section, "Wire & Cables".

1.03 QUALITY ASSURANCE

- A. Reference Standards
 - 1. Underwriter's Laboratories, Inc. (UL) Listing and Labeling. Items provided under this section shall be listed and labeled by UL.
 - 2. National Electrical Code (NEC).
 - 3. Connecticut Electrical Code (CEC).
 - 4. National Electrical Manufacturers Association (NEMA).

1.04 SUBMITTALS

- A. Furnish manufacturer's product data, test reports, and material certifications as required.
- B. Submit the following in accordance with Conditions of Contract and project specification sections:
 - 1. Product data for raceways, boxes and supporting devices

PART 2 - PRODUCTS

2.01 CONDUIT, RACEWAYS & FITTINGS

- A. Provide conduit with 3/4-inch minimum diameter.
- B. Conduit, connectors, and fittings shall be approved for the installation of electrical conductors.
- C. All raceways used in the project shall be the following:
 - 1. Electrical Metallic Tubing (EMT)
 - a. EMT shall be rigid metallic conduit of the thinwall type in straight lengths, elbows, or bends and must conform to NEMA C80.3 and the requirements of UL 797.
 - b. Couplings and connectors shall be steel compression fittings. Where EMT enters outlet boxes, cabinets, or other enclosures, connectors must be the insulated-throat type, with a locknut. Fittings must meet the requirements of NEMA FB 1.
 - 2. Flexible Metallic Conduit
 - a. Flexible metallic (FM) conduit shall meet the requirements of UL 1.
 - b. Liquidtight flexible metallic conduit shall be provided with a protective jacket of PVC extruded over a flexible interlocked galvanized steel core to protect wiring against moisture, oil, chemicals, and corrosive fumes.
 - c. Fittings for flexible metallic conduit shall meet the requirements of UL 514B, Type I box connector, electrical, Type III coupling, electrical conduit, flexible steel, or Type IV adapter, electrical conduit.
 - 3. Wireways
 - a. Wireways and auxiliary gutters for use in exposed, dry locations shall be a prefabricated channel-shaped sheet metal trough with hinged or removable covers, associated fittings, and supports for housing, and protecting electrical wires and cables in accordance with UL 870.
 - b. Straight sections of trough, elbows, tees, crosses, closing plates, connectors, and hanging brackets shall be constructed from sheet steel of commercial quality not less than 16-gage. Sheet metal component parts shall be cleaned, phosphatized, and coated with a corrosion-resistant gray paint.
 - c. Straight sections of wireways and auxiliary gutters shall be solid or have knockouts as indicated in both sides and bottom, 3 inches on center.
 - d. Straight sections shall be not more than 5-feet long, with covers held closed with screws.

2.02 SUPPORTING DEVICES

- A. Supports, support hardware, and fasteners shall be protected with zinc coating or with treatment of equivalent corrosion resistance using approved alternative treatment, finish, or inherent material characteristic. Products for use outdoors shall be hot dip galvanized unless material is inherently corrosion resistant.
- B. Conduit Supports shall meet the following requirements:

1. Conduit Supports

- a. Single run hangers: Galvanized steel conduit straps or clamps, or cast metal beam clamps. Perforated straps and spring steel clips and clamps will not be permitted.

2. Equipment Supports

- a. U-channel: 12-gauge galvanized perforated U-channel struts with fixture and conduit fittings, as applicable, unless indicated otherwise on the Drawings.

2.03 BOXES AND FITTINGS

- A. Boxes must have sufficient volume to accommodate the number of conductors entering the box in accordance with the requirements of NFPA 70 and UL 514A.

- B. Sheet Metal and Junction Boxes shall meet the following requirements:

1. Sheet Metal Pull & Junction Boxes

- a. Sheet metal boxes shall be standard type galvanized steel and must conform to UL 50.
- b. Box dimensions shall be minimum four inch square or octagon by 2/1/2 inch deep.
- c. Sizes up to 12x12x6 inch: Provide screw-type or hinged covers.
- d. Sizes greater than 12x12x6 inch: Provide hinged covers.
- e. Boxes shall be sized to accommodate all incoming raceways and be NEMA 1 rated.

PART 3 – EXECUTION

3.01 CONDUIT

A. Uses Permitted

1. Use liquid tight flexible metal conduit for the final 24 inches of connections to generator or control items subject to movement or vibration.

- B. Any run of conduit between outlet and outlet, between fitting and fitting, or between outlet and fitting shall contain not more than the equivalent of three 90-degree bends, including those bends located immediately at the outlet or fitting. Field bends shall be made in accordance with the manufacturer's recommendations, which normally require use of a one-size-larger bender than would be required for uncoated conduit. Installed conduit and fittings shall be free of dirt and trash and shall not be deformed or crushed. Empty conduit shall have a pull rope stalled.

- C. Conduit shall be installed with a minimum of 3 inches of free air space separation from mechanical piping.

- D. Install exposed conduits, parallel or perpendicular to walls, ceilings, or structural members. Do not run through structural members. Avoid horizontal runs within partitions or sidewalls. Avoid ceiling inserts, lights, or ventilation ducts or outlets. Do not run conduits across pipe shafts or ventilation duct openings and keep conduits a minimum of 6 inches from parallel runs of flues, hot water pipes, or other sources of heat
- E. Do not run conduits exposed on the exterior surface of buildings. Conduits penetrating exterior walls below grade, at grade floors, or below grade floors shall be sealed to prevent moisture migration. The exterior of the conduit shall be sealed with a mechanical pipe seal. The interior conduit seal shall be a gland type sealing bushing or RTV closed cell silicone foam. Ensure that conduits do not retain water against these seals.
- F. All conduits shall be supported with materials specifically made for this purpose. Does not use wire hangers. Do not attach any parts of the raceway system to ventilation ducts. Conduit supports shall be attached to the building. Support conduits on each side of bends and on a spacing not to exceed the following: 6 feet for conduits smaller than 1 1/4 inches and 8 feet for conduits 1 1/4 inches and larger. Support riser conduits at each floor level with clamp hangers. All underground conduits shall be securely anchored to prevent movement during placement of concrete or backfill. Use precast separators and heavy gauge wire ties or other approved fasteners.
- G. Conduit connections to boxes and fittings shall be supported not more than 36 inches from the connection point. Conduit bends shall be supported not more than 36 inches from each change in direction. Conduit shall be installed in neat symmetrical lines parallel to the centerlines of the building construction and the building outline. Multiple runs shall be parallel and grouped whenever possible on common supports. Exposed ends of conduit without conductors shall be sealed with watertight caps or plugs.
- H. Bonding wires shall be used in flexible conduit for all circuits. Flexible conduit shall not be considered a ground conductor.
- I. Liquid tight flexible metallic conduits shall be used in wet and oily locations and to complete the connection to motor-driven equipment.
- J. Electrical connections to vibration-isolated equipment shall be made with flexible metallic conduit in a manner that will not impair the function of the equipment.
- K. A polypropylene pull rope with a tensile strength not less than 130 pounds shall be installed in empty conduit.

3.02 SUPPORTING DEVICES:

- A. Install supporting devices to fasten electrical components securely and permanently in accordance with NEC requirements.
- B. Coordinate with the building structural system and with other electrical installations.
- C. Conform to manufacturer's recommendations for selection and installation of supports.

- D. Install individual and multiple (trapeze) raceway hangers and riser clamps as necessary to support raceways. Provide U-bolts, clamps, attachments, and other hardware necessary for hanger assembly and for securing hanger rods and conduits.
- E. Support individual horizontal raceways by separate pipe hangers. Spring steel fasteners may be used in lieu of hangers only for 1 1/2 inch and smaller raceways serving lighting and receptacle branch circuits above suspended ceilings only. For hanger rods with spring steel fasteners, use 1/4 inch diameter or larger threaded steel. Use spring steel fasteners that are specifically designed for supporting single conduits or tubing.
- F. In vertical runs, arrange support so the load produced by the weight of the raceway and the enclosed conductors is carried entirely by the conduit supports with no weight load on raceway terminals.
- G. Support miscellaneous electrical components as required to produce the same structural safety factors as specified for raceway supports. Install metal channel racks for mounting cabinets, panelboards, disconnects, control enclosures, pull boxes, junction boxes, transformers, and other devices.

3.03 BOXES AND FITTINGS:

- A. Pullboxes shall be furnished and installed where necessary in the conduit system to facilitate conductor installation. Conduit runs longer than 100 feet or with more than three right-angle bends shall have a pull box installed at a convenient intermediate location.
- B. Boxes and enclosures shall be securely mounted to the building structure with supporting facilities independent of the conduit entering or leaving the boxes.
- C. Bonding jumpers shall be used around concentric or eccentric knockouts.
- D. Installation of Pull and Junction Boxes:
 - 1. Use general purpose boxes (NEMA 1) in finished areas with framed construction.

END OF SECTION

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SECTION 16210 - STANDBY POWER SYSTEM

PART 1 - GENERAL

1.01 SCOPE

- A. The work included under this section shall include the installation of a new standby power system as indicated in the Project Specifications and Summary of Work.
- B. The CONTRACTOR shall provide the labor, tools, equipment, and materials necessary to install a complete standby power system in accordance with the Project Specifications. The work shall include but not be limited to the following:
 - 1. Engine/Generator Set.
 - 2. Automatic Transfer Switch.

1.02 RELATED DOCUMENTS

- A. Division 16: Section, "Basic Electrical Requirements".
- B. Division 16: Section, "Wire and Cables".
- C. Division 16: Section, "Raceways, Boxes and Supporting Devices".

1.03 QUALITY ASSURANCE

- A. Reference Standards.
 - 1. National Electrical Code (NEC) Compliance. NEC Article 700.
 - 2. American National Standards Institute National Electrical Manufacturers Association (ANSI/NEMA) Compliance. ANSI/NEMA MG 1.
 - 3. Institute of Electrical and Electronic Engineers (IEEE) Compliance. IEEE Standard.
 - 4. State and Local Code Compliance. All applications, permits, fees, and licenses for the installation shall be submitted, secured, and paid for by the Contractor.
- B. Qualifications
 - 1. Firms regularly engaged in manufacture of engine driven standby generator systems of types, ratings, and characteristics indicated herein and on the drawings.
- C. General Requirements
 - 1. It is the intent of this specification to secure a complete standby power system that has been tested during design verification, production and at the final job site. All finished equipment shall be of the latest commercial design and shall be complete with all of the necessary accessories for complete installation as shown on , but not limited to, the plans, drawings, and as specified herein. The equipment supplied and installed shall meet the requirements of the National Electrical Code, along with all applicable local code and state regulations. All equipment shall be new and of current production of a national firm that manufactures generator sets and controls, transfer switches, and assembles them as a complete and

coordinated system. There shall be only one source responsibility for the warranty, parts, and service through a local representative with factory-trained servicemen.

D. Testing

1. Design Prototype Tests: Components of the standby power system such as the engine/generator set, transfer switch, and accessories shall not be subjected to prototype tests since the tests are potentially damaging. Rather, similar design prototypes and preproduction models shall be subject to the following tests:
 - a) Maximum power (kW).
 - b) Alternator temperature rise by embedded thermocouple and/or by resistance method per NEMA MG1-32.40.
 - c) Governor speed regulation under steady-state and transient conditions.
 - d) Voltage regulation and generator transient response.
 - e) Harmonic analysis, voltage waveform deviation, and telephone influence factor.
 - f) Three-phase short circuit tests.
 - g) Alternator cooling air flow.
 - h) Torsional analysis to verify that the generator set is free of harmful torsional stresses.
 - i) Endurance testing.
2. Factory/Production Tests: Prior to shipment, the unit shall be factory performance tested and performance assurance certified. A written report of this test shall be forwarded to the Engineer for acceptance prior to shipment. Each generator set shall be tested under varying loads with guards and exhaust system in place. Tests shall include:
 - a) Single-step load pickup.
 - b) Transient and steady—state governing.
 - c) Safety shutdown device testing.
 - d) Voltage regulation.
 - e) Rated Power @ 0.8 PF
 - f) Maximum Power.
 - g) The complete automatic transfer switch shall be tested to ensure proper operation of the individual components and correct overall sequence of operation and to ensure that the operating transfer time, voltage, frequency, and time delay settings are in compliance with the specification requirements.
 - h) The complete automatic transfer switch shall be subjected to a dielectric strength test per NEMA Standard ICS 1-109.05.
 - i) The control panel shall meet or exceed the voltage surge withstand capability in accordance with ANSI C37.90a-2978 and the impulse withstand voltage test in accordance with NEMA Standard ICS 1-109.
3. Field Tests: An installation check, start-up, and building load test shall be performed by the manufacturer's local representative. The engineer, owner, and the maintenance staff shall be notified of the time and date of the site test. The tests shall include:
 - a) Fuel, lubricating oil, and antifreeze shall be checked for conformity to the manufacturer's recommendations, under the environmental conditions present and expected.

- b) Accessories that normally function while the set is standing by shall be checked prior to cranking the engine. These shall include: block heaters, battery charger, alternator strip heaters, etc.
 - c) Start-up under test mode to check for exhaust leaks, path of exhaust gases outside the building, cooling air flow, movement during starting and stopping, vibration during running, normal and emergency line-to-line voltage and frequency, and phase rotation.
 - d) Automatic start-up by means of simulated power outage to test remote-automatic starting, transfer of the load, and automatic shutdown. Prior to this test, all transfer switch timers shall be adjusted for proper system coordination. Engine coolant temperature, oil pressure, and battery charge level along with generator set voltage, amperes, and frequency shall be monitored throughout the test. An external load bank shall be connected to the system if sufficient building load is unavailable to load the generator set to the nameplate kW rating.
- E. Manufacturer's Product Warranty: A two year comprehensive warranty for the generator set and automatic transfer switch shall be included to guarantee against defective material and workmanship in accordance with the manufacturer's published warranty from date of start-up. Optional warranties shall be available upon request.

1.04 SUBMITTALS

- A. Furnish manufacturer's product data, test reports, and materials certifications as required.
- B. Submit the following in accordance with conditions of contract and Project Specification sections:
 - 1. Submit a list of materials giving quantities, manufacturer's name, and catalog numbers.
 - 2. Submit manufacturer's technical product data sheets on all equipment to be furnished.
 - 3. Submit drawings that show dimensional layouts of the engine/generator set and its spatial relationship to associated equipment. Fabrication and installation shall be in accordance with the approved shop drawings.
 - 4. Submit wiring diagrams for the engine/generator set and transfer switch showing connections to feeders, and accessory equipment. Clearly differentiate between portions of the wiring that are manufacturer installed and portions to be field wired.
 - 5. Factory Test Report. Results of the required factory test shall be submitted to and approved by the Engineer prior to shipment.
 - 6. Field Test Report. Certified copies of the field test procedures and results shall be forwarded to the Owner's Representative.

PART 2 - PRODUCTS

2.01 GENERATOR

A. Town Bridge Road Pump Station:

1. The generator set shall provide 30 kW, 38 kVA, 91 Amps when operating at 240 volts, 3-phase, 3-wire Delta configured at 0.8 power factor and 1800 rpm. The generator set shall be capable of this rating while operating in an ambient condition of 77°F (25°C) and an altitude of 350 ft.
2. The generator set shall be based on emergency/standby service.
3. Vibration isolators shall be provided between the engine-alternator and heavy-duty steel base

2.02 GENERATOR ENGINE AND COMPONENTS

- A. The generator engine shall be Liquid Propane Gas (Vapor), 4 cycle, and radiator and fan cooled. The horsepower of the engine and its minimum tolerance level shall be sufficient to drive the alternator and all connected accessories. The engine shall be equipped with the following:
1. An electronic isochronous governor capable of +0.5% steady-state frequency regulation.
 2. 12 Volt positive engagement solenoid shift-starting motor.
 3. 70-Ampere minimum automatic battery charging alternator with solid-state voltage regulation.
 4. Positive displacement, full pressure lubrication oil pump, cartridge oil filters, dipstick, and oil drain.
 5. Dry-type replaceable air cleaner elements for normal applications.
- B. Engines shall be supplied with a unit-mounted electric solenoid fuel shut-off valve, flexible fuel line, and secondary fuel pressure regulator.
- C. Engines shall have a minimum of 4 cylinders, and be liquid-cooled by a unit-mounted radiator, blower fan, water pump, and thermostats. This system shall properly cool the engine with up to 0.5 inches H₂O static pressure on the fan in an ambient temperature up to 122F/50C.

2.03 GENERATOR ALTERNATOR

- A. The alternator shall be a brushless type alternator with an auxiliary power brushless exciter design. The exciter field shall include a rare earth neodymium-iron-boron permanent magnet. This powerful magnet is incorporated to assure positive field flashing at startup. The excitation system shall be powered by an auxiliary stator winding that is independent of the main output winding and dedicated solely for field excitation. In one step load and short circuit fault conditions, the power to the field shall be boosted to provide strong recovery or sustained short circuit current support to clean downstream circuit breakers.
- B. Arrange generator connections so that system neutral is not internally grounded to generator frame. Coordinate with switchgear and transfer switch supplier to obtain reliable grounding and ground fault protection.

- C. The alternator shall be salient-pole, brushless, 12-lead reconnectable, self-ventilated of drip-proof construction with amortisseur rotor windings and skewed stator for smooth voltage waveform for possible re-connection to a 208 volt Wye system at a later date. The insulation shall meet the NEMA standard (MG1-32.40) for Class H and be insulated with epoxy varnish to be fungus resistant per MIL 1-24092. Temperature rise of the rotor and stator shall be limited to 130°C. The excitation system shall be of brushless construction controlled by a solid-state voltage regulator capable of maintaining voltage within +/- .25% at any constant load from 0% to 100% of rating. The regulator must be isolated to prevent tracking when connected to SCR loads, and provide individual adjustments for voltage range, stability and volts-per-hertz operations; and be protected from the environment by conformal coating.
- D. The generator set shall meet the transient performance requirements of ISO 8528-5, level G-2.
- E. The generator shall be inherently capable of sustaining at least 250% of rated current for at least 10 seconds under a 3-phase symmetrical short circuit without the addition of separate current support devices.
- F. The alternator having a single maintenance-free bearing, shall be directly connected to the flywheel housing with a semi-flexible coupling between the rotor and the flywheel.
- G. The alternator shall have a 120°C maximum temperature rise above 40°C ambient and have a motor starting KVA at 90 percent sustained voltage of 135 KVA.

2.04 GENERATOR CONTROLLER

- A. Set-mounted controller capable of facing right, left, or rear, shall be vibration isolated on the alternator enclosure. The controller shall be capable of being remote-mounted. The microprocessor control board shall be moisture proof and capable of operation from -40°C to 85°C. Relays will only be acceptable in high-current circuits.
- B. Circuitry shall be of plug-in design for quick replacement. Controller shall be equipped to accept a plug-in device capable of allowing maintenance personnel to test controller performance without operating the engine. The controller shall include the following features:
 1. Fused DC circuit.
 2. Complete 2-wire start/stop control, which shall operate on closure of a remote contact.
 3. Speed sensing and a second independent starter motor disengagement systems shall protect against starter engagement with a moving flywheel. Battery charging alternator voltage will not be acceptable for this purpose.
 4. The starting system shall be designed for restarting in the event of a false engine start, by permitting the engine to completely stop and then re-engage the starter.
 5. Cranking cyclers with 15-second ON and OFF cranking periods.
 6. Overcrank protection designed to open the cranking circuit after 75 seconds if the engine fails to start.
 7. Circuitry to shut down the engine when signal for high coolant temperature, low oil pressure, or overspeed are received.
 8. Engine cooldown timer factory set at 5 minutes to permit unloaded running of the standby set after transfer of the load to normal.
 9. 3-position (Automatic-OFF-TEST) selector switch. In the TEST position, the engine shall start and run regardless of the position of the remote starting contacts. In the Automatic position, the

engine shall start when contacts in the remote control circuit close and stop 5 minutes after those contacts open. In the OFF position, the engine shall not start even though the remote start contacts close. This position shall also provide for immediate shutdown in case of an emergency. Reset of any fault shall also be accomplished by putting the switch to the OFF position.

10. Alarm horn with silencer switch per NFPA 110.

C. Standard indicating lights to signal the following shall be included:

1. Not-in-Auto (flashing red)
2. Overcrank (red)
3. Emergency Stop (red)
4. High Engine Temperature (red)
5. Overspeed (red)
6. Low Oil Pressure (red)
7. Battery Charger Malfunction (red)
8. Low coolant level (red)
9. High Battery Voltage (red)
10. Low Battery Voltage (red)
11. Low Fuel (red)
12. Auxiliary Prealarm (yellow)
13. Auxiliary Fault (red)
14. System Ready (green)

D. Test buttons for indicating lights.

E. Terminals shall be provided for each indicating light above, plus additional terminals for common fault and common prealarm.

2.05 INSTRUMENT PANEL

A. The instrument panel shall include the following:

1. Dual range voltmeter 3 1/2-inch, +/- 2% accuracy
2. Dual range ammeter 3 1/2-inch, +/- 2% accuracy.
3. Voltmeter-ammeter phase selector switch.
4. Lights to indicate high or low meter scale.
5. Direct reading pointer-type frequency meter 3 1/2-inch, 0.5% accuracy, 45 to 65 Hz scale.
6. Panel-illuminating lights.
7. Battery charging voltmeter.
8. Coolant temperature gauge.
9. Oil pressure gauge.
10. Running-time meter.
11. Voltage-adjust rheostat

2.06 GENERATOR ACCESSORIES

A. The generator shall be furnished with a 100A, 3pole, unit mounted 100% rated main line circuit breaker, molded case type provided by the manufacturer. Each circuit breaker shall be furnished with an electronic trip unit that operates to protect the alternator under all overcurrent conditions, or

a thermal magnetic trip with other overcurrent protective devices that positively protect the alternator under overcurrent conditions.

- B. Engine block heater. Thermostatically controlled and sized to maintain manufacturers recommended engine coolant temperature to meet the start-up requirements of NFPA-99 and NFPA-110, Level 1. Provide 120VAC powered engine block heater.
- C. Battery rack, and battery cables, capable of holding the manufacturer's recommended batteries, shall be supplied.
- D. 12-volt lead-antimony battery(ies) capable of delivering the manufacturer's recommended minimum cold-cranking Amps required at 0°F, per SAE Standard J-537, shall be supplied.
- E. 6-Ampere automatic float and equalize battery charger with +/- 1% constant voltage regulation from no load to full load over +/-10% AC input line variation, current limited during engine cranking and short circuit conditions, temperature compensated for ambient temperatures from -40°C to +60°C, 5% accurate voltmeter and ammeter, fused, reverse polarity and transient protected.
- F. The engine exhaust silencer shall be coated to be temperature and rust resistance, rated for critical application. The silencer will reduce total engine exhaust noise by 25-35 dB(A).
- G. Gas-proof, seamless, stainless steel, flexible exhaust bellows with threaded NPT connection.
- H. Two flexible fuel lines rated at a minimum of 257°F and 100 psi ending in pipe thread.
- I. Air cleaner restriction indicator to indicate the need for maintenance of the air cleaners.
- J. Run Relay to provide a three-pole, double-throw relay with 10 amps at 250 VAC contacts for indicating that the generator is running.
- K. Common Failure relay to remotely signal auxiliary faults, emergency stop, high engine temperature, low oil pressure, overcrank, and overspeed via one single-pole, double-throw relay with 10 amps at 120 VAC contacts.

2.07 AUTOMATIC TRANSFER SWITCH

- A. An automatic transfer switch with number of poles, voltage and current ratings as shown on the plans and specified herein shall be provided for each generator. Each ATS shall consist of a power transfer switch unit and a control module interconnected to provide complete automatic operation. All equipment shall be new and of current production by an international firm which manufactures the generator, controls, and transfer switch. The company selected will assemble the standby generator set and transfer switch as a matched unit so that there is one-source responsibility for warranty, parts and service through a local representative with factory-trained personnel.
- B. Electrical Requirements:
 - 1. Automatic transfer switches not intended for continuous duty or repetitive load transfer switching are not acceptable.

2. The automatic transfer switch shall be rated in amperes for total system transfer including control of motors, electric-discharge lamps, electric heating, and tungsten-filament lamp load. Switches rated 400 amperes and below shall be suitable for 100% tungsten-filament lamp load. Switches rated above 400 amperes shall be suitable for 30% tungsten-filament load.
 3. The automatic transfer switch shall be rated to withstand the rms symmetrical short circuit current available at the automatic transfer switch terminals, with the type of overcurrent protection shown on the plans.
- C. The transfer switch shall have the following characteristics:
1. Current rating as indicated.
 2. 3 Pole.
 3. 3 wire, 3 phase.
 4. 240 Volt-60Hz.
 5. The withstand and closing ratings with a current-limiting fuse shall be 200,000 Amps.
 6. The withstand and closing ratings with any overcurrent protective device shall be 10,000 Amps.
 7. NEMA 1 Gasketed Enclosure.
 8. The switch shall be a 600 volt class.
- D. Mechanical Requirements:
1. All main contacts shall be of silver composition. The main contacts shall be protected by arcing contacts in sizes 400 amperes and above. The main contacts shall be of the blow-on configuration and of segmented construction in ratings 600 amperes and above.
 2. All contacts, coils, springs, and control elements shall be conveniently removable from the front of the transfer switch without major disassembly or disconnection of power conductors.
 3. The contact transfer time shall not exceed one-sixth of a second.
 4. All moveable parts of the operating mechanism shall remain in positive mechanical contact with the main contacts during the transfer operation without the use of separate mechanical interlocks.
 5. All contacts, coils, springs, and control elements shall be conveniently removable from the front of the transfer switch without major disassembly or disconnection of power conductors.
- E. Transfer Switch Control System
1. The control module shall direct the operation of the transfer switch. The module's sensing and logic shall be a built-in microprocessor-based system for maximum reliability, minimum maintenance, and inherent digital communications capability. The control settings shall be stored in nonvolatile EEPROM. The module shall contain an integral programmable clock and calendar. The control module shall have a keyed disconnect plug to enable the control module to be disconnected from the transfer mechanism for routine maintenance. The control module shall be mounted separately from the transfer mechanism unit for safety and ease of maintenance. Interfacing relays shall be industrial control grade plug-in type with dust cover.

2. The control module shall include programming keypad, alphanumeric display for monitoring settings and diagnostic values, key-lockable program selector switch, light-emitting diode status indication, and user instructions. These features shall be user accessible when the enclosure door is closed.
3. The control module shall be capable of storing the following records in memory for access either locally (at the control module) or remotely (at a computer):
 - a) Number of hours transfer switch is in the emergency position (total and since record reset)
 - b) Number of hours the emergency is available (total and since record reset)
 - c) Total days that control has been energized (total and since record reset)
 - d) Total transfers in either direction (total and since record reset)
 - e) Date of record reset
 - f) Date of last exercise period
 - g) Date, time, and description of the last four source failures
 - h) Elapsed time during the most recent source outage

F. Transfer Switch Operation & Accessories

1. The voltage of each phase of the normal source and a single phase of the emergency source shall be monitored with pickup adjustable from 75% to 100% and dropout adjustable from 70% to 95% of nominal. Adjustment must be digital. An automatic minimum differential of 2% shall be maintained between pickup and dropout settings. Repetitive accuracy of the setting shall be $\pm 2\%$ or better over an operating temperature range of -20oF to 150oF (-29oC to 65.5oC). The settings shall be fully field-adjustable by keypad or keyboard (local or remote) in increments of 1 Volt without opening the enclosure door and without the use of special tools or separate meters. Factory settings shall be pickup at 90% and dropout at 85%. A light-emitting diode shall indicate that normal and/or emergency voltage is within the set point parameter. The indication shall be viewable when the enclosure door is closed.
2. The control module shall include four time delays that are fully field-adjustable by keypad or keyboard in increments of 1 second over the entire range. Adjustments and viewing of the time delay values shall be accessible when the enclosure door is closed. Light emitting diodes shall indicate when the timing feature is running and when the time delay has ended. Required time delays shall be as follows: Input values outside the allowable parameters shall cause a "range error" message to be displayed.
 - a) Time delay for engine start to delay initiation of transfer for momentary source outages: Range 0-6 seconds. Factory set at 5 seconds.
 - b) Time delay for transfer to emergency: Range 0-5 minutes. Factory set at 5 seconds.
 - c) Time delay for transfer back to normal: Range 0-30 minutes. Factory set at 5 seconds.
 - d) Time delay for engine cool-down: Range 0-30 minutes. Factory set at 5 seconds.
3. The user shall have the ability to manually program an engine start and run for a period of up to 72 hours in the loaded or unloaded mode of operation. The time delay transfer to emergency and/or normal may be bypassed during the run period. A numeric indication shall be displayed of the run time remaining in hours and minutes. The run period may be stopped at any time with a single keystroke. After the run period has stopped, the engine shall run unloaded for the cool-down time.

4. User terminals shall be available to connect a normally closed contact that, when opened, signals the control module to start and transfer load to the engine-generator. Closing these contacts shall initiate a retransfer and engine cool-down sequence. The load shall be transferred to an available utility source immediately if the generator source should fail.
5. The following features shall be built into the control module logic. These features shall be enabled at the factory or in the field by installing an insulated program jumper provided by the vendor as standard.
 - a) Anti-single phasing protection shall detect regenerative voltage as a failed source condition.
 - b) In-phase monitoring shall continuously monitor the contactor transfer times, source voltage, frequency and phase angle to provide a self-adjusting, zero crossing contactor transfer signal.
 - c) Manual operation override shall function to bypass any manual switch accessories if the source to which the transfer switch is positioned fails. This program jumper shall be factory installed.
 - d) Plant Exerciser: Programmable seven-day, fourteen-day or calendar exerciser. Each exerciser mode shall be capable of performing up to two exercise runs in up to five exercise event periods. The exerciser period shall be programmed with the enclosure door closed. The exercise time may be reset at any time with a single keystroke. The engine shall be allowed to run when the exercise period is terminated.
 - e) All phases of normal and all or single phases of emergency shall be monitored for overvoltage and single phase of normal and emergency for over- and under-frequency. The values shall be programmed with the enclosure door closed.
 - f) Extended Time Delay: Allows the time delay settings to be extended to 99 minutes.
6. Light emitting diodes shall indicated the following:
 - a) Contactor Position
 - b) Transfer Switch Position Sensing Fault
 - c) Transfer Switch Fail to Transfer
 - d) Internal Control Module Fault
 - e) Manual Transfer Operation
 - f) External Fault Condition (two inputs)
 - g) ATS in Normal
 - h) ATS in Emergency
 - i) Generator Running
 - j) Generator Fault
 - k) Programming Switch Not In Off
 - l) The system status messages shall also be shown on the alphanumeric display.
 - m) A lamp test push button shall light all light-emitting diodes.
7. The control module shall have a three-position, key-operated, programming control switch. The key shall be removable in any position. The positions shall be:

- a) Off--Allows all enabled accessories to be monitored only. Settings cannot be changed while in this position.
 - b) Local--Allows all enabled accessory settings to be changed by local keypad entry.
 - c) Remote--Allows all enabled accessories to be altered via the remote communications port.
8. A momentary-type test switch shall be provided to simulate a normal source failure.
9. The transfer switch shall be able to control up to 12 isolated form C auxiliary contacts rated 5A, 120/240VAC resistive and shall have the following user programmable functions:
- a) Generator source available (within voltage, frequency & phase balance limits)
 - b) Utility and Generator sources available
 - c) Transfer Fail
 - d) Load on Generator
 - e) Generator Failure
 - f) Generator Running
 - g) ATS in normal
 - h) ATS in emergency
10. A set of gold-flashed contacts rated 10 amps, 28VDC shall be provided for a low-voltage engine start signal when the normal source fails.

2.08 ACCEPTABLE MANUFACTURERS

- A. Cummins or Equivalent

PART 3 - EXECUTION

3.01 INSTALLATION

- A. The engine/generator set shall be shipped from the manufacturer completely assembled and ready to operate. The Contractor shall furnish all necessary equipment as required. Provide equipment grounding connections for engine generator unit as indicated and as required.
 - B. Provisions shall be made to monitor the following conditions of the Standby Power System via the facilities SCADA control panel:
 - 1. Generator Failure
 - 2. Generator Running
 - 3. ATS in Normal
 - 4. ATS in Emergency
- 5.
- C. Make all connections between the automatic transfer switch and the generator controller as required and in accordance with manufacturer's recommendations for a complete and operable installation.
 - D. Perform all field tests as identified in part 1 of this section.

*** END OF SECTION ***

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