

 *Technical Specifications*

*Bid Submittal*

**SOUTH OSLO ROAD  
WATER TREATMENT PLANT  
AUTOMATIC TRANSFER SWITCH  
REPLACEMENT**

*Prepared For:*  
Indian River County Utilities Department

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**SECTION 01000**

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**NO SPECIFICATIONS ON THIS PAGE FOR FORMATTING PURPOSES**

**SECTION 01010**  
SUMMARY OF WORK

**PART 1 - GENERAL**

**1.1 WORK COVERED BY THESE CONTRACT DOCUMENTS**

- A. Furnish all labor, equipment and materials necessary to construct all improvement elements at the South Oslo Water Plant described in the plans and these specifications:
  - 1. Installation of temporary ATS, removal of existing ATS, installation of new ATS (low-voltage paralleling switchgear) and planned outages and temporary loads. Sequence of work is provided to minimize WTP shutdowns and provide emergency standby power throughout duration of construction.
  - 2. Except as specifically noted, provide and pay for:
    - a. Mobilization and demobilization.
    - b. Labor, materials, and equipment.
    - c. Tools, construction equipment, and fuel.
    - d. Electric, water and utilities required for construction.
    - e. Freight and sales tax.
    - f. Testing and laboratory services.
    - g. Record Information in electronic form (both AutoCAD and PDF) and a hardcopy. Information will be used by the Engineer for Record Drawing development.

**1.2 CONTRACTS**

- A. Construct the Work under a Lump Sum Price contract in accordance with the contract documents and with the Owner.
- B. Subcontractors (when used) shall work directly for the contractor.

**1.3 WORK BY OTHERS AND FUTURE WORK**

- A. The Owner reserves the right to add to the work in accordance with the Contract Documents.
- B. The Owner reserves the right to direct purchase significant pieces of equipment and/or materials included in this contract by means of a deductive Change Order to this Contract and issuance of a Purchase Order to the supplier or vendor of the equipment or materials for the purpose of the sales tax end use savings.

**1.4 WORK SEQUENCE**

- A. Procedure to install temporary ATS, removal of existing transfer switch, install of new transfer switchgear and planned outages and temporary loads.
- B. Proposed sequence of construction listed below, it assumes that proper steps and safety measures are taking place, including:
  - 1. Contractor shall submit summary of all steps for review and approval in preparation for each phase/step.
  - 2. Planned all scheduled FPL outages and internal plant equipment outages with WTP personnel and engineer.
  - 3. Procedures for tag and lock out breakers and switches during each of the steps

4. Procedures for checking proper torque of lugs when landing temporary or permanent wires.
  5. After completing each step proper checking procedures are in place before proceeding to the next step.
  6. All OSHA requirements including personnel wearing proper PPE protective gear.
  7. Procedure to make removed wire ends that are disconnected be made safe with proper temporary insulation.
  8. Procedures to lay temporary cables away from heavy traffic areas and properly secured.
- C. The following sequence of work is provided:
1. Contractor shall place, in close proximity to northern exterior wall of electrical room, the rented 1200A, 480V 3 phase ATS switch.
  2. Contractor shall install parallel so cord cables at the rented ATS emergency and normal breaker lugs.
  3. Contractor shall also provide #12 control wiring pairs between rented ATS and the generator controls.
  4. Contractor shall have coordinated with FPL personnel and WTP personnel to then carry on a scheduled shut down of the FPL service transformer.
  5. In preparation of such a power shut down the existing GE switchgear shall be placed on generator power. M1 and M2 service breakers shall be open during the planned power outage. Plant will remain on generator power for the majority of the time of the scheduled shutdown.
  6. 1st FPL shut down of the 480V service:
    - a. By FPL crews: disconnect existing M1 and M2 service wires; 5 sets of parallel 600mcm, 250mcm neutral wires from service 1 & service 2.
    - b. Then connect the three sets of parallel SO cord cables from the rented ATS.
    - c. By contractor: disconnected and make safe M1 and M2 5 sets of parallel 600mcm wires and one set of 250mcm wires for each service
    - d. Then proceed to terminate the 4/0 SO cord cables from the rented ATS to M2 breaker line side.
    - e. When this is completed then FPL may energize the 480V transformer. GE switchgear will be ready to go back to normal power via the rented ATS and M2 service.
  7. Entire GE switchgear will go back on normal FPL power via the M2 and tie breaker being closed and feeding the right side bus (formerly fed from m1 breaker)
  8. In order to remove the Lake Shore emergency breaker switchgear all controls, AC and DC power and control circuits from GE switchboard and Cummins generator must be disconnected.
  9. Next, a partial plant shut down will be needed in order to disable the right bus (mcc2 and mcc3 and MDP) of GE switchgear and remove the connections to the Lake Shore transfer breaker
  10. Contractor shall provide temporary SO cord cables to re-feed 800A MDP from right side of GE switchboard to left side of switchboard (this is to minimize down time on critical equipment)
  11. Use spare 1000A breaker along left side of switchboard.
  12. Remove the Lake Shore transfer breaker switchgear and replace this with new dual breakers transfer switchboard.

13. Contractor shall extend via insulated Polaris taps the 5 parallel sets of 600mcm wires and 1 set of 250mcm service wires (formerly going to M1 breaker) to the normal breaker inside the new transfer switchgear.
14. Connect DC battery and control wiring from GE switchgear and Cummins controller.
15. Also, connection from center pole of new transfer switchgear to the right buss.
16. At this time, re-energize the entire 480V buss and prepare to 2nd FPL outage to disconnect rented ATS and connect generator power to new switch, this planned 2nd FPL shut down will not have generator backup to existing switchboard, so complete plant shutdown with no power (max of 8 hours) will be needed.
17. Contractor shall provide emergency power to have inside electrical room some lighting and provide some portable fans for cooling
18. 2nd FPL shutdown of 480V service:
  - a. By FPL crew: shut down transformer power and disconnect temporary parallel SO cords from rented ATS.
  - b. Now connect the two services M1 and M2, each with 5 sets of 600mcm and 250mcm neutral wires
  - c. By contractor: at the M2 breaker line side disconnect the temporary SO cord cables and re-connect the 5 sets of 600 mcm and 1 250a mcm cables.
  - d. At the new dual breaker transfer switchgear, connect the parallel 600mcm cables and 250mcm neutral from the generator to the emergency breaker line side.
  - e. Complete DC and AC control wiring from Cummins generator/controller and from GE switchgear.
  - f. We have now completed all power, control and DC power connections to switchgear and breakers.
19. Provide discrete and communications and ethernet cat 6 cables from the switchgear controller to the existing PLC 1 for SCADA signals from the new transfer switchgear
20. Provide programming and configuration of the two breaker transfer switchgear and the existing tie and M2 breaker.
21. Provide label at M1 breaker "spare breaker for M2"

#### **1.5 CONTRACTOR-FURNISHED PRODUCTS AND RESPONSIBILITIES**

- A. Products furnished to the site and paid for by Contractor: All products necessary to complete the work described herein these contract documents and specifications to provide a complete and functional system.
- B. Contractor's Responsibilities:
  1. Review and incorporate Owner-reviewed shop drawings, product data, and samples into the construction of the project.
  2. Schedule with the Owner and attend plant site safety training provided by water plant staff. All contractor and subcontractor staff that are working on site are required to attend the training.
  3. Provide any items determined by the Owner to be salvaged to the Owner's on-site staging area.
  4. Receive and unload products at site; inspect for completeness or damage jointly with Owner.
  5. Repair or replace items damaged after receipt.

6. Arrange and pay for product delivery to site.
7. Handle, store, protect and install all delivered products.
8. Submit claims for transportation damage and replace damaged, defective, or deficient items.
9. Arrange for manufacturers' warranties, inspections, and service.
10. Provide the Owner with a one-year warranty on all equipment and workmanship from the date of substantial completion.
11. Obtain any permits that may be required to execute the project. No building permit is expected to be required as part of this project.

#### **1.6 CONTRACTOR'S USE OF THE PREMISES**

- A. All work shall be within the limits of the County owned water treatment plant facility. Contractor shall be responsible for maintenance of traffic when working within the public rights of way.
- B. The Contractor shall coordinate with the County for material lay down and equipment storage areas on site. The contractor shall maintain access to County facilities at all times and not interfere with the operations of other contractors who may also be working within the facility. Any damage caused by the contractor within staging areas shall be completely restored by the contractor to the Owner's satisfaction at no additional cost to the Owner.
- C. All Contractor and subcontractor workers and laborers shall be required to wear clothing that identifies them with their respective contractors. All workers and laborers shall remain in their designated work areas and at no time shall be wandering the site.

#### **1.7 PERMITS REQUIRED**

- A. Contractor shall prepare, submit, and obtain any local building permits and sub-permits as necessary from the IRC Building Department.

#### **PART 2 - PRODUCTS**

Not used.

#### **PART 3 - EXECUTION**

Not used.

**- END OF SECTION -**

**SECTION 01030**  
HURRICANE PREPAREDNESS

**PART 1 - GENERAL**

**1.1 HURRICANE PREPAREDNESS PLAN**

- A. The Contractor's attention is drawn to the possibility of hurricane or severe storm conditions occurring at the site of work during the course of Contract Work.
- B. Within fourteen (14) days of the date of the Notice to Proceed, the Contractor shall submit to the Engineer and Owner a Hurricane Preparedness Plan specific to this project. The plan should outline the necessary measures which the Contractor proposes to perform at no additional cost to the Owner in case of a hurricane or severe weather warning.
- C. In the event of inclement weather, or whenever the Owner shall direct, the Contractor shall, and will, cause Subcontractors to protect carefully the Work and materials against damage or injury. Work and materials damaged due to inclement weather shall be removed and replaced at the expense of the Contractor.
  - 1. Hurricane Watch: Upon designation of a hurricane watch, the Contractor shall be responsible for storing all loose supplies and strapping down or removing large materials and equipment on the job site that may pose a danger. In addition, the Contractor shall remove all bulkheads and plugs in pipelines that would impede drainage in the case of flooding. Structures that may be in danger of floatation shall be flooded. The Contractor shall also cooperate with the Owner in protecting any other structures at the site.
  - 2. Hurricane Warning: No mobile "temporary facility" under the control of or on the property of the Owner shall be staffed during a hurricane warning. Contractor facilities meeting these criteria shall be evacuated. Reasonable steps shall be taken to protect all such facilities and their contents from damage and to avoid the facility causing damage to the surroundings.

**PART 2 - PRODUCTS**

Not used.

**PART 3 - EXECUTION**

Not used.

- END OF SECTION -



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## **SECTION 01300**

### **SUBMITTALS**

#### **PART 1 - GENERAL**

##### **1.1 WORK INCLUDED**

- A. Contractor shall submit to the Engineer, shop drawings, project data and samples required by specification sections.

##### **1.2 SCHEDULES**

- A. Prepare and submit a Construction Schedule.
- B. Prepare and submit a separate schedule listing dates for submission of shop drawings and projected return dates.
- C. Schedules shall be updated and re-submitted on a monthly basis throughout the duration of the project.
- D. Prepare and submit two-week look ahead schedules bi-weekly throughout duration of the project.
- E. Coordinate all work with OWNER operations staff. Construction activities that impact operations require 48 hours advance notice and approval from the OWNER. No WTP shutdowns will be permitted as part of this project.

#### **PART 2 - PRODUCTS**

##### **2.1 SHOP DRAWINGS**

- A. Original drawings, prepared by Contractor, Subcontractor, Supplier or Distributor, which illustrate portions of the Work; showing fabrication, layout, setting or erection details including, but not limited to the following:
  - 1. Construction phasing plan
  - 2. Automatic transfer switch
  - 3. Electrical conductors
  - 4. Electrical conduit
  - 5. Miscellaneous metals
- B. Prepare submittals by a qualified detailer.
- C. Identify details by reference to sheet numbers and detail shown on Contract Drawings.

##### **2.2 PROJECT DATA**

- A. Manufacturer's standard schematic drawings:
  - 1. Modify drawings to delete information which is not applicable to project.
  - 2. Supplement standard information to provide additional information applicable to project.
- B. Manufacturer's catalog sheets, brochures, diagrams, schedules, performance charts, illustrations and other standard descriptive data.
  - 1. Clearly mark each copy to identify pertinent materials, products or models.
  - 2. Show dimensions and clearances required.
  - 3. Show performance characteristics and capacities.

4. Show wiring diagrams and controls.

### **2.3 SAMPLES**

- A. Physical examples to illustrate materials, equipment or workmanship, and to establish standards by which completed work is judged.
- B. Office samples of sufficient size and quantity to clearly illustrate:
  1. Functional characteristics of product or material, with integrally related parts and attachment devices.
  2. Full range of color samples.

### **2.4 PAY REQUESTS**

- A. Pay Requests shall be made in accordance with the requirements of the Agreement between Owner and Contractor. Payment requests shall include updated schedules as required in required 01300-1.2.

## **PART 3 - EXECUTION**

### **3.1 SUBMISSION REQUIREMENTS**

- A. Schedule submissions at least 14 days before dates reviewed submittals will be needed.
- B. Submit number of copies of Shop Drawings, Project Datum and Samples which Contractor requires for distribution plus 4 copies for the Owner and Engineer.
- C. Accompany submittals with transmittal letter, in duplicate, containing:
  1. Date.
  2. Project title and number.
  3. Contractor's name and address.
  4. Notification of deviations from Contract Documents.
  5. Other pertinent data.
- D. Submittals must include:
  1. Date of submittal and revision dates.
  2. Project title and number.
  3. The names of:
    - a. Engineer.
    - b. Contractor.
    - c. Subcontractor.
    - d. Supplier.
    - e. Manufacturer.
    - f. Separate detailer when pertinent.
  4. Identification of product or material.
  5. Relation to adjacent structure or materials.
  6. Field dimensions, clearly identified as such.
  7. Identification of deviations from Contract Documents.
  8. Contractor's stamp, initialed or signed, certifying to review of submittal, verification of field measurements and compliance with Contract Documents.

### **3.2 RESUBMISSION REQUIREMENTS**

- A. Shop Drawings:
  - 1. Revise initial drawings as required and resubmit as specified for initial submittal.
  - 2. Clearly indicate on shop drawings all changes or revisions which have been made other than those requested by Engineer.
  - 3. Re-submittals without all comments from original review addressed will be returned to the contractor.
- B. Project Data and Samples:
  - 1. Submit new datum and samples as required for initial submittal.

### **3.3 DISTRIBUTION OF SUBMITTALS AFTER REVIEW**

- A. Distribute copies of Shop Drawings and Project Datum which carry Engineer's stamp, to:
  - 1. Contractor's file.
  - 2. Job site file.
  - 3. Record Documents file.
  - 4. Other prime contractors.
  - 5. Subcontractors.
  - 6. Supplier.
  - 7. Fabricator.
- B. Distribute samples as directed.

**- END OF SECTION -**

**NO SPECIFICATIONS ON THIS PAGE FOR FORMATTING PURPOSES.**

**SECTION 01700**  
PROJECT CLOSEOUT

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. Comply with requirements stated in the Agreement between Owner and Contractor and in Specifications for administrative procedures in closing out the Work.

**1.2 RELATED REQUIREMENTS SPECIFIED ELSEWHERE**

- A. Section 01720 - Project Record Drawings
- B. Section 01730 – Operating and Maintenance Manuals

**1.3 SUBSTANTIAL COMPLETION**

- A. Substantial completion shall be defined as beneficial use of all proposed equipment. Beneficial use will not occur until both ATS units have been installed, tested, and accepted by the Owner and Engineer of record.
- B. The Contractor shall deliver to the Engineer the Record Drawings and a draft copy of the Operations and Maintenance manuals for review and deliver to the Owner a complete set of all spare parts.
- C. When Contractor considers the Work is substantially complete, Contractor shall submit to Engineer:
  - 1. A written notice that the Work or designated portion thereof, is substantially complete.
- D. Within a reasonable time after receipt of such notice, Engineer will perform a field investigation to determine the status of completion.
- E. Should Engineer determine that the Work is not substantially complete:
  - 1. Engineer will promptly notify the Contractor in writing, giving the reasons therefore.
  - 2. Contractor shall remedy the deficiencies in the Work, and send a second written notice of substantial completion to the Engineer.
  - 3. Engineer will reinvestigate the Work.
- F. When the Engineer finds that the Work is substantially complete, he will:
  - 1. Prepare and deliver to Owner a tentative Certificate of Substantial Completion, with a tentative list of items to be completed or corrected before final payment.
  - 2. After consideration of any objections made by the Owner and when Engineer considers the Work substantially complete, he will execute and deliver to the Owner and the Contractor a definite Certificate of Substantial Completion with a revised tentative list of items to be completed or corrected.

**1.4 FINAL SITE REVIEWS**

- A. When Contractor considers Work is complete, he shall submit written certification that:
  - 1. Contract Documents have been reviewed.
  - 2. Work has been investigated for compliance with Contract Documents.
  - 3. Work has been completed in accordance with Contract Documents.

4. Equipment and systems have been tested in the presence of the Owner's representative and are operational.
5. Work is completed and ready for Final Investigation.
- B. Engineer will perform a field investigation to verify the status of completion with reasonable promptness after receipt of such certification.
- C. Should Engineer consider that the Work is incomplete or defective:
  1. Engineer will promptly notify the Contractor in writing, listing the incomplete or defective work.
  2. Contractor shall take immediate steps to remedy the stated deficiencies and send a second written certification to Engineer that the Work is complete.
  3. Engineer will reinvestigate the Work.
- D. When the Engineer finds that the Work is acceptable under the Contract Documents, he shall request the Contractor to make closeout submittals.

#### **1.5 CONTRACTOR'S CLOSEOUT SUBMITTALS TO ENGINEER**

- A. Project Record Drawings to the requirements specified.
- B. Operating and Maintenance Manuals to the requirements specified.
- C. Contractor's affidavit of payment of debts and claims.
  1. Contractor's release or waiver of liens.
- D. Separate releases or waivers of liens for subcontractors, suppliers and others with lien rights against property of Owner, together with list of those parties.

#### **1.6 FINAL ADJUSTMENTS OF ACCOUNTS**

- A. Submit a final statement of accounting to Engineer.
- B. Statement shall reflect all adjustments to the Contract Sum:
  1. The original Contract Sum.
  2. Additions and deductions resulting from:
    - a. Previous Change Orders.
    - b. Allowances.
    - c. Unit Prices.
    - d. Deductions for uncorrected Work.
    - e. Deductions for liquidated damages.
    - f. Deductions for re-inspection payments.
    - g. Other adjustments.
  3. Total Contract Sum, as adjusted.
  4. Previous payments.
  5. Sum remaining due.
- C. Engineer will prepare a final Change Order reflecting approved adjustments to the Contract Sum which was not previously made by Change Orders.

#### **1.7 FINAL APPLICATION FOR PAYMENT**

- A. Contractor shall submit the final Application for Payment in accordance with procedures and requirements stated in the Condition of the Contract.

**1.8 FINAL CERTIFICATE FOR PAYMENT**

- A. Engineer will issue final certificate in accordance with provisions of the Contract Documents.

**1.9 POST-CONSTRUCTION INSPECTION**

- A. Prior to expiration of one year from Date of Substantial Completion, Engineer will make visual field investigation of Project in company with Owner and Contractor to determine whether correction of Work is required, in accordance with provisions of the Contract Documents.
- B. For Guarantees beyond one year, Engineer will make field investigations at request of Owner, after notification to Contractor.
- C. Engineer will promptly notify Contractor, in writing, of any observed deficiencies.

**PART 2 - PRODUCTS**

Not used.

**PART 3 - EXECUTION**

Not used.

**- END OF SECTION -**



**NO SPECIFICATIONS ON THIS PAGE FOR FORMATTING PURPOSES.**

**SECTION 01720**  
**PROJECT RECORD DRAWINGS**

**PART 1 - GENERAL**

**1.1 PROJECT RECORD DOCUMENTS**

- A. Maintain at the site for the Owner one record copy of:
  - 1. Drawings.
  - 2. Specifications.
  - 3. Addenda.
  - 4. Change Orders and other Modifications to the Contract.
  - 5. Engineer Field Orders or written instructions.
  - 6. Reviewed Shop Drawings.
  - 7. Field test records.

**1.2 RELATED REQUIREMENTS SPECIFIED ELSEWHERE**

- A. Conditions of the Contracts
- B. Section 01700 – Project closeout

**1.3 MAINTENANCE OF DOCUMENTS**

- A. Store documents in approved location apart from documents used for construction.
- B. Maintain documents in a clean, dry, legible condition and in good order. Do not use record documents for construction purposes.
- C. Make documents available at all times for inspection by Engineer and Owner. Record drawing information shall be maintained concurrently with Pay Requests and updated project schedules.

**1.4 MARKING DEVICES**

- A. Provide ink marking pens for recording information in a color code.

**1.5 RECORDING**

- A. Label each document "PROJECT RECORD" in neat large printed letters.
- B. Record information currently with construction progress.
  - 1. Do not conceal any work until required information is recorded.
- C. Drawings shall be drawn to record actual construction:
  - 1. Field changes of dimension and detail.
  - 2. Changes made by Field Order or by Change Order.
  - 3. Details not on original Contract Drawings.
- D. Specifications and Addenda; Legibly mark each Section to record:
  - 1. Manufacturer, trade name, catalog number, and supplier of each item actually installed.
  - 2. Changes made by Field Order or by Change Order.

**1.6 SUBMITTAL**

- A. At Contract Close-out, Record Documents shall be submitted to Engineer in the following formats for Owner:

1. One set on 24" x 36".
- B. Accompany submittal with transmittal letter in duplicate, containing:
  1. Date.
  2. Project title and number.
  3. Contractor's name and address.
  4. Title and number of each record document.
  5. Signature of Contractor or his authorized representative.

**PART 2 - PRODUCTS**

Not used.

**PART 3 - EXECUTION**

Not used.

**- END OF SECTION -**

## **SECTION 01730**

### **OPERATION AND MAINTENANCE MANUALS**

#### **PART 1 - GENERAL**

##### **1.1 RELATED INFORMATION**

- A. Compile product data and related information appropriate for Owner's maintenance and operation of products furnished under the Contract.
  - 1. Prepare operating and maintenance data as specified in this Section and as referenced in other pertinent sections of Specifications.
- B. Instruct Owner's personnel in the maintenance of products and in the operation of equipment and systems.
- C. Related Requirements Specified in Other Sections.
  - 1. Section 01300 - Submittals
  - 2. Section 01720 - Project Record Drawings
  - 3. Section 16231 – Paralleling Low-Voltage Switchgear

##### **1.2 FORM OF SUBMITTALS**

- A. Prepare data in the form of an instructional manual and electronic format for use by Owner's personnel.
- B. Hard-Copy Format:
  - 1. Size: 8-1/2 in. x 11 in.
  - 2. Text: Manufacturer's printed data, or neatly typewritten.
  - 3. Drawings:
    - a. Provide reinforced punch binder tab, bind in with text.
    - b. Fold larger drawings to the size of the text pages.
  - 4. Provide fly-leaf for each separate product, or each piece of operating equipment.
    - a. Provide typed description of product, and major component parts of equipment.
  - 5. Cover: Identify each volume with typed or printed title "OPERATING AND MAINTENANCE INSTRUCTIONS". List:
    - a. Title of Project.
    - b. Identity of separate structure as applicable.
    - c. Identity of general subject matter covered in the manual.
- C. Binders:
  - 1. Commercial quality expandable catalog binders with durable and cleanable plastic covers.
  - 2. When multiple binders are used, correlate the data into related consistent groupings.
- D. Electronic format shall be in .pdf file format. Copies of specific manuals shall either be scanned or converted to .pdf format and submitted on CD disc to Owner. Submit after approval of hard copies from Engineer.

##### **1.3 CONTENT OF MANUAL**

- A. Neatly typewritten table of contents for each volume, arranged in a systematic order.
  - 1. Contractor, name of responsible principal, address and telephone number.
  - 2. A list of each product required to be included, indexed to the content of the volume.

3. List, with each product, the name, address and telephone number of:
  - a. Subcontractor or installer.
  - b. Maintenance contractor, as appropriate.
  - c. Identify the area of responsibility of each.
  - d. Local source of supply for parts and replacement.
4. Identify each product by product name and other identifying symbols as set forth in Contract Documents.
- B. Product Data:
  1. Include only those sheets which are pertinent to the specific product.
  2. Annotate each sheet to:
    - a. Clearly identify the specific product or part installed.
    - b. Clearly identify the data applicable to the installation.
    - c. Delete references to inapplicable information.
- C. Drawings:
  1. Supplement product data with drawings as necessary to clearly illustrate relations of component parts of equipment and systems.
  2. Coordinate drawings with information in Project Record Documents to assure correct illustration of completed installation.
  3. Do not use Project Record Documents as maintenance drawings.
- D. Written text, as required to supplement product data for the particular installation:
  1. Organize in a consistent format under separate headings for different procedures.
  2. Provide a logical sequence of instructions for each procedure.
- E. Copy of each warranty issued.
  1. Provide information sheet for Owner's personnel, give:
    - a. Proper procedures in the event of failure.
    - b. Instances which might affect the validity of warranties.

#### **1.4 MANUAL FOR EQUIPMENT AND SYSTEMS**

- A. Submit six (6) complete copies of manual in final form and two compact discs (CD) in PDF format. CD shall include bookmarks and chapters to closely duplicate that of the paper copy.
- B. Content, for each unit of equipment and system, as appropriate:
  1. Description of unit and component parts.
    - a. Function, normal operating characteristics, and limiting conditions.
    - b. Performance curves, engineering data and tests.
    - c. Complete nomenclature and commercial number of all replaceable parts.
  2. Operating procedures:
    - a. Start-up, break-in, routine and normal operating instructions.
    - b. Regulation, control, stopping, shut-down and emergency instructions.
    - c. Summer and winter operating instructions.
    - d. Alignment, adjusting and checking.
  3. Servicing and lubrication schedule:
    - a. List of lubricants required for each piece of equipment.
    - b. Schedule for manufacturer recommended maintenance.
  4. Manufacturer's printed operating and maintenance instructions.

5. Original manufacturer's parts list, illustrations, assembly drawings and diagrams required for maintenance.
6. Other data as required under pertinent sections of specifications.

#### **1.5 SUBMITTAL SCHEDULE**

- A. Submit one copy of completed data in final form fifteen days prior to final inspection or acceptance. Electronic submittal for initial review is acceptable.
  1. Copy will be returned after final inspection or acceptance, with comments.
- B. Submit specified number of copies of approved data in final form 10 days after final inspection or acceptance.

#### **1.6 INSTRUCTION OF OWNER'S PERSONNEL**

- A. Prior to final inspection or acceptance, fully instruct Owner's designated operating and maintenance personnel in the operation, adjustment and maintenance of all products, equipment and systems.
- B. Operating and maintenance manual shall constitute the basis of instruction.
  1. Review contents of manual with personnel in full detail to explain all aspects of operations and maintenance.

#### **PART 2 - PRODUCTS**

Not used.

#### **PART 3 - EXECUTION**

Not used.

**- END OF SECTION -**

**NO SPECIFICATIONS ON THIS PAGE FOR FORMATTING PURPOSES.**

## SECTION 16000

### ELECTRICAL GENERAL REQUIREMENTS

#### PART 1 GENERAL

##### 1.01 RELATED DOCUMENTS

- A. The general provisions of the Contract, including General Conditions, apply to all the Work specified in the Electrical 16000 Sections.

##### 1.02 LAWS, PERMITS, FEES AND NOTICES

- A. Secure and pay all permits, fees and licenses necessary for the proper execution of the Work. Submit all notices and comply with all laws, ordinances, rules and regulations of any public agency bearing on the Work. CONTRACTOR shall be licensed electrical CONTRACTOR in the county of construction.

##### 1.03 DEPARTURES

- A. If any departures from the Contract drawings or specifications are deemed necessary, details of such departures and the reasons therefore shall be submitted to the ENGINEER for advance written approval, prior to departure.

##### 1.04 GUARANTEES

- A. Furnish written guarantee covering all materials, workmanship, labor and equipment for a period of one (1) year from the date of acceptance as described in the Contract General Conditions.
- B. The OWNER reserves the right to operate and use all materials and equipment failing to meet the requirements of the Contract documents until such unacceptable materials and equipment are replaced or repaired to the satisfaction of the ENGINEER.

##### 1.05 AS-BUILT INFORMATION

- A. A set of "red-lined" electrical drawings shall be carefully maintained at the job site. Actual conditions are to be put on the drawings in red on a daily basis so the drawings will continuously show locations and routes of cable trays, conduits, pull-boxes, circuit numbers, and other information required by the ENGINEER.



1.06 JOB SITE VISIT

- A. Visit the project site before submitting a bid. Verify all dimensions shown and determine the characteristics of existing facilities which will affect performance of the Work, but which may not be shown on drawings or described within these specifications.

1.07 CLEANUP

- A. Maintain a continuous cleanup during the progress of the Work and use appointed storage areas for supplies. The premises shall be kept free from accumulations of waste materials and rubbish.

1.08 CUTTING AND PATCHING

- A. Cut and prepare all openings, chases and trenches required for the installation of equipment and materials. Repair, remodel and finish in strict conformance with the quality of workmanship and materials in the surroundings. Obtain written permission from the ENGINEER for any alterations to structural members before proceeding.

1.09 MAINTENANCE

- A. Render all necessary measures to ensure complete protection and maintenance of all systems, materials and equipment prior to final acceptance. Any materials or equipment not properly maintained or protected to assure a factory new condition at the time of final acceptance shall be replaced immediately at no additional cost to the OWNER.

1.10 WATERPROOFING

- A. Whenever any Work penetrates any waterproofing, seal and render the Work waterproof. All Work shall be accomplished so as not to void or diminish any waterproofing bond or guarantee.

1.11 TESTS

- A. Conduct an operating test of equipment prior to the ENGINEER's approval. The equipment shall be demonstrated to operate in accordance with the requirements of these specifications. The tests shall be performed in the presence of the ENGINEER or an authorized representative. The electrical CONTRACTOR shall furnish all instruments, electricity and personnel required for the tests.

1.12 SUMMARY OF ELECTRICAL WORK

- A. Provide all labor, materials, tools, supplies, equipment and temporary utilities to complete the Work shown on the drawings and specified herein. All systems are to be completely installed and fully operational. Specifically, the Work includes, but is not necessarily limited to:

1. Electrical power and control wiring for proposed breaker pair low voltage switchgear transfer switch, including programming and configuration with existing GE switchgear motorized breakers M1, M2, and TIE breakers to work with new breaker transfer pair switchgear.
2. Provide coordination with FPL for several planned outages during installation of equipment for temporary rental ATS switch and connection to FPL service and existing generator. Including later removal of temporary ATS and re-connection of former service wires, see drawings.
3. Provide Rental ATS switch and all required temporary so cord cables and temporary control wiring to handle the temporary connections and shifting of some switchgear loads during the removal and installation phases of the existing Lake Shore switchgear style breaker switch and replacement with new parallel low voltage switchgear transfer switch.
4. Provide the service of authorized switchgear field technicians to help with the removal and disconnect of power and control wiring from the existing switchgear and perform the installation of new parallel low voltage switchgear along with the configuration, programming and testing of the new switchgear and the existing GE switchgear motorized breakers M1, M2 and TIE. These should all work in unison with the new low voltage motorized breaker pair switchgear equipment being installed.
5. Provide grounding as required per NEC and indicated on drawings.
6. Provide communications cables, equipment, and installation to the existing PLC control panel, see drawings and other specification sections; coordinate with Owner's SCADA manager.

### 1.13 CODES AND STANDARDS

- A. General Applicable provisions of the following codes and standards and other codes and standards required by the State of Florida and local jurisdictions are hereby imposed on a general basis for electrical Work (in addition to specific applications specified by individual Work sections of these specifications):
  1. U.L.: Electrical materials shall be approved by Underwriters' Laboratories, Inc. This applies to materials which are covered by U.L. standards. Factory applied labels are required.
  2. National Electrical Code.

3. OSHA: Standards of the Occupational Safety and Health Administration are to be complied with.
4. NEMA: National Electrical Manufacturers Association Standards are to be met wherever standards have been established by that agency and proof is specifically required with material submittals for switchboards, motor control centers, panelboards, cable trays, motors, switches, circuit breakers and fuses.
5. ANSI: America National Standards Institute
6. NESC: National Electrical Safety Code
7. Any and all local codes.

#### 1.14 ELECTRICAL TEMPORARY FACILITIES

- A. The electrical CONTRACTOR shall include in his bid the cost of furnishing, installing, maintaining and removing all materials and equipment required to provide temporary light and power to perform his Work during construction and until Work is completed.
- B. Safety
  1. All reasonable safety requirements shall be observed to protect workers and the public from shock and fire hazards. Ground fault interrupters shall be employed in accordance with codes.
  2. Ground wires are required in all circuits. Ground poles are required on all outlets. All metallic cases shall be grounded.
  3. Raintight cabinets shall be used for all equipment employed in wet areas.

#### 1.15 EXCAVATING FOR ELECTRICAL WORK

- A. General – Not needed

#### 1.16 ELECTRICAL SUBMITTALS

- A. Submittals for Approval
  1. Refer to Contract General Conditions for additional instructions on the General Conditions and this section, the more stringent requirements shall apply.
  2. Shop Drawings and Manufacturer's data sheets are required for all electrical materials.

3. Submittals will not be accepted for partial systems. Submit all materials for each specification section at one time. Submittals must be arranged, correlated, indexed and bound in orderly sets for ease of review.
4. Samples are to be supplied for any substitute as requested by the ENGINEER.
5. The following numbers of copies are required:
 

Shop drawings	6 sets
Samples	1 each
Manufacturer's data	6 sets
Certifications	6 sets
Test reports	6 sets
Warranties/Guarantees	6 sets
6. Submit shop drawings, Manufacturer's data and certifications on all items of electrical Work prior to the time such equipment and materials are to be ordered. Order no equipment or materials without approval from the ENGINEER. Submittals will not be accepted for partial system submittals; submit all data at one time. Submittals will be promptly returned, approved, approved as noted, or not approved. Items "approved as noted" must be changed to comply with the ENGINEER's comments and need not be resubmitted for "approved" status. Items "not approved" are not suitable, requiring complete new submittals.
7. Time delays caused by rejection of submittals are not cause for extra charges to OWNER or time extensions. CONTRACTOR shall be responsible for investigating existing systems or shop drawings in order to fully integrate the new equipment into the system. Adequate shop drawings may or may not exist for all existing systems.

B. Operation and Maintenance Manuals

1. Submit to the ENGINEER five (5) copies of all Manufacturer's service installation and operation manuals, instructions and bulletins. These manuals shall be subject to review of the ENGINEER. If acceptable they shall be forwarded to the OWNER. If not acceptable they shall be returned to the CONTRACTOR for revision and resubmittal. Manuals shall contain, but not be limited to, the following:
  - a. Brief description of system and basic features.
  - b. Manufacturer's name and model number for all components in the system.

- c. List of local factory authorized service companies.
- d. Operating instructions.
- e. Maintenance instructions
- f. Trouble shooting instructions
- g. Manufacturer's literature describing each piece of equipment.
- h. Power and control wiring diagrams
- i. Parts lists

#### 1.17 ELECTRICAL PRODUCTS

##### A. Standards Products

- 1. Unless otherwise indicated in writing by the ENGINEER, the products to be furnished under this specification shall be the Manufacturer's latest design. Units of equipment and components of the same purpose and rating shall be interchangeable throughout the project. All products shall be newly manufactured. Defective equipment or equipment damaged in the course of installation or test, shall be replaced or repaired in a manner meeting with the approval of the ENGINEER at no additional expense to the OWNER.

##### B. Delivery, Storage and Handling

- 1. Deliver products to project properly identified with names, model numbers, types, grades, compliance labels and similar information needed for distinct identification; adequately packaged or protected to prevent deterioration during shipment, storage and handling. Store in a dry, well ventilated, indoor space, except where prepared and protected by the Manufacturer specifically for exterior instructions for storage locations.

##### C. Substitutions

- 1. Comply with instructions in the Contract General Conditions and Special Conditions and obtain pre-approval of the ENGINEER regarding substitutions.

#### 1.18 SKILLED ELECTRICAL CRAFTSMEN

- A. CONTRACTOR shall employ and staff the project with skilled Craftsmen experienced in the project requirements.

- B. As a minimum, a Licensed Journeyman Electrician shall be present on the project at all times.
- C. Other skilled persons shall be present as the project requirements dictate including Manufacturers representatives, start-up technicians, ENGINEERS, etc.

#### 1.19 DRAWINGS AND SPECIFICATIONS

- A. Refer to the drawings for additional requirements. There are requirements indicated on the drawings which are not noted in the specification.
- B. Bidders, suppliers, equipment vendors, General CONTRACTOR, Sub Contractors and other similar entities are required to read all the Contract documents including drawings and specifications.

#### 1.20 SCHEMATIC NATURE

- A. Plan views are schematic in nature and meant to show the schematic arrangement of equipment and conduit.
- B. CONTRACTOR shall provide the OWNER/ENGINEER with an 11 x 17 (min) drawing (to scale) of the final layout of the equipment and conduit routing for approval. This drawing shall include measurements for all NEC required clearances and separations for equipment and conduit. Refer to other spec sections for conduit routing requirements.

#### 1.21 APPROVED SHOP DRAWINGS

- A. Use approved shop drawings for lay out of equipment. The Contract documents will vary from the shop drawings. Inform the ENGINEER immediately if there are lay out issues or inadequate space for equipment or clearances. Land conduits in openings of enclosures per the approved shop drawings, do not use the Contract drawings.
- B. Housekeeping pads, equipment racks and the like shall be based on the approved shop drawings.

#### 1.22 CLEARANCES

- A. It shall be the CONTRACTOR's responsibility to meet N.E.C. clearances about equipment.

#### 1.23 ROUTING

- A. Conduit routing is schematic in nature. Conduit routing is shown for clarity on the Contract drawings. See other spec sections for additional conduit routing requirements.

#### 1.24 FUTURE FACILITIES

- A. Where future facilities are indicated, conduit routing shall account for such facilities.

#### 1.25 DRAWINGS FURNISHED BY CONTRACTOR

- A. OWNER shall be provided all CONTRACTOR furnished drawings. Such drawings include, but are not limited to: Control panels, MCC.s, VFD.s, switch boards, instrumentation details, ATS, redline mark-up of the Contract drawing and the like.
- B. Drawings shall be furnished for review and approval. No materials shall be provided without the ENGINEER's approval.
- C. Final drawings shall be furnished or as field modified accounting for any changes made during start up.

#### 1.26 HOMERUNS

- A. CONTRACTOR shall coordinate home runs between plan views. Where any conduit is shown in any plan view it shall be installed the entire length may be required.

#### **PART 2 PRODUCTS (NOT USED)**

#### **PART 3 EXECUTION (NOT USED)**

END OF SECTION

## SECTION 16001

### ELECTRICAL DEMOLITION

#### PART 1 GENERAL

##### 1.01 GENERAL REQUIREMENTS

- A. CONTRACTOR shall take precautionary and safety measures to assure the safety of his personnel. All wires shall be identified and disconnected from power sources before removal.
- B. CONTRACTOR shall coordinate with the OWNER, ENGINEER
- C. The general demolition scope shall also include the following minimum requirements whether indicated on drawings or not.
  - 1. Before demolition, CONTRACTOR shall verify that the equipment is no longer needed or that the demolition will not adversely affect plant operation.
  - 2. CONTRACTOR shall work with Switchgear vendor and his field technical staff during demolition of former switchgear transfer switch and installation of new switchgear and wiring and configuration.
  - 2. Removal of all exposed conduit. Removal of all wire within raceways, cabinets, outlet boxes, trenches and the like associated with equipment shown to be removed on plans.
  - 3. Removal of all hangers and support systems which are not needed as a result of the demolition.
  - 4. CONTRACTOR shall cover all openings as a result of demolition and removals including but not limited to the following:
    - a. Cabinets and enclosures
    - b. Wall and masonry openings.
    - c. Cut conduit, instrumentation line, etc. flush with slab, fill with concrete, patch and paint holes in walls.
- D. Operational Systems
  - 1. To the fullest extent possible, all required systems shall remain operational. CONTRACTOR shall replace and/or repair existing facilities which may be damaged due to equipment removals.



2. Where required wiring passes through or uses enclosures or raceways shown for demolition. CONTRACTOR shall provide raceways and wire as required to keep those systems operational.
  3. CONTRACTOR shall remove existing equipment in an orderly, planned and coordinated fashion. All replacement equipment shall be on site and ready to install immediately after the removal of existing equipment.
  4. Where demolition interrupts the normal automatic control of the station, CONTRACTOR shall provide full time manual control until automatic control is restored unless otherwise directed by the OWNER. CONTRACTOR shall obtain permission of the OWNER before removing automatic control.
- E. CONTRACTOR shall be required to visit the site before bid to ascertain the magnitude of the Work. The drawings indicate the minimal effort. Any electrical raceway associated with any equipment shall be demolished. The drawings do not call out every item of Work. All the building electrical equipment shall be replaced with new, unless otherwise indicated by the drawings or noted elsewhere by the specifications.
- F. The OWNER shall select equipment to be salvaged to the OWNER. Salvaged equipment shall be provided to the OWNER onsite.
- G. Provide demolition in support of any civil or mechanical Work as may be required. See civil and mechanical documents.

#### 1.02 INCLUDED WORK

- A. Contractor shall coordinate with the Owner, FPL, and Engineer and provide temporary rental transfer switch and so cord parallel temporary cables.
- B. Contractor shall provide for approval a sequence of installation and removal of existing lake shore transfer switch switchgear and how to implement the temporary rental ATS switch and temp cables, and final installation of the proposed low voltage switchgear switch.
- C. Demo all existing raceways, wiring, grounding, that is not planned to be reused. Be aware that some of the existing parallel sets of power and control wires are to be reused.
- D. Contractor shall coordinate with the Owner and Engineer all demolition efforts.

#### 1.03 DISPOSITION OF EQUIPMENT

- A. Provide removed equipment and/or materials to OWNER as may be required by Owner, coordinate before disposing of all equipment.

- B. Except as otherwise indicated, all removed or demolished electrical equipment shall become the property of the CONTRACTOR. All rubble shall be disposed of by the CONTRACTOR.
- C. CONTRACTOR shall load, transport, and dispose of all or demolished equipment including all enclosed gear, panels, j-boxes, disconnects, raceways, wire and cable, supports, step-down transformers, control panels, light fixtures, equipment racks and the like.

**PART 2 PRODUCTS (NOT USED)**

**PART 3 EXECUTION (NOT USED)**

END OF SECTION

## SECTION 16050

### BASIC MATERIALS AND METHODS

#### PART 1 GENERAL

##### 1.01 SUBMITTALS

- A. Submit data sheets on all items per Section 16000.

##### 1.02 CODES AND STANDARDS

- A. General applicable provisions of the following codes and standards and other codes and standards required by the State of Florida and local jurisdictions are hereby imposed on a general basis for electrical Work (in addition to specific applications specified by individual Work sections of these specifications):
  - 1. U.L.: Electrical materials shall be approved by the Underwriters' Laboratories, Inc. This applies to materials which are covered by U.L. standards. Factory applied labels are required.
  - 2. NEC: National Electrical Code
  - 3. OSHA: Standard of the Occupational Safety and Health Administration are to be complied with.
  - 4. NEMA: National Electrical Manufacturers Association Standards are to be met wherever standards have been established by that agency, and proof is specifically required with material submittals for switchboards, motor control centers, panelboards, cable trays, motors, switches, circuit breakers, and fuses.
  - 5. ANSI: American National Standards Institute
  - 6. NESC: National Electrical Safety Code

#### PART 2 PRODUCTS

##### 2.01 GROUNDING MATERIALS

- A. All ground rods shall be 20 foot 5/8" copperclad, unless otherwise indicated.
- B. Ground wires shall be soft drawn copper sized per National Electrical Code, unless otherwise indicated.

## 2.02 CONDUIT

### A. PVC Conduit

1. PVC conduit shall be Schedule 80 or Schedule 40 unless otherwise noted and shall be U.L. approved. Comply with Federal Spec WC-1094 and NEMA TC-1.

### B. Flexible Conduit

1. All flexible conduits shall be liquidtight, made of corrosion resistant plated steel with extruded polyvinyl covering and watertight connectors.

### C. Refer to schedule in drawing for location requirements.

## 2.03 CABLE, WIRE AND CONNECTORS

### A. 600 Volt Power Wiring

1. Individual conductors shall be rated for 600 volts and shall meet the requirements below:
  - a. Conductors shall be stranded.
  - b. All wire shall be brought to the job in unbroken packages and shall bear the date of manufacturing; not older than 12 months.
  - c. Type of wire shall be THWN except where required otherwise by the Contract drawings.
  - d. No wire smaller than No. 12 gauge shall be used unless specifically indicated.
  - e. Conductor metal shall be copper.
  - f. All conductors shall be meggered after installation. Megger testing shall exceed 50 mega ohms.
2. Multi-conductor cables shall be type TC UL 1277 THWN, PVC jacketed 600V with conductor and quantities as indicated.

### B. Instrumentation and Control Cable

1. Process instrumentation wire shall be 16 gauge, single twisted pair, 600V., aluminum tape shielded, polyvinyl chloride jacketed, as manufactured by Houston Wire and Cable HW 106 or an approved equal.

C. Control Cable

1. Multi-conductor control cable shall be stranded copper 14 gauge, 600V. THWN insulated overall shielded with PVC jacket, as manufactured by Houston Wire and Cable HW 153 or an approved equal.

2.04 TERMINATIONS AND SPLICES (600 VOLTS AND LESS)

- A. Terminations of power cable shall be by means of U.L. approved connectors. All connectors shall meet U.L. 486B and shall be compatible with the conductor material.
- B. Terminate all control and instrumentation cable with screw-clamp type terminal blocks.
- C. Splicing of power, control, or instrumentation wiring will not be allowed except by written approval of the ENGINEER. Where splicing is allowed, splices shall be made with approved compression connectors, and splices shall be made waterproof regardless of location.

2.05 BOXES

- A. Boxes for wiring devices, switches and receptacles installed outdoors shall be weatherproof fiberglass with polycarbonate cover plates.

2.06 PULL BOXES AND SPLICE BOXES

A. Location

1. Units used outdoor or in a damp or corrosive environment shall be 316 ss or fiberglass unless otherwise indicated on plans.
2. Units used indoors in dry and clean A/C environments shall be NEMA 1.

B. Size

1. Units shall be sized per NEC as minimum.

C. Required Units

1. Plans depict minimum requirements. Additional units shall be provided as may be required to complete raceway systems.

2.07 MOUNTING AND SUPPORTING ELECTRICAL EQUIPMENT

- A. Furnish and install all supports, hangers, and inserts required to mount fixtures, conduits, cables, pull boxes, and other equipment.

- B. Support system used indoors in clean, dry and air conditioned areas shall be galvanized steel. All other areas shall be 316 ss with ss fasteners.
- C. Perforated straps and wires are not permitted for supporting electrical devices. Anchors shall be of approved types.
- D. All supports, hangers, hardware, etc. used outdoors or in in non-air conditioned indoor areas or in hazardous areas shall be non-ferrous, corrosion resistant or 316 stainless steel. Supports shall be selected to avoid galvanic reactions. Support devices shall be submitted for approval.
- E. Provide trapeze, bridge systems or wall bracketed cantilevered system to support the raceway system.
- F. Spacing of support systems shall be per NEC. Provide spacing of conduits according to the NEC and the materials used. For PVC conduit, refer to NEC table 347-8.
- G. Plans depict minimum requirements. Provide additional units as required to complete raceway system.
- H. Pipe stands shall be 316 stainless steel.

#### 2.08 DUCT SEAL

- A. Provide Garvin Industries' duct seal or an approved equal
- B. Provide and install duct seal at all conduit ends for all new conduit installations.
- C. Duct seal shall be used to seal around junction boxes, control panels and the like, It shall be a permanently soft, non toxic compound. It shall also not affect other plastic materials or corrode metals.

### **PART 3 EXECUTION**

#### 3.01 GROUNDING

- A. Provide ground system as indicated on the drawings and as required by the National Electrical Code.
- B. All raceways require grounding conductors. Metallic raceways are not adequate grounding paths. Bonding conductors through the raceway systems shall be continuous from main switch ground buses to panel ground bars of the panelboards, and from panel grounding bars of panelboards and motor control centers to branch circuit outlets, motors, lights, etc. THESE GROUND CONDUCTORS ARE REQUIRED

THROUGHOUT THE PROJEC REGARDLESS OF WHETHER CONDUIT RUNS SHOW GROUND CONDUCTORS ON THE DRAWINGS.

- C. All connections made below grade shall be of the exothermic type.
- D. The grounding system test shall not exceed a 48 hour span dry resistance of 10 ohms. Additional grounding to meet this requirement shall be installed at no extra cost. Grounding and bonding connections shall not be painted.

### 3.02 CONDUIT

#### A. Locations:

Conduits shall be used as follows:

1. Refer to schedule on drawings.

#### B. Installation

1. Conduits subjected to rough handling or usage shall be removed from the premises.
2. Conduits must be kept dry and free of water or debris with approved pipe plugs or caps. Care shall be given that plugs or caps be installed before pouring of concrete.
3. Where conduits pass through exterior concrete walls or fittings below grade, the entrances shall be made watertight.
4. Infurred ceilings, conduit runs shall be supported from structure, not furring.
5. Conduits entering panelboards, pull boxes, or outlet boxes shall be secured in place by galvanized locknuts and bushings, one (1) locknut outside and one (1) locknut inside of box with bushing on conduit end. The locknuts shall be tightened against the box without deforming the box. Bushings shall be of the insulating type.
6. Field conduit bends shall be made with standard tools and equipment manufactured especially for conduit bending.
7. Where embedded conduits cross expansion joints, furnish and install offset expansion joints or sliding expansion joints. Sliding expansion joints shall be made with straps and clamps.
8. Exposed runs of conduits shall be installed with runs parallel or perpendicular to walls, structural members or intersections of vertical planes and ceilings, with right angle turns consisting of

symmetrical bends. No attempts are made in plans to show required pull boxes, gutters, etc. necessary for the construction of the raceway system but the CONTRACTOR shall provide these raceways as may be required.

9. Conduits in structural slabs shall be placed between the upper and the lower layers of reinforcing steel, requiring careful bending of conduits. Conduits embedded in concrete slabs shall be spaced not less than eight (8) inches on centers or as widely spaced as possible where they converge at panels or junction boxes. Conduits running parallel to slab supports, such as beams, columns and structural walls shall be installed not less than 12 inches from such supporting elements. To prevent displacement during concrete pour, saddle supports for conduit, outlet boxes, junction boxes, inserts, etc., shall be secured.
10. Conduit runs shall always be concealed except where indicated on plans.
11. Pull lines shall be installed in all empty conduits. All pull wires shall be identified with conduit number at each end.
12. Where conduits are run individually, they shall be supported by approved pipe straps secured by means of toggle bolts or tapcons on hollow masonry; tapcons on concrete or solid masonry; machine screws or bolts on metal surfaces and wood screws on wood construction. The use of perforated straps or wires will not be permitted.
13. Wire shall not be installed until all Work of any nature that may cause damage is completed, including pouring of concrete. Mechanical means shall not be used in pulling in wires No. 8 or smaller.
14. Underground conduits not under concrete slabs are to be buried at least two (2) feet below finished grade for circuits rated 600 volts or less, except under traffic areas where motor vehicles may cross. Under traffic areas, conduits are to be buried at least three (3) feet below finished grade.
15. All conduits shall be cleaned by pulling a brush swab through before installing cables.
16. All conduits shall be sealed at each end with electrical putty. Special care shall be taken at all equipment where entrance of moisture could be detrimental to equipment. Approved backing gauze is required prior to the installation of conduit putty.



17. A maximum of two (2) feet of flexible conduit shall be used at connections of all motors, transformers, motor operated valve and gates, instruments and other items of equipment where vibration is present. It shall be supported where required with stainless steel bands.
20. PVC conduit shall be supported to walls and slabs using carlon snap strap conduit wall hangers. Two hole PVC conduit clamps shall not be permitted.

### 3.03 WIRES, CABLES AND CONNECTIONS

- A. Cables pulled into conduits shall be pulled using pulling eyes attached to conductors.
- B. Shields shall be grounded at only one termination point.

### 3.04 BOXES

- A. Installation of boxes shall be in accordance with the National Electrical Code requirements.
- B. Boxes shall be mounted plumb and level in accessible locations and mounting shall be secure, vibration resistant and galvanically compatible. Hardware shall be used that is specifically intended for the purpose. When mounted in corrosive, damp or wet locations, stainless steel hardware shall be utilized.

### 3.05 WIRING DEVICES

- A. Wiring devices shall be installed in device boxes approved for the application. All connections shall be made with screw terminals. Wiring devices shall be Leviton or approved equal.
- B. Wire devices on UPS systems shall be isolated ground, colored orange.
- C. Cover plates shall be provided as follows except as otherwise noted.
  1. Interior finished area – brushed aluminum
  2. Wet areas – gasketed plastic with flip cover.
- D. Receptacles installed outdoors, below grade, or in areas other than clean and dry environments shall be GFI and weatherproof. Receptacles shall be weatherproof with cords plugged in.
- E. All receptacles shall be GFI protected.

### 3.06 SUPPORTING DEVICES

- A. All items shall be supported from the structural portion of the building and studs, except standard ceiling mounted lighting fixtures and small devices may be supported from ceiling system where permitted by the ENGINEER. However, no sagging of the ceiling will be permitted. Supports and hangers shall be types approved by Underwriters' Laboratories.
- B. All floor-mounted devices (switchboards, motor control centers, transformers, etc.) shall be securely anchored to the floors. Where recommendations are made by Manufacturer, these recommendations shall be followed.

### 3.07 CLEANING

- A. All electrical equipment enclosures shall be thoroughly cleaned before acceptable by the OWNER. As a minimum, CONTRACTOR shall remove all debris including stripped wire insulation, dirt, and debris.

END OF SECTION

## SECTION 16231

### LOW-VOLTAGE TRANSFER SWITCHGEAR

#### Part 1. GENERAL

##### 1.01 RELATED DOCUMENTS

- A. Project drawings and contract document requirements apply to this section

##### 1.02 SUMMARY

- A. This section describes requirements for controls and transfer switchgear for transfer generator sets and distributing alternate source power. Equipment provided shall be new factory assembled transfer equipment and dedicated purpose microprocessor-based controls designed for fast, reliable operation, and including functions described herein.
- B. Related sections of the project specifications include:
  - 1. 16000 ELECTRICAL GENERAL REQUIREMENTS
  - 2. 16001 ELECTRICAL DEMOLITION

##### 1.03 DEFINITIONS

- A. ATS: Automatic Transfer Switch
- B. GFP: Ground Fault Protection
- C. HMI: Human-Machine Interface
- D. Manufacturer: The entity that maintains engineering design control for the equipment provided, provides service and maintenance documentation, provides service direction, and provides warranty support.
- E. Supplier: The entity that provides manufacturer-authorized local sales and service support for the manufacturer's equipment.
- F. Equipment provided shall conform to the requirements of the following codes and standards to the extent they are applicable:
  - 1. ANSI C37.13 – Low voltage power circuit breakers
  - 2. ANSI C37.17 – Trip devices
  - 3. ANSI/IEEE C57.13 – Requirements for Instrument Transformers

4. NEMA SG5 – Switchgear assemblies
5. MENA SG3 – Low voltage power circuit breakers
6. UL891 – Switchboards and Controls. Control equipment provided in switchboard enclosures shall be listed and labeled under this standard.
7. UL489 – Molded Case Circuit Breakers
8. CSA C22.2, No. 14 – M91 Industrial Control Equipment
9. CSA 282 – Emergency Electrical Power Supply for Buildings
10. NFPA 70 – National Electrical Code
11. NFPA 99 – Healthcare Facilities
12. NFPA 110 – Emergency and Standby Power Systems
13. IEEE446 – Recommended Practice for Emergency and Standby Power Systems for Commercial and Industrial Applications.
14. NEC 240.87 Breakers shall comply with Arc Energy Reduction

#### 1.04 SUBMITTALS

- A. Product Data: Provide the noted technical data for the controls, switchgear, and transfer equipment described in this section. Materials required include:
  1. Technical data fully describing the critical design features of the equipment proposed, and substantiating compliance of the requirements of this specification.
  2. Data shall include a complete description of the features and function of the proposed equipment.
  3. Include a detailed sequence of operation for the specific equipment provided.
- B. Shop Drawings: For each control enclosure, switchgear section, or independent piece of equipment provide:
  1. Elevation and other Drawings: Describing physical dimensions, weights, mounting provisions and requirements, mechanical and wiring access points.
  2. Wiring Diagrams: Describing internal control schematic and wiring details for each component, power connection provisions, and interconnecting wiring details.
  3. Submit names, qualifications, and locations of individuals who will service and support the equipment.
- C. Coordination Drawings: Provide product information necessary for development of floor plans layouts for the facility.
- D. Source Quality Control Test Reports: Provide factory test report plan for integrated transfer controls and switchgear system.

- E. Operation and Maintenance Data: Provide information for system as a whole and each major system component, including all component operation manuals, drawings, and system design data.

#### 1.05 DELIVERY, STORAGE, AND HANDLING.

- A. Deliver transfer system equipment in section sizes that can be moved past all obstructions in the physical site.
- B. All transfer equipment shall be stored indoors in a temperature-controlled environment, in accordance with manufacturer's temporary storage instructions. At a minimum, equipment shall be protected from moisture, dirt, and physical damage.
- C. With written approval of the equipment manufacturer, equipment may be stored outdoors, as long as it is protected according to the manufacturer's instructions, including protection from condensation, rain, dust/dirt, and physical damage.

#### 1.06 QUALITY ASSURANCE

- A. Source Limitations: The transfer switchgear shall be designed, manufactured, and warranted by the generator set manufacturer to provide a single source of responsibility for all the products provided. Warranty documents shall be provided verifying compliance to this requirement. Supplier shall directly employ service technicians specifically trained and qualified on the diagnosis and repair of engines, alternators, power transfer equipment, and transfer equipment. The technicians shall be trained in the installation and commissioning of complex generator systems, including line voltage generator transfer equipment.
- B. The transfer system, including generator sets and transfer equipment, shall be manufactured, sold and serviced by a single local service organization that is trained and factory certified in both generator set and transfer equipment service. The technicians serving the site shall be specifically trained and certified by the manufacturer in the diagnosis and repair of the synchronizing, transfer, and load sharing equipment provided. The supplier shall maintain an inventory of critical replacement parts at the local service organization, and in-service vehicles. The service organization shall be on call 24 hours per day, 365 days per year.
- C. The manufacturer shall maintain model and serial number records for the transfer equipment for at least 20 years.
- D. The manufacturer of the transfer gear system level transfer controller shall be the same as the generator set controller.

#### 1.07 EXTRA MATERIALS

- A. Provide additional items to support the transfer system equipment, completely programmed and tested, packaged and labeled consistently with designations in system drawings.
  - 1. Submit on racking handle(s) with equipment. A charging handle shall be furnished on each breaker mechanism.
  - 2. For all switchgear with circuit breakers in upper compartments, provide [one] circuit breaker lifting device – portable, floor-supported with a roller base.
- B. Maintenance tools: Furnish tools and miscellaneous items required for system inspection, monitoring, maintenance, and operation.

## **PART 2 PRODUCTS**

### **2.01 MANUFACTURERS**

- A. Acceptable Manufacturers: Only approved bidders shall supply equipment provided under this contract. Equipment specifications for this project are based on microprocessor-based transfer equipment manufactured by Cummins Power Generation. Digital Transfer Equipment by other suppliers that meets the requirements of this specification is acceptable, if approved no less than 2 weeks before scheduled bid date. Proposals must include a line by line compliance statement based on this specification.

### **2.02 GENERATOR TRANSFER MONITOR AND CONTROL SYSTEM**

- A. Acceptable Manufacturers
  - 1. Cummins Power Generation
    - a) Equipment specifications for this project are based on microprocessor-based transfer equipment manufactured by Cummins Power Generation.
  - 2. Approved equal switchgear vendor like Eaton, Russelectic using Cummins Power Command system level controllers for compatibility with existing Cummins generator controller.

### **2.03 RATINGS**

- A. The low voltage switchgear shall consist of an indoor, non-walk-in enclosure containing circuit breakers and the necessary accessory components all factory assembled (except for necessary shipping splits) and operationally checked.
- B. The assembly shall be a self-supporting and floor mounted on a level concrete pad.
- C. The integrated switchgear assembly shall withstand the effect of closing, carrying and interrupting currents up to the assigned maximum short circuit rating.

- D. Voltage rating shall be as indicated on the drawings. The entire assembly shall be suitable for 600 voltage maximum AC service. System voltage shall be 480/277-volt, 3 phase, 4 wire with ground.
- E. The ampacity of the Low Voltage Switchgear shall be determined by the loading of the feeder circuits. The main bus rating shall be 2000A.
- F. The assembly shall be rated to withstand mechanical forces exerted during short-circuit conditions when connected directly to a power source having available fault current of 65,000 amperes symmetrical at rated voltage.
- G. All circuit interruption shall be accomplished by the circuit breaker and without the aid of limiter fuses. The circuit breaker short-time ratings shall be as specified on the drawings.
- H. The assembly is designed for use on 60 Hz electrical systems up to 600VAC. The assembly shall be properly braced to the ratings of the circuit breaker installed within the assembly.
- I. Any items not specifically mentioned but which are obviously necessary for proper operation are implied in this specification.

## 2.04 CONSTRUCTION

### A. General

1. Switchboard lineup shall be Front Access
2. Each steel section shall contain one or more individual circuit breakers, or instrumentation compartments, and a rear compartment for the buses and outgoing cable connections.
3. The finish shall be medium gray ANSI #61.

### B. Dimensions

1. Master Control section width should be no more than 54" and no less than 48", this is to match the space constraints of the former Laker Shore switchgear
2. Sections without Master Control should be 48", or 60" wide dependent on the size of the circuit breakers being installed.
3. The lineup shall provide adequate wire bending space for mains and feeder breakers using up to 750 kcmil wires.
4. Section depth shall be no less than 48", and height shall be 90".
5. Adequate conduit space shall be provided to allow all conductors to exit the structure at the same end.

C. Moving and Handling

1. The Lineup shall be divided into shipping splits not to exceed 48" wide, unless otherwise specified, and shall be capable of being lifted overhead or by a forklift.

2.05 BREAKER COMPARTMENT

A. Circuit Breakers

1. Each circuit breaker shall be mounted in its own compartment with barriers.
2. Generator transfer, Generator Main, and Utility Main circuit breakers shall be 100% rated. Feeder breakers shall be 100%.
3. Operational buttons on the circuit breaker as well as the trip unit and the display shall be accessible without opening the breaker compartment door.
4. All circuit breakers in a given section shall be fixed-mount construction.
5. Draw-out circuit breakers of like sizes and rated 1600A or less shall be interchangeable as standard. Circuit breakers of lower interruption ratings shall be mechanically prohibited from being placed in a cell.
6. Draw-out circuit breakers and prepared space compartments shall be "keyed" such that a breaker cannot be incorrectly installed with respect to interrupting Rating, Frame Size, or Secondary connections.
7. Prepared spaces shall be totally complete, include the racking mechanism (if draw-out breakers), bussing, and secondary contacts as necessary, so that a circuit breaker of the correct frame size can be installed with no modifications required.

B. Secondary Connections

1. All customer secondary control and communications connections shall be made from the front of the switchgear lineup.
2. A dedicated wiring area accessible from the front shall allow easy access to all control or communications terminations
3. All control wire shall be 14-gauge SIS.



4. Dedicated conduit entry for control wires shall be provided at the top and bottom of each section, capable of landing up to 3 each 1 ½" conduits and accessible from the front.
5. All secondary and communication wiring shall be securely fastened to the switchgear without the use of adhesive backed wire anchors.

C. Instrumentation

1. Compartments containing instrumentation, metering devices, etc. shall have barriers.
2. The instrumentation compartment shall not inhibit the routing of control or communication wires.

2.06 BUSSING AND CABLE COMPARTMENT

A. Bussing

1. All horizontal distribution bussing shall be rated for the full ampacity of the lineup.
2. All bus joints shall consist of Grade 5 hardware and locking washers to withstand mechanical forces exerted during short circuits. All joints shall consist of a minimum of 2 bolts.
3. Bussing shall be silver plated copper
4. Bussing shall be braced to withstand the instantaneous interrupting rating 65kA.
5. The entire length of the bussing shall be plated.

B, Cable Compartment

1. All incoming or outgoing power conductors shall be routed through this area.
2. Breakers shall have adequate wire bending space regardless of the interrupting rating
3. Conduit area dimensions shall be sized to support full bottom cable entry, or full top cable entry.

2.07 CIRCUIT BREAKERS AND TRIP UNITS

A. Circuit Breakers

1. The circuit breaker shall comply with ANSI C37/UL1066 and UL 489 standards. Basis of design is SQD Master Pact, NW frame with Micrologic 5 trip plug.
  2. Circuit breakers shall be suitable for the required instantaneous rating without the use of current limiting fuses.
  3. All circuit breakers shall have field interchangeable electrical accessories including shut trip, spring release, electrical operator, auxiliary contacts, and Trip Unit.
  4. All secondary connections shall be made directly to the front of the circuit breaker cradle.
  5. Each circuit breaker shall have built in contact temperature and contact wear sensors.
  6. Circuit breaker must be equipped with an interlock to discharge the stored energy spring before the circuit breaker can be withdrawn from the cell. Circuit breaker must provide a positive ground contact check between the circuit breaker and cell when the accessory cover is removed while the circuit breaker is in the connected, test or disconnected positions.
- B Located on the face of the circuit breaker shall be buttons, with optional lockable clear cover, to open and close the circuit breaker and indicators to show the position of the circuit breaker contacts, status of the closing springs, and circuit breaker position in the cell. An indicator shall show “charge-not OK to close” if closing springs are charged but circuit breaker is not ready to close. Circuit breaker racking system must have positive stops at the connected, test, disconnected and withdrawn positions.
- C. Circuit breaker must be equipped with an interlock to discharge the stored energy spring before the circuit breaker can be withdrawn from the cell. Circuit breaker must provide a positive ground contact check between the circuit breaker and cell when the accessory cover is removed while the circuit breaker is in the connected, test or disconnected positions.
- D. Circuit breaker shall provide long service life. The 3200 A circuit breaker frame and those of lower ratings must be certified to perform a minimum of 10,000 operations without maintenance. The 4000A and 5000A frames must be certified to 5,000 operations without maintenance.
- E. Trip Units
1. All trip units shall be removable to allow for field upgrades.
  2. Rip units shall incorporate “True RMS Sensing”, and have LED Long-time pickup indications.

3. Electronic trip unit functions shall consist of adjustable long-time pickup and delay, short-time pickup and delay, instantaneous.
4. Adjustable long-time pickup ( $I_r$ ) and delay shall be available in an adjustable rating plug that is UL Listed as field-replaceable. Adjustable rating plug shall allow for nine long-time pickup settings from 0.4 to 1 times the sensor plug ( $I_n$ ). Other adjustable rating plugs shall be available for more precise settings to match the application. Long-time delay settings shall be in nine bands from 0.5-24 seconds at six times  $I_r$ .
5. Short-time pickup shall allow for nine settings from 1.5 to 10 time  $I_r$ . Short-time delay shall be in nine bands from 0.1-0.4  $I^2t$  ON and -0.4  $I^2t$  OFF.
6. Instantaneous settings on the trip units with LSI protection shall be available in nine bands from 2 to 15 times  $I_n$ .
7. All trip units shall have the capability for the adjustments to be set and read locally by rotating a switch. Trip unit shall provide local trip indication.
8. Ground-fault protection shall be available for solidly grounded three-phase/three-wire, or three-phase/four-wire systems. Trip unit shall be capable of the following types of ground-fault protection; residual, source ground return, and modified differential. Ground-fault sensing systems may be changed in the field.
9. Ground-fault settings for circuit breaker sensor sizes 1200 A or below shall be in nine bands from 0.2 to 1.0 times  $I_n$ . The ground-fault settings for circuit breakers above 1200 A shall be nine bands from 500 to 1200 A.
10. Neutral current transformers shall be available for four-wire systems.
11. Trip units shall be available to provide real time metering. Metering functions include current, voltage, power and frequency.
12. Basis of Design is SqD Micrologic 5
13. Vendor field technician shall be equipped with proper programmer and field equipment to setup, configure the Micrologic 5 trip unit. & also be equipped with the proper field equipment to program/configure any of the three M1, M2 and TIE breaker's trip unit in the GE switchgear.

## 2.08 DIFFERENTIAL GROUND FAULT PROTECTION

- A. 480Y/277V or 600Y/347V, 4-wire connected equipment having multiple sources shall a modified differential ground fault system (MDGF). The manufacturer shall complete the MDGF design prior to building equipment to ensure that the proper main1, main2, or tie breaker(s) operate properly during the following occurrences on the main bus.
  1. Ensure the system will trip with the occurrence of a ground fault at any location in the switchgear.

2. Ensure system will not trip without ground fault and with normal current flow.
3. Ensure system will not trip due to large single-phase currents.
4. Ensure system will trip with combination of normal current flow and ground fault current flowing together.
5. Ensure system will not trip with circulating currents through the neutral due to multiple grounds and sources external to the immediate low voltage power sources.
6. The manufacturer shall be required to include additional CTs, ground fault relays, interlocks, wiring, components etc. to ensure the ground fault system operates without nuisance tripping on the main bus of the switchgear.

## 2.09 TRANSIENT VOLTAGE SURGE SUPPRESSION

- A. Provide 240kA transient voltage surge suppression.

## 2.10 INDIVIDUAL GENERATOR MONITORING AND CONTROL PANEL

- A. Provide a transfer control panel for each generator set in the emergency/standby power system. The transfer control functions shall be integrated with the generator set control functions, and provided in a single, dedicated purpose microprocessor-based control designed and manufactured by the generator set manufacturer. Each transfer control panel shall contain the functions as described in this section. No PLC-based control shall be used to provide these functions. Each transfer control shall be independent and autonomous, requiring no interaction with other controls for proper operation, except load sharing and transfer breaker status functions. Failure of the system master control shall have no impact on the functions described in this section for the generator sets.
  1. The control shall be designed for proper operations without recalibration in ambient temperatures from -40°C (-40°F) to +70°C (158°F), and for storage from -55°C (-67°F) to +80°C (176°F). Control will operate with humidity up to 95%, non-condensing.
  2. The HMI shall be designed for proper operation in ambient temperatures from -20°C (-4°F) to +70°C (158°F), and for storage from -30°C (-22°F) to +80°C (176°F). The control board shall be fully encapsulated to provide superior resistance to dust and moisture. Display panel shall have a single membrane surface, which is impervious to effects of dust, moisture, oil and exhaust fumes. The panel shall use a sealed membrane to provide long reliable service life in harsh environments. The control system shall be specifically designed and tested for resistance to RFI/EMI and to resist effects of vibration to provide a long reliable life when mounted on a generator set. The control shall not effect from vibration to provide a long reliable life when mounted on a generator set. The control shall include transient voltage surge suppression to provide compliance to referenced standards.

3. Each transfer control shall be provided with an operator panel to allow the operator to view the status and control operation of the specific generator set being paralleled. The operator panel shall be provided with the following features and capabilities.
  - a) The control shall include an option to provide both a local and remote operation panel.
  - b) The control shall provide comprehensive three phase AC metering functions for the generator set and an additional source, including: 3-phase voltage (L-L and L-N) and current, frequency, phase rotation, individual phase and totalized values of kW, kVAR, kVA and Power Factor; totalized positive and negative kW-hours, kVAR-hours, and kVA-Hours. Three wire or four wire voltage connection direct sensing of voltage to 600V, and up to 45kV with external transformers. Current sensing is accomplished with either 5 amp or 1 amp CT secondary with up to 10,000 amp primary.
  - c) Running Time Meter, Start Counter.
  - d) Four tactile feel membrane switches shall be included to control auto mode, stop/off, manual mode, and manual start.
  - e) Two tactile fee membrane switches dedicated to control of circuit breaker shall be included.
  - f) One tactile feel membrane switch shall be provided for fault reset.
  - g) One tactile fee membrane switch shall be provided to test panel lamps. Operation of this switch shall cause all lamps on the panel to be simultaneously tested.
  - h) The control panel shall be provided with a set of DC-power lamps with a switch to all viewing of all functions on the front panel when normal lighting systems are not available.
  - i) Emergency Stop switch. The emergency stop switch shall be a red, mushroom head switch which maintains its position until manually reset.
  - j) Precision voltage and frequency adjust raise/lower switches. Switches shall allow the generator set frequency and voltage to be adjusted plus or minus 5% when the generator set is operating independently of the system bus. The switches shall be disabled when the transfer breaker is closed. Voltage and frequency adjustments while the transfer breaker is open shall not impact on the load sharing when the transfer breaker is closed.
  - k) The control shall support menus and setting navigation in English language. The following languages maybe supported: English, Spanish, French, German, Italian, Greek, Portuguese,

Finnish, Norwegian, Danish, Russian (Cyrillic), Chinese, Hungarian, Japanese, Polish, and Czech.

- l) Alarm and status indicating panel to indicate the following conditions (alarm horn shall be located on master control).

Function	Lamp Color	Alarm Horn	Shutdown
Low DC Voltage	Amber	*	
High DC Voltage	Amber	*	
Weak Battery	Amber	*	
Fail to Sync	Amber	*	
Low Oil Pressure	Amber	*	
Low Fuel Day Tank	Amber	*	
High Engine Temp	Amber	*	
Ground Fault	Amber	*	
Overcurrent	Amber	*	
Breaker Failure	Red	*	*
Breaker Tripped	Red	*	*
Not in Auto	Red	*	*
High Engine Temp	Red	*	*
Low Oil Pressure	Red	*	*
Overcurrent	Red	*	*
Short Circuit	Red	*	*
Loss of Excitation	Red	*	*
Reverse Power	Red	*	*
Overcrank	Red	*	*
Overspeed	Red	*	*
Under Frequency	Red	*	*
Under Voltage	Red	*	*
Over Voltage	Red	*	*
Phase Rotation	Red	*	*
Low Coolant Level	Red	*	*
Automatic	Green		
Genset Running	Green		
Breaker Open	Green		
Breaker Closed	Green		
Demand Mode Standby	Green		
Timing for Start	Green		
Timing for Shutdown	Green		

- B. Internal Controls. The following internal control functions shall be provided for each generator set control in the system.

1. The control shall include a synchronizer to electronically adjust the engine governor to match the voltage, frequency and phase angle of another source such as another generator set(s) or the utility grid. Synchronizer shall maintain the engine-generator voltage within 0.5 – 10% (adjustable) of bus voltage and phase angle within 0.1 – 20 electrical degrees (adjustable) of the bus for 0.5 – 5 seconds (adjustable) before circuit breaker closing. The synchronizer shall include provisions for proper operation even with highly distorted bus voltage waveforms. The synchronizer can match other sources over a range of 60-110% of nominal voltage and -24 to +6 hertz. The system shall be provided with a fail to synchronize time delay that is adjustable from 10-900 seconds. Control logic for fail to synchronize function shall allow field adjustment of function for either alarm or shutdown of the generator set on failure condition. Each unit shall have its own synchronizer; systems using a switching scheme to utilize a single system synchronizer will not be approved. Synchronizers and systems which utilize a motor driven pot for control of AC voltage during the synchronizing process will not be accepted.
2. Controls shall include a sync check function to prevent accidental closure of the transfer breaker with the generator set of phase with the bus. Provisions to allow closure of the first generator set to a de-energized bus shall be included. Adjustable criteria are for the sync check function shall be phase difference from 0.1-20 degrees, frequency difference from 0.001-1.0 Hz, voltage difference from 0.5-10%, and a dwell time from 0.5-5.0 seconds. The sync check function should ensure that generator set phase rotation matches bus phase rotation. Internally the synch check shall be used to confirm synchronization prior to performing closed transition operations. An external sync check output is also available. The sync check function shall operate in both the automatic and manual mode of the generator set control.
3. Electronic isochronous kW load sharing control to operate the engine governors during synchronizing and to provide isochronous load sharing when paralleled. The control system shall allow sharing of real kW load between all generator sets in the system to within 1% of equal levels, without introduction of frequency droop into the system. The control system shall include all equipment required for kW load sharing with an infinite bus. Electronic kVAR load sharing control shall operate the alternator excitation system while the generator set is paralleled. The control system shall allow sharing of reactive load between all generator sets in the system to within 1% of equal levels, without introduction of voltage droop into the system. The isochronous load sharing module shall be integral function of the generator control.

4. When the generator set control receives a signal indicating that the generator set is paralleled with an infinite source such as a utility (mains) service, the shall operate in load govern mode. Control shall be adjustable for kW values form 0-100% of standby rating, and 0.7-1.0 power factor (lagging). The control shall include inputs to allow independent control of kW and kVAR load level by a remote device while in the load govern mode. The rate of load increase and decrease shall also be adjustable in the control.
5. Load demand governing controls shall be provided to cause the generator set to ramp down to zero load when signaled to shut down in a load demand mode. On a signal to re-start, the load demand governing controls shall cause the generator set to synchronize to the system bus, close, and ramp up to its proportional share of the total bus load. The ramp rate of the generator set shall be operator-adjustable.
6. The control shall include a first start function to monitor all of the generator sets as they are starting to positively prevent out-of-phase transfer if two or more engine-generator sets reach operating conditions simultaneously. The control shall provide a lockout signal to disable breaker closure for generator set(s) in the system which have not been selected to be the first units to close to the bus. The control shall verify that the generator set has reached at least 90% of nominal voltage and frequency before closing to the bus. Controls shall recognize a failure of the first breaker signaled to close and allow system operation to proceed in spite of this failure. The first start function shall be integral to each generator set control and failure of any generator set control shall not affect the first start functionality of the other controls in the system. Systems using dead bus relay schemes without a disable signal to positively prevent out-of-phase transfer shall not be acceptable under this specification. Systems that provide an independent PLC to perform this function shall not be acceptable. The system shall include an independent backup to automatically operate in the event that the primary system fails.
7. The control shall include an integrated three phase line-to-line sensing voltage regulation system that is compatible with shunt or PMG excitation systems. The voltage regulation system shall be three phase full wave rectified and have a FET output for good motor starting capability. Major system features shall include: Digital output voltage regulation – Capable of regulating output voltage to within +/-1.0% for any loads between no load and full load. Voltage drift shall not exceed +/-1.5% for 40°C (104°F) change in temperature in an eight hour period. On engine starting or sudden load acceptance, voltage shall be controlled to a maximum of 5% overshoot over nominal level.



8. The control shall include an integrated isochronous governing system capable of controlling engine speed within +/-0.25% for any steady state load from no load to full load. Frequency drift shall not exceed +/-0.5% for a 33° (60°F) change in ambient temperature over an 8 hour period. The control shall include temperature dependent governing dynamics that will modify the engine governing control parameters as a function of engine temperature.
9. The control shall include a de-rate function to reduce output power of the generator set in response to a fault condition. If a de-rate command occurs while operating on an isolated bus, the control shall issue commands to reduce the load on the generator set via contact closures for Modbus. If a de-rate command occurs while in utility parallel mode, the control shall actively reduce power by lowering the base load kW to the de-rated target kW.
10. The control shall provide a load shed signal when the generator set overloaded or in an under-frequency condition. The overload parameters shall be adjustable from 80%-140% of generator kW rating for more than 0-120 seconds. The frequency parameters shall be adjustable from 0.1-10Hz under nominal frequency for more than 0-20 seconds.
11. The control shall accept up to four alarm or status inputs to indicate a configurable (customer-specified) condition. The inputs shall be programmable for warning, de-rate, shutdown, shutdown with cooldown or status indication and for labeling the input.
12. The control in conjunction with In-Power software, shall accept commands to allow a technician to verify the proper operation of the control and its interface by simulating failure modes or by forcing the control to operate outside of its normal operating ranges.
13. The control shall include provisions for utility and generator set breaker interfaces including separate relays for opening and closing the perspective breaker, as well as inputs for both 'a' and 'b' breaker position contacts and tripped status. Breaker diagnostics shall include contact Failure, fail to close, fail to open, fail to disconnect, and tripped. Upon breaker failure, appropriate control action shall be taken to maintain system integrity.
14. The control shall provide adjustable start delay from 0-300sec, stop delay from 0-800sec, transfer delay from 0-120sec, retransfer delay from 0-1800 sec, programmed transition delay from 0-60sec, and maximum parallel time from 0-1800sec.

15. Cooldown time delay, adjustable: 0-600 seconds. The control panel shall indicate the time remaining in the time delay period when the generator set is timing for shutdown
  16. Control equipment shall contain a system of diagnostic LEDs to assist in analyzing proper system function.
- C. Generator Set Protection – The control shall include the protective functions listed below. On operator of a protective function the control shall indicate a fault by illuminating the appropriate status LED on the HMI, as well as display the fault code and fault description on the HMI display screen. The nature of the fault and time of occurrence shall be logged in the control.
1. The control shall include a Maintenance Mode that will provide the capability to instantaneously shutdown the generator set in order to reduce the risk of Arc Flash due to thermal overload or electrical faults by inverse time protection.
  2. Reverse power shutdown (32) – Controls shall be provided to sense reverse power conditions on the engine while paralleled to the system bus. Reverse power protection shall be set to operate at not more than 20% of the kW rating of the generator set at standby conditions. Adjustment range: 5-20% of standby kW rating, delay 1-15 seconds. Default: 10%, 3 seconds.
  3. Reverse Var shutdown – Controls shall be provided to sense reverse Var conditions on the alternator while paralleled to the system bus. Reverse Var protection shall be set to operate at not less than 15% of the kVar rating of the alternator at standby conditions. A reactive capability curve shall be provided to allow proper setting of this protection. Shutdown level is adjustable: 15-50% of rated Var output, delay 10-6- seconds.
  4. Overcurrent warning/shutdown (51) – Electronic alternator overcurrent alarm and shutdown protection. The protection shall be required in addition to the overcurrent trip on the transfer breaker, and shall sense current flow at the generator set output terminals. The overcurrent alarm shall be indicated when the load current on the generator set is more than 110% of rated current for more than 60 seconds. The overcurrent shutdown shall be matched to the thermal damage curve of the generator set, and shall not have an instantaneous function.
  6. Short circuit protection – This protection is in addition to the overcurrent trip on the transfer breaker. The short circuit shall occur when the load current on the generator set is more than 175% of rated current and an aggregate time/current calculation indicates that the system is approaching the thermal damage point of the alternator. The equipment

used shall not have an instantaneous function and shall be selectively coordinated with the feeder circuit breakers. Control shall include algorithms to protect alternator from repeated over current conditions over a short period of time.

7. Current Regulation – A UL-listed comprehensive monitoring and control system shall be integral to generator set control that guards the electrical integrity of the alternator and power system by providing protection against a wide array of fault conditions in the generator set or in the load. The current regulation control system shall provide single and three phase fault current regulation so that downstream protective devices have the maximum current available to quickly clear fault conditions without subjecting the alternator to potentially catastrophic failure conditions. The control shall provide overcurrent and short circuit protection for the conductors connecting the generator set to the transfer switchgear. This protection may be integrated with alternator protection but must be positively coordinated to prevent tripping of the transfer breaker prior to the operation of the alternator protective equipment.
8. Controls shall be provided to regulate output current on any phase to a maximum of 3 times rated current under fault conditions for both single phase and three phase faults. In conjunction with a permanent magnet generator, it shall provide 3 times rated current on all phases for motor starting and short circuit coordination purposes.
9. High AC voltage shutdown (59) – Controls shall be provided to shut down generator set and initiate alarm when the generator set output voltage on any phase exceeds preset values. Time to trip is inversely proportional to amount above threshold. Values adjustable from 105-125% of nominal voltage, with time delay adjustable from 0.1-10 seconds.
10. Low AD voltage shutdown (27) – Controls shall be provided to shut down generator set and initiate alarm when the generator set voltage on any phase has dropped below a preset value. Adjustable over a range of 50-95% of reference voltage, time delay 2-20 seconds. Function tracks reference voltage. Control does not nuisance trip when voltage varies due to the control directing voltage to drop, such as during a V/Hz roll-off or synchronizing.
11. Under frequency shutdown (81U) – Controls shall be provided to shut down generator set and initiate alarm when the generator set output frequency cannot be maintained. Settings are adjustable from 2-10 Hz below reference governor set point, for a 5-20 second time delay. Under frequency protection is disabled when excitation is switched off, such as when engine is operating in idle speed mode.

12. Over frequency shutdown/warning (81O) – Control shall be provided to shut down generator set and initiate alarm when the generator set is operating at a potentially damaging frequency level. Setting are adjustable from 2-10 Hz above nominal governor set point for a 1-20 second time delay.
13. Low and high battery voltage warning – The control shall indicate status of battery charging systems (failure) by continuously monitoring battery voltage.
14. Weak battery warning – The control shall test the battery each time the generator set is signaled to start and indicate a warning if the battery indicates impending failure.

## 2.11 MASTER CONTROL SYSTEM AND MONITORING EQUIPMENT

Provide an independent system master control to monitor and control the operation of the entire transfer system. Each panel shall contain the components and devices as described in this section.

The master control shall be capable of all functionality as described herein, regardless of the utilization of limited functionality that may outlined in the Sequence of Events for this specific project.

### A. Construction

1. The Master Control should be housed fully incorporated into the switchgear. Basis of Design is Power Command DMC1000 with the built-in MCM3320 module.
2. The enclosure frame shall be welded and constructed of a minimum of 12-gauge steel. Covers shall be constructed of a minimum of 14-gauge steel.
3. All doors and covers shall have foam-in place urethane gaskets for NEMA 3R non-walk-in type enclosure.
4. The enclosure shall be a design to allow top lifting with lifting eyes.
5. The enclosure shall include a lockable door handle which operates a three-point latching system, with a minimum of two keys provided.
6. All interior panels and doors shall be bonded to the grounding bar located in each section.

7. The master controls system shall be listed and labeled under the requirements of UL891, including all covers, barriers, and supports.
8. All wiring shall be UL listed 105°C, 600 volt rated, and sized as required. Each wire, device or function shall be suitably identified by silk-screen or similar permanent identification.
9. AC control circuits in the switchboard shall be protected with properly size circuit breakers. Potential transformers shall be protected on line and load side.
10. All CT installations shall include shorting type terminal blocks.
11. All field control interconnecting wiring shall be sized as specified by system manufacturer (wiring not designated by the system manufacturer shall be minimum 14 AWG copper. All control interconnect wiring shall be stranded.
12. All active control system components in the system shall be suitable for operation in ambient temperatures ranging from -20° to +70°C. The active control electronics shall be environmentally protected from dust, dirt, and humidity. The controls shall be suitable for operation in an ambient ranging from 5-95% relative humidity, and shall be protected from the effects of equipment vibration.

B. Main Controller

1. The Main controller of the Master Control shall be Microprocessor based
2. 0-50°C operating temperature
3. -20 to +70°C storage temperature
4. 9Vdc to 32Vdc operating voltage
5. LED diagnostics for troubleshooting

C. Operator Panel

1. The display shall be a backlit LCD display with a status LED lamps and tactile-feel membrane switches that are used by the operator to navigate through menus. The home screen provides one-line topology information, including source availability, source connected status, voltage, frequency, and power data.
2. Control Menus provide for viewing and all adjustment of relevant operating set-points. Control Menus shall include the following categories:
  - a) Test
  - b) Extended Parallel
  - c) Load Demand

- d) Load Add and Load Shed
3. Adjust Menus allow complete configuration, setup, and fine-tuning of the controller settings. Adjust Menus shall include the following categories at minimum:
- a) AC Metering
  - b) AC Meter Setup
  - c) Configuration Output
  - d) Demand
  - e) Power Transfer Control
  - f) Sync Check
  - g) Sync Adjust
  - h) Scheduler
  - i) Load Add and Load Shed
  - j) Generator Bus Overload
4. Monitor Menus shall provide an organized access to all controller data. The Monitor Menus shall include the following categories at minimum:
- a) AC Metering
  - b) Analog Inputs
  - c) Analog Outputs
  - d) Breakers
  - e) Communications
  - f) Load Control
  - g) Priority
  - h) Relay Outputs
  - i) Switch Inputs
  - j) Synchronizer
  - k) System Status
  - l) Load Demand
  - m) Load Add and Load Shed
  - n) Generator Bus Overload
  - o) Scheduler
5. Fault Menus shall provide Pop-up diagnostic messages when they occur, and can be acknowledged with a single button. In addition to current messages, historical information on faults and events shall be available for viewing with Fault Menus. Fault Menus shall include the following categories:
- a) Current Faults
  - b) Active Event Table
  - c) Event Occurrence Table
  - d) Active Fault Table
  - e) Fault History
  - f) Fault Occurrence Table

D. Annunciators

- a) Test
- b) Extended Parallel
- c) Genset Bus Overload
- d) Load Demand

1. Load Add/Shed Conditions:

- a) Add Level 1 ON
- b) Add Level 2 ON
- c) Add Level 3 ON
- d) Add Level 4 ON
- e) Add Level 5 ON
- f) Add Level 6 ON
- g) Shed Level 1 ON
- h) Shed Level 2 ON
- i) Shed Level 3 ON
- j) Shed Level 4 ON
- k) Shed Level 5 ON

E. PLC interface

1. Provide an interface module (per SCADA plant personnel) and communications cables to provide communications and interfacing between the plant's Allen Bradley Control Logix PLC/SCADA system in PLC-1 control panel in the electrical room, via MODBUS communications protocol, using provided Belden twisted shielded cable and other approved communications cable compatible with the equipment from the Vendor to provide Modbus interfacing.
2. Provide interface SCADA Communications device from the Switchgear controller's Modbus RTU 485 protocol to the existing PLC control panel; coordinate with the Owner's SCADA programmer for model and vendor of SCADA communications interface device.
3. Provide configuration of DCM1000 interface/MCM3320 unit so built in information is available to Owner's exterior equipment like SCADA work via Modbus communications.
4. Assist Owner's SCADA manager/programmer and provide registers and I/O mapping info on the DCM 1000 unit and the built-in MCM 3320 information captured by the device so the available parameters registered by the new controller can be accessed and programmed into the Owner's existing SCADA.





supply, a UPS, and a set of batteries capable of supply the Master Control power indefinitely during normal conditions, and for at least 30 minutes during an entire facility outage before additional charging is required.

- J. When transfer with the utility, a Master synchronizer and kW/kVar controller shall be used to ensure the generators are synchronized with the Utility prior to transfer. The master synchronizer shall be designed and manufactured by the generator control and master control manufacturer to ensure compatibility and optimized algorithms for synchronizing.
- K. When transfer with the Utility, the Master Control shall use a kW and kVar controller to control the output of the generator. The controller shall be a separate controller from the main Master Control PLC and shall be manufactured and designed by the generator control manufacturer to ensure compatibility and optimized algorithms.
- L. The Master Control shall be able to actively control kW and kVar output of the generator in multiple modes:
  - 1. Closed Loop PI Control to control Utility kW and kVar import.
    - a) Closed Loop PI Control to control Generator kW and kVar outputs with an option to constrain the utility export/import value.
    - b) Open Loop control to hold the Generator %kW and kVar outputs constant.
    - c) Closed Loop PI control to hold the Generator power factor constant.
    - d) Closed Loop PI control to hold the Utility power factor constant.
  - 2. The controller shall calculate the amount of power to be produced by the generators at a minimum of 50 times per second.

## 2.12 SEQUENCE OF OPERATION:

- A. Modes of Operation: The master controller shall be capable of Open, Programmed, Base Load and 100MS Closed Transition transfer as required by FP&L. For the purposes of brevity in Documents, the below only describes the Open Transition sequence of operations which shall be used for this phase of the Project.
  - 1. Open Transition Transfer. Under normal operating conditions, utility power is provided to the load through the normal (utility) circuit breaker. (UM1) The emergency (Generator set) circuit breaker is open and the Generator set is stopped. Four modes of operation are available and can be configured from the front panel of the Power Command ATS controller. This is a password protected function.
    - a. Open transition will provide a load break transfer between sources.
  - 2- Loss of Normal Power

- . System generates a start signal upon loss of normal (utility) power as sensed by the master control. On loss of utility voltage, the utility breaker is opened; the generator set automatically starts, and accelerates to rated frequency and builds up to rated voltage. The control system verifies that the generator set is at 90% or rated voltage and frequency and the generator breaker is closed to the system bus.
- 3- Failure of A Unit To Start Or Fail to Crank
  - a. On receipt of a start signal, the generator set will time out it's time delay start, and then issue a command to the engine controls to start the engine. The control will verify that that the engine is rotating when the start command is issued. If the engine does not rotate when the start command is issued, the start signal will be stopped, and reissued. If the engine still does not rotate, the generator set will be shut down and a "FAIL TO CRANK" shutdown alarm will be issued.
  - b. If the generator set cranks but fails to start, after the over crank time delay (in the generator set control) has expired, the unit will be shut down, and an alarm will sound.
- 4- Return of Normal Power
  - a. When utility voltage returns (following the retransfer time delay) the system will begin a retransfer process in an open transition mode.
  - b. Running in the open transition mode, the system will sequentially transfer back to the utility by opening the generator breaker, then closing the utility breaker at an operator-programmed time period. Time Delay Retransfer and then Program Transition.
  - c. When all loads have been transferred back to the utility, the generator set will operate at no load for a cooldown period. When the cooldown period has been completed, the generator set will shut down. \*\*If a system start signal is received during the cooldown period, the system will immediately retransfer to generator set power, as described in "Loss of Normal Power".
- 5- Fail to Transfer
  - a. The control system will continuously monitor the breakers as they are issued signals to operate. If a breaker does not operate properly, the control system will alarm

#### 2.13 -Test Operation – Open Transition (Load Break)

- A. TEST is selected as the Control Mode, the Generator set is signaled to start. After the Generator set reaches normal voltage and frequency, the normal circuit breaker will open, and after a programmed time delay the emergency breaker will close.

- B. Upon returning to the NORMAL control mode, and after a programmed time delay, the emergency breaker will open, and the normal breaker will close. The Generator set will continue to run for a cooldown period and stop.

#### 2.14 EXAMINATION

- A. The installer shall be responsible for inspection of the site and verification that the equipment can be installed and operated as required by the manufacturer.

#### 2.15 INSTALLATION

- A. The equipment shall be installed as recommended by the equipment manufacturer.
- B. Remove temporary lifting provisions prior to commissioning.

#### 2.16 IDENTIFICATION

- A. Mount permanent operating instructions at each transfer point, and at the system master control. Instructions shall include a one-line system drawing, description of the operating sequences of the system and the manual operation instructions for the panel where they are installed.
- A. A notice indicating location of the operation and maintenance manual shall be provided.
- B. A notice indicating service support information including supplier name, telephone numbers, and manufacturer's contact information shall be provided on each major piece of equipment.

#### 2.17 CONNECTIONS

- A. Ground each piece of equipment according to the requirements of the equipment vendors and NEC.
- B. Connect power conductors in compliance to appropriate instructions based on voltage class, per the vendor, and NEC.
- C. Provide control interconnection wiring and connect all control interconnections in strict compliance to the equipment manufacturers' instructions.

#### 2.18 FIELD QUALITY CONTROL

- A. Prior to acceptance testing, test insulation resistance of each switchgear bus, component, connecting supply, feeder, and control circuit (in compliance and under supervision of equipment manufacturer(s).) Test continuity of each circuit. Retain permanent records of this testing.

- B. A factory-authorized and certified service technician shall inspect all control wiring for type of wiring material and installation practice, verify that the wiring is properly installed by point to point testing, and complete installation and startup checks as required by the equipment manufacturer.

#### 2.19 ADJUSTING

- A. Set all breaker trip units and protective relaying according to the results as required by a coordination study.
- B. Record all settings and provide in system operation and maintenance manuals.

#### 2.20 CLEANING

- A. All equipment is to be thoroughly cleaned, any shipping or installation damage repaired, prior to equipment commissioning and final test.

#### 2.21 PROTECTION

- B. Equipment shall be protected from the environment in compliance to the recommendations. At a minimum, equipment shall be protected from moisture, dirt, and condensation.

#### 2.22 DEMONSTRATION

- 1. Factory Testing – Before shipment of the equipment to the jobsite, the entire control system (including generator set controls) and all t the control system shall be tested together at the manufacturer’s facility to demonstrate that it is fully functional prior to shipment to the jobsite. No exceptions to the requirements of this paragraphs will be accepted.
- A. The supplier of the transfer system shall provide a manufacturer-certified representative to train the owner’s personnel in the proper operation and maintenance of the transfer system. Refer to general requirements in the contract documents.

#### 2.23 FINAL TESTING AND TRAINING

- A. Vendor, field technician and Contractor shall work together to configure, program and test the new low voltage parallel switchgear transfer switch along with the proper operation during a loss of normal power event for the GE switchgear M1 M2, and TIE breakers. Provide training and demonstration to the plant operators, set aside 4 hours of training on how to manually operate the parallel low voltage switchgear and its Normal and Emergency breaker pair.

### **PART 3 EXECUTION (NOT USED)**

END OF SECTION