HARRIMAN

**ADDENDUM**

Date May 14, 2019

To Prospective Bidders

Re Addendum No. 1 to the Construction Documents for:

Central Maine Community College
Campus Generator
Auburn, Maine
Project No. 18473

This Addendum forms a part of the Contract Documents and modifies the original Construction Documents dated April 23, 2019. Acknowledge receipt of this Addendum in the space provided in the Bid Form.

This Addendum consists of three pages, Pre-Bid Attendees List, Sections 001113, 004113, 012300, 017900, 230900, 260010, 260300, 260425, 260621, 260622 and Drawing ES50.1.

Harriman

John W. Tarr, P.E.
Principal

AUBURN

BOSTON

PORTLAND

PORTSMOUTH

harriman.com

**DOCUMENTS ISSUED FOR REFERENCE**

1. Pre-Bid Meeting Attendees List

**GENERAL INFORMATION**

1. Existing underground fuel oil tank registration number is 13277.

**CHANGES TO BIDDING DOCUMENTS**

1. SECTION 00 11 13 – NOTICE TO CONTRACTORS
    a. Revised and reissued with this addendum.

2. SECTION 00 41 13 - CONTRACTOR BID FORM
    a. Revised and reissued with this addendum.

**CHANGES TO SPECIFICATIONS**

1. SECTION 012300 - ALTERNATES
    a. Issued with this addendum.

2. SECTION 017900 - DEMONSTRATION AND TRAINING
    a. Revised and reissued with this addendum.

3. SECTION 230900 - INSTRUMENTATION AND CONTROL FOR MECHANICAL SYSTEMS
    a. Issued with this addendum.

4. SECTION 231113 – FACILITY FUEL-OIL PIPING
    a. Article 2.1, add the following:
        "B. Underground, double wall, flexible fuel oil piping is an acceptable product. It shall be equal to ATP brand, XP as manufactured by Franklin Fueling Systems. Provide all required fittings, entry boots and transition joints. All piping system accessories shall be provided by the piping system manufacturer."

    b. Article 2.3, add the following:
        "B. Underground, double wall, flexible fuel oil piping is an acceptable product. It shall be equal to ATP brand, XP as manufactured by Franklin Fueling Systems. Provide all required fittings, entry boots and transition joints. All piping system accessories shall be provided by the piping system manufacturer."

5. SECTION 260010 - BASIC ELECTRICAL REQUIREMENTS
    a. Revised and reissued with this addendum.

6. SECTION 260300 – PRIMARY ELECTRICAL DISTRIBUTION
    a. Revised and reissued with this addendum.

7. SECTION 260323 - CUSTOM METAL-ENCLOSED SWITCHGEAR
    a. Article 1.2, add the following:
        "C. See Section 017900 "Demonstration and Training" for generator and electrical distribution commissioning and operational requirements."

8. SECTION 260425 – SWITCHBOARDS
    a. Revised and reissued with this addendum.

9. SECTION 260621 - ENGINE GENERATOR SET-DIESEL
    a. Revised and reissued with this addendum.

10. SECTION 260622 - ENGINE GENERATOR SET-NATURAL GAS
    a. Revised and reissued with this addendum.

**CHANGES TO DRAWINGS**

1. DRAWING M20.1 – SITE PLAN FUEL OIL PIPING
    a. Add the following details:
        "1. 8" Steel Conduit not required to house underground fuel oil supply and return piping.
        2. Underground fuel oil supply and return line sizes shall be increased to 1 ½"."

**DRAWINGS REVISED AND REISSUED WITH THIS ADDENDUM**

1. ES50.1 - SITE POWER RISER DIAGRAM

HARRIMAN

AUBURN
BOSTON
PORTLAND
PORTSMOUTH

www.harriman.com

# PRE-BID MEETING ATTENDANCE FORM

Project Name: Central Maine Community College Campus Generator
Project No.: 18473
Date: 05/09/2019
Time: 2:00 PM
Location: CMCC Jalbert Hall Room #314

| | NAME | COMPANY | BUSINESS PHONE | E-MAIL |
|---|---|---|---|---|
| 1. | Nick Hamel | CMCC | | |
| 2. | Dan Graham | CMCC | | |
| 3. | Dave Hunt | Harriman | | |
| 4. | John Tarr | Harriman | 207.784.5100 | jtarr@harriman.com |
| 5. | Ray Masse | CMCC | 207.212.6193 | rmasse@cmcc.edu |
| 6. | Shawn Henderson | Milliken Bros | | |
| 7. | Anthony Cimino | C.M. Cimino, Inc. | | acimino@cmciminoinc.com |
| 8. | Garrett Gustafson | ES Boulos Company | 207.464.3706 | ggustafson@esboulos.com |
| 9. | Matt Tassinari | Electrical Systems of Maine | | matt@electricalsystemsofmaine.com |
| 10. | Jordan Parker | Kraft Power | | jparker@kraftpower.com |
| 11. | Bruce Damon | Damon Mechanical | | bdamon@damonmechanical.com |
| 12. | Chris Breau | A.L. Doggett | | chris@aldoggett.net |
| 13. | Christine Kendall | H.E. Callahan Const. Co. | | ckendall@hecallahan.com |
| 14. | Joe Perryman | St. Laurent & Son | | joe@stlaurentandson.com |
| 15. | Chad Ellis | CCB Construction | | cellis@ccb-inc.com |
| 16. | Tim Davison | ECS | | tdavison@ecsincorp.com |

**00 11 13**
**Notice to Contractors**

**Central Maine Community College**
**Campus Generator**

*The project consists of addition of campus paralleling generators. Work includes modifications to existing medium voltage switchgear, addition of 480V paralleling generators, 480V switchgear, site and concrete work, natural gas and diesel fuel piping.*

The cost of the work is approximately $ 1,500,000. The work to be performed under this contract shall be completed on or before the Final Completion date of *December 20, 2019*.

1. Sealed Contractor bids, in envelopes plainly marked "Bid for *Campus Generator*" and addressed to:
   *Dr. Scott Knapp, President*
   *Central Maine Community College*
   *1250 Turner Street*
   *Auburn, Maine 04210*

   will be opened and read aloud at *the address shown above, in Jalbert Hall Conference Room J314* at **2:00 p.m.** on ***May 23, 2019***. Any bid submitted after the noted time will not be considered a valid bid and will remain unopened.

2. The bid shall be submitted on the Contractor Bid Form (section 00 41 13) provided in the Bid Documents. The Owner reserves the right to accept or reject any or all bids as may best serve the interest of the Owner.

3. Bid security *is required* on this project.
   If noted above as required, the Bidder shall include a satisfactory Bid Bond (section 00 43 13) or a certified or cashier's check for 5% of the bid amount with the completed bid form submitted to the Owner. The Bid Bond form is available on the BREM website.

4. Performance and Payment Bonds *are required* on this project.
   If noted above as required, the selected Contractor shall furnish a 100% contract Performance Bond (section 00 61 13.13) and a 100% contract Payment Bond (section 00 61 13.16) in the contract amount to cover the execution of the Work. Bond forms are available on the BREM website.

5. Filed Sub-bids *are not required* on this project.

6. There *are no* Pre-qualified General Contractors on this project.
   If Pre-qualified General Contractors are identified for this project, the name of each company, with their city and state, are listed below.

7. An on-site pre-bid conference *will* be conducted for this project.
   If a pre-bid conference is scheduled, it is *mandatory* for General Contractors and optional for Subcontractors and suppliers. Contractors who arrive late or leave the meeting early may be prohibited from participating in this meeting and bidding. *May 9, 2019 in Jalbert Hall Conference Room J314 at 2:00 p.m .*

8. Bid Documents - full sets only - will be available on or about *April 23, 2019* and may be purchased *for a nonrefundable deposit of $100* from:
   *Harriman*
   *46 Harriman Drive*
   *Auburn, Maine 04210*
   *207-784-5100*

9. Bid Documents may be examined at:
   *AGC Maine*
   *188 Whitten Road*
   *Augusta, ME 04330*
   *Phone 207-622-4741 Fax 207-622-1625*

   *Construction Summary*
   *734 Chestnut Street*
   *Manchester, NH 03104*
   *Phone 603-627-8856 Fax 603-627-4524*

   *Dodge Data and Analytics*

   *Harriman*
   *46 Harriman Drive*
   *Auburn, Maine 04210*

**00 41 13**
**Contractor Bid Form**

**Central Maine Community College Campus Generator**

To: *Dr. Scott Knapp, President*
Central Maine Community College
1250 Turner Street
Auburn, Maine 04210

The undersigned, or *Bidder*, having carefully examined the form of contract, general conditions, specifications and drawings dated *April 23, 2019*, prepared by *Harriman* for *Central Maine Community College Campus Generator*, as well as the premises and conditions relating to the work, proposes to furnish all labor, equipment and materials necessary for and reasonably incidental to the construction and completion of this project for the **Base Bid** amount of:

$ _____ .00

1. Allowances *are not included* on this project.
   *Bid amount above includes the following Allowances*

   $

   $

2. Alternate Bids *are included* on this project.
   *Alternate Bids are as shown below*
   Any dollar amount line below that is left blank by the Bidder shall be taken as a bid of **$0.00**.

| | | |
|---|---|---|
| *1* | *Alternate 1 - Generators* | $ _____ .00 |
| *2* | *Not Used* | $ _____ .00 |
| *3* | *Not Used* | $ _____ .00 |
| *4* | *Not Used* | $ _____ .00 |
| *5* | *Not Used* | $ _____ .00 |

3. The Bidder acknowledges receipt of the following addenda to the specifications and drawings:

   Addendum No. _____ Dated: _____

   Addendum No. _____ Dated: _____

   Addendum No. _____ Dated: _____

   Addendum No. _____ Dated: _____

   Addendum No. _____ Dated: _____

4. Bid security *is required* on this project.
   If noted above as required, the Bidder shall include a satisfactory Bid Bond (section 00 43 13) or a certified or cashier's check for 5% of the bid amount with this completed bid form submitted to the Owner.

5. Filed Sub-bids *are not required* on this project.

**Central Maine Community College Campus Generator**

6. The Bidder agrees, if this bid is accepted by the Owner, to sign the designated Owner-Contractor contract and deliver it, with any and all bonds and affidavits of insurance specified in the Bid Documents, within twelve calendar days after the date of notification of such acceptance, except if the twelfth day falls on a State of Maine government holiday or other closure day, or a Saturday, or a Sunday, in which case the aforementioned documents must be received before 12:00 noon on the first available business day following the holiday, other closure day, Saturday, or Sunday.

   As a guarantee thereof, the Bidder submits, together with this bid, a bid bond or other acceptable instrument as and if required by the Bid Documents.

7. This bid is hereby submitted by:

Signature: _____

Printed name and title: _____

Company name: _____

Mailing address: _____

City, state, zip code: _____

Phone number: _____

Email address: _____

State of incorporation, if a corporation: _____

List of all partners, if a partnership: _____

This Page Intentionally Blank

SECTION 012300 – ALTERNATES

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

### 1.2 SUMMARY

A. This Section includes administrative and procedural requirements for alternates.

### 1.3 DEFINITIONS

A. Alternate: An amount proposed for certain work defined in the construction documents that may be added to or deducted from the contract amount if Owner decides to accept a corresponding change either in the amount of construction to be completed or in the products, materials, equipment, systems, or installation methods described in the Contract Documents.

### 1.4 PROCEDURES

A. Coordination: Modify or adjust affected adjacent work as necessary to completely integrate work of the alternate into Project.
   1. Include as part of each alternate, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation whether or not indicated as part of alternate.

B. Notification: Immediately following award of the Contract, notify each party involved, in writing, of the status of each alternate. Indicate if alternates have been accepted, rejected, or deferred for later consideration. Include a complete description of negotiated modifications to alternates.

C. Execute accepted alternates under the same conditions as other work of the Contract.

D. Schedule: A Schedule of Alternates is included at the end of this Section.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF ALTERNATES

A. Alternate No. 1: Generators
   1. Alternate: In lieu of Tier 4F diesel generator(s), and EPA compliant natural gas generator(s), provide the following:
      a. Tier 4F diesel generators with minimum total standby rating of 950kW with maximum 500kW individual kW rating each.
      b. Adjust design requirements to suit alternate generators including but not limited to ground work, piping, wiring, associated distribution and controls to achieve design intent as described in design documents.

END OF SECTION 012300

SECTION 017900 - DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes:
   1. Operational Requirements and Commissioning of Generator and Electrical Distribution Systems.
      a. Commissioning is a systematic process of ensuring that all systems perform interactively according to the design intent and the owner' s operational needs. This is achieved with careful installation, coordination, integration, documentation, and verification of performance. The commissioning process shall encompass and coordinate the traditionally separate functions of system integration, documentation, equipment startup, control system calibration, testing and training.
      b. Contractor shall provide all devices, controls, control interfaces, integration, wiring and other appurtenances as required to ensure that all systems and subsystems indicated in the contract documents operate as indicated and intended.
   2. Administrative and procedural requirements for instructing Owner's personnel, including the following:
      a. Demonstration of operation of systems, subsystems, and equipment.
      b. Training in operation and maintenance of systems, subsystems, and equipment.

B. Related Sections include the following:
   1. Division 01 Section "Project Management and Coordination" for requirements for preconstruction conferences.
   2. Divisions 02 through 33 Sections for specific requirements for demonstration and training for products in those Sections.

1.3 SUBMITTALS

A. Attendance Record: For each test, demonstration, and training session, submit list of participants.

B. Provide letter certifying system operation per design requirements subsequent to contractor' s coordination and commissioning testing and prior to final demonstration.

1.4 QUALITY ASSURANCE

A. Demonstrator and Instructor Qualifications: A factory-authorized service representative, complying with requirements in Division 1 Section "Quality Requirements," experienced in operation and maintenance procedures and training.

1.5 COORDINATION

A. Coordinate the Generator and Electrical Distribution subsystems with the owner and owner' s Building Management System representative, to communicate and operate as a single operational system per design requirements.

B. Coordinate initial programming and setpoints for generator and electrical distribution systems with owner' s requirements.

C. Coordinate startup, initial testing and adjusting prior to final demonstration. Demonstration shall be done after hours so as to not disrupt owner' s schedule.

D. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations.

E. Coordinate providing notification of dates, times, length of instruction time, and training content.

F. Coordinate content of training with content of approved operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 COMMISSIONING

A. Contractor shall verify and certify as indicated above that Generator and Electrical Distribution subsystems and associated controls and support systems operate as an integrated operational system indicated below.

B. Contractor shall verify and certify that monitoring and control systems function as required to monitor and control the following power system components:
   1. Low voltage 480V switchgear paralleling bus
   2. Engine generators.
   3. Circuit breakers integral to engine generators.
   4. 15kV utility “normal” power and associated switch.
   5. 15kV generator “standby” power and associated switch.
   6. Building Management System interface:
      a. Demand Response output to 15kV switchgear and Engine Generator Controls
      b. Load monitoring input from 15kV energy metering
      c. Alarm inputs from 15kV switchgear and Engine Generator Controls
      d. Generator status including generator running, generator synchronized, and generator alarms.
   7. Fuel oil transfer system.

C. Sequence of Operation for Normal Conditions:
   1. 15kV switches, controlled generators and controlled circuit breakers shall be in the automatic position and ready to operate on loss of power or other designated initiation conditions.
   2. Generator control system shall be wired and programmed to receive a "start" signal from the following:
      a. Building Management system (Demand Response)

b. 15kV & Generator control system normal power monitoring.

3. Generator Control system shall communicate with Building Management System such information as Generator alarms, Generator status, fuel tank fill level, and control switch setting via communication link.
4. 15kV energy metering shall log and communicate to Building Management System energy consumption, demand load data, and power quality.

D. Sequence of Operation for Loss of Normal Power Conditions:
1. Generator control system shall sense loss of normal power at 15kV switchgear.
2. On detecting loss of normal power, generator control system shall start engine generators and achieve rated voltage and frequency.
3. Generator control system initiates "Lead" generator to energize 480V Switchgear paralleling bus.
4. Generator control system synchronizes engine generators and allows closure of respective breaker to the 480V switchgear paralleling bus.
5. 15kV switchgear senses Generator Standby Power and after preset adjustable time delay opens 15kV Utility Power switch and closes 15kV Generator Standby Power switch, energizing campus primary loop.
   a. 15kV switchgear shall not close 15kV Generator Standby Power switch until adequate capacity exists on 480 Switchgear paralleling bus to meet last known demand as indicated by 15kV energy meter.
6. If engine generator fails to start, after expiration of overcrank time delay, engine generator shuts down, alarm is initiated, and Building Management system is notified.
7. Failure of an Engine Generator to Synchronize: If engine generator fails to synchronize, sound an alarm and send signal to Building Management system after a preset time delay, but continue to attempt to synchronize the engine generator until signaled to stop.
8. After preset adjustable period of time, engine generators shall optimize down to only the number of engine generators required to serve load and avoid wet stacking. (see Load-Demand Sequence of Operation below).
9. After return of stable utility power sequence shall follow Return to Normal Condition Sequence of Operation below.

E. Demand Response Sequence of Operation:
1. Start engine generators manually or by remote contact initiated from Building Management System demand response signal.
2. Engine generator(s) start and achieve rated voltage and frequency.
3. Generator control system initiates "Lead" generator to energize 480V Switchgear paralleling bus.
4. Generator control system synchronizes engine generators and allows closure of respective breaker to the 480V switchgear paralleling bus.
5. 15kV switchgear senses Generator Standby Power and after preset adjustable time delay opens 15kV Utility Power switch and closes 15kV Generator Standby Power switch, energizing campus primary loop.
   a. 15kV switchgear shall not close 15kV Generator Standby Power switch until adequate capacity exists on 480 Switchgear paralleling bus to meet last known demand as indicated by 15kV energy meter.
6. If engine generator fails to start, after expiration of overcrank time delay, engine generator shuts down and alarm is initiated, and Building Management system is notified.
7. Failure of Engine Generator to Synchronize: If generator set fails to synchronize, sound an alarm and send signal to Building Management system after preset time delay, but

continue to attempt to synchronize engine generator until signaled to stop by manual operation.

8. After preset adjustable period of time, engine generators shall optimize down to only the number of engine generators required to serve load and avoid wet stacking. (see Load-Demand Sequence of Operation below).
9. After demand response is no longer required as signaled by Building Management System, Control System senses 15kV Utility Power and after preset adjustable time delay opens 15kV Generator Standby Power switch and closes 15kV Utility Power switch. Transfer to utility power only if present and stable.
10. System initiates shut down of Generators using sequence in automatic mode.
11. If there is an outage during this mode of operation, automatically change to requirements specified in "Sequence of Operation for Loss of Normal Power Conditions".

F. Load-Demand Sequence of Operation:
1. With load-demand sequence of operation activated, controller continuously monitors total 480V switchgear paralleling bus load.
2. If 480V switchgear paralleling bus load is below preset limits (initial setpoint shall be such that generators provide a minimum of 125% of measured load) and after a preset time delay (initial setting shall be 5 minutes), controller shuts down engine generators as required to best follow loads. All preset limits, and preset time delay, as well as manual operation interface, shall be accessible from human-machine interface.
3. On sensing available 480V switchgear paralleling bus capacity diminished to set point (load increasing beyond setpoint), controller starts engine generators, synchronizes to 480V switchgear paralleling bus and closes associated breaker to provide additional capacity to 480V switchgear paralleling bus to accommodate load.
4. Tier 4F Diesel generator shall be set as priority generator.

G. Return to Normal Condition Sequence of Operation:
1. Process starts on sensing normal Utility power at 15kV switchgear.
2. Control System senses 15kV Utility Power and after preset adjustable time delay opens 15kV Generator Standby Power switch and closes 15kV Utility Power switch. Transfer to utility power only if present and stable.
3. When no load remains on 480V switchgear paralleling bus, all generator-controlled breakers open, de-energizing 480V switchgear paralleling bus, then generators go through preset cool-down period, and shut down.
4. If start signal is received during cool-down period, generators are reconnected to 480V switchgear paralleling bus, and system operation follows that of "loss of normal power conditions."

H. Weekly Exercise Sequence of Operation:
1. Start engine generators automatically via generator control system.
2. Engine generator(s) start and achieve rated voltage and frequency.
3. Generator control system initiates “Lead” generator to energize 480V Switchgear paralleling bus.
4. Generator control system synchronizes engine generators and allows closure of respective breaker to the 480V switchgear paralleling bus.
5. 15kV switchgear senses Generator Standby Power but does not close 15kV Generator Standby Power switch.
    a. Send signal to Building Management system from 15kV switchgear monitoring indicating that 15kV generator power is present. Intent is to provide record that system is functioning including 1,000kVA transformer.

6. If engine generator fails to start, after expiration of overcrank time delay, engine generator shuts down and alarm is initiated, and Building Management system is notified.
7. Failure of Engine Generator to Synchronize: If generator set fails to synchronize, sound an alarm and send signal to Building Management system after preset time delay, but continue to attempt to synchronize engine generator until signaled to stop by manual operation.
8. At the end of predetermined exercise timer (initially set to 30 minutes) as signaled by Generator Control System, System initiates shut down of Generators using sequence in automatic mode.
9. If there is an outage during this mode of operation, automatically change to requirements specified in "Sequence of Operation for Loss of Normal Power Conditions".

2.2 INSTRUCTION PROGRAM

A. Program: Develop an instruction program that includes individual training for each system and equipment not part of a system, as required by individual Specification Sections, and as follows:
1. Operation of each generator.
2. Operation of 15kV switchgear and controls

B. Training Modules: Include instruction as applicable for the following:
1. Basis of System Design, Operational Requirements, and Criteria: Include the following:
a. System, subsystem, and equipment descriptions.
b. Performance and design criteria if Contractor is delegated design responsibility.
c. Operating standards.
d. Regulatory requirements.
e. Equipment function.
f. Operating characteristics.
g. Limiting conditions.
h. Performance curves.
2. Documentation: Review the following items in detail:
a. Operations and maintenance manuals.
b. Project Record Documents.
c. Warranties and bonds.
d. Maintenance service agreements and similar continuing commitments.
3. Emergencies: Include the following, as applicable:
a. Instructions on meaning of warnings, trouble indications, and error messages.
b. Instructions on stopping.
c. Shutdown instructions for each type of emergency.
d. Operating instructions for conditions outside of normal operating limits.
e. Sequences for electric or electronic systems.
f. Special operating instructions and procedures.
4. Operations: Include the following, as applicable:
a. Instructions on meaning of warnings, trouble indications, and error messages.
b. Startup procedures.
c. Equipment or system break-in procedures.
d. Routine and normal operating instructions.
e. Regulation and control procedures.
f. Control sequences.
g. Safety procedures.
h. Instructions on stopping.

i. Normal and emergency shutdown instructions.
j. Operating procedures for system, subsystem, or equipment failure.
k. Seasonal and weekend operating instructions.
l. Required sequences for electric or electronic systems.
m. Special operating instructions and procedures.

5. Adjustments: Include the following:
   a. Alignments.
   b. Checking adjustments.
   c. Noise and vibration adjustments.
   d. Economy and efficiency adjustments.
6. Troubleshooting: Include the following:
   a. Diagnostic instructions.
   b. Test and inspection procedures.
7. Maintenance: Include the following:
   a. Inspection procedures.
   b. Types of cleaning agents to be used and methods of cleaning.
   c. List of cleaning agents and methods of cleaning detrimental to product.
   d. Procedures for routine cleaning
   e. Procedures for preventive maintenance.
   f. Procedures for routine maintenance.
   g. Instruction on use of special tools.
8. Repairs: Include the following:
   a. Diagnosis instructions.
   b. Repair instructions.
   c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
   d. Instructions for identifying parts and components.
   e. Review of spare parts needed for operation and maintenance.

C. Documenting Training:
   1. Each training session shall be video recorded and two record copies presented to the owner in the form of DVD video discs.

## PART 3 - EXECUTION

### 3.1 PREPARATION

A. Contractor shall verify each system is installed per contract documents and manufacturer's recommendations.

B. Contractor shall verify all integration, programming and initial setpoints are coordinated and set per owner's requirements.

C. Prior to final demonstration of system, provide letter to Engineer certifying that all systems have be installed, programmed and tested and are fully operational.

D. Contractor shall provide system demonstration to Owner and Engineer at mutually agreed upon time. Each generator and electrical distribution system and each support system shall be demonstrated according to sequence of operations as indicated above.

E. Assemble materials necessary for instruction.

F. Set up instructional equipment at instruction location.

3.2 INSTRUCTION

A. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
   1. Owner will furnish Contractor with names and positions of participants.

B. Scheduling: Provide instruction at mutually agreed on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.
   1. Schedule training with Owner with at least fifteen days' advance notice.

C. Documenting Instruction:
   1. Each instruction session shall be video recorded and two record copies presented to the owner in the form of DVD video discs.

END OF SECTION 017900

This Page Left Intentionally Blank

SECTION 230900 – INSTRUMENTATION AND CONTROL FOR MECHANICAL SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Direct Digital Control (DDC) equipment.

B. Software.

C. Installation.

D. Mechanical Commissioning.

1.2 REFERENCES

A. U.S. Department of Justice – 2010 ADA Standards for Accessible Design.

B. ASME MC85.1 - Terminology for Automatic Control.

C. NEMA EMC1 - Energy Management Systems Definitions.

D. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

E. NFPA 70 - National Electrical Code.

F. NFPA 90A - Installation of Air Conditioning and Ventilation Systems.

1.3 SYSTEM DESCRIPTION

A. The general intent of this section is to provide monitoring of the generators and fuel oil management system through the existing campus BMS.

1.4 DEFINITIONS

A. Note: The terms ATC, BMS, BAS, and DDC may be used interchangeably in this Section and on the Drawings, to indicate the overall control system.

B. Definitions:
1. ATC: Automatic temperature control.
2. BACnet: A control network technology platform for designing and implementing interoperable control devices and networks.
3. BAS: Building Automation System.
4. BMS: Building Management System
5. DDC: Direct digital control.
6. I/O: Input/output.
7. MS/TP: Master slave/token passing.
8. PC: Personal computer.
9. PID: Proportional plus integral plus derivative.

10. RTD: Resistance temperature detector.

## 1.5 SYSTEM PERFORMANCE

A. Comply with the following performance requirements:
   1. Graphic Display: Display graphic with minimum 20 dynamic points with current data within 10 seconds.
   2. Graphic Refresh: Update graphic with minimum 20 dynamic points with current data within 8 seconds.
   3. Object Command: Reaction time of less than two seconds between operator command of a binary object and device reaction.
   4. Object Scan: Transmit change of state and change of analog values to control units or workstation within six seconds.
   5. Alarm Response Time: Annunciate alarm at workstation within 45 seconds.
   6. Program Execution Frequency: Run capability of applications as often as five seconds, but selected consistent with mechanical process under control.
   7. Performance: Programmable controllers shall execute DDC PID control loops, and scan and update process values and outputs at least once per second.
   8. Reporting Accuracy and Stability of Control: Report values and maintain measured variables within tolerances as follows:
      a. Electrical: Plus or minus 5 percent of reading.

## 1.6 SUBMITTALS

A. Submit in accordance with Division 01 Section “Submittal Procedures.”

B. Qualification Data: For Installer and manufacturer.

C. Product Data: Include manufacturer's technical literature for each control device. Indicate dimensions, capacities, performance characteristics, electrical characteristics, finishes for materials, and installation and startup instructions for each type of product indicated.
   1. Hardware: Bill of materials of equipment indicating quantity, manufacturer, and model number. Include technical data for control units, transducers/transmitters, sensors, actuators, valves, relays/switches, control panels, and operator interface equipment.
   2. Controlled Systems: Instrumentation list with element name, type of device, manufacturer, model number, and product data. Include written description of sequence of operation including schematic diagram.

D. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   1. Bill of materials of equipment indicating quantity, manufacturer, and model number.
   2. Schematic flow diagrams showing fans, coils, dampers, valves, and control devices.
   3. Wiring Diagrams: Power, signal, and control wiring.
   4. Details of control panel faces, including controls, instruments, and labeling.
   5. Written description of sequence of operation.
   6. Schedule of dampers including size, leakage, and flow characteristics.
   7. Schedule of valves including size and flow characteristics.
   8. DDC System Hardware:
      a. Wiring diagrams for control units with termination numbers.

b. Schematic diagrams and floor plans for field sensors and control hardware.
c. Schematic diagrams for control, communication, and power wiring, showing trunk data conductors and wiring between operator workstation and control units.

9. Control System Software: List of color graphics indicating monitored systems, data (connected and calculated) point addresses, output schedule, and operator notations.
10. Controlled Systems:
    a. Schematic diagrams of each controlled system with control points labeled and control elements graphically shown, with wiring.
    b. Scaled drawings showing mounting, routing, and wiring of elements including bases and special construction.
    c. Written description of sequence of operation including schematic diagram.

E. Software and Firmware Operational Documentation: Include the following:
1. Software operating and upgrade manuals.
2. Program Software Backup: On a magnetic media or CD, complete with data files.
3. Device address list.
4. Printout of software application and graphic screens.

F. Field quality-control test reports.

G. Operation and Maintenance Data.

## 1.7 OPERATION AND MAINTENANCE DATA

A. Submit under provisions of Division 01 Section “Operation and Maintenance Data.”

B. For mechanical instrumentation and control system to include in emergency, operation, and maintenance manuals.

C. In addition to items specified in Division 01, include the following:
1. Maintenance instructions and lists of spare parts for each type of control device.
2. Exploded assembly views.
3. Interconnection wiring diagrams with identified and numbered system components and devices.
4. Inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.
5. Calibration records and list of set points.

D. Manuals: Provide the following:
1. An Operator's Manual with graphic explanations of keyboard use for operator functions specified under Operator Training.
2. Computerized printouts of equipment controller’s data file construction including point processing assignments, physical terminal relationships, scales and offsets, command and alarm limits, and others as applicable.
3. A manual including revised as-built documents of materials required under the paragraph "SUBMITTALS" in this Specification Section.
4. Provide the quantity of manuals specified in Division 01, and at least 2 Operator’s Manuals and 2 As-Built Manuals to the Owner. Refer to other Sections of the Specifications for project requirements for quantities of documentation.

## 1.8 CODES AND APPROVALS

A. The complete temperature control installation shall be in strict accordance to the national and local electrical codes and the electrical Division of these Specifications. Devices designed for or used in line voltage applications shall be UL listed. Microprocessor based remote and central devices shall be UL916 Listed.

B. Electronic equipment shall conform to the requirements of FCC regulation Part 15, Section 15 governing radio frequency electromagnetic interference and be so labeled.

## 1.9 QUALITY ASSURANCE

A. Installer Qualifications: Automatic control system manufacturer's authorized representative who is trained and approved for installation of system components required for this Project.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with ASHRAE Standard 135 (BACnet) for DDC system components.

## 1.10 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products to site under provisions of Division 01 Section “Project Requirements.”

B. Factory-Mounted Components: Where control devices specified in this Section are indicated to be factory mounted on equipment, provide shipping of control devices to equipment manufacturer, in a timely manner coordinated with the equipment manufacturer.

C. Components to be Installed under Other Sections: For components to be installed under other Sections of the Specifications, provide delivery of components to appropriate Subcontractors, provide installation instructions, and supervise their installation.

## 1.11 COORDINATION

A. Coordinate location of thermostats and other exposed control sensors with Contract Drawings before installation.

B. Coordinate equipment with Division 26 and existing fire alarm system to achieve compatibility with equipment that interfaces with that system.

C. Coordinate line-voltage power supplies with Division 26.

## 1.12 WARRANTY

A. Components, system software, parts, and assemblies furnished under this Section shall be guaranteed against defects in materials and workmanship for 1 year from acceptance date.

B. Labor to troubleshoot, repair, reprogram, or replace system components shall be provided at no charge to the Owner during the warranty period.

C. Corrective software modifications made during warranty service periods shall be updated on user documentation and on user and manufacturer archived software disks.

## PART 2 - PRODUCTS

### 2.1 ACCEPTABLE SUPPLIERS

A. Acceptable Manufacturers and Installers:
   1. XL Automation
   2. No Substitutions.

B. The Temperature Control Contractor (or Subcontractor) shall hereinafter be referred to as the ATC Contractor.

### 2.2 SYSTEM REQUIREMENT

A. Provide complete direct digital and electronic control system consisting of operators, indicating devices, interface equipment, and other apparatus required to monitor mechanical system components listed and to perform functions specified. Provide interface controls to the existing campus BMS for the following:
   1. Generators and Fuel oil management system
   2. Provide hardware and software required for remote monitoring of the ATC system through modem or ethernet interface for the generators and fuel oil management system.
   3. Closely coordinate with generator manufacturer and fuel oil management system manufacturer requirements for interface to existing campus BMS.

### 2.3 DATA INPUTS AND OUTPUTS

A. Input/output sensors and devices shall be closely matched to the requirements of the remote panel for accurate, responsive, noise-free signal input/output. Control input response shall be high-sensitivity and matched to the loop gain requirements for precise and responsive control.

B. Control relays and analog output transducers shall be compatible with equipment controllers output signals. Relays shall be suitable for the loads encountered. Analog output transducers shall be designed for precision closed loop control with pneumatic repeatability error no greater than 1/2 percent.

### 2.4 GRAPHIC PROGRAMMING

A. Graphic Programming. Provide hardware and software required for complete equipment controllers ATC programming of plant programs including plant system schematic development, I/O hardware point definition, hardware and software text point descriptors, ATC algorithmic development, a controller software loading utility, and a live programming test facility. At a minimum, the following shall be provided in the graphics package:
   1. Generator –

a. Load Monitoring: Electrical loads for both Generator and Utility power
b. Alarm Inputs: Generators need to report multiple alarms, including Failure to start, failure to synchronize, etc.
c. Demand Response Signal: BMS initiates Demand Response and sends a signal to both the Generators and 15kV switchgear

2. Fuel oil management system (pump set, filtration system and leak detection monitoring).

B. Provide a program testing utility which allows live and dynamic monitoring of the graphically displayed control programs provided.

C. Provide 2 sets of programmer's manuals.

## 2.5 DATA COMMUNICATIONS

A. Equipment controllers shall be interconnected via a primary communications network. Terminal controllers shall also be connected together via secondary networks to provide data concentration and parallel processing. Networks shall support sensor sharing, global application programs, and bus-to-bus communications without the presence of a host PC.

B. The equipment controller's communications network shall support true peer protocol such that loss of any single device will not cause total bus failure.

## 2.6 GENERAL

A. ATC setpoints, reset schedules, time programs, monitoring information and historical trends shall be displayable at local ATC panels and on the system's operator workstations.

B. I/O Interface: Hardwired inputs and outputs may tie into system through controllers. Protect points so that shorting will cause no damage to controllers.
1. Binary Inputs: Allow monitoring of on-off signals without external power.
2. Pulse Accumulation Inputs: Accept up to 10 pulses per second.
3. Analog Inputs: Allow monitoring of low-voltage (0- to 10-V dc), current (4 to 20 mA), or resistance signals.
4. Binary Outputs: Provide on-off or pulsed low-voltage signal, selectable for normally open or normally closed operation with 3-position (on-off-auto) override switches and status lights.
5. Analog Outputs: Provide modulating signal, either low voltage (0- to 10-V dc) or current (4 to 20 mA).
6. Tri-State Outputs: Provide two coordinated binary outputs for control of 3-point, floating-type electronic actuators.
7. Universal I/Os: Provide software selectable binary or analog outputs.

C. Power Supplies: Transformers with Class 2 current-limiting type or overcurrent protection; limit connected loads to 80 percent of rated capacity. DC power supply shall match output current and voltage requirements and be full-wave rectifier type with the following:
1. Output ripple of 5.0 mV maximum peak to peak.
2. Combined 1 percent line and load regulation with 100-microsecond response time for 50 percent load changes.
3. Built-in overvoltage and overcurrent protection and be able to withstand 150 percent overload for at least 3 seconds without failure.

D. Power Line Filtering: Internal or external transient voltage and surge suppression for workstations or controllers with the following:
   1. Minimum dielectric strength of 1000 V.
   2. Maximum response time of 10 nanoseconds.
   3. Minimum transverse-mode noise attenuation of 65 dB.
   4. Minimum common-mode noise attenuation of 150 dB at 40 to 100 Hz.

## 2.7 CONTROL CABLE

A. Provide electronic and fiber-optic cables for control wiring in accordance with Division 26.

## 2.8 STATUS SENSORS

A. Voltage Transmitter (100- to 600-V ac): Comply with ISA 50.00.01, single-loop, self-powered transmitter, adjustable, with suitable range and 1 percent full-scale accuracy.

B. Power Monitor: 3-phase type with disconnect/shorting switch assembly, listed voltage and current transformers, with pulse kilowatt hour output and 4-20 mA kW output, with maximum 2 percent error at 1.0 power factor and 2.5 percent error at 0.5 power factor.

# PART 3 - EXECUTION

## 3.1 ELECTRICAL WIRING AND CONNECTION INSTALLATION

A. Wiring and conduits shall be properly supported and run in a neat and workmanlike manner. Wiring and conduits exposed and in equipment rooms shall run parallel to or at right angles to the building structure. Wiring and conduits within enclosures shall be neatly bundled and anchored to prevent obstruction to devices and terminals. Wiring, conduits, wall boxes, and accessories shall conform to Division 26 – Electrical of the Contract Documents.

B. The ATC Contractor shall be responsible for electrical installation, including any low voltage and line voltage wiring which is required for a fully functional control system and not indicated on the Electrical Drawings or required by the Electrical Specifications (Divisions 26).

C. Wiring shall be in accordance with local and national Codes and regulations.

D. Provide electrical materials and installation under this Section. Requirements and standards shall be as specified in other Sections and Divisions of the Specifications, as indicated in paragraphs below.
   1. Install raceways, boxes, and cabinets in conformance to Division 26.
   2. Install building wire and cable in conformance to Division 26.
   3. Provide interface wiring (line and low voltage) as required to complete ATC system installation.
   4. Install signal and communication cable according to Division 26.
      a. Conceal cable, except in mechanical rooms and areas where other conduit and piping are exposed.
      b. Install exposed cable in raceway.
      c. Install concealed cable in raceway.

d. Bundle and harness multi-conductor instrument cable in place of single cables where several cables follow a common path.
e. Fasten flexible conductors, bridging cabinets and doors, along hinge side; protect against abrasion. Tie and support conductors.
f. Number-code or color-code conductors for future identification and service of control system, except local individual room control cables.
g. Install wire and cable with sufficient slack and flexible connections to allow for vibration of piping and equipment.

E. Control wiring in mechanical rooms shall be installed in conduit which shall comply with the requirements of the Electrical Specifications.

F. Electronic low-voltage wiring shall be #18 AWG minimum THHN and shielded if required.

G. Seal conduits, sleeves, wall boxes, and other penetrations of clean spaces (such as the Production room and related rooms) in accordance with the sealing requirements of Division 26, Electrical.

## 3.2 INSTALLATION

A. Enter computer programs and data files into the related computers including control programs, initial approved parameters and settings, and English descriptors.

B. Maintain CD copies of data file and application software for reload use in the event of a system crash or memory failure. 1 copy shall be delivered to the Owner during training session, and 1 copy shall be archived in the ATC Contractor's local software vault.

C. Install software in control units and operator workstation(s). Implement features of programs to specified requirements and as appropriate to sequence of operation.

D. Connect and configure equipment and software to achieve sequence of operation specified.

## 3.3 FIELD QUALITY CONTROL

A. Coordinate with the requirements of Division 01 Section “General Commissioning Requirements”.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.

C. Perform the following field tests and inspections and prepare test reports:
1. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation. Remove and replace malfunctioning units and retest.
2. Test and adjust controls and safeties.

D. DDC Verification:
1. Verify that instruments are installed before calibration, testing, and loop or leak checks.
2. Check instruments for proper location and accessibility.

3. Check instrument installation for direction of flow, elevation, orientation, insertion depth, and other applicable considerations.
4. Check flow instruments. Inspect tag number and line and bore size, and verify that inlet side is identified and that meters are installed correctly.
5. Check pressure instruments, piping slope, installation of valve manifold, and self-contained pressure regulators.
6. Check temperature instruments and material and length of sensing elements.
7. Check control valves. Verify that they are in correct direction.
8. Check DDC system as follows:
    a. Verify that DDC controller power supply is from emergency power supply, if applicable.
    b. Verify that wires at control panels are tagged with their service designation and approved tagging system.
    c. Verify that spare I/O capacity has been provided.
    d. Verify that DDC controllers are protected from power supply surges.

E. Replace damaged or malfunctioning controls and equipment and repeat testing procedures.

## 3.4 VALIDATION

A. The ATC Contractor shall completely check out, calibrate, and test connected hardware and software to insure that the system performs in accordance with the approved submittals for specifications and sequences of operations.

B. Witnessed Validation Demonstration: Shall consist of:
1. Display and demonstrate each type of data entry to show site specific customizing capability.
2. Execute digital and analog commands.
3. Demonstrate ATC loop precision and stability via trend logs of inputs and outputs.
4. Demonstrate that each control point, tag, or address is associated with the proper device, such as a room sensor input or an actuator output. This demonstration shall include visual confirmation that the measured values and the output actions match what is indicated in the control system.

END OF SECTION 230900

This Page Left Intentionally Blank

SECTION 260010 - BASIC ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Basic Electrical Requirements specifically applicable to all Division 26 Sections.

B. Intent is to provide and install complete electrical systems, as required to accommodate the new campus paralleling generators and associated equipment.

C. Access Panels: Where required by NFPA 70 (N.E.C.)

D. See Section 017900 “Demonstration and Training” for Generator and Electrical Distribution Commissioning and Operational Requirements.

1.2 RELATED REQUIREMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section. Examine all contract documents for requirements affecting the work.

1.3 DEFINITIONS

A. As used in this section, "provide" shall mean, "furnish and install". "Furnish" shall mean "to purchase and deliver to the project site complete with every necessary appurtenance and support", and "Install" shall mean "to unload at the delivery point at the site and perform every operation necessary to establish secure mounting and correct operation at the proper location in the project".

1.4 OWNER FURNISHED PRODUCTS

A. Products Furnished to The Site And Paid For By Owner:
   1. Technology equipment including servers, network switches, HUBS, transceivers to activate the LANs.

B. Work Associated with Owner Furnished Products and Provided under Division 26:
   1. All interconnecting wiring and all final connections as required for complete operating systems. Coordinate with the Owner for specific requirements.
   2. Receive delivery, store, protect, handle and place at location indicated on the drawing.
   3. Include all required rigging.
   4. Provide new transformer foundation for pad mounted transformer.

1.5 SUBSTITUTIONS

A. Refer to Division 01 for Substitutions and Product Options.

1.6 REFERENCES

A. NEMA Standards.

B. NECA "Standard of Installation."

C. NFPA 70 (N.E.C.) latest edition.

D. NFPA 101 Life Safety Code.

E. U.L. Standards.

F. ANSI Standards.

G. Maine Uniform Building and Energy Codes (MUBEC) which include provisions of:
1. (IBC) International Building Code.
2. (IEBC) International Existing Building Code.
3. (IRC) International Residential Code.
4. (IECC) International Energy Conservation Code.
5. ASHRAE 62.1 Ventilation for Acceptable Indoor Air Quality.
6. ASHRAE 62.2 Ventilation and Acceptable Indoor Air Quality in Low-Rise Residential Buildings.
7. ASHRAE 90.1 Energy Standard for Buildings except Low-Rise Residential Buildings.
8. ASTM E1465-06 Radon Standard for new residential construction - (Maine Model Standard).

1.7 SUBMITTALS

A. Submit Shop Drawings, Owner's Manuals, and Operating Instructions in accordance with Division 01 Section “Submittal Procedures”.

B. Include products specified in Division 26 individual sections.

C. Submit Shop Drawings and product data grouped by individual Sections to include complete submittals of related systems, products, and accessories. Label each with Section number and title. Partial Section submittals will not be reviewed.

D. Include access panels.

E. Include fire-stop seals and fillers.

1.8 RECORD DRAWINGS

A. Submit under provisions of Division 01 Sections “Operation and Maintenance Data” and “Project Record Documents”.

B. Keep a marked set of Drawings at the site as a record set indicating all revisions in the work as the work progresses. At the completion of the work, mark the Drawings "As Built Drawings" with the Contractor's name and date, and deliver to the Architect. Locate center line of each new ductbank from a permanent reference point and the burial depth of the center of each ductbank run section from top of adjacent manhole rim.

## 1.9 PERFORMANCE REQUIREMENTS

A. Conform to requirements of the latest edition of ANSI/NFPA 70 National Electrical Code (N.E.C.).

B. Conform to requirements of all local, State and Federal laws and regulations, plus local electric utility company's rules, and the Fire Underwriters' requirements.

C. Furnish products listed and classified by Underwriters' Laboratories, Inc. (U.L.) as suitable for purpose specified and shown.

D. Secure and pay for all permits and certificates as required by local, State and Federal laws.

E. Request inspections from authority having jurisdiction.

F. Run separate circuits for lighting and receptacle outlets as indicated.
   1. Circuits shall be balanced and loads and capacities shall be in accordance with requirements of local electric light company and National Board of Fire Underwriters.
   2. Do not share neutral on branch circuits.

G. The entire electrical system shall be permanently and effectively grounded in accordance with Code requirements.

H. The Drawings indicate only diagrammatically the extent, layout and the general location and arrangement of equipment, conduit and wiring. Become familiar with all details of the work and verify all dimensions in the field so that the outlets and equipment will be properly located and readily accessible.
   1. Note that drawings do not show all junction boxes. Provide boxes as required.
   2. Devices shown with same panel and circuit designation with no home run symbol may share same home runs to panelboards provided that the furthest device on the circuit does not exceed 2-1/2% voltage drop.
   3. Where home run symbols are shown, use separate run to panelboard for each symbol, and do not share home run with other devices having same panel and circuit designation.

## 1.10 PROJECT/SITE CONDITIONS

A. Coordinate with all other trades to ensure proper access and space requirements.

B. Where project conditions occur necessitating departures from the drawings, submit for approval the details of and reasons for departures prior to implementing any change.

C. Alterations
   1. Visit the site and become familiar with the existing conditions, and the requirements of the Plans and Specifications. No claim will be recognized for extra compensation due to failure of becoming familiar with the conditions and extent of the proposed work.
   2. Execute all alterations, additions, removals, relocations, or new work, etc., as indicated or required to provide a complete installation in accordance with the intent of the Drawings and Specifications.
   3. Repair or replace to the Owner's satisfaction, all existing work disturbed or damaged by the alterations.

4. Except as follows, Retain ownership and remove from site all existing materials, equipment, fixtures, wiring and devices disconnected and not reused; Pay all charges for proper disposal of materials.
5. Do not reuse existing wiring except as specifically indicated. Existing conduit raceways may be reused, provided that the existing wires are removed and new wires are installed.
6. Provide finished blank plates on all existing ceiling and wall boxes which can not be removed.
7. Ensure all circuits in existing buildings are re-energized where existing panelboards are replaced, or existing wiring is rerouted, disconnected, or disturbed. Provide and install new wiring as required to meet this condition. Verify breaker/fuse sizes on existing circuits and do not load wiring to beyond 75% of their ampacities.

1.11 SEQUENCING AND SCHEDULING

A. Construct Work in sequence under provisions of Division 01 Section “Summary”.

B. Arrange to execute the work at such times and in such locations as may be required to provide uninterrupted services for the occupied sections of the buildings, or any of its sections or portions of the Campus.
1. Services Include but Not Limited to: Power, lighting, fire alarm, paging/intercom, telephone, computer, and life safety systems as required to maintain occupancy.
2. If necessary, install temporary work to provide for this condition. Authorization for interrupting services for any building or portions of the campus shall be obtained, in writing, from the Owner.
3. Provide temporary diesel generator(s) as required for extended hours.
4. Costs for overtime work and temporary work shall be included in the bid.

1.12 TEMPORARY LIGHT AND POWER

A. "Temporary Light and Power" specified under Division 01 Section “Temporary Facilities and Controls”.

B. Furnish all temporary equipment, wiring, lamps, etc., as required for the completion of the work, including the work of all Subcontractors.

C. Temporary electrical work shall comply with OSHA and NEC requirements.

D. Contractor shall provide temporary power for campus primary loop - minimum 1MW diesel generator, 1000kVA transformer, all associated hardware and cabling as required. Temporary generator and transformer shall be on-site and available (set in place protected by temporary fencing and tested) prior to any power disruption. At no time shall the campus be without power during construction. Connect to primary loop at Transformer 1 near Jalbert Hall boiler room. Close sectionalizing switch near Kirk Hall to close primary loop.

1.13 PAINTING

A. Refer to Division 09 Section “Painting”.

1.14 ACCESS PANELS

A. Access panels required for items furnished under Division 26 shall be provided under this Division and installed under Divisions 08 and 09.

B. Standard panels: 12" x 16" except as indicated. Doors: flush type 14-gauge steel, hinged to 16-gauge frame. Latch: Flush face screw. All factory primed and painted to match in the field.
   1. Same U.L. fire rating as wall, floor, or ceiling in which they are installed.
   2. Equal To: Inryco/Milcor style "M" and Miami-Carey "HM".

PART 2 - EXECUTION

2.1 WORKMANSHIP AND INSTALLATION

A. Execute all work in a neat manner acceptable to the Local and State Electrical Inspector. Follow manufacturer's installation recommendations.

B. All electrical components and their attachments shall be properly supported and where required shall be designed for seismic forces.

C. Perform all electrical work by licensed electricians well skilled in the trade and supervised by a Master Electrician. The Electrical Contractor shall be approved by CMP for work on CMP medium voltage systems.

D. Replace or repair to new condition, defective equipment and equipment damaged during installation or testing.

E. Position isolated electrical equipment so that it is free standing and does not come in rigid contact with the building structure or other systems.

2.2 TESTING AND ADJUSTING

A. The entire installation shall be free from short circuits and improper grounds. Test in the presence of the Architects or their representatives.

B. Test feeders with the feeders disconnected from the branch circuit panels.

C. Test each individual branch circuit at the panel. In testing for insulation resistance to ground, the power equipment shall be connected for proper operation. In no case shall the insulation resistance be less than that required by the National Electrical Code and the manufacturer's recommendations. Correct failure in a manner satisfactory to the Architect and Engineers.

D. Completely test and adjust each system specified under Division 26 for proper operation.

2.3 SLEEVES, INSERTS AND OPENINGS

A. Sleeves:
   1. Furnish and install all sleeves required for the work.
   2. Sleeves through exterior building walls or through concrete construction shall be rigid galvanized steel.

3. Sleeves shall be sized to provide a total of not less than 1/2-inch clearance around conduit.
4. Sleeves for setting into walls shall be flush with finished construction. Sleeves for setting into floor shall be embedded in concrete slab and extend approximately 2 inches above finished floors.
5. All sleeved openings within building shall be sealed airtight using fire barrier caulking with a UL classification for use as a fire penetration seal for walls and floors with up to a 3-hour fire rating expanded.
6. Sleeves shall be provided in all locations where cables and conduits penetrate walls and floors.
7. Selection of firestopping materials and installation shall be in accordance with specifications Division 07 Section “Through-Penetration Firestop Systems”.

END OF SECTION 260010

SECTION 260300 - PRIMARY ELECTRICAL DISTRIBUTION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Pad-Mounted Transformers.

B. Medium Voltage Cables.

C. Medium Voltage Splice Kits.

D. Medium Voltage Terminating Kits.

1.2 RELATED SECTIONS

A. Division 32 Section 323000 "Site Improvements."

B. Division 26 Section 260010 "Basic Electrical Requirements."

C. Division 26 Section 260323 “Custom Metal-Enclosed Switchgear”

1.3 REFERENCES

A. NEMA Standards.

B. ANSI/IEEE C2 - National Electrical Safety Code.

C. NFPA 70 (N.E.C.) Latest Edition.

D. U.L. Standards.

E. ANSI Standards.

1.4 PERFORMANCE REQUIREMENTS

A. Conform to requirements of ANSI/NFPA 70. (N.E.C.)

B. ANSI/IEEE C2 - National Electrical Safety Code.

C. Medium voltage is defined as 1,000 to 35,000 volts.

D. Medium voltage work for this project is 12470/7200 volts, 3 phase , grounded wye, neutral conductor is required and is carried in the distribution system using 1/3 capacity neutral concentric conductors.

E. Size per drawings

1.5 QUALIFICATIONS

A. Manufacturer:

1. Company specializing in manufacturing the products specified in this Section with minimum five years documented experience.
2. Company maintaining engineering and service departments capable of rendering advice regarding installation.
3. Company maintaining field service engineers for assistance during start up and testing.

B. Installer:
1. Company specializing in applying work of this Section with minimum three years documented experience.
2. Company offering repair service contracts.
3. Company with certified trades persons.
4. Cable splicer working on this project shall have a minimum of 5 years experience in terminating and splicing 15 kV medium voltage cable and shall have experience installing the terminations and splices specified.

1.6 SUBMITTALS

A. Submit Shop Drawings, Owner's Manuals, and Operating Instructions in accordance with Division 01 Section "Submittal Procedures."

B. Include all materials, equipment and components specified under this Section.

C. Include Certification of Competency: Cable splicer's experience during the past three years, describing performance in splicing and terminating cables of the type and classification being provided under the contract.

D. Submit manufacturers' instructions.

E. Terminator manufacturer's installation instructions.

F. Typical installation instructions for splicing and terminating kits.

G. Include Pad transformer details, primary fusing details.

H. Include documentation that work is being coordinated, including proper cable terminations.

1.7 PROJECT CONDITIONS

A. Intent is to provide onsite electrical generation to power entire 15kV campus primary loop. Generators will be 480V with step-up transformer to boost voltage to 12,470V. Existing 13.8kV switchgear shall be modified to provide two motor operated switches to enable transfer between Utility and Generator power.

B. Wire and cable routing shown on Drawings are approximate unless dimensioned. Route and locate as required to meet Project Conditions.

C. Details on Drawings are diagrammatic only to show intent. Details of installation shall conform to standards of the Rural Electrification Authority, and ANSI C2.

1.8 EXTRA MATERIALS

A. Furnish a spare fuse for each fuse provided.

## PART 2 - PRODUCTS

### 2.1 THREE-PHASE PAD-MOUNTED TRANSFORMERS, DEAD-FRONT

A. Acceptable Manufacturers:
   1. Cooper Power Systems (RTE) or equal.
   2. General Electric.
   3. Square D.
   4. ITE-Siemens.

B. ANSI C57.12.28 with separate Medium and low-voltage compartments, primary switching and fuses, and accessories. Tamper resistant welded weatherproof enclosure with interlocking doors and penta-head bolt/padlock handle assembly on low voltage door. Provide bolted access handhole at transformer top.

C. Compartments: Divided medium and low-voltage compartments in sections with steel isolating barriers extending the full height and depth of the compartment.

D. Compartment Doors: hinged lift-off type with stop in open position and three-point latching.

E. Medium-Voltage Compartment: Contain the incoming line, insulated Medium-voltage load-break connectors, inserts, transformer medium-voltage bushing wells, connector parking stands dead-front surge arresters, load-break switch handle, access to oil-immersed fuses, externally-operated pad-lockable no load tap changer, drain valve and sampler, and ground pad.
   1. Insulated Medium-voltage load-break connectors IEEE 386.
   2. Bushing well and insert ratings:
      a. 125 kV BIL, rated voltage 8.3 kV for operation on a 12.47 kV system.
      b. Current rating: 200 amperes rms continuous.
      c. Fault Close-in: 10,000 A.
      d. Corona Extinction: 19 kV.

F. Load break inserts and bushings plus load break elbows: The product of a single manufacturer and provide with the transformer to insure compatibility.

G. Load-break elbow connectors: Complete with steel reinforced hook-stick eye, grounding eye, and arc-quenching contact material all sized for the medium voltage cable specified and provided with transformer to insure compatibility.

H. Load-Break Oil Rotary switch (LBOR): Two position oil-immersed type, gang-operated, spring loaded quick-make quick-break.
   1. Locate the switch handle in the medium-voltage compartment.
   2. LBOR ratings:
      a. 125 kV BIL, rated voltage 27 kV L-L, 15.5 kV L-G.
      b. Current rating: 200 amperes rms continuous.
      c. Making current: 12 kA RMS Sym/19.2 kA Assym.

I. Primary Fuses: 150-kV fuse assembly with fuses complying with IEEE C37.47. Rating of current-limiting fuses shall be 50-kA RMS at specified system voltage.
   1. Bay-O-Net liquid-immersed fuses in series with liquid-immersed current-limiting fuses. Bay-O-Net fuses shall be externally replaceable without opening transformer tank.

J. Parking stands: Provide a parking stand near each bushing well.

K. Low-voltage Compartment: Containing liquid temperature and level gages, cable lugs, low-voltage bushings, pressure relief valve, filling provisions, stainless steel transformer nameplate, and ground pad.

L. Transformer: Oil insulated, two winding, 60 hertz, 65°C rise above a 30°C average ambient, self-cooled type.
   1. Rated 1,000kVA for step up operation
   2. 95kV BIL, Medium voltage of 12.47kV wye primary, with four 2-1/2 percent full capacity taps two above and two below rated primary voltage.
   3. Secondary voltage: 480Y/277.
   4. Minimum tested impedance: Not less than 4.0%.
   5. Tap changer: Externally operated, manual type for changing tap setting when the transformer is de-energized.
   6. Transformer kVA and voltage ratings: Conspicuously displayed on the exterior of its enclosure.
   7. The transformer shall have an insulated low-voltage neutral bushing with removable ground strap with lugs for ground cable.

M. Insulating Liquid: Less flammable, edible-seed-oil based, and UL listed as complying with NFPA 70 requirements for fire point of not less than 300°C when tested according to ASTM D 92. Liquid shall be in conformance with FM Approval Standard 6933. Liquid shall be readily biodegradable and nontoxic. Listed less-flammable fluid meeting the requirements of National Electrical Code® Section 450-23 and the requirements of the National Electrical Safety Code (IEEE C2-1997), Section 15. The dielectric coolant shall be readily and completely biodegradable per EPA OPPTS 835.3100. The base fluid shall be 100% derived from edible seed oils with performance enhancing additives. The fluid shall be published under US EPA Environmental Technology Verification (ETV) requirements, and tested for compatibility with transformer components. The fluid shall be Factory Mutual Approved, UL® Classified Dielectric Medium (UL-EOUV) and UL Classified Transformer Fluid (UL-EOVK), Envirotemp® FR3® fluid.

N. Corrosion Protection Using ALL Processes in Order Listed:
   1. Phosphate coating on pretreated, clean bare metal.
   2. Epoxy primer using a cationic electro-deposition dip process. Minimum 0.0005" thick.
   3. Baked-on Electrostatic thermosetting polyester powder spray. Minimum 0.0015" thick.
   4. Coating of urethane spray paint for final color. Minimum 0.0010" thick.
   5. Final color: Green.

O. Accessories:
   1. Drain Valve: 1 inch (25 mm), with sampling device.
   2. Dial-type thermometer.
   3. Liquid-level and temperature gages.
   4. Pressure-vacuum gage.
   5. Pressure Relief Device: Self-sealing with an indicator.

6. Mounting provisions for low-voltage current transformers.
7. Mounting provisions for low-voltage potential transformers.
8. Warning Signs: Provide on door: "DANGER HIGH VOLTAGE KEEP OUT".

2.2 UNDERGROUND DISTRIBUTION

A. Conduits And Duct Banks
1. Conduits Specified Under Division 26 Section 260111 “Conduit.”
2. Duct Banks: Minimum concrete cover all sides as indicated on drawings. Form sides for smooth finish to minimize frost action.
3. Concrete for Duct Banks: Specified under Division 32 Section 323000 “Site Improvements”: Minimum 3000 psi concrete with one-inch maximum aggregate.
4. Trenching, Backfill, Earthwork: Specified under Division 31 and 32.
5. Separators: High impact polystyrene, spacing as indicated. Stagger the joints of the conduits by rows and layers.

B. Medium Voltage Wires and Cables: Shielded cable, copper conductors minimum No. 2/0 AWG.
1. Rated: 15kV, 133 percent insulation level (ungrounded).
2. Conductor: Annealed uncoated copper, compact stranded per ASTM B-496.
3. Strand Screen: Extruded semiconducting EPR conforming to ICEA S-68-516 AEIC CS6 and UL 1072.
4. Insulation: Ethylene-propylene based (EPR) conforming to ICEA S-68-516 AEIC CS6 and UL 1072.
5. Insulation Screen: Extruded semiconducting EPR conforming to ICEA S-68-516 AEIC CS6 and UL 1072.
6. Concentric conductor: Bare copper wires, 1/3 neutral capacity.
7. Jacket: Polyvinyl chloride (PVC), oil, acid, chemical and sunlight resistant.
8. Designed for both wet and dry locations.
9. Equal to Okonite type URO-J, sized as indicated.
10. Shall meet the following manufacturers' published data:

| Conductor Size | AMPS Direct Burial | AMPS Underground Duct |
|---|---|---|
| 2/0 AWG | 335 | 245 |
| | | |
| Three Conductor 105 deg C, 100% load, Earth Temp 20 deg C, RHO=90 | | |

C. Lightning Arresters: M.O.V.E. deadfront Arrester designed to plug in same as a load break elbow. Provide one per phase at loop feed pad mounted transformer locations as shown on 15kV One-Line, using load break inserts. Provide proper grounding. Rated min 7.65 kV, max 9kv.

D. Medium Voltage Load Break Dead Front Termination:
1. Loadbreak Inserts: Conforming to ANSI/IEEE Standard 386 for 200A, 15kV Class. Compatible with bushing wells/inserts of associated equipment. Use on Source side to allow installation of the M.O.V.E. deadfront Arrester.
2. Load Break Elbows: Conforming to ANSI/IEEE Standard 386 for 200A, 15kV Class. Compatible with bushing wells/inserts of associated equipment. Elbows shall have an optional capacitive test point, made of corrosion resistant plastic, for use with fault

indicators. Provide insulated cap for elbows that do not require FCI. Loadbreak Elbow Connectors shall be fully-shielded and insulated plug-in termination for connecting underground cables to transformers, switching cabinets and junctions equipped with loadbreak bushings.

3. Load Break Dead Front Terminations shall be as manufactured by Cooper Power Systems or equal.

E. Medium Voltage Termination:

1. Medium Voltage Cable Terminations: IEEE 48 Class 1 (exterior wet locations). Include all components, and materials which shall include stress relief cones/ devices, plus complete manufacturer's instructions for installation.
2. Cast Epoxy Resin Type Termination: IEEE 48, Class 1, terminating single conductor, solid insulated, nonmetallic jacketed type cables for service voltage up to 15 kV outdoors. Terminations for shielded conductors shall include stress control, with a shield ground connection brought out through the insulation and covering, and grounded at installation. Terminations exposed to the weather shall include porcelain insulator and weather shield.

F. Medium Voltage Permanent Splices:

1. Medium Voltage Cable Splices: IEEE 48 Class 1 (exterior wet locations). 15kV, 200A, permanent, fully-shielded, fully submersible cable joint, EPDM rubber, designed specifically for the medium voltage cables being spliced. Manufactured in full compliance with all applicable IEEE standards, 404 and 592. Include all components, and materials which shall include stress relief cones/ devices, plus complete manufacturer's instructions for installation.
2. As manufactured by Cooper Power Systems, One-Piece EZ II Splice or equal.

## PART 3 - EXECUTION

### 3.1 GROUNDING ELECTRODES

A. Provide driven ground rods as specified in Division 26 Section 260170 “Grounding and Bonding”.

B. Connect ground conductors to the upper end of the ground rods by exothermic weld.

C. Provide compression connectors at equipment end of ground conductors.

### 3.2 GROUNDING

A. Grounding: NFPA 70 and ANSI C2, and Power Company requirements, except that grounds and grounding systems shall have a resistance to solid earth ground not exceeding 5 ohms. Provide multiple ground rods as required.

B. Make joints in grounding conductors and taps to ground ring by exothermic weld, Cadweld or equal.

### 3.3 PAD-MOUNTED TRANSFORMER GROUNDING

A. Grounding: NFPA 70 and ANSI C2, and Power Company requirements, except that grounds and grounding systems shall have a resistance to solid earth ground not exceeding 5 ohms. Provide multiple ground rods as required.

B. Connect copper grounding conductors to the ground loop as specified. In addition to the bonding strap provided by the manufacturer, provide a ground conductor from the transformer secondary neutral to the ground loop.

C. Make joints in grounding conductors and taps to ground ring by exothermic weld, Cadweld or equal.

## 3.4 INSTALLATION UNDERGROUND WORK

A. Earthwork: Excavation, backfilling, and pavement repairs for electrical requirements are specified under Divisions 31, 32, 33.

B. Install and make all final connections to pad-mounted transformers furnished under this section as indicated on project drawings, the approved shop drawings, and as specified herein. Mount transformers on concrete slab and secure with at least four anchor bolts.

C. Disconnect, remove and re-install pad mounted transformers as indicated.

D. Grounding:
1. Ground Rods: Install in each new electric manhole and handhole, at a convenient point close to the wall, a 3/4-inch by 10-foot copper-clad steel ground rod. Approximately 4 inches of the ground rod shall extend above the floor. Properly connected to the cable shielding, metallic sheath, and armor at each cable joint or splice by means of No.4 AWG or equivalent braided tinned copper wire. Ground wires shall be neatly and firmly attached to manhole and handhole walls and shall be connected to all metallic surfaces.
2. Counterpoise / Fault current grounding: In all conduit paths containing Medium voltage cables, include a 4/0 bare copper grounding conductor. Cadweld to manhole, handhole, and tranformer pad ground rods and all metal associated metallic surfaces.

E. Cable Pulling: Test duct lines with a mandrel and thoroughly swab out to remove foreign material before the pulling of cables. Pull cables down grade with the feed-in point at the manhole or buildings of the highest elevation. Accumulate cable slack at each manhole or junction box and train the cable around the interior to form one complete loop. Minimum allowable bending radii shall be maintained in forming such loops.
1. Lubricants for assisting in the pulling of jacketed cables shall be those specifically recommended by the cable manufacturer.
2. Cable pulling tensions shall not exceed the maximum pulling tension recommended by the cable manufacturer.

F. Installation of Cables in Manholes, Handholes and Vaults:
1. Do not install cables utilizing the shortest route, but route along those walls providing the longest route and the maximum spare cable lengths.
2. Form all cables to closely parallel walls, not to interfere with duct entrances, and support on brackets and cable insulators at a maximum of 18 inches.
3. Support cable splices in underground structures by racks on each side of the splice. Locate splices to prevent cyclic bending in the spliced sheath.

G. Cable Terminating: Install all terminations in accordance with the manufacturer's requirements. Make terminations using materials and methods designated by the written instructions of the cable manufacturer and termination kit manufacturer.

H. Splices for 600 Volt Class Cables: Locate splices in underground systems only in accessible locations such as manholes and handholes. Use compression connector on the conductor and insulate and waterproof by one of the following methods suitable for continuous submersion in water.
   1. Cast-type splice insulation by means of molded casting process employing a thermosetting epoxy resin insulating material and apply by a gravity poured method or by a pressure injected method. The component materials of the resin insulation shall be in a packaged form ready for mixing without removing from the package.
   2. Gravity poured method: Employ materials and equipment contained in an approved commercial splicing kit which includes a mold suitable for the cables to be spliced.

I. Splices in Medium Voltage Cables: Intent is to not allow splicing. Splicing may be allowed do to existing condition and only after specific written approval from the engineer. Where allowed, splices shall be suitable for continuous immersion in water and shall be made only in accessible locations in manholes or handholes.
   1. Cast-Type Splice Methods: Cast-type splice insulation shall be provided by means of a molded casting process employing a thermosetting epoxy resin insulating material which shall be applied by a gravity poured method or by a pressure injected method. The component materials of the resin insulation shall be in a packaged form ready for mixing without removing from the package.
   2. Kit Methods: Medium voltage splices made using a "kit" shall be the product of one manufacturer and shall have the approval in writing of the manufacturer of the cable which is to be spliced.
   3. Splices in Shielded Cables: Splices in shielded cables shall include covering the spliced area with metallic tape, or like material, to the original cable shield and by connecting it to the cable shield on each side of the splice. Provide a No. 6 AWG bare copper ground connection brought out in a watertight manner and grounded to a 3/4 inch by 10 foot ground rod as part of the splice installation.

J. Fireproofing Tape for Medium Voltage Cable: Strips of fireproofing tape approximately 1/16-inch thick by 3 inches wide shall be wrapped tightly around each cable spirally in half-lapped wrapping, or in two butt-joined wrappings with the second wrapping covering the joints in the first. The tape shall be applied with the coated side toward the cable and shall extend one inch into the ducts. To prevent unraveling, the fireproofing tape shall be random wrapped the entire length of the fireproofing with pressure sensitive glass cloth tape. The fireproofing tape shall consist of a flexible, conformable fabric having one side coated with flame retardant, flexible, polymeric coating and/or a chlorinated elastomer not less than 0.050 inch thick and shall weight not less than 2.5 pounds per square yard. The tape shall be non-corrosive to cable sheath, shall be self-extinguishing, and shall not support combustion. The tape shall not deteriorate when subjected to oil, water, gases, salt water, sewage and fungus.

## 3.5 TESTING

A. Provide earth ground testing at each existing transformer, manhole and vault.
   1. Resistance of the grounding electrode system shall be measured using an earth ground testers that can perform earth ground loop resistances using only clamps (Stakeless

testing). This method shall not require the use of earth ground stakes or the disconnection of ground rods. Tester shall automatically determine the ground loop resistance at the grounding connection. Clamp-on earth ground resistance tester jaws shall clamp completely around the conductor to be tested.

2. If ground resistance is over 5 ohms, then install a second ground rod.

B. Medium Voltage Cables: After installation, and before placing in service, perform a D.C. High Potential Test on all cables rated above 600 volts. All precautions and limits as specified in the applicable standards shall be adhered to. Current sensing circuits in test equipment shall measure only the leakage current associated with the cable under test, and shall not include internal leakage current of the test equipment. Test procedures shall be as follows and the results for each cable test shall be recorded.

1. Record temperature and relative humidity. Do not perform tests unless weather is clear and relative humidity is low.
2. Each conductor shall be individually tested with all other conductors grounded. All shields shall be grounded.
3. Terminations shall be properly corona suppressed by guard ring, field reduction sphere, or other suitable methods.
4. Perform megger and continuity test prior to high-pot.
5. A D.C. high potential shall be applied in at least five equal increments until maximum test voltage is reached. The D.C. leakage current shall be recorded at each step after a constant stabilization time consistent with system charging current decay. 100% voltage shall be reached in a maximum of 60 seconds.
6. A graphic plot shall be made of leakage current (X axis) versus voltage (Y axis) at each increment.
7. The test conductor shall be raised to a maximum test voltage and held for a total of 15 minutes. Readings of leakage current (Y axis) versus time (X axis) shall be recorded and plotted. Take values at 15 seconds, 30 seconds, 60 seconds, then one minute interval till end of test.
8. The conductor test potential shall be reduced to zero and grounds applied for at least ten minutes to discharge the cable.
9. The maximum D.C. test voltage shall be as recommended by the cable manufacturer and by IPCEA for "Voltage Tests After Installation".
10. When new cables are spliced into existing cables, the high potential test shall be performed on the new cable prior to splicing. After test results are approved for new cable and splice is made, an insulation resistance test and continuity test shall be performed on the length of cable including the splice; the existing cable shall be tested to the nearest disconnection point. Written results shall be submitted for approval.

END OF SECTION 260300

This Page Left Intentionally Blank

SECTION 260425 – SWITCHBOARDS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Exterior generator paralleling switchboards.

1.2 RELATED SECTIONS

A. Section 260010 “Basic Electrical Requirements.”

B. Section 260170 “Grounding and Bonding.”

C. See section 017900 “Demonstration and Training” for Generator and Electrical Distribution Commissioning and Operational Requirements.

1.3 REFERENCES

A. NEMA Standards.

B. NFPA 70 N.E.C. Latest Edition.

C. U.L. Standards.

D. ANSI Standards.

1.4 PERFORMANCE REQUIREMENTS

A. Conform to requirements of ANSI/NFPA 70. (N.E.C.)

B. Furnish products listed and classified by Underwriters' Laboratories, Inc. (U.L.) as suitable for purpose specified and shown.

C. Size as indicated on the Drawings.

1.5 SUBMITTALS

A. Submit shop drawings, Owner's Manuals, and Operating Instructions in accordance with Division 01 Section “Submittal Procedures”.

B. Include front and side views of enclosures with overall dimensions shown; conduit entrance locations and requirements; nameplate legends; size and number of bus bars per phase, neutral, and ground; switchboard instrument details; instructions for handling and installation of switchboard; and electrical characteristics including voltage, frame size and trip ratings, withstand ratings, and time-current curves of all equipment and components. Plus catalog, specification and sizes of all protection devices.

C. Include manufacturer' s recommended initial settings for each over current device.

D. Submit manufacturer's instructions.

E. All equipment shall be fully rated, series ratings will not be accepted.

1.6 OPERATION AND MAINTENANCE DATA

A. Submit operation and maintenance data.

B. Include spare parts data listing; source and current prices of replacement parts and supplies; and recommended maintenance procedures and intervals.

1.7 DELIVERY, STORAGE AND HANDLING

A. Deliver in 48 inch maximum width shipping splits, individually wrapped for protection, and mounted on shipping skids.

B. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to switchboard internal components, enclosure, and finish.

1.8 SPARE PARTS

A. Keys: Furnish 1 for each panel to Owner. Minimum 5 keys.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. General Electric.

B. I-T-E Siemens

C. Cutler Hammer.

D. Square D.

2.2 SWITCHBOARD CONSTRUCTION AND RATINGS

A. Standard Manufacturer's Construction: Number of sections, size and circuit details as indicated and specified. Sections and branch circuit devices shall be connected with bus bars braced for 100,000 AIC.

B. Designed with 600 volt components, and isolators. Connected for operation on 480/277 volt, three-phase, four-wire service. Vertically mounted breakers shall have "on" position at top and "off" position at bottom.

C. Factory-assembled, dead front, metal-enclosed, and self-supporting switchboard assembly conforming to NEMA PB 2, and complete from incoming line terminals to load-side terminations.

D. Provide space, bus capacity and bus connections for future as indicated. Electrical ratings and configurations shall be as indicated.

E. Line and Load Terminations: Accessible from the front only of the switchboard, suitable for both copper and aluminum conductors.

F. Main Section Devices: Individually or Group mounted.

G. Distribution Section Devices: Group or Panel mounted.

H. Bus Criteria as Follows:
   1. Bus operating at 600 volts and below shall be:
      a. 98% conductivity copper rated at a maximum of 1000 amperes per square inch, silver-plated.
   2. Bus structure shall be mounted on high quality, high impact non-tracking insulators adequately braced for specified short circuit rating.
   3. Provide isolated solid neutral bus bars full size, complete with lugs for connection of neutral conductors.
   4. Provide continuous bus bar for metallic bonding of sections.

I. Properly insulated wires may be used from load lugs to conduits extending to loads with wiring securely tied in accordance with good practice. Provide suitable solderless lugs for all cables entering and leaving switchboard.

J. The switchgear enclosure shall be designed for outdoor, un-protected application, and shall be completely gasketed and weather tight without the use of a “protected aisle enclosure”. A shallow double door may be utilized to help protect sensitive instruments and switches.

K. Switchboard Height: Approximately ninety inches (90") high with channel iron sills.

L. Finish: Manufacturer's standard light gray enamel over external surfaces. Coat internal surfaces with minimum one coat corrosion-resisting paint, or plate with cadmium or zinc.

## 2.3 OVERCURRENT PROTECTIVE DEVICES

A. Fusible Switch Assemblies:
   1. Not acceptable.

B. Main Devices: Encased Breakers. GE Power Break II, Insulated case circuit breaker with MicroVersa Trip Plus Trip Unit. Minimum 65,000 amperes interrupting rating at 480 volts. 2500 Ampere envelope size. Provide with the following features:
   1. Stationary mounting.
   2. True RMS sensing for accurate response to distorted waveforms for long-Time, Short-Time, and Ground fault protection with adjustable delay.
   3. Overload, Short Circuit and Short-Time trip indicators.
   4. Adjustable coordination settings:
      a. Ampere.

b. Long-Time pickup with four delay bands.
c. Instantaneous pickup.
d. Short-Time pickup with three delay bands.
e. Ground fault pick-up with three delay bands.
f. Anti-single phase protection.

5. LCD display with five button keypad for function selection and setpoint adjustments and three phase ammeter.

C. Distribution Section Circuit Breakers:

1. Molded Case: Digital, Solid State Spectra RMS series, fully rated 65KAIC@480V and U.L. series rated with specific down stream breakers to AIC values specified below:
   a. Types: SEL, SFL, SGL, up to 600A UL Current Limiting.
   b. Types: SKL, 800A to 1200A.
   c. True RMS sensing for accurate response to high harmonic content.
   d. Interchangeable trip rating plugs.
   e. Adjustable Instantaneous with short time tracking function.
   f. Trip rating as scheduled on drawings.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

A. Install erected and completely equipped. Locate as shown on Drawings, in accordance with manufacturer's written instructions.

B. Torque accessible bus connections and mechanical fasteners to manufacturer's specifications after placing switchboard.

### 3.2 FIELD QUALITY CONTROL

A. Inspect completed installation for physical damage, proper alignment, anchorage, and grounding.

B. Measure insulation resistance of each bus section phase to phase and phase to ground for one minute each. Test voltage shall be 1000 volts, and minimum acceptable value for insulation resistance is 2 megohms.

C. Check tightness of accessible bolted bus joints using a calibrated torque wrench. Tightness shall be in accordance with manufacturer's recommended values.

### 3.3 ADJUSTING AND CLEANING

A. Adjust all operating mechanisms for free mechanical movement.

B. Touch-up scratched or marred surfaces to match original finish.

C. Adjust trip and time delay settings to values as indicated on the manufacturers shop drawing and as instructed by the Architect/Engineer.

END OF SECTION 260425

SECTION 260621 – ENGINE GENERATOR SET-DIESEL

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Packaged exterior diesel engine generator set. Generator set shall be fully compliant with all RICE – New Source Performance standards (NSPS) and National Emission Standards for Hazardous Air Pollutants (NESHAP) requirements for stationary non-emergency Compression ignition (CI) engines. Certificate of compliance shall be included with submittals.

B. Exhaust silencer and fittings.

C. Fuel fittings.

D. Remote annunciator panel.

E. Remote Emergency Stop “Mushroom” Switches.

F. Battery and charger.

G. Weather-proof sound attenuated enclosure

H. Sub-base fuel tank

I. On-board paralleling controls

J. All work as required for a complete and fully functional System.

K. Load bank test and documentation.

1.2 RELATED SECTIONS

A. Division 01 Section “Submittal Procedures”.

B. Division 26 Section 260010 “Basic Electrical Requirements.”

C. See section 017900 Demonstration and Training for Generator and Electrical Distribution Commissioning and Operational Requirements.

1.3 REFERENCES

A. NSPS – 40 CFR Part 60

B. NESHAP – 40 CFR Part 63

C. ANSI/NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

D. ANSI/NEMA MG 1 - Motors and Generators.

E. NFPA 110 - Standard for Emergency and Standby Power Systems.

F. NEMA standards.

G. NFPA 70 ( N.E.C.) latest edition.

H. U.L. standards.

I. ANSI standards.

1.4 SUBMITTALS

A. Submit Shop Drawings, Owner's Manuals, and Operating Instructions in accordance with Division 01 Section “Submittal Procedures”.

B. Include drawings showing plan and elevation views with overall and interconnection point dimensions, fuel consumption rate curves at various loads, and electrical diagrams including schematic and interconnection diagrams.

C. Include product data showing dimensions, weights, ratings, interconnection points, and internal wiring diagrams for engine, generator, control panel, battery, battery rack, battery charger, exhaust silencer, vibration isolators.

D. Include documentation showing proof of U.L. and factory tests.

E. Include documentation showing EPA NSPS Stationary Non-Emergency Tier 4 certification for non-road diesel emergency and standby generators.

F. Submit manufacturers' instructions.

G. Include calculations verifying systems ability to start all motor loads plus general loads with a maximum of 15% voltage drop. Use data on panel schedules to obtain loads.

H. Include sample of second year extended service contract listing services included and costs. The cost of this service contract is not included. The Owner reserves the right to accept this additional service once the one-year guarantee is successfully completed.

I. Include list of extra materials.

J. Include Factory Test results.

1.5 PROJECT RECORD DOCUMENTS

A. Accurately record location of engine generator and mechanical and electrical connections.

B. Include Field Test results.

1.6 OPERATION AND MAINTENANCE DATA

A. Include instructions for normal operation, routine maintenance requirements, service manuals for engine, oil sampling and analysis for engine wear, and emergency maintenance procedures.

B. Include parts lists and pricing.

1.7 QUALIFICATIONS

A. Manufacturer:
   1. Company specializing in manufacturing the products specified in this Section with minimum five years documented experience.
   2. Company maintaining engineering and service departments capable of rendering advice regarding installation and final adjustment of the system.

B. Supplier/Installer:
   1. Authorized distributor of engine generator manufacturer with service facilities within 75 miles of project site and minimum three years documented experience.
   2. Company offering service contracts for continuing factory authorized service after the initial warranty period.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Accept packaged engine generator set and accessories on site in crates and verify damage.

B. Transport, receive, store, protect, rig, handle and place at location indicated on the drawing.

C. Protect equipment from dirt and moisture by securely wrapping in heavy plastic.

1.9 EXTRA MATERIALS

A. Furnish one set of tools required for preventative maintenance of the engine generator system. Package tools in adequately sized metal tool box.

B. Provide two additional sets of each fuel, oil, and air filter element required for the engine generator system.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Provide monitoring and control systems as required for the generator control system to function as specified. The generator control system shall monitor and control the following power system components:
   1. Low voltage paralleling bus (480V)
   2. Engine generators.
   3. Circuit breakers integral to engine generators.
   4. 15kV utility “normal” power.
   5. Building Energy Management System

2.2 MANUFACTURERS

A. Caterpillar - Basis of Design

B. Cummins/Onan

C. Basis of Design equipment is established to provide a minimum capacity of 1100kW, with multiple fuel sources. Intent is to provide a combination of Tier4F diesel generator(s) and EPA compliant Natural Gas Generator(s) in parallel to achieve this capacity while meeting EPA regulations and providing the ability to follow demand load. Deviations from the Basis of Design kW ratings will be considered where such deviations provide these characteristics. Contractor shall adjust work, peripheral equipment and wiring etc to suit generators supplied.
   1. Acceptable range of Diesel generators: 275kW to 500kW with minimum total of 500kW.

2.3 ENGINE-GENERATOR SET

A. Engine generator Set, factory designed, assembled and tested, mounted on steel structural skid base with integral fuel tank, starting batteries and all accessories for a complete package ready to provide source of prime power.
   1. Designed and certified for load shedding applications.
   2. Shall include on-board paralleling controls and circuit breaker.
   3. The complete generator set assembly shall be CSA certified and UL2200 Listed.

B. System Capacity Ratings:
   1. Standby: 500 kW, 625 kVA at 0.8 P.F.
   2. Prime: 455kW, 569 kVA
   3. Designed for 277/480 volts, 3 phase 4 wire, 60 Hz.

C. Skid base mounted radiator system including belt driven pusher fan, coolant pump and thermostat temperature control. Rated for full load operation in a 50 Degrees C ambient. Provide radiator with minimum 50% ethylene glycol antifreeze solution.

D. Operation: In accordance with ANSI/NFPA 110.

E. Skid mounted tank shall be sized for minimum 24 hours at full load.

F. Provide weather proof sound attenuating enclosure.

G. Engine shall meet all Federal, State and Local Stationary Emission Standards in effect at time of installation.

2.4 GENERATOR SET PERFORMANCE

A. Capacity to accept 100% of the nameplate standby rating in one step, in compliance with NFPA 110 requirements.

B. Voltage Regulation under load from no load to 100% load: Plus or minus 1%.

C. Random Voltage Variation for constant loads, from no load to 100% load: not to exceed plus or minus 1% of mean value.

D. Frequency Regulation under varying loads fro no load to 100% load: 5% with isochronous electronic governor.

E. Random Frequency Variation for constant loads, from no load to 100% load: not to exceed plus

or minus 1% of mean value.

F. AC Waveform Total Harmonic Distortion (THD): Less than 5% no load to full linear load and less than 3% for any single harmonic.

G. Telephone Influence Factor (TIF): Less than 50 per NEMA MG1.

H. Alternator Temperature Rise at rated load: Less than 125 Deg C at standby rating per NEMA MG1, IEEE 115 and IEC34-1.

I. Remote start features with cycle cranking of 15 seconds ON, 15 seconds OFF, for three attempts (total 75 seconds). If engine fails to start, lock out engine and indicate overcrank on alarm panel.

J. Unit shall shut down and lock out and indicate cause on alarm panel upon initiation of herein specified Safety Devices.

## 2.5 ENCLOSURE AND INTERGRAL SUB-BASE FUEL TANK

A. Weatherproof Enclosure: C18 Tier 4 Final Sound Attenuated Enclosure.
1. Factory pre-assembled package designed for outdoor use.
2. Minimum 14-gauge steel construction (panels) with Stainless steel hardware.
3. Corrosion resistant environmentally friendly, polyester powder coat paint.
4. Durable powder topcoat paint.
5. Fuel and electrical stub-up area within enclosure perimeter.
6. Pitched roof for improved rain ingress protection.
7. Recessed, lockable doors in two sides with retainers to hold doors open for easy access.
8. Internally mounted super critical exhaust silencing system.
9. Rodent barriers on inlet.
10. Louvers on air inlet and outlet to protect from ice and snow accumulation.
11. Factory mounted battery charger.
12. Rain hoods for air inlet.
13. All factory installed powered features shall be pre-wired.
14. Seismic isolators.
15. Full Load Sound Pressure Levels: at 7 meters 72dBA
16. Dual breakers.

B. Integral Sub-Base Fuel Tank
1. UL 142 Listed ULC-S601-07 Listed and NFPA37 compliant.
2. Approximately 1024 gallons for 24 hour operation at full load.
3. Dual walled, steel construction.
4. Emergency tank and rupture basin vents.
5. Tank mounted mechanical fuel gauge and Fuel supply and return tubes.
6. Top mounted leak detection float switch, plus low and high level fuel switches.
7. Provisions for fuel transfer fill and float switches.
8. Integral lifting points.
9. Fuel overfill alarm.
10. Five gallon spill fill box.
11. Fill pipe extender.
12. Basin drain.

C. Approximate dimensions:
   1. Enclosure: 226"L x 81"W x 114"H.

2.6 ENGINE AND ENGINE EQUIPMENT

A. Emissions Level: EPA NSPS Stationary Non-Emergency Tier 4 Final for non-road diesel emergency/standby generators.

B. Engine Type: Water-cooled C18 ATAAC, I-6, 4 stroke, diesel 18.13-liter, direct injection utilizing in-cylinder combustion technology.

C. Fuel System: Number 2 low sulfur Diesel fuel.

D. Engine Speed: 1800 rpm.

E. Governor: Isochronous electronic type to maintain engine speed within 0.5 percent, steady state, and 1 percent, no load to full load, with recovery to steady state within 2 seconds following sudden load changes.

F. Starting 24 Volt, negative ground.

G. Battery Charging Alternator: 45 Ampere.

H. Safety Devices: Engine shutdown on high water temperature, low oil pressure, overspeed, and engine over-crank. Limits as selected by manufacturer.

I. Engine Starting: DC starting system with positive engagement, number and voltage of starter motors in accordance with manufacturer's instructions. Include remote starting control circuit, with MANUAL-OFF-REMOTE selector switch on engine-generator control panel.

J. Engine Features & Accessories: Dual Fuel filters, Fuel water separator, Automatic electric fuel shut off, electric solenoid fuel shutoff valve, lube oil filter, intake air filter with restriction indicator, lube oil cooler, fuel oil cooler, gear-driven water pump, battery charging alternator.

K. Mounting: Provide unit with suitable linear-type vibration isolators and mount on structural steel skid base.

2.7 GENERATOR

A. Generator: ANSI/NEMA MG 1; single bearing, direct coupled, self-aligning, three phase, four pole, 12 wire reconnectible, brushless synchronous generator with brushless exciter and direct driven blower for proper cooling.

B. Rating: As specified herein.

C. Insulation: ANSI/NEMA MG 1, sustain 300% of rated current based on the 125C (Class H) rise rating for ten seconds during a fault condition.

D. Maximum Temperature Rise: 125 degrees C.

E. Enclosure: ANSI/NEMA MG 1; open drip proof.

F. Wave form deviation: 2%.

G. Voltage regulator: 3 phase sensing with load adjustable module.

H. Voltage Regulation: Less than ±1/2% (steady state) Less than ±1/2% (3% speed change).

2.8 ENGINE-GENERATOR CONTROLS

A. Engine-Generator Digital Control Panel, EMCP 4.4: Fully solid-state, microprocessor based, generator set control. The control panel shall be designed and built by the engine manufacturer. Mount with the top not more than six (6) feet above finished floor or grade (this may require remote mounting). The control shall provide all operating, monitoring, and control functions for the generator set. The control panel shall provide real time digital communications to all engine and regulator controls via SAE J1939. Include the following equipment and features:
   1. The control shall include a minimum 480 x 320 pixel, 5.5 inch, white backlit graphical display with text-based alarm/event descriptions.
   2. On-board Paralleling functions including automatic and manual synchronizing, dead bus arbitration, load sharing, and load sense/load demand (LSLD.
   3. Audible horn for alarm and shutdown with horn silence switch
   4. Standard ISO labeling
   5. Multiple language capability
   6. Remote start/stop control
   7. Local run/off/auto control integral to system microprocessor
   8. Cool down timer
   9. Speed adjust
   10. Lamp test
   11. Emergency stop push button
   12. Voltage adjust
   13. Voltage regulator V/Hz slope - adjustable
   14. Password protected system programming

B. Control Panel Digital Monitoring Capability (minimum)
   1. Engine
      a. Engine oil pressure
      b. Engine oil temperature
      c. Engine coolant temperature
      d. Engine RPM
      e. Battery volts
      f. Engine hours
      g. Engine crank attempt counter
      h. Engine successful start counter
      i. Service maintenance interval
      j. Real time clock
      k. Engine exhaust stack temperature
      l. Engine main bearing temperature
   2. Generator
      a. Generator AC volts (Line to Line, Line to Neutral and Average)
      b. Generator AC current (Avg and Per Phase)
      c. Generator AC Frequency
      d. Generator kW (Total and Per Phase)

e. Generator kVA (Total and Per Phase)
f. Generator kVAR (Total and Per Phase)
g. Power Factor (Avg and Per Phase)
h. Total kW-hr
i. Total kVAR-hr
j. % kW
k. % kVA
l. % kVAR
m. Generator bearing temperature
n. Generator stator winding temperature

3. Voltage Regulation
   a. Excitation voltage
   b. Excitation current

C. Alarms and Shutdowns: The control shall monitor and provide alarm indication and subsequent shutdown for the following conditions. All alarms and shutdowns shall be accompanied by a time, date, and engine hour stamp that are stored by the control panel for first and last occurrence:

1. Engine Alarm/Shutdown.
   a. Low oil pressure alarm/shutdown
   b. High coolant temperature alarm/shutdown
   c. Loss of coolant shutdown
   d. Over-speed shutdown
   e. Over-crank shutdown
   f. Emergency stop shutdown
   g. Low coolant temperature alarm
   h. Low battery voltage alarm
   i. High battery voltage alarm
   j. Control switch not in auto position alarm
   k. Battery charger failure alarm
2. Generator Alarm/Shutdown
   a. Generator phase sequence
   b. Generator over voltage
   c. Generator under voltage
   d. Generator over frequency
   e. Generator under frequency
   f. Generator reverse power (real and reactive)
   g. Generator overcurrent
3. Voltage Regulator Alarm/Shutdown
   a. Loss of excitation alarm/shutdown
   b. Instantaneous over excitation alarm/shutdown
   c. Time over excitation alarm/shutdown
   d. Rotating diode failure
   e. Loss of sensing
   f. Loss of PMG

D. Inputs and Outputs

1. Programmable Digital Inputs: The Controller shall include the ability to accept programmable digital input signals. The signals may be programmed for either high or low activation using programmable Normally Open or Normally Closed contacts.

2. Programmable Relay Outputs: The control shall include the ability to operate programmable relay output signals, integral to the controller. The output relays shall be rated for 2A @ 30VDC and consist of six (6) Form A (Normally Open) contacts and two (2) Form C (Normally Open & Normally Closed) contacts.
3. Programmable Discrete Outputs: The control shall include the ability to operate two (2) discrete outputs, integral to the controller, which are capable of sinking up to 300mA.

E. Maintenance: All engine, voltage regulator, control panel and accessory units shall be accessible through a single electronic service tool. The following maintenance functionality shall be integral to the generator set control:
1. Engine running hours display
2. Service maintenance interval (running hours or calendar days)
3. Engine crank attempt counter
4. Engine successful starts counter
5. 40 events are stored in control panel memory
6. Programmable cycle timer that starts and runs the generator for a predetermined time. The timer shall use 7 user-programmable sequences that are repeated in a 7-day cycle. Each sequence shall have the following programmable set points:
    a. Day of week
    b. Time of day to start
    c. Duration of cycle

F. Remote Communications
1. Remote Communications:
2. The control shall include Modbus RTU communications as standard via RS-485 half duplex with configurable baud rates from 2.4k to 57.6k.
3. Remote Monitoring Software: The control shall provide Monitoring Software with the following functionality:
    a. Monitor up to eight (8) generator sets, plus ATS and UPS.
    b. Provide access to all date and events on generator set communications network.
    c. Provide remote control capability for the generator set(s).
    d. Ability to communicate via Modbus RTU or remote modem.

G. Local and Remote Annunciation
1. Local Annunciator (NFPA 99/110, CSA 282): Provide a local, control panel mounted, annunciator to meet the requirements of NFPA 110, Level 1.
    a. Annunciators shall be networked directly to the generator set control
    b. Local Annunciator shall include a lamp test pushbutton, alarm horn and alarm acknowledge pushbutton
    c. Provide the following individual light indications for protection and diagnostics:
        1) Overcrank
        2) Low coolant temperature
        3) High coolant temperature warning
        4) High coolant temperature shutdown
        5) Low oil pressure warning
        6) Low oil pressure shutdown
        7) Overspeed
        8) Low coolant level
        9) EPS supplying load
        10) Control switch not in auto

11) High battery voltage
12) Low battery voltage
13) Battery charger AC failure
14) Emergency stop
15) Spare
16) Spare

2. Remote Annunciator (NFPA 99/110, CSA 282): Provide a remote annunciator to meet the requirements of NFPA 110, Level 1.
   a. The annunciator shall provide remote annunciation of all points stated above and shall incorporate ring-back capability so that after silencing the initial alarm, any subsequent alarms will sound the horn.
   b. Ability to be located up to 4000 ft from the generator set.

2.9 COOLING SYSTEM

A. The generator set shall be equipped with a rail-mounted, engine-driven radiator with blower fan and all accessories. The cooling system shall be sized to operate at full load conditions and 110F ambient air entering the enclosure.

B. The generator set supplier shall be responsible for providing a properly sized cooling system based on the enclosure static pressure restriction.

2.10 Fuel System

A. The fuel system shall be integral with the engine. In addition to the standard fuel filters provided by the engine manufacturer, provide a primary fuel filter/water separator in the fuel inlet line to the engine.

B. All fuel piping shall be black iron or flexible fuel hose rated for this service. Galvanized piping is not permitted. Flexible fuel lines shall be minimally rated for 300 degrees F and 100 psi.

C. Provide on board fuel system fluid cooler.

2.11 ACCESSORIES

A. Exhaust Silencer: As specified with the weather proof enclosure, complete with muffler companion flanges and flexible stainless-steel exhaust fitting, suitable for horizontal orientation, sized in accordance with engine manufacturer's standards.

B. Remote Annunciator Panel:
   1. Provide one remote annunciator each genset with features as previously specified.

C. Batteries: Heavy duty, diesel starting type lead-acid storage batteries, sized per manufacturer' s recommendations to allow for cranking cycles herein specified at temperatures of 0 Degrees C. Match battery voltage to starting system. Include necessary on skid mounting supports, cables and clamps.

D. Battery Tray: Plastic coated metal or wooden tray treated for electrolyte resistance, constructed to contain spillage of electrolyte.

E. Battery Charger:

1. Fully automatic, all-electronic operation.
2. Constant voltage, Current limited.
3. Equalize charge timer type designed to maintain batteries at full charge.
4. 4-rate charging: Constant current charge, High-rate taper charge, Finishing charge, Maintaining charge.
5. Disconnected/reversed/incorrect voltage battery alarm and protection.
6. Lightning and voltage transient protection.
7. Include overload protection
8. Digital DC voltmeter and ammeter, and 120 volts AC fused input.
9. Battery-fault alarm. Send alarm to the Building Automation System (BAS). Coordinate with Div 23. Include Labeled terminal strip to allow for wiring by the BAS.
10. Locate within WP enclosure.

F. Line Circuit Breaker: As specified in Section 260470 - Panelboards; sized in accordance with ANSI/NFPA 70 and as shown on the power riser diagram. Two breakers are required, one for required emergency (Life Safety) and one for the non-required (standby alternate power) loads. Use flex from generator to coupling at Pad.

G. Engine start/stop selector switch.

H. Automatic Exerciser, initially set for 7:00 AM – Friday or as directed by the Facilities department.

I. Remote Emergency Stop "Mushroom" Switch: Provide emergency shut off switch on the unit generator and at location(s) indicated on drawings. The engine controls shall be arranged to stop the engine if a remote maintained contact emergency stop switch is depressed. Once the switch has been operated, it should not be possible to start the engine until the stop switch is released. The "Switch Off Normal" indicating lamp on the front of the panel and remote engine fail alarm shall both be activated if the stop switch has been operated.
1. Remote mounted devices installed outdoors shall be installed in approved lockable wet location wiring method.
2. Shut off switch: Red button with (2) N.O. and (2) N.C. contact block. Switch shall be capable of lockout and tag-out.
3. Provide label with "Emergency Shut Down"- White letters on Red background.
4. Provide all wiring, raceways and mounting systems as required.

J. Over-Current Protective Device:
1. Circuit breaker required: Provide a mainline molded case circuit breaker(s), 100% electronic, size as indicated on Drawings, on generator output with adjustable long time and short time delay and instantaneous trip; complying with NEMA AB 1 and UL489. Trip settings shall be factory set to generator thermal damage curve.

K. Block Heater: Engine mounted, thermostatically controlled water jacket heater sized to maintain engine jacket water at 90 degrees F (32 degrees C) or sized by manufacturer to maintain recommended jacket temperature for quick starting. Select to allow connection to a 20A, 1P, 120 volt circuit. Provide 120v circuit to heater.

## 2.12 ENCLOSURE

A. Weather protective housing (Level 3 Acoustic Enclosure or equal) with the following features: Skin Tight.

1. Factory pre-assembled package designed for outdoor use. Galvanized Steel body.
2. Minimum 14-gauge steel construction (panels) with Stainless steel hardware.
3. Lifting points on base frame.
4. Corrosion resistant zinc phosphate pretreatment, e-coat primer and super-durable powder topcoat paint.
5. Fuel and electrical stub-up area within enclosure perimeter.
6. Cambered roof to prevents water accumulation.
7. Recessed, lockable doors in two sides with retainers to hold doors open for easy access.
8. Enclosed exhaust silencer to ensure safety and to protect against rust.
9. Rodent barriers on inlet.
10. Vandal-resistant.
11. Motorized louvers on air inlet and outlet (as required) to protect from ice and snow accumulation.
12. Factory mounted battery charger.
13. Rain hoods for air inlet.
14. All factory installed powered features shall be pre-wired.
15. Seismic isolators.
16. Average Sound Pressure Level at 7 meters measured per ANSI S1.13 and ANSI S12.18: 70.4 dB(A)

## PART 3 - EXECUTION

### 3.1 EXAMINATION

A. Verify that surfaces are ready to receive work and field dimensions are as shown on Drawings.

B. Verify that required utilities are available in proper location and ready for use.

C. Beginning of installation means installer accepts existing conditions.

### 3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Generator set shall be anchored to concrete pad.

C. Coordinate with mechanical and site contractor for fuel transfer fill piping and control.

D. Generator installations shall be provided with battery powered emergency lighting. This shall include interior locations and units mounted within exterior enclosures.

E. Generator Emergency Shutdown switch shall be located on exterior paralleling switchboard enclosure.

### 3.3 PRODUCTION TESTS

A. Factory test of the specific unit supplied for this project as described in ANSI Standards.

B. Every production unit shall be factory tested at rated load and power factor. Testing shall include demonstration of rated power and single-step rated load pickup.

C. Provide documentation of factory tests.

3.4 FIELD TEST and ADJUSTING

A. Perform by the Supplier/Installer.

B. Provide full load test at the site, after installation. Utilize portable resistance load bank, to augment transferred loads to meet full load requirements. Simulate power failure including operation of transfer switch, automatic starting cycle, and automatic shutdown, and return to normal.
1. Run set at 50% load for 2 hours.
2. Run set at 75% load for 2 hours.
3. Run set at 100% load for 1 hour.
4. Run test continuously from no load to full load. If any test is interrupted for more than one hour then restart from step 1.

C. DO NOT allow engine set to overheat.

D. During test, record the following at 30 minute intervals:
1. Time of day.
2. Engine Coolant temperature.
3. Outside air temperature.
4. Temperature within enclosure.
5. Kilowatts.
6. Amperes.
7. Voltage.
8. Frequency.
9. Oil pressure.

E. Test alarm and shutdown circuits by simulating conditions.

F. Confirm operation of the remote annunciator.

G. Adjust generator output voltage and engine speed.

3.5 DEMONSTRATION

A. Provide systems demonstration.

B. Simulate power outage by interrupting normal source, and demonstrate that system operates to provide standby power.

C. Initiate demand response by receiving input from energy management system and demonstrate that system operates to provide standby power.

D. Provide placard, framed under glass, at the remote annunciator locations describing the sequence of operation, including manual override to force the system to transfer to standby generator source and assume standby loads.

END OF SECTION 260622

This Page Left Intentionally Blank

SECTION 260622 – ENGINE GENERATOR SET–NATURAL GAS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Packaged exterior engine generator set. Generator set shall be fully compliant with all RICE – New Source Performance standards (NSPS) and National Emission Standards for Hazardous Air Pollutants (NESHAP) requirements for stationary non-emergency spark ignition (SI) engines.

B. Exhaust silencer and fittings.

C. Fuel fittings.

D. Remote annunciator panel.

E. Remote Emergency Stop “Mushroom” Switch.

F. Battery and charger.

G. Weather-proof sound attenuated enclosure

H. On-board paralleling controls

I. All work as required for a complete and fully functional System.

J. Load bank test and documentation.

K. Emissions Certification Testing

1.2 RELATED SECTIONS

A. Division 01 Section “Submittal Procedures”.

B. Division 26 Section 260010 “Basic Electrical Requirements.”

C. See section 017900 Demonstration and Training for Generator and Electrical Distribution Commissioning and Operational Requirements.

1.3 REFERENCES

A. NSPS – 40 CFR Part 60

B. NESHAP – 40 CFR Part 63

C. ANSI/NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

D. ANSI/NEMA MG 1 - Motors and Generators.

E. NFPA 110 - Standard for Emergency and Standby Power Systems.

F. NEMA standards.

G. NFPA 70 (N.E.C.) latest edition.

H. U.L. standards.

I. ANSI standards.

1.4 SUBMITTALS

A. Submit Shop Drawings, Owner's Manuals, and Operating Instructions in accordance with Division 01 Section “Submittal Procedures”.

B. Include drawings showing plan and elevation views with overall and interconnection point dimensions, fuel consumption rate curves at various loads, and electrical diagrams including schematic and interconnection diagrams.

C. Include product data showing dimensions, weights, ratings, interconnection points, and internal wiring diagrams for engine, generator, control panel, battery, battery rack, battery charger, exhaust silencer, vibration isolators.

D. Include documentation showing proof of U.L. and factory tests.

E. Include documentation demonstrating compliance with all EPA RICE-NSPS-SI requirements. This documentation shall be submitted a minimum of sixty (60) days prior to the generator arriving on site.

F. Submit manufacturers' instructions.

G. Include sample of second year extended service contract listing services included and costs. The cost of this service contract is not included. The Owner reserves the right to accept this additional service once the one-year guarantee is successfully completed.

H. Include documentation demonstrating emission testing service contract. The costs for emission testing shall be included for initial emission testing and third year testing, providing for 6 years of EPA emission testing compliance. All documentation for and coordination with owner and EPA for testing shall be included in the base bid.

I. Include list of extra materials.

J. Include Factory Test results.

1.5 PROJECT RECORD DOCUMENTS

A. Accurately record location of engine generator and mechanical and electrical connections.

B. Include Field Test results.

## 1.6 OPERATION AND MAINTENANCE DATA

A. Include instructions for normal operation, routine maintenance requirements, service manuals for engine, oil sampling and analysis for engine wear, and emergency maintenance procedures.

B. Include parts lists and pricing.

## 1.7 QUALIFICATIONS

A. Manufacturer:
   1. Company specializing in manufacturing the products specified in this Section with minimum five years documented experience.
   2. Company maintaining engineering and service departments capable of rendering advice regarding installation and final adjustment of the system.

B. Supplier/Installer:
   1. Authorized distributor of engine generator manufacturer with service facilities within 75 miles of project site and minimum three years documented experience.
   2. Company offering service contracts for continuing factory authorized service after the initial warranty period.

## 1.8 DELIVERY, STORAGE, AND HANDLING

A. Accept packaged engine generator set and accessories on site in crates and verify damage.

B. Transport, receive, store, protect, rig, handle and place at location indicated on the drawing.

C. Protect equipment from dirt and moisture by securely wrapping in heavy plastic.

## 1.9 EXTRA MATERIALS

A. Furnish one set of tools required for preventative maintenance of the engine generator system. Package tools in adequately sized metal tool box.

B. Provide two additional sets of each fuel, oil, and air filter element required for the engine generator system.

# PART 2 - PRODUCTS

## 2.1 SYSTEM DESCRIPTION

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Provide monitoring and control systems as required for the generator control system to function as specified. The generator control system shall monitor and control the following power system components:
   1. Low voltage paralleling bus (480V)

2. Engine generators.
3. Circuit breakers integral to engine generators.
4. 15kV utility “normal” power.
5. Building Energy Management System

## 2.2 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Caterpillar - Basis of Design
   2. Cummins/Onan

B. Basis of Design equipment is established to provide a minimum nominal capacity of 1100kW, with multiple fuel sources. Intent is to provide a combination of Tier4F diesel generator(s) and EPA compliant Natural Gas Generator(s) in parallel to achieve this capacity while meeting EPA regulations and providing the ability to follow demand load. Deviations from the Basis of Design kW ratings will be considered where such deviations provide these characteristics. Contractor shall adjust work, peripheral equipment and wiring etc to suit generators supplied.
   1. Acceptable range of Natural Gas generators: 300kW to 500kW

## 2.3 ENGINE-GENERATOR SET

A. Engine generator Set, factory designed, assembled and tested, mounted on steel structural skid, starting batteries and all accessories for a complete package ready to provide source of standby/prime power.
   1. Designed and certified for load shedding applications (prime power)
   2. Shall include on-board paralleling controls and circuit breaker.
   3. The complete generator set assembly shall be designed in accordance with CSA2.2 standards and shall be UL2200 Listed.

B. Mounting Frame: Maintain alignment of mounted components without depending on concrete foundation; and have lifting attachments.
   1. Rigging Diagram: Inscribed on metal plate permanently attached to mounting frame to indicate location and lifting capacity of each lifting attachment and generator-set center of gravity.

C. Capacities and Characteristics:
   1. Power Output Ratings: 300ekW (standby).
   2. Output Connections: 277/480 volts, 3 phase 4 wire, 60 Hz.

D. Nameplates: For each major system component to identify manufacturer's name and address, and model and serial number of component.

E. Skid base mounted radiator system including belt driven pusher fan, coolant pump and thermostat temperature control. Rated for full load operation in a 50°C ambient. Provide radiator with minimum 50% ethylene glycol antifreeze solution.

F. Provide weather proof sound attenuating enclosure.

G. Engine shall meet all Federal, State and Local Stationary Emission Standards in effect at time of installation.

## 2.4 GENERATOR SET PERFORMANCE

A. Voltage Regulation under load from no load to 100% load: Plus or minus 1%.

B. Random Voltage Variation for constant loads, from no load to 100% load: not to exceed plus or minus 1% of mean value.

C. Frequency Regulation under varying loads from no load to 100% load: 5% with isochronous electronic governor.

D. Random Frequency Variation for constant loads, from no load to 100% load: not to exceed plus or minus 1% of mean value.

E. AC Waveform Total Harmonic Distortion (THD): Less than 5% no load to full linear load and less than 3% for any single harmonic.

F. Telephone Influence Factor (TIF): Less than 50 per NEMA MG1.

G. Alternator Temperature Rise at rated load: Less than 125°C at standby rating per NEMA MG1, IEEE 115 and IEC34-1.

H. Maximum Sound Level at 23 Feet at full load: see enclosure requirements.

I. Remote start features with cycle cranking of 15 seconds ON, 15 seconds OFF, for three attempts (total 75 seconds). If engine fails to start, lock out engine and indicate over-crank on alarm panel.

J. Unit shall shut down and lock out and indicate cause on alarm panel upon initiation of herein specified Safety Devices.

K. Sustained Short-Circuit Current: For a 3-phase, bolted short circuit at system output terminals, system shall supply a minimum of 250 percent of rated full-load current for not less than 10 seconds and then clear the fault automatically, without damage to generator system components.

L. Start Time: Comply with NFPA-110, Type-10, Level 1 system requirements.

M. Unit shall meet all Federal, State and Local Stationary Emission Standards in effect at time of installation.

## 2.5 ENGINE AND ENGINE EQUIPMENT

A. Engine Type: Water-cooled, turbo-charged, four cycle, internal combustion engine.
   1. Rated Engine Speed: 1800 rpm.

B. Fuel Type: Natural gas.

C. Governor: Isochronous electronic type to maintain engine speed within 0.5 percent, steady state, and 1 percent, no load to full load, with recovery to steady state within 2 seconds following sudden load changes.

D. Safety Devices: Engine shutdown on high water temperature, low oil pressure, over-speed, and engine over-crank. Limits as selected by manufacturer.

E. Engine Accessories: Include intake air filter, fuel filter, fuel priming pump, automatic electric fuel shutoff, fuel/water separator, gear-driven water pump, positive displacement mechanical full pressure lubrication oil pump, full flow lubrication oil filters with replaceable elements, dipstick oil level indicator, and oil drain valve with hose extension. Include engine mounted battery charging alternator with solid state voltage regulator.

F. Engine Jacket Heater: Thermal circulation type water heater with integral thermostatic control, sized to maintain engine jacket water at 90°F (32°C). Comply with NFPA 110 requirements for Level 1 equipment for heater capacity. See Drawings for required circuiting or provide circuit from nearest panelboard.

G. Cooling System: Unit mounted radiator using glycol coolant, with blower type fan, coolant pump and thermostat temperature control sized to maintain safe engine temperature in ambient temperature up to 105°F. Radiator shall be provided with a duct adapter flange permitting the attachment of air discharge duct directing the discharge of radiator air to exterior louver location. The equipment supplier shall provide 50% ethylene glycol antifreeze solution, with anticorrosion additives as recommended by engine manufacturer, to fill engine cooling system.
   1. Size of Radiator: Adequate to contain expansion of total system coolant from cold start to 110 percent load condition.
   2. Temperature Control: Self-contained, thermostatic-control valve modulates coolant flow automatically to maintain optimum constant coolant temperature as recommended by engine manufacturer.
   3. Coolant Hose: Flexible assembly with inside surface of nonporous rubber and outer covering of aging-, ultraviolet-, and abrasion-resistant fabric.
      a. Rating: 50-psig (345-kPa) maximum working pressure with coolant at 180°F (82°C), and non-collapsible under vacuum.
      b. End Fittings: Flanges or steel pipe nipples with clamps to suit piping and equipment connections.

H. Exhaust System: Provide critical grade silencer, with muffler companion flanges and flexible stainless-steel exhaust fitting, suitable for horizontal orientation, sized in accordance with engine manufacturer's instructions. The muffler shall be mounted so its weight is not supported by the engine.
   1. Flexible exhaust connections shall be provided as required for connection between engine exhaust manifold and exhaust line, in compliance with applicable codes and regulations.
   2. Provide an exhaust condensation trap with manual drain valve to trap and drain off exhaust condensation and to prevent condensation from entering the engine. Provide drain line to drip pan.
   3. Provide a suitable rain cap at the stack outlet. Provide all necessary flanges and special fittings for proper installation.
   4. Minimum sound attenuation of 25 dB at 500 Hz.

I. Fuel System: Provide fuel lockout solenoid and fuel regulator, based on manufacturers operating pressure, between 7”-14” H2O.
   1. Provide flexible supply and return line fittings and all connections for connecting fuel system to the engine in compliance with applicable codes and regulations. All fuel piping shall be pressure tested for minimum 2 hours. Primary regulator and flexible fuel hose with stainless steel over-braid shall be provided by the generator supplier.
   2. The Division 23 Contractor shall provide assistance and coordinate with the local utility gas provider for new gas service and associated regulator. Piping shall be compliant with utility

company installation requirements. Provide a gas meter and regulator for the generator service. Meter and regulator serving generator shall be separate from the building's gas service and shall be connected on the supply side of the main gas shutoff valve.

3. Provide separate identifying labeling and tags at shutoff valves indicating an emergency generator and main building.

J. Starting System: DC starting system with positive engagement, number and voltage of starter motors in accordance with manufacturer's instructions. Include remote starting control circuit, with MANUAL-OFF-REMOTE selector switch on engine-generator control panel.
   1. 12-V electric, with negative ground.
   2. Components: Sized so they will not be damaged during a full engine-cranking cycle with ambient temperature at maximum for installed locality.
   3. Cranking Motor: Heavy-duty unit that automatically engages and releases from engine flywheel without binding.
   4. Cranking Cycle: As required by NFPA110 for system level specified.
   5. Battery: Heavy duty, lead-acid type storage battery with adequate capacity within ambient temperature range for installed locality to provide specified cranking cycle at least three times without recharging at a temperature of 0°C. Match battery voltage to starting system. Include necessary on skid mounting supports, trays, cables and clamps, etc.
   6. Battery Cable: Size as recommended by engine manufacturer for cable length indicated. Include required interconnecting conductors and connection accessories.
   7. Battery Compartment: Factory fabricated of metal with acid-resistant finish and thermal insulation. Thermostatically controlled heater shall be arranged to maintain battery above 10°C regardless of external ambient temperature. Include accessories required to support and fasten batteries in place.
   8. Battery-Charging Alternator: Factory mounted on engine with solid-state voltage regulation and 35-A minimum continuous rating.
   9. Battery Charger: Current-limiting, automatic-equalizing and float-charging type. Unit shall comply with UL1236 and include the following features:
      a. Operation: Equalizing-charging rate of 10A shall be initiated automatically after battery has lost charge until an adjustable equalizing voltage is achieved at battery terminals. Unit shall then be automatically switched to a lower float-charging mode and shall continue to operate in that mode until battery is discharged again.
      b. Automatic Temperature Compensation: Adjust float and equalize voltages for variations in ambient temperature from minus 40°C to plus 60°C to prevent overcharging at high temperatures and undercharging at low temperatures.
      c. Automatic Voltage Regulation: Maintain constant output voltage regardless of input voltage variations up to plus or minus 10%.
      d. Ammeter and Voltmeter: Flush mounted in door. Meters shall indicate charging rates.
      e. Safety Functions: Sense abnormally low battery voltage and close contacts providing low battery voltage indication on control and monitoring panel. Sense high battery voltage and loss of ac input or dc output of battery charger. Either condition shall close contacts that provide a battery-charger malfunction indication at system control and monitoring panel.
      f. Enclosure and Mounting: NEMA 250, Type 1, wall-mounted cabinet.

K. Mounting: Provide unit with suitable spring-type vibration isolators and mount on structural steel skid base.

2.6 ALTERNATOR

A. Insulation: ANSI/NEMA MG 1, Class H.

B. Alternator Speed: 1800 rpm

C. The unit shall be single bearing, self-aligning, four pole, brushless, synchronous type, revolving field windings, and direct-driven centrifugal blower for proper cooling and minimum noise.

D. The unit shall be three-phase, broad range, re-connectable and shall have 12 leads brought out to allow the user to connect as required to obtain any of the available voltages. Leads shall terminate in NEMA-1connection enclosure. A fully rated, isolated neutral connection shall be included by the manufacturer.

E. The alternator shall meet temperature rise standards of UL2200. The insulation system material shall be class H.

F. Maximum Temperature Rise: 125°C.

G. The regulator design shall include torque-matching characteristics to allow the engine to use its fullest power producing capacity (without exceeding it or over compensating) at speeds lower than rated, to optimize motor starting capability and provide the fastest possible recovery from transient speed dips. Regulators which use a fixed volt per hertz characteristic are not acceptable.

H. The alternator shall include a permanent magnet generator (PMG) exciter and electronic voltage regulator, and shall be self-ventilated drip-proof construction built in accordance with NEMA, AIEE and ANSI standards.
   1. Voltage Regulation: Include manual controls to adjust voltage drop +/- 5 percent voltage level, and voltage gain.

I. The alternator shall be protected against overloads and short circuits by electronic control panel protective functions. Functions shall be implemented electronically in the control panel. The generator design shall be of the self-protecting type as demonstrated by the prototype short circuit test. Systems utilizing 3-wire, solid state control elements rotating in the rotor, will not be acceptable.

2.7 ENGINE-GENERATOR CONTROLS

A. Engine-Generator Digital Control Panel (Unit Mounted): EMCP 4.4 Fully solid-state, microprocessor based, generator set control. The control panel shall be designed and built by the engine manufacturer. Mount with the top not more than six (6) feet above finished floor or grade (this may require remote mounting). NFPA – 110, NEMA Type 1 generator mounted control panel enclosure with engine and generator controls and indicators containing the following:
   1. Automatic remote start capability with the mode of operation selectable from a panel mounted 4-position switch (Stop, Manual, Automatic, Reset).
   2. Emergency Stop push button with manual reset and lockable weatherproof cover.
   3. A communications adapter shall be provided to allow RS-232 communications between the generator set and a remote personal computer or other RS-232 device. Use of the adapter will allow the generator set to be remotely started or stopped and provide access to any of the engine or generator operational parameters as well as all alarms, shutdowns, or diagnostic codes. A Windows based software package shall be provided with the adapter.
   4. “Run-Off-Auto” switch

5. Shut downs as required by NFPA 110 5.6.5.2(3)
6. Alarms as required by NFPA 110 5.6.5.2(4)
7. Frequency Meter: 45-65 Hz range.
8. AC Output Voltmeter: 2 percent accuracy, with phase selector switch.
9. AC Output Ammeter: 2 percent accuracy, with phase selector switch.
10. Output voltage adjustment.
11. Individual alarm indication as required by NFPA 110.5.6.5.2(4) and table 5.6.5.2
12. Controls as required by NFPA 110 5.6.5.2(5)
13. Include remote starting control circuit, with RUN-OFF-AUTO selector switch on engine generator control panel.
14. Fuel pressure, water temperature, and lube oil pressure shall be monitored by the engine-generator controller.
15. The control shall include surge suppression for protection of solid state components. A front control panel illumination lamp with On/Off switch shall be provided. The engine-generator set starting batteries shall power the monitor.
16. Auxiliary Relay: 3PDT, operates when engine runs, with contact terminals prewired to terminal strip.
17. Remote Alarm Contacts: Pre-wire form C contacts to terminal strip for remote alarm functions required by ANSI/NFPA 110.

2.8 ACCESSORIES

A. Remote Emergency Stop "Mushroom" Switch: Provide emergency shut off switch on the unit generator and at location(s) indicated on drawings. The engine controls shall be arranged to stop the engine if a remote maintained contact emergency stop switch is depressed. Once the switch has been operated, it should not be possible to start the engine until the stop switch is released. The "Switch Off Normal" indicating lamp on the front of the panel and remote engine fail alarm shall both be activated if the stop switch has been operated.
   1. Remote mounted devices installed outdoors shall be installed in approved lockable wet location wiring method.
   2. Shut off switch: Red button with (2) N.O. and (2) N.C. contact block. Switch shall be capable of lockout and tag-out.
   3. Provide label with "Emergency Shut Down"- White letters on Red background.
   4. Provide all wiring, raceways and mounting systems as required.

B. Over-Current Protective Device:
   1. Circuit breaker required: Provide a mainline molded case circuit breaker(s), 100% electronic, size as indicated on Drawings, on generator output with adjustable long time and short time delay and instantaneous trip; complying with NEMA AB 1 and UL489. Trip settings shall be factory set to generator thermal damage curve.

C. Block Heater: Engine mounted, thermostatically controlled water jacket heater sized to maintain engine jacket water at 90°F (32°C) or sized by manufacturer to maintain recommended jacket temperature for quick starting. Select to allow connection to a 20A, 1P, 120 volt circuit or as indicated on Drawings.

D. Generator Source Alarm Annunciation/Indication: Provide audio/visual alarm indication to generator control panel and to remote annunciator panel if the generator output circuit breaker(s) or OCPD serving the "alternate" side of each automatic transfer switch is in the "Tripped or "Open" position. Provide monitoring micro-switches. Provide wiring diagram at equipment submittal. Green

light to indicate OCPD is closed and Red light to indicate OCPD is open. One point per each OCPD. Provide all wiring, raceway and contacts as required for this function. Separation between NEC article 700 wiring shall be maintained.

1. Provide wiring diagram at equipment submittal.

E. Remote Annunciator Panel: Flush mounted. Digital. Annunciator panel shall be powered from unit storage battery and located as indicated on Drawings. Provide with alarm buzzer, silence switch, 20 status conditions based on network inputs, plus four custom relays based on signals received from the unit control panel. Provide all interconnecting wiring as required in 1-1/4" conduit run concealed from generator to annunciator location. Wiring between the generator control panel and the annunciator shall be per manufacturer' s requirements. Provide with the following annunciator lamps (A)mber, (R)ed, (G)reen:

1. High battery voltage (A)
2. Low battery voltage (A)
3. Genset running (G)
4. Genset (EPS) supplying load (G)
5. Pre-low oil pressure (A)
6. Low oil pressure (R)
7. Pre-high coolant temperature (A)
8. High coolant temperature (R)
9. Low engine temperature (A)
10. Overspeed (R)
11. Fail to start (over-crank) (R)
12. Not in auto (R)
13. Battery charger malfunction (A)
14. Low fuel (A)
15. Low coolant level (R)
16. Fault: Basin fuel overflow
17. Spare (4) (G)
18. Common alarm

F. Monitor Start Circuit: The generator start circuit(s) shall be monitored and alarmed/annunciated as required by the National Electrical Code (NEC). The alarm condition (faulty Start circuit) shall be indicated on the integral and remote annunciators and all actions as required by the NEC shall be initiated.

G. Generator Feeder: The ampacity of the conductors from the generator terminals to the first distribution device containing overcurrent protection shall not be less than 115% of the nameplate current rating of the generator.

## 2.9 ENCLOSURE

A. Weather protective housing (Level 3 Acoustic Enclosure or equal) with the following features: Skin Tight.

1. Factory pre-assembled package designed for outdoor use. Galvanized Steel body.
2. Minimum 14-gauge steel construction (panels) with Stainless steel hardware.
3. Lifting points on base frame.
4. Corrosion resistant zinc phosphate pretreatment, e-coat primer and super-durable powder topcoat paint.
5. Fuel and electrical stub-up area within enclosure perimeter.

6. Cambered roof to prevents water accumulation.
7. Recessed, lockable doors in two sides with retainers to hold doors open for easy access.
8. Enclosed exhaust silencer to ensure safety and to protect against rust.
9. Rodent barriers on inlet.
10. Vandal-resistant.
11. Motorized louvers on air inlet and outlet (as required) to protect from ice and snow accumulation.
12. Factory mounted battery charger.
13. Rain hoods for air inlet.
14. All factory installed powered features shall be pre-wired.
15. Seismic isolators.
16. Average Sound Pressure Level at 7 meters measured per ANSI S1.13 and ANSI S12.18: 70.4 dB(A).
17. Approximate dimensions: 207.2” (L) x 63.7” (W) x 128.9” (H)

## PART 3 - EXECUTION

### 3.1 EXAMINATION

A. Verify that surfaces are ready to receive work and field dimensions are as shown on Drawings.

B. Verify that required utilities are available in proper location and ready for use.

C. Beginning of installation means installer accepts existing conditions.

### 3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Generator set shall be anchored to concrete pad.

C. Coordinate with local utility gas provider for new gas service and associated regulator. Piping shall be compliant with utility company installation requirements. Shut off valve handle shall be removed and located inside generator enclosure if valve is installed exposed at generator.

D. Generator installations shall be provided with battery powered emergency lighting. This shall include interior locations and units mounted within exterior enclosures.

E. Generator Emergency Shutdown switch shall be located on exterior paralleling switchboard enclosure.

### 3.3 PRODUCTION TESTS

A. Factory test of the specific unit supplied for this project as described in ANSI Standards.

B. Every production unit shall be factory tested at rated load and power factor. Testing shall include demonstration of rated power and single-step rated load pickup.

C. Provide documentation of factory tests.

3.4 FIELD TEST and ADJUSTING

A. Performed by the Supplier/Installer.

B. Provide full load test at the site, after installation. Utilize portable resistance load bank to meet full load requirements. Simulate power failure including operation of transfer switch, automatic starting cycle, and automatic shutdown, and return to normal.
   1. Run set at 50% load for 2 hours.
   2. Run set at 75% load for 2 hours.
   3. Run set at 100% load for 1 hour.
   4. Run test continuously from no load to full load, if any test is interrupted for more than one hour then restart from step 1.

C. DO NOT allow engine set to overheat.

D. During test, record the following at 30-minute intervals:
   1. Time of day.
   2. Engine Coolant temperature.
   3. Outside air temperature.
   4. Temperature within enclosure.
   5. Kilowatts.
   6. Amperes.
   7. Voltage.
   8. Frequency.
   9. Oil pressure.

E. Test alarm and shutdown circuits by simulating conditions.

F. Confirm operation of the remote annunciator.

G. Adjust generator output voltage and engine speed.

3.5 DEMONSTRATION

A. Provide systems demonstration.

B. Simulate power outage by interrupting normal source, and demonstrate that system operates to provide standby power.

C. Initiate demand response by receiving input from energy management system and demonstrate that system operates to provide standby power.

D. Provide placard, framed under glass, at the remote annunciator locations describing the sequence of operation, including manual override to force the system to transfer to standby generator source and assume standby loads.

END OF SECTION 260622

ALTERNATE 1
SEE SPECIFICATION SECTION 012300 - ALTERNATES FOR ALTERNATIVE GENERATOR CONFIGURATION REQUIREMENTS

CONTRACTOR SHALL PROVIDE TEMPORARY POWER FOR CAMPUS PRIMARY LOOP - MINIMUM 1MW DIESEL GENERATOR, TRANSFORMER, ALL ASSOCIATED HARDWARE AND CABLING AS REQUIRED. TEMPORARY GENERATOR AND TRANSFORMER SHALL BE ON-SITE AND AVAILABLE (SET IN PLACE PROTECTED AND SECURED BY TEMPORARY FENCING AND TESTED) PRIOR TO ANY POWER DISRUPTION. AT NO TIME SHALL THE CAMPUS BE WITHOUT POWER DURING CONSTRUCTION. CONNECT TO PRIMARY LOOP AT TRANSFORMER 1 NEAR JALBERT HALL BOILER ROOM. CLOSE SECTIONALIZING SWITCH NEAR KIRK HALL TO CLOSE PRIMARY LOOP.

SEE DETAILS ON DRAWING E70.1 FOR ADDITIONAL REQUIREMENTS

SEE SPECIFICATIONS FOR ENERGY METER REQUIREMENTS

CENTRAL MAINE POWER CO. ELECTRIC SERVICE
(12,470 / 7,200 VOLTS)

GEN #1
NON-EMERGENCY GENERATOR
500KW 277/480Y
DIESEL (TIER 4F)
800A

GEN #2
NON-EMERGENCY GENERATOR
300KW 277/480Y
NATURAL GAS
500A

GEN #3
NON-EMERGENCY GENERATOR
300KW 277/480Y
NATURAL GAS
500A

2,000A EXTERIOR 480/277V SWITCHGEAR
ULSE RATED
SPACE
500A
500A
800A
1600A

FIBER CONVERTER. SEE DETAIL DRAWING E70.1

480/277V
12,470/7200V
1000 KVA
TRANSFORMER

CORE EXISTING MANHOLE AS REQUIRED TO FACILITATE NEW CABLES

REWORK EXISTING 15KV SWITCHGEAR TO ACCEPT NEW MOTORIZED INTERRUPTER SWITCH SECTIONS

200/5
200A AM AS
SOLVC
PROVIDE BUS UM, VS AND FUSED VT'S
NC 600AS 150AF
NC 600AS 150AF
MONITORING / CONTROL
CONTROL WIRING TO ENERGY MANAGEMENT SYSTEM. COORDINATE WITH OWNER FOR REQUIREMENTS

CMP METERING (EXISTING)
200 AT FUSED CUT OUT
RELOCATE EXISTING GROUNDING AS REQUIRED

DP1-18
4 SETS 3#600&G-4"C & 1-4"C SPARE
2 SETS 4#600&G-4"C (EA) & 1-4"C SPARE
2 SETS 4#250&G-4"C (EA) & 1-4"C SPARE
3-4"C SPARE
4" C W/ 3-15KV, 2/0 AWG CU & 1/0 AWG BARE CU G &1-4"C SPARE

DP1-14,16,18 (ALL #10 AWG)-1"C GENERATOR CONTROLS, BLOCK HEATER AND SERVICE RECEPTACLE LOCATE INSIDE GENERATOR ENCLOSURE

DP1-20,22,24 (ALL #10 AWG)-1"C GENERATOR CONTROLS, BLOCK HEATER AND SERVICE RECEPTACLE LOCATE INSIDE GENERATOR ENCLOSURE

DP1-38,40,42 (ALL #10 AWG)-1"C GENERATOR CONTROLS, BLOCK HEATER AND SERVICE RECEPTACLE LOCATE INSIDE GENERATOR ENCLOSURE

MH # P9 (EXISTING)
MH # P10 (EXISTING)
MH # P1 (EXISTING)
MH # P2 (EXISTING)
MH # P8 (EXISTING)
MH # P3 (EXISTING)
MH # P4 (EXISTING)
MH # P5 (EXISTING)
MH # P7 (EXISTING)
MH # P6 (EXISTING)
HH #3
HH #2
HH #4

XFMR #6 (CMP 9.21) LOCATION: JALBERT HALL
150 KVA 12,470 KV-480/277 V
SERVES LOADS IN JALBERT HALL AUTOMOTIVE DEPT (EXISTING)

XFMR #1 (CMP #9.31) LOCATION: JALBERT HALL
225 KVA 12,470 KV-208/120 V
SERVES LOADS IN JALBERT HALL BOILER PLANT (EXISTING)

XFMR #7 (CMP #?) LOCATION: LAPOINTE HALL
500 KVA 12,470 KV-480/277 V
SERVES LOADS IN LAPOINTE HALL (EXISTING)

XFMR #9 LOCATION: TOWER
500 KVA 12,470 KV-277/480 V
SERVES LOADS IN TOWER (EXISTING)

SECTIONALIZING CABINET ON FOUNDATION
NORMALLY OPEN LOOP AT THIS LOCATION

XFMR #4 (CMP #9.23) LOCATION: JALBERT HALL
225 KVA 12,470 KV-480/277 V
SERVES LOADS IN MACHINE TOOL (EXISTING)

XFMR #3 (CMP #9.22) LOCATION: JALBERT HALL
150 KVA 12,470 KV-208/120 V
SERVES LOADS IN CAFETERIA (EXISTING)

XFMR #2 (CMP #9.221) LOCATION: KIRK HALL
300 KVA 12,470 KV-208/120 V
SERVES LOADS IN KIRK HALL (EXISTING)

XFMR #5 (CMP #9.221) LOCATION: FORTIN HALL
150 KVA 12,470 KV-208/120 V
SERVES LOADS IN FORTIN HALL (EXISTING)

XFMR #8 (CMP #?) LOCATION: NEW DORM
150 KVA 12,470 KV-208/120 V
SERVES LOADS IN NEW DORM (EXISTING)

HARRIMAN
AUBURN BOSTON PORTLAND PORTSMOUTH

# CENTRAL MAINE COMMUNITY COLLEGE CAMPUS GENERATOR

AUBURN, MAINE

| Harriman Project No. | 18473 |
|---|---|
| Key Plan | Proj North |

**CONSTRUCTION DOCUMENTS**
APRIL 23, 2019

| Rev Date | Revision Description |
|---|---|
| 05-14-19 | ADDENDUM #1 |

STATE OF MAINE JOHN W. TARR No. 7700 LICENSED PROFESSIONAL ENGINEER

Drawing Scales

PA / PE: JWT
Drawn By: DSH



## SITE POWER RISER DIAGRAM

# ES50.1