SECTION [26 23 13] [16430]

PARALLELING LOW VOLTAGE SWITCHGEAR

ASCO 7000 SERIES POWER CONTROL SYSTEM

Editor's Note:

This guide specification is written in accordance with the Construction Specifications Institute (CSI) Master Format. This section must be carefully reviewed and edited by the architect or the engineer to meet the requirements of the project. Coordinate this section with other specification sections within the Contract Documents and Drawings.

To properly use / edit this document, show formatting and hidden text by selecting ¶ on the menu or by typing (Ctrl+*) simultaneously. Except for these introductory and closing paragraphs, green hidden text will not print. Text in red is optional. Sections containing [-NOT USED] are optional Red text in [brackets] denotes multiple options where one or more should be chosen. All red text should be edited and changed to black for final project conformation. In addition, these introductory paragraphs should be deleted.

PART 1 - GENERAL

1.1 SUMMARY

A. Scope: Metal enclosed, low voltage, circuit breaker switchgear rated 600V and less and associated monitoring and control systems for paralleling standby generators and for distributing electrical power as shown on the Drawings and as herein specified. It is the intent of this specification to provide a complete control and power distribution system for the operation of [X] generator units, rated [XXXX] kW at 0.8 PF, [480] volts, 3 phase, [3][4] wire, [50][60] Hertz. All components, testing, and services specified or required for a complete operable system shall be included. The switchgear shall consist of [XX] Generator Sections, one Master Control Section and [XX] Distribution Sections.

B. Section Includes: The work specified in this Section includes, but shall not be limited to, the following:

1. Low voltage metal enclosed, drawout paralleling switchgear constructed to UL 1558 and ANSI C37.20.1 standards

C. Related Sections: Related sections include, but shall not be limited to, the following:

1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
2. Applicable general requirements for electrical Work specified within Division 26 Specification Sections apply to this Section.
3. The following information is typically depicted on the Drawings: bus configuration, bus ratings, interrupting ratings, circuit breaker size and type, power line and feeder connections, elevation and footprint, etc. Where not shown on or able to be derived from the Drawings, the minimum requirements specified herein shall be provided.
4. Refer to specification Section 263213 "Engine Generators" for individual generator protection.
5. Refer to specification Section 26 27 13.13 Power and Energy Meters for additional requirements.
6. Refer to specification Section 26 27 13.16 Power Quality Meters for additional requirements.
7. Refer to specification Section 26 28 11.13 Power Circuit Breakers for additional requirements
8. Refer to specification Section 26 43 13 Surge Protective Devices for Power Circuits for additional requirements
9. Refer to specification Section 26 09 13 Electrical Power Management Systems for additional requirements

1.2 REFERENCES

A. General, Publications: The publications listed below form a part of this Specification to the extent referenced. The publications are referred to in the text by the basic designation only. The edition/revision of the referenced publications shall be the latest date as of the date of the Contract Documents, unless otherwise specified.

1. Institute of Electrical and Electronics Engineers (IEEE) and American National Standards Institute (ANSI)
   a. ANSI/IEEE C37.13, “Low-Voltage AC Power Circuit Breakers Used in Enclosures”
   b. ANSI/IEEE C37.20.1 - “Metal Enclosed Low Voltage Power Circuit Breaker Switchgear”
   c. ANSI/IEEE C37.51 - “Testing of Metal-Enclosed Low Voltage AC Power Circuit Breaker Switchgear”
   d. ANSI/IEEE C37.16 - “Preferred Rating, Related Requirement and Application Recommendations for Low Voltage Power Circuit Breakers and AC Power Circuit Protectors”
   e. ANSI/IEEE C37.50 – “Testing of Low Voltage AC Power Circuit Breakers”
2. International Electrotechnical Commission (IEC):
   a. IEC 61000-4-30.- “Electromagnetic compatibility (EMC) - Part 4-30: Testing and Measurement Techniques - Power Quality Measurement Methods”
3. International Organization for Standardization (ISO)
   a. ISO 9001, “Quality Management Systems - Requirements National Fire Protection Agency (NFPA)”
4. National Fire Protection Agency (NFPA)
   a. NFPA 70, “National Electrical Code (NEC)”
   b. NFPA 99, “Essential Electrical Systems for Health Care Facilities”
   c. NFPA-110 – “Standard for Emergency and Standby Power Systems”
5. Underwriters Laboratories, Inc. (UL)
   a. UL 1558, “Metal Enclosed Low Voltage Power Circuit Breaker Switchgear”
   b. UL1066, “Low-Voltage AC and DC Power Circuit Breakers Used in Enclosures”
6. International Building Code (IBC), California Building Code (CBC)

1.3 DEFINITIONS

A. Unless specifically defined within the Contract Documents, the words or acronyms contained within this specification shall be as defined within, or by the references listed within this specification, the Contract Documents, or, if not listed by either, by common industry practice.

1. PCS – Power Control System
2. BMS – Building Management System
3. EPMS – Electric Power Monitoring System
4. ATS – Automatic Transfer Switch
5. PLC – Programmable Logic Controller
6. OIT – Operator Interface Terminal

1.4 SUBMITTALS

A. Submittals shall include the following as specified herein:

1. Deviations from the Contract Documents shall be indicated within the submittal. Each deviation shall reference the corresponding drawing or specification number and shall include a detailed written justification for the deviation.

2. Submit required product data and drawings specific to each product and accessory proposed. In addition, include the following information:
   a. Elevation drawings with shipping splits identified and estimated weights
   b. Outline drawings showing conduit entry areas and anchoring provisions.
   c. Single Line Diagram.
   d. Sequence of Operation including failure modes.
   e. System Sequencer which graphically and dynamically demonstrates system one line sequence of operation via animated sequences including failure recovery modes.
   f. Bill of material listing items by manufacturer's name, part number and description.
   g. Complete nameplate and status annunciator panel schedule.
   h. Technical literature for major components.

3. Seismic Qualification Certificates: For each Switchgear assembly provide the following:
   a. Equipment, including installed overhead lifting device, shall be seismic shake table tested in accordance with ICC-ES AC-156 by an independent and certified seismic qualification agency.
   b. Equipment, including installed overhead lifting device, shall be certified with Design Spectral Response Acceleration at Short Periods (SDS) equal to 2.46
   c. Switchgear shall be provided with IBC 2018 certification and label

B. Operation & Maintenance (O&M) manuals shall be provided and shall include the following items.

1. Submit required Operations & Maintenance data specific to each product and accessory proposed. In addition, include the following information:
   a. Complete set of drawings included the following:
      1) Elevations and plan views
      2) One line diagrams
      3) Elementary schematics
      4) Power Control System (PCS) Network Architecture Diagram
      5) Detailed Interconnect Spreadsheet
   b. Detailed Sequence of Operation
   c. Manufacturer's standard operation and maintenance data.
   d. Complete Bill of Material including furnished spare parts
   e. Instruction Manuals for all Major Components including but not limited to synchronizing controllers, circuit breakers, programmable logic controllers, operator interface terminals, protective devices and meters.
   f. Electronic O&M manual to be provided via secure link.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: The equipment described, as a minimum, shall meet all of the requirements specified in this section. The equipment shall be the product of a manufacturer who has produced paralleling switchgear for a period of no less than 25 years. The manufacturer must provide integral electrical and mechanical design, fabrication and construction services for all cubicle structures, formed and punched bus bar, and control panel assemblies. Comprehensive documentation detailing electrical and mechanical designs shall be available upon request.

1. The manufacturer shall have a valid ISO 9001 certification and an applicable quality assurance system that is regularly reviewed and audited by a third-party registrar. Manufacturing, inspection, and testing procedures shall be developed and controlled under the guidelines of the quality assurance system.

2. The manufacturer shall have service, repair, and technical support services available on a 24 hours 7 days a week basis.

B. Paralleling Switchgear, Automatic Transfer Switches, Bypass Isolation Switches, Switchboards, Station Batteries (if required) and required Monitoring & Control Stations shall be supplied by a single manufacturer.

C. All work performed and all materials used shall be in accordance with the National Electrical Code, and with applicable local regulations and ordinances. Equipment assemblies, materials, and equipment shall be listed and labeled by Underwriter's Laboratories or by a testing agency acceptable to authorities having jurisdiction and marked for intended use.

D. Order Management: Management of orders shall be assigned to personnel employed and trained specifically and exclusively for project management; the use of field service representatives, design engineers or sales representatives for order management purposes shall not be acceptable. Each order shall be managed by both a factory-based project manager and a factory-direct field-based project manager.

1.6 DELIVERY, STORAGE AND HANDLING

A. Prior to delivery to the Project site, the electrical contractor shall ensure that suitable storage space is available to store materials in a well-ventilated area protected from weather, moisture, soiling, extreme temperatures, humidity, and corrosive atmospheres. Materials shall be protected during delivery and storage and shall not exceed the manufacturer stated storage requirements. As a minimum, store indoors in clean, dry space with uniform temperature to prevent condensation. In addition, protect electronics from all forms of electrical and magnetic energy that could reasonably cause damage.

B. Electrical Contractor shall deliver materials to the Project site in supplier's or manufacturer's original wrappings and containers, labeled with supplier's or manufacturer's name, material or product brand name, and equipment tag number or service name as identified within the Contract Documents.

C. Electrical Contractor shall inspect and report any concealed damage or violation of delivery storage, and handling requirements to the Engineer.

1.7 WARRANTY AND SERVICE

A. General: Refer to [Section 01 77 00 - Closeout Procedures].

B. The Manufacturer shall warrant the equipment for a minimum of 18 months from date of shipment [30 months from the date of shipment] [42 months from the date of shipment] [60 months from the date of shipment] subject to terms and conditions of manufacturer's current warranty publication.

C. Manufacturer shall have an established network of factory-direct service technicians capable of servicing the equipment.

D. Manufacturer's field service representatives shall be on call and available for immediate dispatch 24 hours a day, 365 days a year. All field service personnel shall be factory trained, by the manufacturer, and certified in the maintenance and repair of the specified equipment. Manufacturer must employ a minimum of 2 field service technicians within a 150 mile radius of the installation site. Field service representatives shall have access to common replacement components locally and the service organization shall have a detailed counter-to-counter process for providing emergency spares 24 hours a day 7 days a week.

E. Post-warranty service contracts shall be made available to the owner by the manufacturer to provide scheduled maintenance and/or emergency repair of the equipment.

1.8 SPECIAL TOOLS AND SPARE PARTS

A. Spare parts shall be provided for each type and size of unit installed. At a minimum, the following shall be provided:
   1. Provide the minimum spare parts recommended by the manufacturer.
   2. Provide [1] set of each type of control fuse installed within equipment
   3. Provide [1] set of each type of indicating lights installed within equipment
   4. Portable Circuit Breaker Lifting Device

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide ASCO Power Technologies Series 7000 Switchgear

B. Acceptable Products: Switchgear specified herein shall be the product of a single manufacturer. Products and manufacturers specified are to establish a standard of quality for design, function, materials, and appearance. Provide the following specified product and manufacturer without exception, unless approved as a substitute by addendum to the Contract Documents prior to the bid date:
   1. ASCO Power Technologies Series 7000 Switchgear
   2. {2nd manufacturer}

2.2 GENERAL REQUIREMENTS

A. The following paralleling switchgear information is typically shown on the Drawings: bus configuration, bus ratings, interrupting ratings, component size and type, power line and feeder connections, elevation and footprint, etc. Where not shown on or able to be derived from the Drawings, the minimum requirements specified herein shall be provided.

B. System ampacity shall be [2000A][3000A][4000A][5000A][6000A][8000A][10,000A]. All horizontal bus shall be rated to the full ampacity of the system.

C. The equipment bus system shall be braced according to ANSI/IEEE C37.20.1 with a short-circuit withstand rating of [100,000][200,000] amperes (RMS symmetrical).

D. Equipment shall be suitable for use as service entrance equipment and labeled according to UL requirements.

E. Equipment shall be Seismic Qualified and Certified by 3rd party testing to meet IBC requirements. Seismic qualification shall be determined from seismic shake table test results as defined in the International Code Counsel Evaluation Service (ICC ES) Acceptance Criteria for Seismic Qualification Testing of Nonstructural Components (AC156).

F. Equipment shall have Preapproval (OSP) under California Office of Statewide Health Planning & Development (OSHPD) Special Seismic Certification program for California Healthcare facilities.

2.3 STRUCTURE

A. General: The enclosure shall be free-standing, and floor supported, with front and rear access. An adequate number of anchor bolt holes shall be designed to place the base in direct contact with the foundation when bolted. The flatness of the floor surface upon which the equipment is installed shall

deviate no more than 0.125 inches per 10 feet in any direction. All doors shall be formed of 11 gauge steel and be provided with sufficient hinges to support the door and components. Doors must swing open more than 90 degrees. Front doors shall be supplied with a lockable handle. Rear doors shall be supplied on all bussed sections. All door locks shall be keyed alike, with one key supplied for each lock. All panel covers shall be formed type and secured with screws as necessary.

B. The sheet steel used for the finished assembly shall be degreased and thoroughly cleaned through a minimum five stage aqueous process. The finish shall be ANSI-61, light gray, electrostatically charged powder paint over a phosphate coating, at an average of 2.0 mils. Finish shall be suitable for indoor and outdoor environments.

C. Bus: The main bus shall be silver plated (minimum 5 x 10-6 inch plating) copper and have a maximum current density of no more than 1000 amperes per square inch. Main bus shall be rated for [2000, 3000, 4000, 5000, 6000, 8000, 10000] amperes and have a minimum bracing level of not less than [100,000] [200,000] amperes RMS symmetrical, for a minimum of (4) cycles and must meet UL 1558 heat rise test. Short Time rating shall be 85,000A for 60 cycles. The neutral bus shall be silver plated copper and 100% rated. The ground bus shall be bare copper and 25% rated. All bus joints shall consist of SAE Grade 5 hardware and Belleville type washers to withstand mechanical forces exerted during short circuits.

D. Lugs: Lugs shall be 2-hole [compression] [mechanical], size, conductor type and quantity per conductor as shown on drawings.

E. Nameplates: Engraved laminated plastic nameplates, having black letters on white background, shall identify major components, vertical sections, and circuit breakers. Nameplates shall be attached with self-tapping screws.

F. Wiring. Control wiring shall be UL 1015 rated for 600 volt. Current transformer circuit terminations shall be ring tongue type and include shorting terminal blocks.

1. Control wires shall be numbered every eight (8) inches or less, numbers shall be visible next to the terminals. Wiring shall be permanently marked at each end with wire termination designations that identify wire “to – from” terminal designations. Sleeve type wire markers are not acceptable. These designations shall include the device and connection point where the wire is terminated. All control wire markings shall be printed directly on the wire insulation and be permanent. Current Transformer wire shall be 12 gauge.
2. Low level signal circuits shall be separated and provided with shielded wire to minimize electromagnetic interference. Shielded wire shall be grounded at one point. Ethernet cabling shall be unshielded category 5 or higher.
3. Wiring between each section shall not be spliced and shall be free of abrasions and tool marks. Connections between cubicles shall use labeled connection plugs. Wires shall be placed in wire duct or harnessed and shall be supported to prevent sagging or breakage from weight or vibration. Inter-cubicle wiring harnesses shall be contained in overhead steel wire troughs. Communication cables and current transformer circuits shall be hard wired.
4. All wiring to hinged doors shall be run through door terminal blocks or connection plugs. Terminal blocks shall be provided for all external connections and placed in an accessible area not exposed to hazardous bus or cables, if possible. Current transformer circuits shall be connected through shorting terminal blocks.

G. Each vertical section shall be provided with side barriers, and rear barriers between bus/cable compartments to provide increased protection against propagating faults.

H. Equipment shall include an integrated overhead lifting device. The device shall travel on rails and extend beyond the front of the switchgear to facilitate the insertion or removal of a withdrawn power circuit breaker. Seismic certification of the switchgear shall include the overhead lifting device

I. Moving and Handling

1. The switchgear shall be provided with shipping splits at each section and shall be capable of being lifted overhead or by a forklift.

2. Each section shall be provided with removable lifting plates for overhead lifting purposes.

2.4 COMPONENTS

A. Metering Instrumentation: Analog metering instrumentation shall consist of industrial switchboard type meters, 4-1/2" square, 1% accuracy. Current and potential transformer ratios shall be selected and coordinated for nominal and rated values for ammeters, voltmeters and kW meters.

B. Instrument Switches: Instrument switches shall be of the rotary type. Each switch shall be supplied with a titled escutcheon plate, suitably marked for each position. The switches shall have positive means of maintaining contact, which shall be silver to silver with a wiping action.

C. Current Transformers: Current transformers shall be furnished with VA burden ratings suitable to supply the metering and protective devices without affecting accuracy.

D. Potential Transformers: Three (3) wye-wye connected potential transformers shall be provided in turns ratio and VA burden rating to be compatible with the controls and voltage sensing as applied. Transformers shall have integrally mounted primary and secondary fuses.

E. Alarm and Status Indication: Visual and audible alarm and status indication lights, including spares, shall be furnished as indicated by customer. Visual alarms shall be reset only after the fault condition has been corrected. The audible alarm shall include a silencing circuit which after activation shall permit audible annunciation of subsequent failures. Visual Alarms shall be provided via a solid state status panel with redundant LEDs for each annunciation point. Lamp test shall be an integral feature of this indicator. Each illuminated indicator tile shall be 24 mm x 24 mm. Systems which provide some or all alarms via a touchscreen only are unacceptable.

F. Control Fuses: Fuses shall be mounted in locations where they are readily accessible. Pull-out type fuses shall be provided for all primary circuits and shall be of the current limiting type.

G. Electromagnetic Control Relays: All electromagnetic control relays shall be suitable and adequately rated for their intended service in the control system. All relays for control circuit duty shall be plug-in type with retaining clips and transparent plastic covers. Relays shall be clearly marked for control voltage. When possible, all relays shall have light-emitting diodes to indicate that the coil is energized.

2.5 GENERATOR POWER AND CONTROL SECTION

A. Generator Circuit Breaker: Each generator section shall contain over-current protection, controls, relays and auxiliary devices associated with its respective engine generator set. It shall include the following:

1. For each generator set, a 100% rated, UL 1066 listed low voltage power circuit breaker shall be furnished to provide over-current protection and paralleling functions. The breaker shall be Square D Type MTZ, [ ] AF, [ ]AT, 3 pole, electrically operated, draw-out, with Micrologic 5.0X trip unit with Energy Reduction Maintenance Setting (ERMS) switches and local connectivity via contactless, wireless, and secure Bluetooth® and NFC connection for self-diagnosis and monitoring energy consumption, power quality, phase balance and health status. Coils shall provide status, self-diagnosis (functionality and number of coil operations) and wiring diagnostics. Trip unit shall operate in Fast Instantaneous trip mode, 25 to 30 milliseconds, when ERMS is active. The trip unit screen shall indicate when trip unit is in ERMS mode. Trip unit shall include adjustable long time, short time, and instantaneous trip settings as well as ground fault alarm. Breakers shall have stored energy closing. The draw-

out feature shall provide for connected, test, and disconnected positions. In the connected position, the main line and load terminals, all auxiliary control contacts, and circuitry shall be connected, and the breaker shall be fully operable. In the test position, the breaker auxiliary control contacts, and circuitry only shall be connected, to permit automatic operation of the complete control system without connecting the generator to the main bus. In the disconnect position, main auxiliary control contacts, and circuitry shall be completely disconnected. The breaker draw-out mechanism shall be mechanically interlocked with the breaker to permit draw-out operation only when the breaker main contacts are open. The circuit breaker shall be provided with [65,0000] [85,0000] [100,000] [200,000] AIC rating.

B. Generator Control System

1. Paralleling controls for each generator shall include a programmable logic controller and a Woodward DSLC-2 digital synchronizer and load controller designed for use on three-phase AC generators and mounted in the switchgear. The controls shall combine a synchronizer (with voltage matching capability), load sensor, load control, dead bus closing system interlock, VAR, power factor and process control. The load sharing network and VAR sharing network shall be redundant and completely integrated in the switchgear with network status monitoring and diagnostics available via switchgear operator terminal screens. The controls shall sense true RMS power and provide soft loading and unloading functions on the main bus.

2. DC-to-DC converter(s) shall be provided in each generator control section to provide constant 24VDC power. The Generator Section DC-to-DC converter shall supplement the DC-to-DC converter in the Master Control section. A single DC-to-DC Convertor located in the Master Section only is not acceptable. Control power shall be sourced from generator set batteries and sustain adequate control voltage during an engine crank. The converters shall provide power for up to 75% rated load if the source voltage drops to 12 volts. Source voltage shall not exceed 32 volts.

3. Generator controls shall include the following functions, components, devices, and indicators:

   a. Reverse Power Protection (Device 32R)

   b. Generator Voltage Monitoring and Frequency Monitoring

   c. Generator controls shall monitor voltage and frequency to ensure the generator is not connected to the bus until frequency is at least 59 Hertz and 90% rated voltage

   d. Automatic Synchronizer

      1) The synchronizer shall include a differential voltage detector, differential frequency detector and differential phase detector. Analog voltage bias signal shall be provided for voltage matching and an analog speed bias signal shall be provided for frequency matching and phase angle control. Synchronizer shall issue a breaker close signal when frequency, phase and voltage conditions are met.

      2) The differential voltage detector shall compare the voltage of the oncoming generator to the paralleling bus. If the voltage is not within the factory set difference of plus or minus 5% (adjustable from 0 to plus or minus 10%), the voltage detector shall inhibit the circuit breaker from closing. When the oncoming generator voltage is within the preset acceptable limit, the inhibit shall be removed

      3) The differential frequency detector shall compare the frequency of the oncoming engine generator set to the paralleling bus. If the frequency is not within the preset acceptable difference of plus or minus 0.5 Hz (adjustable from 0 to plus or minus 0.5 Hz), the frequency detector shall inhibit the circuit breaker from closing. When the oncoming engine generator frequency is within the acceptable limit, the inhibit shall be removed.

      4) The differential phase detector shall compare the phase angle of the oncoming engine generator set to the paralleling bus. If the phase angle is not within the preset acceptable difference of plus or minus 0.05 Hz (adjustable from plus/minus

0.02 to 0.25 Hz), the phase detector shall inhibit the circuit breaker from closing. When the oncoming engine generator phase angle is within the acceptable limit, the inhibit shall be removed.

e. Multiple Circuit Interlock: Generator controls shall provide for first-up, first-on operation of the generator set. This device shall positively prevent more than one set from being simultaneously connected to a dead bus. Upon initiation of the connection of the first set to the bus, this circuit shall shift the control of the remaining sets to automatic or manual synchronizing at the operator's discretion.

4. Programmable Logic Controller and Engine Controls

a. The automatic engine starting control shall be provided via a dedicated programmable logic controller and shall automatically start, protect, and monitor each engine generator set. The controller shall be provided with a power supply, CPU and required I/O modules. Engine start control shall additionally be provided with a hard wired backup so that the engine can be automatically started without operator intervention if the controller is not available. Systems without hard wired backup are not acceptable. The programmable logic controller shall be dedicated for control exclusively of the engine generator set and shall be independent of the Master PLC. Distributed I/O systems which rely on a master controller shall not be acceptable. Loss of communication from the Master PLC to the Generator Programmable Controller shall not inhibit automatic engine start control, operation of the individual generator section controls or require the engine controls to be placed in manual mode to start their respective engines. Programmable Controller shall be Modicon type M340.

b. Engine Start/Stop Operation: The automatic engine control logic shall initiate operation of the engine upon receipt of a signal from a contact that closes for engine run and opens for engine stop.

c. Five Position Engine Control Selector Switch

1) Lockout/Reset - When placed in this position, the engine shall not be capable of starting and/or running from the ASCO controls. If the engine was shut down due to the operation of a protective device, the shutdown shall be reset when the switch is moved to this position. If the engine is running when the switch is moved to this position, it shall immediately shut down, the circuit breaker shall be opened and the and the generator locked out.

2) Off/Cooldown - When placed in this position, the generator shall be soft unloaded from the bus (when possible) and the engine start signal shall be removed after a defined cool-down period.

3) Automatic - When placed in this position, the engine control shall be in readiness for fully automatic operation upon receipt of a start signal.

4) Test Off-Line - When placed in this position, the engine shall start and run as if a start signal were received except the circuit breaker shall not be closed and it shall not be connected to the bus. If a start signal is received, normal automatic functions shall resume. When returned to the Automatic position, the engine shall shut down.

5) Test On-Line - When placed in this position, the engine shall start, run, and connect to the bus. When returned to the Automatic position the circuit breaker shall open, provided no automatic start signal is present, and the engine shall run for its cool-down period before shutting down.

6) The Engine Control Switch shall be hard wired so the operator can choose to start the engine manually via the Test On-Line position if desired. Systems which do not include this feature are not acceptable

d. Four Position Synchronizing Mode Selector Switch

1) Permissive - In this position the governor controls are deactivated. However, the synchronizer shall operate as a passive synch check relay and signal the closing of the generator breaker when both sources are in phase.

2) Check - In this position the synchronizer is fully operational except it cannot close the generator breaker. The phase-lock feature holds the generator output in synchronism with the bus.

3) Off - In this position the synchronizer is turned off to allow for manual paralleling at the Master Cubicle.

4) Run - In this position the synchronizer is in the fully operational, automatic mode.

e. Engine Cooldown Time Delay

1) The cooldown time delay shall be adjustable from 1 to 10 minutes (factory set at 5 minutes) and automatically bypassed for malfunction and manual shutdown of the engine generator set.

f. Failure to Synchronize Time Delay

1) The failure to synchronize time delay shall be fixed at 60 seconds. It shall provide audible and visual indication, but it shall not terminate synchronizing attempts nor shut down the engine.

g. 1% Generator Analog Metering / Instrumentation

1) Ammeter 0 - [ ] Ampere scale.

2) Voltmeter 0 - 600 Volt scale.

3) Kilowatt meter 0 - [ ] Kilowatt scale.

4) Frequency meter 55 - 65 Hertz scale.

5) 4 Position Ammeter and 7 Position Voltmeter selector switches shall be included.

h. Generator Control Station to include the following

1) 5 Position Engine Generator Control Switch with Lockout/Reset, Off/Cooldown, Automatic, Test Off Line and Test On Line Positions

2) 4 Position Synchronizing Mode Selector Switch with Permissive, Check, Off and Run Positions

3) Red Emergency Stop Pushbutton

4) Alarm Reset Pushbutton

5) 3 Position Voltage Control Switch with Lower, Off and Raise Positions

6) 3 Position Speed Control Switch with Lower, Off and Raise Positions

i. Alarm and Status Indication Panels with the following indications:

1) Lamp Test (Pushbutton)
2) Parallel CB Open* - Green
3) Parallel CB Closed* - Red
4) Parallel CB Lockout - Red
5) Parallel CB Fail to Close - Red
6) Failure to Sync - Red
7) Gen Output CB Open - Green
8) Gen Output CB Closed - Red
9) Parallel CB Not Connected - Red
10) Parallel CB Fail to Open - Red
11) Ground Fault Alarm - Red
12) Over Crank Shutdown - Red
13) Over Speed Shutdown - Red
14) Reverse Power Shutdown - Red
15) Low Oil Pressure Shutdown - Red
16) High Water Temp Shutdown -Red
17) Auto Start* - Green
18) ECS Reset Required - Red
19) Engine Control Not in Auto - Red
20) Low Oil Pressure Alarm - Amber
21) High Water Temp Alarm - Amber
22) Engine Running* - Green
23) PLC Stopped* - Red
24) Control Voltage Failure* - Red
25) Controls Not in Auto - Red
26) Local/Remote Emergency Stop - Red
27) Low Water Level Alarm - Amber
28) Low Water Temp Alarm - Amber
29) Powerquest Override - Amber
30) Day Tank Low Fuel - Amber
31) Day Tank High Fuel - Amber
32) Day Tank Rupture Basin - Amber
33) Battery Charger Failure - Red
34) High Battery Voltage - Amber
35) Low Battery Voltage - Amber
36) Gen Common Shutdown* - Red
37) Gen Common Alarm - Amber
38) DC Converter Failure - Red
39) DSLC-2 Self Test Failed - Red

* Includes hard wired backup if PLC is not available

2.6 SYSTEM MASTER CONTROL SECTION

A. The Master Control Section shall contain redundant programmable logic controllers capable of storing necessary control sequence algorithms, variable operation set-points, time delays and alarming levels. I/O shall include modular input and output cards for discrete and analog signals necessary to provide the integrated system operations specified below. Master PLCs shall be Modicon M580.

B. Priority Load Control

1. Discrete output modules shall be provided to control the necessary priority load blocks. The number of load blocks shall equal the number of engine generator sets and shall be sized such that the connectable load of each block is not greater than the kW rating of the generator set connected. As the generators are connected to the bus, the controller shall signal for the connection of the load blocks in an ascending sequential priority with the highest priority load requiring emergency power being connected first. Priority pass-along logic shall initiate the connection of low priority loads to the first generator on-line if start signals have not been received from higher priority transfer switches or other devices.

2. In the event of an engine failure system loads shall not be shed if remaining capacity can serve the connected load unless a bus overload or a bus under frequency occurs; this feature is referred to as “load-latch”.

3. If Load shedding is required it shall be done on a last-on, first-off basis. The generator bus shall have a solid-state frequency monitor, with integral time delay to initiate load shedding upon a reduction of bus frequency to 58 Hz or less, for a period of three seconds or more. Upon sensing a bus underfrequency, the system shall automatically shed the lowest priority load connected at the time of occurrence. This shed circuit shall override any manual load-add operation and shall lock out the manual load-add circuitry. It shall provide visual and audible alarm annunciation of bus underfrequency load shed.

4. Provide means to reset the bus underfrequency signal.

5. Provide a “load shed bypass/reset” push-button, for manual supervised operation over the load-shed, load-add control logic. One push-button shall be provided for each priority block except priority 1. Logic shall be provided if a bus overload occurs resulting in a reduction in bus frequency; the bypassed priority load shall be shed automatically through override logic control.

C. Power Management Features

1. Master Control features shall include Bus Load Optimization and Generator Load Demand. Applications shall dynamically adjust to bus conditions.

2. [Standard] Bus Load Optimization shall control up to 128 individually prioritized and separately controlled distribution loads via power transfer switches and/or electrically operated circuit breakers. Loads shall be added or removed from the bus according to the available headroom on the bus. If a Priority Block of load has been shed or has not been added to the bus while operating in the Emergency Mode, Load Bus Optimization is provided to re-add shed loads individually based on predetermined kW loading values up 95% (adjustable via OIT) of the capacity of the on-line power. Bus Optimization loading control determines if there is enough room to add the next load by checking the pre-set Load Value (field adjustable, accessible via the OIT) assigned to each shed load. If it is determined that the load can be added without exceeding the available headroom, the load is signaled to add.

a. The real time kW output of the generator bus is constantly measured, and the next sub-priority load is evaluated. Loads are evaluated at a preset time interval defined via the OIT. When the bus has been loaded to a level such that the next load will exceed the available headroom load adding will pause.

b. The system will continuously monitor the generator load and evaluate if the next load step can fit on the bus. If building load decreases and the next load can be added, the system

will add it and continue the evaluation process until as many loads as possible are added to the bus.

1) With the Bus Optimization switch in the "on" position during emergency mode and with loads shed (loads requiring power but are not connected to the emergency bus), after a stabilization time delay the optimization feature is activated and a Bus Optimize Active light illuminates.
2) The Bus Optimize Active light flashes through the duration of the stabilization time delay (default 30 seconds, adjustable via OIT).
3) Bus Optimization loading control will determine if there is enough room to add the next load by checking the pre-set Load Value (field adjustable, accessible via the OIT) assigned to the first sub-priority within the highest priority block that is shed and compare it to the excess generator bus capacity.
4) If it is determined that the load can be added without exceeding the Bus Optimization KW loading value (95%), the load is signaled to add.
5) The real time kW output of the generator bus is constantly measured and the next sub-priority load is evaluated.
6) Loads are evaluated at a preset time interval defined via the OIT
7) When the bus has been loaded to a level such that the next load would exceed the KW loading value (95%), the Next Load Exceeds Headroom light will activate and load adding will pause.
8) The system will continuously monitor the generator load and evaluate if the next load step can be added to the bus.
9) If building load decreases and the next load can be added (for the duration of the step time delay), the system will add it and continue the evaluation process until as many loads as possible are added to the bus.

3. [Dynamic Bus Optimization] Should a Priority Block fail to be added to the bus while operating in the Emergency Mode, Load Bus Optimization is provided to re-add shed loads one at a time based on dynamically monitored kW readings via an ASCO Power Meter mounted at the ATS up to 95% (adjustable via OIT) of the capacity of the on-line power.

a. With the Bus Optimization switch in the "on" position during emergency mode and with loads shed (loads requiring power but are not connected to the emergency bus), after a stabilization time delay the optimization feature is activated and a Bus Optimize Active light illuminates.
b. The Bus Optimize Active light flashes through the duration of the stabilization time delay (default 30 seconds, adjustable via OIT).
c. The Bus Optimization loading control will determine if there is enough capacity to add the next load by checking the dynamically monitored Load Value (via communication to an ASCO power meter mounted at the ATS) assigned to the first sub-priority within the highest priority block that is shed and compare it to the excess generator bus capacity.
d. If it is determined that the load can be added without exceeding the Bus Optimization KW load value (95%), the load is signaled to add.
e. The real time kW output of the generator bus is constantly measured, and the next sub-priority load is evaluated.
f. Loads are evaluated at a preset time interval defined via the OIT
g. When the bus has been loaded to a level such that the next load would exceed the de-rating value, the Next Load Exceeds Headroom light will activate and load adding will pause.
h. The system will continuously monitor the generator load and evaluate if the next load step can fit on the bus.

i. If building load decreases and the next load can be added (for the duration of the step time delay), the system will add it and continue the evaluation process until as many loads as possible are added to the bus.

j. Once all loads in a priority load block have been added to the bus, the Load Shed Active light will turn off.

4. Generator Load Demand controls the number of generator sets to remove excess generator capacity and add additional capacity when needed, keeping the optimum number of generators online at all times. Generator load demand saves fuel and wear by running fewer generators at a more efficient load level. Engine-generator sets shall be added or removed from the bus according to dynamic measurements of power consumption and engine-generator efficiency set-points.

a. After all generator sets have been paralleled to the bus and all loads connected that require power, a stabilization time delay (0-300 seconds) factory set at 30 seconds will be initiated and the Load Demand Mode light flashes. At the expiration of the time delay period, the system will operate in load demand mode.

b. Load demand removes the lowest priority generators (priority value set at the OIT) that are in excess of N. When the system is operating with more generators online than the system requires and the system load falls below the drop out load value (default setting of 80% kW) a 20 second time delay (field adjustable from 0 - 300 seconds) is initiated and the "Gen Stop TD Active" light flashes. If the load stays below the dropout value for the duration of the time delay, the generators with the lowest priority will be taken offline. The engines will run for their cool down period, then shutdown. If the bus KW (system load), is equal to or greater than the generator load demand pickup value for the duration of the load demand start td (default 5 seconds), the controls will initiate the starting and paralleling of the next set in sequence.

c. [Run Time Based Load Demand feature –]

1) Provide a run time based, automated load demand feature that automatically rotates generators to be removed from the bus when operating in load demand mode. Engines will be rotated based on actual engine run time.

D. Master Programmable Logic Controller

1. The master programmable logic controller shall be programmed by ASCO and shall meet or exceed the following specifications:

a. Modicon M580 with CPU, power supply, I/O, and communications.

b. The controller shall have the capability to interface to an I/O rack; I/O network shall be a managed ring configuration.

2. Master PLC Redundancy

a. The system shall consist of identical and synchronized redundant programmable logic controllers and a common I/O system. Normally, the primary PLC shall be the active one that controls the system I/O while the secondary PLC shall be on standby, ready to take control of the system I/O. Any single failure to the active controller shall cause automatic switch over to the standby controller. As both controllers shall be synchronized, there shall be a transfer from one controller to the other without interruption. The I/O shall be held in their current state during the transfer.

b. If the active controller fails and control transfers to the standby controller, the failed controller can be turned off and repaired without affecting the rest of the system.

c. Status indicators shall indicate which controller is active and if a controller is in run or stop mode.

d. [Redundant I/O –]

1) I/O shall be redundant and connected to the PLC's through a managed ring communication network. Loss of a single I/O module shall be annunciated but have no impact on the performance of the system.

E. Manual Paralleling Controls

1. A Synchroscope selector switch shall be provided to select any generator for manual paralleling operation. The positioning of the selector switch shall simultaneously connect the synch-check relay, Synchroscope, and "manual paralleling" push-button to the selected generator.

2. A solid-state sync check relay shall be furnished for manual paralleling, to sense and compare the phase angle difference between the oncoming generator and the bus. This relay shall lockout the manual paralleling push-button until the oncoming generator is within 15 degrees of synchronism.

3. Operation shall be arranged so the operator shall depress and hold the manual paralleling push-button. When the relative phase angle reduces to 15 degrees and going towards zero degrees, the sync check relay's output contact shall initiate the closing of the respective oncoming generator breaker.

4. The manual paralleling interface controls and metering shall be grouped in a central location on the front of the master control section. This shall allow for paralleling multiple generators from one location within the switchgear. Manual paralleling controls and sync check relay shall be hardwired and shall not rely on touch screens or programmable logic controllers to perform manual paralleling functions. Systems that rely on touchscreens only for manual paralleling or that require manual paralleling to be initiated at the engine generator control panel are not acceptable.

F. DC Control Power Selector – Best Battery System

1. Control power for the system logic shall be derived from the engine starting batteries and/or an optional station battery system. The control logic shall be powered through a suitable means that shall permit continuity of power until the last battery is no longer available. The controls shall be powered from any battery or combination of batteries and prevent feedback to a failing battery. The transition of control logic power from any battery combination to any other battery combination shall be accomplished without disruption in the power flow.

2. DC-to-DC converters shall provide a constant 24VDC power to the Master and Generator controllers during starting and cranking of all engine generator sets "simultaneously". Dedicated DC to DC convertors shall be provided in each Generator Control Section and the Master Control Section.

3. The best battery system shall provide power to each generator paralleling circuit breaker trip coil if the generator battery power to its cubicle is lost.

G. System Test Switch

1. Provide a system no-load test switch to initiate a complete automatic system operation by simulating the closure of the remote engine start signal. This switch shall be mounted inside the master section to limit access to authorized personnel only.

H. Main Bus Monitoring

1. Main bus monitoring shall include discrete Bus Under/Overvoltage (Device 27/59) and Bus Under/Over-Frequency Relays (Device 81O/U) and a Main Bus Power Watt Transducer.

I. 1% Paralleling Bus Analog Metering / Instrumentation

1. Ammeter 0 - [ ] A scale
2. Voltmeter 600V scale
3. Kilowatt Meter 0 - [ ] kW scale
4. Frequency Meter 55 - 65 Hz scale
5. Synchroscope
6. Synchroscope Plant Selector Switch with positions for each generator
7. 4 Position Ammeter and 7 Position Voltmeter selector switches shall be included.

J. Alarm and Status Indication Panels with the following indications:

1. Lamp Test (Pushbutton)
2. Gen # Running (one for each Generator) - Green
3. Gen # Online (One for each Generator) - Red
4. Gen # Locked Out (One for each Generator) - Red
5. Pri # Load Shed Active (One for each Priority) - Amber
6. Pri # Load Shed Bypassed (One for each Priority) - Amber
7. System Test - Amber
8. Emergency Mode - Amber
9. I/O Comm Failure - Red
10. System PLC Diagnostic Fault - Amber
11. Load Demand Mode Active - Amber
12. Load Demand Start TD Active - Amber
13. Load Demand Stop TD Active - Amber
14. Bus Under Frequency - Red
15. Bus Over Frequency - Red
16. Bus Under Voltage - Red
17. Bus Over Voltage - Red
18. Bus Optimization Mode Active - Amber
19. Next Load Exceeds Headroom - Amber
20. Bus Loaded to Capacity - Amber
21. Bus Overload - Red
22. Station Battery Charger Failure - Amber
23. Main Tank Low Fuel - Amber
24. ATS Control Fuse Blown - Red
25. PLC 1 Stopped - Red
26. PLC 2 Stopped - Red
27. Control Voltage Failure - Red

28. Dc Converter Failure - Red

K. System Master Control Station to include the following:

1. Bus Alarm Reset Pushbutton
2. Alarm Silence Pushbutton – Red
3. Lighted Manual Parallel Pushbutton – Green
4. Load Shed Bypass Pushbuttons – 1 for each priority except priority 1

L. Main Audible Alarm

1. Provide a main audible alarm horn. The alarm horn shall be the DC vibration type, subsequent malfunctions will resound the alarm if the horn had been previously silenced following an initial malfunction.

2.7 SYSTEM OPERATOR INTERFACE TERMINAL

A. The monitoring and control operator interface shall be an ASCO PowerQuest 7000 SCADA.

B. Metering and monitoring network devices and design standards shall include IEC 62443-3, NERC CIP and IEEE 1613, providing a secure network with security management. Encrypted connections and configuration files shall provide data confidentiality with connection verification required for access. Simple general purpose security for industrial applications shall include IEC 62443-4-2 Level 1 and Level 2 for medium and high security options. The controls network shall remain isolated.

C. The monitoring and control interface shall include a programmable 24” color touch screen unit and shall interface with Programmable Logic Controllers, Synchronizer/Load Controllers, Power Meters, Circuit Breaker Trip Units and Transfer Switches. The automatic operation of the system shall not be impeded by the unavailability, disconnection or failure of any single or all color touchscreens.

D. The main default screen shall consist of a one-line overview of the system that includes:

1. Dynamically updated and color-coded (according to status) one-line representing power flow and sources, and emergency power system elements such as engine-generator sets, circuit breakers included in scope of delivery (including breaker position and alarms), switchgear assemblies, and transfer switches (including transfer switch position, source availability, and bypass position if available).
2. Communication status of PLCs
3. Generators and transfer switches shall, when selected, link to a separate screen showing detailed status and alarm information (“drill down screens”)
4. Main menu buttons, buttons linking to user guides, and buttons that link to other screens
5. ATS summary/configuration screen shall be accessible via menu button
6. Common alarm status including number of active alarms, number of unacknowledged alarms, and a flashing warning indicator if there are active alarms
7. The current KW value of all main and tie breakers
8. Color legend, abbreviation legend, and customer logo

E. Drill down screens shall include:

1. A dynamically updated mimic of the Master Status Panel.
2. Generator status panels shall mimic the actual switchgear panels including dynamically updated color indications and signal nomenclature.
3. Generator control stations shall mimic the actual switchgear control stations with fully functional engine control switch and synchronizing mode switch.
4. Metering screens shall include an image icon of the meters and dynamically updated parameters that are available from the meter (voltages, currents, power measurements)
5. Synchronizer/Load Share controller screens shall include a photographic image icon of the actual controller and dynamically updated parameters that are available from the controller such as metering status (voltages, currents, power measurements) and synchronization status (frequencies, voltages, synchroscope).
6. Transfer Switch drill down screens shall include details of selected transfer switches, if available, including present status and position, source availability, transfer/retransfer controls (password protected), bypass status, pickup/dropout settings, time delay settings, and metering data.

F. The monitoring and control interface screens shall also include:

1. A load management screen which shall dynamically indicate the current load demand status and provide operator controls to change settings (password protected). Each generator shall be represented and include “pick up” and “drop out” information and parameters (user-defined time delays, current timer status, and actual power) to manage loading of all engine-generator sets.
2. A bus optimization screen which shall dynamically indicate application status (enabled/disabled), most recent step load added, next available step load information, headroom, and priority load shed controls.
3. A generator priority screen for load demand.
4. A load priority screen for assigning unique priorities and tag names to each transfer switch and/or electrically operated circuit breaker for distribution loads. Parameters for each load shall include current power status and step add time delay. Transfer switches shall include (when available) engine start signal, load shed signal, and HOA (Hand-Off-Auto) mode.
5. An alarm summary screen with a current listing of all active alarms up to 500 entries and option for operator to acknowledge alarms (password protected)
6. An alarm history screen with up to 500 entries and a button linking to folder containing archive of 3 months or longer
7. A communication status screen with network connections color-coded and dynamically updated
8. Historical trending of up to 10 parameters (phase currents; average current; average line-to-line voltage; total apparent, real, and reactive power; frequency; power factor) for 3 months or longer. Buttons shall be provided to zoom in and out as well as recall historical data and fast forward up to the current time. Plots shall display up to 8 curves concurrently.

G. Security features shall include at least three distinct security levels (monitor, control, manage) and a unique user name and password for each individual. Each individual account shall also be assigned to a security level thereby defining the scope of their access and control. Logging into or out of the system shall be an event entered into the alarm history. Each operator-triggered alarm shall be logged as an alarm history entry with the operator identity included. If an individual is logged in to the system with no activity for 30 minutes, the individual shall be automatically logged out.

H. On loss of screen communication, the operator must be able to take control at any time; systems that utilize “instant auto” features shall be excluded.

I. Screens shall be turned off (power standby mode) after 30 minutes of inactivity to protect the LCD monitor; a single touch of the screen shall turn the screen back on.

2.8 REMOTE OPERATOR INTERFACE TERMINAL [-NOT USED]

A. The remote operator interface terminal shall consist of a [24”][42]” color operator interface terminal and audible alarm horn. Connectivity to the Master Control Section shall be via network communication.

B. Monitoring and Control Features shall duplicate those of the System Master Control Operator Interface Terminal

C. A UPS shall provide standby power for the annunciation panel (customer to supply 120VAC power for the UPS)

2.9 DISTRIBUTION SECTIONS

A. Emergency distribution sections shall be provided with number and size of distribution circuit breakers as shown on the project drawings.

B. All emergency distribution circuit breakers shall be 100% rated, Square D Type MTZ, [ ] AF, [ ] AT, 3 pole, draw-out, with Micrologic X trip units with Energy Reduction Maintenance Setting (ERMS) switches and local connectivity via contactless, wireless, and secure Bluetooth® and NFC connection for self-diagnosis and monitoring energy consumption, power quality, phase balance and health status. Coils shall provide status, self-diagnosis (functionality and number of coil operations) and wiring diagnostics. Trip unit shall operate in Fast Instantaneous trip mode, 25 to 30 milliseconds, when ERMS is active. The trip unit screen shall indicate when trip unit is in ERMS mode. Trip unit shall include adjustable long time, short time, and instantaneous trip settings as well as ground fault alarm. Breakers shall have stored energy closing. The draw-out feature shall provide for connected, test, and disconnected positions. In the connected position, the main line and load terminals, all auxiliary control contacts, and circuitry shall be connected, and the breaker shall be fully operable. In the test position, the breaker auxiliary control contacts, and circuitry only shall be connected, to permit automatic operation of the complete control system without connecting the generator to the main bus. In the disconnect position, main auxiliary control contacts, and circuitry shall be completely disconnected. The breaker draw-out mechanism shall be mechanically interlocked with the breaker to permit draw-out operation only when the breaker main contacts are open. Where indicated on the drawings, circuit breakers shall be electrically operated, all other distribution circuit breakers shall be manually operated, if not indicated on the drawings all distribution circuit breakers shall be electrically operated [spec writer to determine if electrically or manually operated breakers are required]. All circuit breakers shall be provided with Long Time, Short Time and Instantaneous trip functions and Ground Fault [trip][alarm] function Circuit breaker interrupting rating shall not be less than [65,000, 85,000, 100,000, 200,000] amperes RMS symmetrical.

D. Provide circuit breaker control switches for all electrically operated circuit breakers. Control switches shall have built in LED indicating lights to indicate breaker status (open, closed, tripped). Manually opening the circuit breaker via circuit breaker control switch shall inhibit automatic operation and shall be annunciated on the one-line screen.

E. Provide individual control power transformers for each electrically operated circuit breaker. Use of a single control power transformer for multiple circuit breakers is not acceptable.

F. Distribution sections shall be provided with main bus of the same ampacity as the generator switchgear sections.

G. Prepared spaces shall be completely assembled included circuit breaker cradles/cells with complete provisions for addition of future Circuit Breakers

2.10 ELECTRICAL POWER MANAGEMENT SYSTEM CONNECTIVITY [-NOT USED]

A. The equipment specified herein shall provide the necessary communications connectivity and functionality required to support the functionality of an Electrical Power Management System (EPMS). This shall include, but not be limited, to the following:

1. Communications connectivity to EPMS system shall be via a Modbus/TCP protocol otherwise Ethernet protocol connectivity shall be provided within the equipment.
2. Refer to Electrical Power Management System specification 26.09.13 for additional requirements.

2.11 ARC MITIGATION AND SAFETY

A. Energy Reduction Maintenance Setting Switch (ERMS)

1. For each circuit breaker, provide a Maintenance OFF ON selector switch capable of being initiated on the breaker compartment door or mobile device app to temporarily switch the circuit breaker to ERMS mode tripping characteristics during maintenance activities
2. Trip unit shall provide a separate trip curve for arc energy-reducing maintenance setting (ERMS).
3. Trip unit shall operate in Fast Instantaneous trip mode (25 to 30 ms), when ERMS trip curve is active.
4. A lock feature shall be provided so that the ERMS may be locked in the ON position.
5. A blue indicating light shall be provided to indicate trip unit is in the ERMS ON mode.

B. Remote Racking Device

1. Provide a Remote racking device specifically designed by circuit breaker manufacturer for use with the specified circuit breakers.
2. The device shall not obstruct view of the front of the breaker during operation, allowing for the breaker trip indication window to be viewed at all times.
3. The device shall have an ergonomically designed control handle with a selector switch to change between racking the breaker to the connected-to-disconnected and disconnected-to-connected states.
4. The device shall rack the circuit breaker between connected, test, and disconnected positions, stopping at each position before continuing.
5. The control handle shall come with a minimum of 25 feet control cable allowing for the user to rack the breaker from a distance.
6. A 120VAC external power source shall be required to power this device.

2.12 POWER METERING [- NOT USED]

A. Provide power meters as follows [as shown on drawings]:

1. Generator Sections: Provide a power metering device at each Generator [as follows:][a Power Quality Meter as specified in Section 26 27 13.16 Power Quality Meters.]
   a. Provide the following specified product and manufacturer without exception, unless approved as a substitute by addendum to the Contract Documents prior to the bid date: PowerLogic [PM5580 Meter][PM8244 Meter] [ION9000 Meter] by Schneider Electric.

2. Distribution Circuit Breakers: Provide a power metering device at each Distribution Circuit Breaker [as follows:][a Power Quality Meter as specified in Section 26 27 13.16 Power Quality Meters.]

a. Provide the following specified product and manufacturer without exception, unless approved as a substitute by addendum to the Contract Documents prior to the bid date: Powerlogic [PM5580 Meter][PM8244 Meter] [ION9000 Meter] by Schneider Electric.

2.13 REMOTE DESKTOP STATION [-NOT USED]

A. The remote desktop station shall consist of a desktop computer with Microsoft Windows 10, 24" rotatable monitor, keyboard, mouse and color printer. Connectivity to the Master Control Section shall be via network communication.

B. Monitoring and Control Features shall duplicate those of the System Master Control Operator Interface Terminal

C. A UPS shall provide standby power for the annunciation panel (customer to supply 120VAC power for the UPS)

2.14 PCS SYSTEM SIMULATOR [-NOT USED]

A. To verify system operating sequence and facilitate on-site training by developing and evaluating operator expertise, PCS System Simulator shall be provided comprising:

1. Operator Station: The Operator Station shall be a monitor and control station that includes the actual operator screens from the specified PCS system.

2. Master PLC - The Master PLC shall be a fully-functioning Modicon M580 PLC that includes and executes the actual sequences of operation from the specified PCS system.

3. Configuration Station: The Configuration Station shall include application software to simulate devices and system components including circuit breakers, synchronizers, switchgear control stations, automatic transfer switches, utility feeds and generators. The Configuration Station shall also provide ways to set up scenarios including device and component failures and system events in order to test operator knowledge, capabilities and responsiveness.

4. Simulator shall be provided separately from the switchgear and shall include the following:

a. Master PLC identical to the System Master PLC containing the identical Master PLC program.

b. System Operator Interface Terminal identical to the one in the System Master Control Section used to view system status and set system parameters. This OIT utilizes the same program that the OIT in the system gear uses.

c. A Simulator Operator Interface Terminal (OIT) that mimics the state of the actual specified simulated switchgear. This OIT simulates the operation of the switchgear and communicates with the simulator PLC to mimic the control signals normally received by the System Master PLC in the actual specified switchgear. The simulator OIT mimics the operation of the generators, circuit breakers, control stations, master synchronizers, utility sources (available/not available), automatic transfer switches, alarm horn, electrical interlocks, and simple KW simulation (for purposes of bus optimization, load demand, and load shedding).

5. Simulations shall include the following:

a. Circuit Breaker Simulation

1) Open/close/connected

2) Spring charge

3) Fail to open and fail to close

4) Electrical circuit breaker control switch interlocks for closing

b. Generator Simulation
   1) Start/Stop
   2) Parallel circuit breaker close/open
   3) Common Alarm and Common Pre-Alarm
   4) Cooldown Mode
   5) Generator Control Switch Simulation

c. Automatic Transfer Switch (ATS) Simulation
   1) Engine Start
   2) Load Shed
   3) Normal Source Failure Simulation
   4) ATS Normal available and Emergency available indication
   5) ATS on Normal, ATS on Emergency
   6) Normal Time Delay Bypass
   7) ATS simulation depends upon which features are present in the actual system, these features shown are all supported.

d. Master Control Station Simulation includes all pushbuttons/switches/and lights

e. Simple KW simulation to simulate the load changes in the system and how they affect system loading/load shed/bus optimization/load demand

f. Under Frequency alarm simulation to see how the system reacts to an under frequency condition.

g. Alarm Horn Simulation to know when the alarm horn will sound and what triggers it.

h. Utility Source Simulation - Changes if the utility source is available or not

6. Provide Enclosed Computer Desk with Monitor mounting and CPU holder

2.15 POWER CONTROL SYSTEM TECHNOLOGY PACKAGE [-NOT USED]

A. Supply a [150PCS-S technology package] [150PCS-R redundant data storage and control power package] integral to the 7000 Series Power Control System to provide a single Ethernet TCP/IP communications interface to building monitoring systems, configurable email/text alerts and time synchronization for event logs of connected PCS devices.

B. The technology package shall consist of a gateway device that is able to aggregate and share power control systems and integral power devices, transfer switches, circuit breakers, surge protection devices, power meters and protective relays. Aggregated data shall be shared in industry standard open ethernet-based protocols including Modbus, BACnet, SNMP and OPC.

C. Automatically generate accreditation and regulatory compliance reports to comply with required regulatory emergency power testing standards including NFPA 110, CALEA, NFPA 99, DVL GL, The Joint Commission EC 7.40 and CMS. The report shall include engine-generator, transfer switches and load bank loading.

D. Automated Utility Outage reports shall be self-triggered and automatically generate a power outage report.

E. Increased cybersecurity by (1) encrypting generator and transfer control and monitored signals between PCS and ATS using AES 128-bit encryption, (2) Utilize the IT digital certificate to encrypt all HTTPS data, and (3) support Active Directory (LDAP) for user authentication management, and (4) offering 4-levels of user privileges including administration, supervisor, control and monitoring.

F. Aggregated analog trend, alarm log and sequence of events data shall be downloadable in an Excel file format.

G. The technology package shall be compatible with facility wide EcoStruxure-ASCO Critical Power Management Systems & Power Expert Modules.

H. The gateway device shall automatically synchronize the time clocks of power control system devices including transfer switches, power quality meters, circuit breakers, protective relays, active surge monitors and generators.

I. Alarms and alert notifications shall be user-configurable and instantly sent individually or combined into a single periodic email alert.

J. Provide a central repository to upload and view facility drawings, equipment user manuals, and other reference material.

K. Automated performance reports include energy-usage, alarm, control activity, settings and event log reports. Reports generation can be automated and scheduled once a week or month and emailed to users.

2.16 REMOTE TERMINAL UNIT(S) [-NOT USED]

A. Provide a Remote Terminal Unit in a NEMA 1 wall mounted enclosure for each group of ATS to contain the following:

1. Ethernet I/O: Modicon X80 I/O [Redundant I/O] [***Spec writer note:*** Redundant I/O can be provided as an option, requires redundant I/O in the Master Controls] shall be provided to allow control and monitoring of up to [16][32] local ATS Including Engine Start , Load Shed, ATS Position (On Normal, On Emergency)
2. Ethernet Switches: Ethernet Switches shall be provided with fiber converters [Redundant fiber convertors] to allow the I/O to communicate with the System Master PLC.
3. DC Power Supply
   a. Provide a 120VAC – 24VDC Power Supply to provide DC power from a building 120VAC source to the Remote Terminal Unit.
   b. Provide an APC, Model SMT750C, 750VA/500W UPS for powering the RTU components with dedicated 120VAC inputs.

PART 3 - EXECUTION

3.1 GENERAL

A. In addition to the requirements specified herein, execution shall be in accordance with the requirements of specifications Section [26 00 10][16010], Section [26 08 00][16080] and Drawings.

B. Examine equipment exterior and interior prior to installation. Report any damage and do not install any equipment that is structurally, moisture, or mildew damaged.

C. Pre-Installation Conference: Prior to commencing the installation, an onsite pre-installation conference shall review the material selections, installation procedures, and coordination with other trades. Attendees shall include, but shall not be limited to, the Contractor, the Installer, manufacturer's representatives, and any trade that requires coordination with the work. Date and time of the pre-installation conference shall be acceptable to the Owner and the Engineer

A. Beginning of the work shall indicate acceptance of the areas and conditions as satisfactory by the Installing Contractor.

B. Contractor shall install equipment in accordance with reviewed product data, final shop drawings, manufacturer's written instructions and recommendations, and as indicated on the Drawings.

C. Contractor shall Provide final protection and maintain conditions in a manner acceptable to the manufacturer that shall help ensure that the equipment is without damage at time of Substantial Completion.

3.2 FACTORY ACCEPTANCE TESTING [-NOT USED]

A. An inspection and witness test of the switchgear prior to shipment shall be scheduled in advance with the factory.

B. The factory acceptance shall include the following:

1. Mechanical Inspection with equipment deenergized
2. Complete sequence of operation testing

3.3 INSTALLATION ASSISTANCE

A. The manufacturer of the generator control switchgear shall provide the services of a factory-employed and factory-trained technician to provide installation assistance.

B. It shall be the responsibility of the installing contractor to verify that the following items have been completed per applicable codes and standards, and are ready to perform as specified before the arrival of the factory technician

1. Inspect for obvious shipping damage.
2. The switchgear is properly installed, anchored and grounded.
3. Shipping splits have been reinstalled with the splits bolted together, interconnect wiring installed, and bus splice plates installed.
4. Terminate all power cables.
5. Install customer control wiring to external equipment including engines, batteries, building management systems, associated motor control, etc.
6. The engine generator set is installed and ready to run.
7. Associated motor controls, plumbing, building utilities are complete and operational.

C. It shall be the responsibility of the Field Service Technician to perform the following:

1. Verify contractor connections and control power availability.
2. With the engine generator supplier's technical representative controlling the engines, verify that the switchgear and control equipment are fully operational, and perform per the sequence of operation specified. Test equipment and services as required for the engine generator sets shall be provided by the engine generator set supplier.
3. With the engine generator supplier's technical representative controlling the engines, demonstrate all functions of the control system, both automatic and manual, to the satisfaction of the owner or representative.
4. Provide plant operators with instruction on the plant operating procedures and major component maintenance after acceptance by the owner's representative.

3.4 TRAINING [- NOT USED]

A. Onsite training specific to the equipment furnished shall be provided to the Owner's staff by a factory trained manufacturer's representative. Training duration shall be sufficiently adequate to cover the operation and maintenance of the equipment and shall consist of not less than [1][2 repeated] session(s) with [4] hours of onsite classroom and hands-on instruction for a minimum of [4] attendees per session.

1. The instructor shall provide sufficient time and detail in each session to cover the following as a minimum:
   a. Sequence of operation
   b. Major components of equipment
   c. Operation of equipment
   d. Configurations of equipment
   e. Maintenance, troubleshooting and repair

END OF SECTION [26 23 00][16430]