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SUGGESTED SPECIFICATION

for

Low Voltage (600V) Generator and Distribution Control Switchgear

Division 26

Standby Power Generator Systems

PART 1 GENERAL

1.1 Scope

A. It is the intent of this specification to provide a complete control and power distribution system for the operation of _____ generator units, rated ____ kW at 0.8 PF, _____ volts, 3 phase, _ wire, 60 Hertz. All components, testing, and services specified or required for a complete operable system shall be included. The switchgear shall consist of _____ generator section(s), one master control section and _____ distribution sections.

1.2 Related Sections

A. Section 26___: *(spec writer to determine applicable section)*

1.3 Application Codes and Standards

A. Institute of Electrical & Electronic Engineers (IEEE)
Standard 27 - Switchgear Assemblies

B. American National Standards Institute, Inc. (ANSI/IEEE)
C37.20.1 – LV Metal Enclosed Switchgear Assemblies

C. National Fire Protection Association (NFPA)
NFPA-70 - National Electrical Code
NFPA-99 - Essential Electrical Systems for Health Care Facilities
NFPA-110 - Standard for Emergency and Standby Power Systems

D. Underwriters Laboratories, Inc.
[UL 891 Low Voltage Switchboard]
[UL 1558 Low Voltage Metal Enclosed Switchgear]

Note: Spec writer to determine which UL listing shall be applicable.

E. International Standards Organization
ISO 9001

F. International Building Code (IBC)
California Building Code (CBC)

- 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.
- Equipment, including installed overhead lifting device, shall be certified with Design Spectral Response Acceleration at Short Periods (S_{DS}) equal to 2.46
- Switchgear shall be provided with IBC 2019 certification and label

1.4 Manufacturer's Qualifications

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

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.

1.5 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 Documentation

A. Submittals for approval shall include the following:

1. Elevation drawings with shipping splits identified and estimated weights.
2. Outline drawings showing conduit entry areas and anchoring provisions.
3. Single line diagram.
4. Sequence of operation.
5. Bill of material listing items by manufacturer's name, part number and description.
6. Complete nameplate and status annunciator panel schedule.
7. Technical literature for major components.

B. Operation and maintenance manuals shall contain:

1. Complete Set of Drawings
2. Detailed Interconnect Spreadsheet
3. Complete Bill of Material
4. Instruction Manuals for Major Components
5. Sequence of Operation
6. Warranty Statement

O&M manuals will be provided in electronic format via a secure link.

1.7 Testing

The equipment shall be fully assembled for factory testing. Testing shall include, but not be limited to primary injection of the applicable three phase voltage for potential transformer circuits, and three phase 5A secondary injection testing of the current circuits. The circuit breakers supplied shall be installed in their intended positions and electrically and mechanically tested. All cubicles shall be subjected to a dielectric voltage-withstand test, for 1 minute, at twice the service voltage plus 1000 volts. A narrative of the system operation shall be provided and shall be utilized when testing the equipment. A certified factory test report shall be furnished to verify system testing.

1.8 Warranty and Service

A. Manufacturer shall warrant the equipment for a minimum of eighteen months from date of shipment subject to terms and conditions of manufacturer's current warranty publication.

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

C. 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.

D. 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.

1.9 General Requirements

A. Switchgear Enclosure

1. Structure. 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.

   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.

2. Bus. 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 _____ amperes and have a minimum bracing level of not less than [ ] 100,000 amperes [ ] 200,000 amperes RMS symmetrical, for a minimum of (4) cycles and must meet UL 1558 heat rise test. The neutral bus shall be silver plated copper and 100% rated. The ground bus shall be bare copper and 25% rated.

3. 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.

   Control wires shall be numbered every eight (8) inches or less and visible next to the terminals. Wiring shall be permanently marked with wire termination 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.

   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.

   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.

   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.

4. 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.

5. [OPTIONAL: *Overhead Lifting Device. 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, if required, shall include the overhead lifting device.]

6. Lugs. Lugs shall be 2-hole [*compression | mechanical*], size, conductor type and quantity per conductor as shown in drawings.

*[**Note**: spec writer to choose compression or mechanical lugs]*

B. Components

1. Synchroscope. Synchroscope shall consist of industrial switchboard type meters, 4-1/2" square, 1% accuracy.

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

4. 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.

5. 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. Lamp test shall be an integral feature of this indicator. Each illuminated indicator tile shall be 24 mm x 24 mm.

6. 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.

C. 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.

1.10 Acceptable Manufacturer

The equipment described shall be manufactured by ASCO Power Technologies. Any alternates to this bid shall only be considered if a complete written description of the proposed system along with any variances to the specification, are received ten (10) days prior to bid due date. Any variances not specifically enumerated prior to bidding shall be considered non-responsive. Alternate manufacturers must be approved in writing by the Engineer as an addendum. Costs incurred to modify the building and/or interfacing equipment which are affected as a result of an alternate, shall be the responsibility of the contractor.

PART 2 SECTIONS

2.1 Generator Power and Control Section

A. 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:

For each generator set, a 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 X trip unit with Energy Reduction Maintenance Setting 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. Trip unit shall include adjustable long delay, short delay, 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 _____AIC rating. *(Spec writer to determine interrupt capacity required)*

B. Generator Control System

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.

DC-to-DC converter(s) shall be in each generator control section to provide a 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.

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

1. Reverse Power Protection (Device 32R)

2. Generator Voltage Monitoring and Frequency Monitoring

   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.

3. Automatic Synchronizer

   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.

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.

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.

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.

4. 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.

C. Programmable Logic Controller

1. The automatic engine starting control shall be in a dedicated programmable logic controller and shall automatically start, protect, and monitor each engine generator set. The controller shall be provided with power supply, CPU and required I/O modules. Engine start control shall additionally be hard wired so that the engine can be automatically or manually started 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 and generator set and shall be independent of the Master PLC. Distributed I/O

systems which rely on a master controller shall not be acceptable. Programmable Controller shall be Modicon type M340.

2. 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.

3. Five Position Engine Control Selector Switch

Lockout/Reset - When placed in this position, the engine shall not be capable of starting and/or running from the ASCO PCS 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.

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.

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

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.

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.

4. Four Position Synchronizing Mode Selector Switch

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.

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.

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

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

5. Engine Cooldown Time Delay

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.

6. Failure to Synchronize Time Delay

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.

D. Hardwired Alarm and Status Indication per Generator

FUNCTION	COLOR
LAMP TEST (PUSHBUTTON)	
PARALLEL CB OPEN	GREEN
PARALLEL CB CLOSED	RED
AUTO START	GREEN
ENGINE RUNNING	GREEN
PLC STOPPED	RED
CONTROL VOLTAGE FAILURE	RED
CONTROLS NOT IN AUTO	RED
POWERQUEST OVERRIDE	AMBER
GEN COMMON SHUTDOWN	RED
DC CONVERTER FAILURE	RED
DSLC-2 SELF TEST FAILED	RED

E. Generator Control Station

FUNCTION	SELECTIONS
GENERATOR CONTROL SWITCH	LOCKOUT/RESET OFF/COOLDOWN AUTOMATIC TEST OFFLINE TEST ONLINE
SYNCHRONIZING MODE SWITCH	PERMISSIVE CHECK OFF/COOLDOWN RUN
EMERGENCY STOP PUSHBUTTON	-
ALARM RESET PUSHBUTTON	-
VOLTAGE CONTROL SWITCH	LOWER OFF RAISE
SPEED CONTROL	LOWER OFF RAISE

2.2 Master Control Section

(note: spec writer to select from PLC options below)

The master control section shall contain [*a programmable logic controller | redundant programmable logic controllers*] capable of storing necessary control sequence algorithms, variable operation set-points, time delays and alarming levels. Distributed I/O stations 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.

A. Priority Load Control

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 kilowatt 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 failure 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 high priority transfer switches or other devices.

Load shedding 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 give provide and audible alarm annunciation of bus underfrequency load shed.

Provide means to reset the bus underfrequency signal.

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 first priority. Logic shall be provided in the event that a bus overload occurs resulting in a reduction in bus frequency; the bypassed priority load shall be shed automatically through override logic control.

System loads shall not shed unless a bus overload or a bus under frequency occurs; this feature is referred to as "load-latch".

B. Power Management Applications

Master controls applications shall include Load Bus Optimization and Generator Load Demand.

Load Bus Optimization shall control 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.

Generator Load Demand shall control individually prioritized and separately controlled engine-generator sets. Engine-generator sets shall be added or removed from the bus according to dynamic measurements of power consumption and engine-generator efficiency set-points.

C. Manual Paralleling Controls

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.

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.

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.

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.

D. DC Control Power Selector – Best Battery System

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.

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".

Additionally, 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.

E. System Test Switch

Provide a system no-load test switch to initiate a complete automatic system operation by simulating the closure of the remote engine start signal.

F. Alarm and Status Indication

FUNCTION	COLOR
LAMP TEST (PUSHBUTTON)	
EMERGENCY MODE	AMBER
I/O COMM FAILURE	RED
BUS UNDER FREQUENCY	RED
ATS CONTROL FUSE BLOWN	RED
PLC 1 STOPPED	RED
PLC 2 STOPPED *	RED
CONTROL VOLTAGE FAILURE	RED
DC CONVERTER FAILURE	RED

* Only with redundancy option

G. Main Audible Alarm

Provide a main audible alarm. The alarm horn shall be the DC vibration type, subsequent malfunctions to resound the alarm if the horn had been previously silenced.

H. Paralleling Bus Metering / Instrumentation

1. Synchroscope and Synchroscope Plant Selector Switch with positions for each generator
2. Bus Under/Over-Voltage Relay
3. Bus Under/Over-Frequency Relay

I. Master Control Station

FUNCTION	COLOR
BUS ALARM RESET PUSHBUTTON	-
ALARM SILENCE PUSHBUTTON	RED
MANUAL PARALLEL PUSHBUTTON	GREEN

J. Master Controller

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

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

2. The controller shall have the capability to interface to I/O racks.

(spec writer note: the following section is for optional redundant PLCs; remove if not included)

K. Optional Master PLC Redundancy
*[**optional**: spec writer to remove this section if not required]*

This system shall consist of identical and synchronized redundant programmable logic controllers and common distributed I/O systems between the controllers. Normally, the primary controller shall be the active one that controls the system I/O while secondary controller(s) 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.

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.

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

2.3 Operator Interface Terminals

The monitoring and control interface shall be ASCO PowerQuest 4000 HMI.

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.

The monitoring and control interface shall include programmable 12-inch color touch screen unit and shall interface with Programmable Logic Controllers, Synchronizer/Load Controllers 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 touch screens.

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

- 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 the scope of delivery (including

breaker position and alarms), and transfer switches (including transfer switch position, source availability, and bypass position if available)
- Communication status of PLCs [option: *and redundancy status*]
- Dynamically updated and color-coded interconnect lines representing power flow and source
- ATS summary screen shall be accessible via menu button
- The current main bus KW value

Additional screens shall include:
- Generator status shall include dynamically updated color indications and signal nomenclature.
- Generator control shall include fully functional engine control switch and synchronizing mode switch.
- Generator metering screens shall include dynamically updated values.
- Synchronizer/Load Share controller screens shall include dynamically updated parameters that are available from the controller such as metering status (voltages, currents, power measurements) and synchronization status (frequencies, voltages, synchroscope).
- Transfer Switch screens shall include details of selected transfer switches including present state and position, source availability, transfer/retransfer controls (password protected), bypass status, pickup/dropout settings, time delay settings, and metering data (if available).
- 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.
- 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.
- A generator priority screen for load demand.
- 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 and step add time delay. Transfer switches shall include (when available) engine start signal, load shed signal, and HOA (Hand-Off-Auto) mode.
- An alarm summary screen with a current listing of all active alarms and file archival
- An alarm history screen with file archival

- A communication status screen shall be dynamically updated and include [*redundant*] PLC status information [and indicate which redundant PLC is currently in control]
- Historical trending of up to 4 parameters: voltage, frequency, real power (KW) and reactive power (KVAR).

The following discrete status and alarms shall be displayed (when available).

Warnings	Low Oil Pressure Pre-Alarm High Water Temperature Pre-Alarm Low Coolant Level Battery Charger Failure Low Battery Voltage High Battery Voltage Engine Battery Common Alarm Day Tank Low Fuel Day Tank High Fuel Day Tank Ruptured Basin Low Water Temperature Common Alarm Ground Fault Alarm 24VDC Control Voltage failed Fail To Synchronize Circuit Breaker Open Failure DC-DC Converter Failure
Monitored Shutdown Conditions	Local Gen Controls Not In Auto Day Tank Low Fuel Critical Low Oil Pressure Shutdown High Water Temperature Shutdown Overspeed Shutdown Reverse Power Shutdown Parallel Circuit Breaker Tripped Overcrank Shutdown Common Shutdown Emergency Stop Active Controls Not In Auto Circuit Breaker Close Failure Local Gen Breaker Open Shutdown
Status	Parallel CB Not Connected Auto Start Present ECS Reset Required Local Gen CB Open

Local Gen CB Closed
Paralleling Gen CB Open
Paralleling Gen CB Closed
Generator Running

Security features shall include definition of 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. If an individual is logged in to the system with no activity for 15 minutes, the individual shall be automatically logged out.

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.

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.

2.4 Remote Panel *[optional; spec writer to determine if needed]*

Remote panel shall consist of a color operator interface mounted in a suitable enclosure. Connectivity to the main PCS assembly shall be via network communication. Power to be customer supplied [*with optional UPS*].

2.5 Distribution Sections

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

All emergency distribution circuit breakers shall be drawout Square D MTZ breakers. Where indicated on the drawings, circuit breakers shall be electrically operated, all other distribution circuit breakers shall be manually operated *(spec writer to determine if electrically or manually operated breakers are required)*. All circuit breakers shall be provided with Long Delay, Short Delay, Instantaneous, and Ground Fault trip settings *(spec writer to determine if ground fault trip or ground fault alarm/indication is required)*. Circuit breaker interrupting rating shall not be less than _____ amperes RMS symmetrical.

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

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

(Spec writer note: Drawout UL 1066 listed circuit breakers are required if UL 1558 construction/listing is desired.)

PART 3 DESCRIPTION OF OPERATION

The equipment shall conform to the operational specifications described in the document "ASCO PCS 4000 Series Description of Operation". A graphical representation of the sequence of operation shall be provided with the submittal.

PART 4 ACCESSORIES AND FACTORY WITNESS TEST

4.1 Circuit Breaker Accessories

A. A portable circuit breaker lifting device shall be provided.
B. A portable circuit breaker test kit shall be provided.

4.2 Witness Test *[optional]*

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

4.3 PCS Technology Package

[optional: spec writer to remove this section if not required]

A. Supply a 150PCS-S technology package (OPTIONAL: Specify 150PCS-R instead for redundant data storage and control power) integral to the 7000 Series Power Control System (PCS herein) 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.

PART 5 INSTALLATION ASSISTANCE

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

5.1 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.

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

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

A. Verify contractor connections and control power availability.
B. 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.
C. 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.
D. Provide plant operators with instruction on the plant operating procedures and major component maintenance after acceptance by the owner’s representative.