SECTION 26 00 00

ELECTRICAL

PART 1 - GENERAL

1.01 CONDITIONS

A. Furnish all labor, materials, equipment and services to complete the electrical work as shown on the drawings or as specified. Refer to the General Conditions, Supplemental General Conditions and other sections below, as they apply.

1.02 RELATED SECTIONS

A. Section 22 00 00 - Mechanical - General

1.03 SCOPE

A. Furnish and install all electrical systems complete in every respect and ready to operate. Furnish all miscellaneous items and accessories required for such installation, whether or not each such item or accessory is shown on the drawings or mentioned in these specifications.

B. The work shall consist of, but is not limited to the following general items:

1. Lighting Fixtures and Lamps
2. Raceways
3. Wiring Devices and Plates
4. Branch Circuits
5. Control Wiring
6. Panelboards

1.04 SUBMITTALS

A. Submit under provisions of Section 013300

B. Submit shop drawings for:

1. Lighting Fixtures and Lamps
2. Wiring Devices and Plates
3. Safety Disconnect Switches
4. Control Wiring for all Mechanical Systems
5. Panelboards

PART 2 - PRODUCTS

2.01 MATERIALS

A. Submit material lists for all raceways and connectors, conductors and their connectors, boxes and grounding facilities.

PART 3 - EXECUTION

3.01 RACEWAYS

A. GENERAL: Provide raceways for all wiring systems, minimum 3/4 inch. Raceways shall include rigid galvanized steel, conduit, rigid aluminum conduit, (EMT) electrical metallic tubing, flexible metallic conduit, surface metal raceways, wire ways and troughs. Raceways shall be mechanically and electrically continuous from service entrance to final outlet. Raceways shall be run perpendicular and parallel to building construction. Except in Mechanical Rooms or as otherwise noted, all raceways shall be concealed. All breaks and turns with exposed raceways shall be made with malleable iron cadmium or hot dipped galvanized conduit fittings and covers. Raceways shall be rigidly supported with malleable iron conduit clamps or trapeze supports and clamps at intervals not exceeding 7 feet with 12 inches of all outlet boxes, elbows, and changes or direction. Concealed raceways shall be supported from structural members and not furring. All raceway systems shall be completely installed and secured and swabbed out, and all work in the area shall have progressed sufficiently to prevent injury to cables, before any conductors are installed. Provide caps and plugs on ends of raceways and openings in boxes to prevent foreign material from entering during construction. Provide double locknuts where 1 1/2 inch and larger conduits terminate, where No. 4 and larger conductors are installed, and where required by NEC. Do not use running threads. Leave No. 12 pull wire (identified at both ends) in all empty raceways. Provide plastic insulating busing on all conduit connections and fiber inserts on all tubing connections. Surface metal raceways, surface wiremold and surface metal troughs shall be installed only where shown on the drawings.

B. RIGID CONDUIT: Provide rigid galvanized steel conduits for service entrance, panel feeders and all motor feeders. Threadless fittings, all thread and running threads shall not be used. Rigid conduits shall be provided for all raceway systems run underground or embedded in concrete or solid masonry. Rigid conduit shall be as manufactured by Youngstown, Allied, Triangle, or equal. Conduits located underground shall be PVC or shall be rigid galvanized steel and have an additional coat or polyvinylchloride and shall be manufactured by Robroy, or equal.

C. ELECTRICAL METALLIC TUBING (EMT): Electrical metallic tubing (EMT) may be used for conduits concealed in furred ceilings or walls, run exposed in the building, or embedded in hollow masonry construction above grade. EMT shall be as manufactured by Triangle, Allied, Republic, or equal. EMT fittings shall be ferrous metal galvanized or plated to resist corrosion and shall be of the compression-ring type, rain-tight and concrete-tight. Set screw, indenter or friction type fittings will not be allowed. All fittings shall be wrench tight and shall have insulated throats. Fittings shall be as manufactured by Steel City, Raco, Appleton, or equal.

D. FLEXIBLE CONDUIT: Provide flexible conduit for all connections to motors and other equipment subject to vibration or motion with a maximum length of 18 inches. Flexible conduit may be used for final connection to lighting fixtures in lay-in ceilings. Conduit shall be rigidly supported where connection to flexible conduit is made. Conduit and fittings shall be self-grounding and, in addition, copper bonding jumpers shall be used. Flexible conduit shall be as manufactured by Republic, Anaconda, Pittsburg, or equal. Connectors shall be ferrous metal, galvanized or plated to resist corrosion, of the two (2) screw clamp type, or the squeeze type, as manufactured by Raco, Appleton, Steel City, or equal. Flexible conduit and fittings used outdoors or in other areas subject to moisture shall be

of the liquid-tight type with connectors having an O-ring assembly. Liquid tight connectors shall be Raco type 3500, Appleton STB, or equal.

E. CONDUIT HANGERS AND SUPPORTS: All conduits shall be rigidly supported and securely fastened to structural members. Perforated iron straps or wire shall not be used for support. Maximum support spacing shall be five (5) foot for one (1) inch and smaller conduits, and seven (7) foot for conduits larger than one (1) inch. All conduit shall be installed to permit expansion and contraction, and type hanger, method of support, location of support, etc. shall be governed in part by this consideration.

3.02 OUTLET, JUNCTION AND PULL BOXES

A. Provide outlet and junction boxes where shown on the drawings or as required by Code. Boxes shall be independently rigidly supported and accessible. All outlet boxes shall be minimum of two (2) inches deep. Provide a four (4) inch square box with plaster ring and cover at each switch and receptacle location. Wiring device boxes located in brick, block or concrete walls shall be approved for the type of installation being at mortar joints. Multi-gang boxes shall be installed for more than two (2) adjacent devices; sectional boxes will not be allowed. All exposed cover plates as manufactured by Crouse Hinds, or equal. Outlets exposed to the weather shall be type FD with weatherproof gaskets and covers. Pull boxes shall be constructed of code gauge galvanized steel and shall be sized not less than 1 1/2 times all dimensions as recommended by the NEC. All conductors in pull boxes shall be identified with tags.

3.03 CONDUCTORS

A. All conductors shall be rated 600 volts, and shall be copper with type THHN insulation. Minimum size shall be No. 12 and No. 8, and larger shall be stranded. All conductors shall be color coded, with sizes through No. 10 being of the solid compound coating. Stripes, bands or hash marks with respective color coding may be used for conductors No. 8 and larger. Color coding shall be phase A - black, phase B - red, phase C - blue, neutral - white, and ground - green. All conductors shall be by the same manufacturer and shall be Triangle, Simplex, Anaconda, General, Okonite, or equal.

B. Mains and feeders shall be run continuous without joints or splices. Branch circuit splices shall be made with 3M "Scotchloks," or equal. In panelboards and boxes, conductors shall be neatly placed in phase groups and supported away from all enclosure sides. Lacing shall be done at intervals not greater than six (6) inches and shall be done with linen cord or T & B self-locking "Ty-Raps," or equal.

3.04 LIGHTING FIXTURES

A. Provide all lighting fixtures as noted on the drawings. Fixtures shall be suspended from structural members or from ceiling structural members, by standard bar hangers, or other approved means. Structural steel necessary to support fixtures shall be furnished and installed under this Section. Provide plaster frames as required. All fixtures shall be grounded. Fixtures shall be completely wired and lamped and shall be in perfect condition and operating at the time of completion. New building fixtures shall not be used for construction lighting.

B. Fixture locations shall be coordinated with ceiling patterns or other details or notes as shown on the drawings.

C. If a lighting fixture for a specific location is not clearly noted, the Contractor shall bring it to the attention of the Engineer prior to bidding, or the Contractor shall furnish and install a fixture similar and comparable in cost to that specified for other like location.

3.05 LAMPS

A. Provide and install lamps in lighting fixtures.

3.06 WIRING DEVICES AND PLATES

A. Furnish and install all wiring devices and plates where shown on the drawings and herein specified. All devices shall be NEMA rated specification grade, with all parts except terminals totally enclosed, and with each device separately packaged upon arrival at job site. Height of wiring device shall work with brick joints and concrete block joints, but in general, lighting switches shall be mounted 4'-0" above floor, and receptacles and telephone outlets shall be mounted 12" above floor. Adjacent wiring devices shall be mounted as close to each other as possible. All wiring devices shall be side wired.

B. Wiring devices and plate color shall be selected by the Owner.

3.07 SAFETY DISCONNECT SWITCHES

A. Furnish and install safety disconnect switches where shown on the Drawings or as required by NEC. Switches shall be NEMA heavy duty, horsepower rated, with padlocking provisions and with a nameplate identifying equipment served. In wet or exterior locations, switches shall be in NEMA 3R enclosures. Switches shall be as manufactured by Square "D", General Electric, Westinghouse, ITE, or equal.

3.08 GROUNDING

A. The entire electrical system and the building structure shall be grounded, or as indicated on the drawings. The electric service, equipment and enclosures, conduits and raceways, switches, breakers and panels, motors, controllers, lighting fixtures and receptacles shall be gounded. Each branch or power circuit shall have an independent grounding conductor whether shown or not, with the exception of lighting switches.

B. Bonding jumpers shall be installed to maintain continuity at water meters, connections shall be made with approved clamps as manufactured by Burndy.

3.09 GROUND FAULT CIRCUIT INTERRUPTERS

A. Conformance with UL Std. 943, Class A.

B. Temperature tolerance level of -31°F to 158°F.

C. Equal to Leviton Suregard V, NEMA 5-15R, Model 6598-W with indicator light, 15A, 125 volt.

PART 4 – ENGINE GENERATOR

4.01 SUMMARY

A. This section includes the following items from a single supplier:

1. Engine Generator Set.

2. Enclosure
3. Related Accessories as specified

B. Related Requirements

1. It is the intent of this specification to secure an engine-driven generator set that has been prototype tested, factory built, production-tested, and site-tested together with all accessories necessary for a complete installation as shown on the plans and drawings and specifications herein.
2. It is the intent of this specification to secure a generator set system that has been tested during design verification, in production, and at the final job site. The generator set will be a commercial design and will be complete with all of the necessary accessories for complete installation as shown on the plans, drawings, and specifications herein. The equipment supplied shall meet the requirements of the National Electrical Code and applicable local codes and regulations.
3. All equipment shall be new and of current production by an international, power system anufacturer of generators, transfer switches, and paralleling switchgear. The manufacturer shall be a supplier of a complete and coordinated system. There will be single-source responsibility for warranty, parts, and service through a factory-authorized representative with factory-trained technicians.

4.02 SUBMITTALS

A. Action Submittals

1. Product Data
   a. The submittal shall include prototype test certification and specification sheets showing all standard and optional accessories to be supplied; schematic wiring diagrams, dimension drawings, and interconnection diagrams identifying by terminal number each required interconnection between the generator set, the transfer switch, and the remote annunciator panel if it is included elsewhere in these specifications.
2. Shop Drawings
3. Samples

B. Informational Submittal

1. Certificates
   a. The generator set shall be listed to UL 2200 or submitted to an independent third party certification process to verify compliance as installed.
2. Test and Evaluation Reports
3. Manufacturer's Instruction
4. Source Quality Control Submittals
5. Field or Site Quality Control
6. Manufacturer's Report
7. Special Procedure Submittal
8. Qualification Statement

C. Closeout Submittal

1. Maintenance Contracts
2. Operation And Maintenance Data
3. Bonds
4. Warranty Documentation
5. Record Documentation

6. Software

D. Maintenance Material Submittals

4.03 QUALITY ASSURANCE

A. Regulatory Agency

1. The generator set shall conform to the requirements of the following codes and standards:
   a. CSA C22.2, No. 14-M91 Industrial Control Equipment.
   b. EN50082-2, Electromagnetic Compatibility-Generic Immunity Requirements, Part 2: Industrial.
   c. EN55011, Limits and Methods of Measurement of Radio Interference Characteristics of Industrial, Scientific and Medical Equipment.
   d. IEC8528 part 4, Control Systems for Generator Sets.
   e. IEC Std 61000-2 and 61000-3 for susceptibility, 61000-6 radiated and conducted electromagnetic emissions.
   f. IEEE446 Recommended Practice for Emergency and Standby Power Systems for Commercial and Industrial Applications.
   g. NFPA 70, National Electrical Code, Equipment shall be suitable for use in systems in compliance to Article 700, 701, and 702.
   h. NFPA 99, Essential Electrical Systems for Health Care Facilities.
   i. NFPA 110, Emergency and Standby Power Systems. The generator set shall meet all requirements for Level 1 systems. Level 1 prototype tests required by this standard shall have been performed on a complete and functional unit. Component level type tests will not substitute for this requirement.
2. Qualifications
   a. The equipment shall be produced by a manufacturer who is ISO 9001 certified for the design, development, production and service of its complete product line.
   b. The power system shall be produced by a manufacturer who has produced this type of equipment for a period of at least 10 years and who maintains a service organization available twenty-four hours a day throughout the year.
3. Manufacturers
   a. The power system shall be furnished by a single manufacturer who shall be responsible for the design, coordination, and testing of the complete system. The entire system shall be installed as shown on the plans, drawings, and specifications herein.

4.04 DELIVERY, STORAGE, HANDLING

A. Delivery and Acceptance Requirements

B. Storage and Handling Requirements

C. Packaging Waste Management

4.05 FIELD OR SITE CONDITIONS

A. Ambient Conditions

1. Engine- generator set shall operate in the following conditions without any damage to the unit or its loads.
   a. Ambient Temperature: 77 °F

b. Altitude : 500 ft
c. Relative Humidity: 95%

4.06 WARRANTY OR BOND

A. Manufacturer's Warranty

1. The generator set shall include a standard warranty covering one (1) year or 2000 hours, whichever occurs first, to guarantee against defective material and workmanship in accordance with the manufacturer's published warranty from the date of initial startup.
2. The generator set manufacturer and its distributor shall maintain a 24-hour parts and service organization. This organization shall regularly engage in maintenance contract programs to perform preventive maintenance and service on equipment similar to that specified. A service agreement shall be available and shall include system operation under simulated operating conditions; adjustment to the generator set, transfer switch, and switchgear controls as required, and certification in the owner's maintenance log of repairs made and functional tests performed on all systems.

PART 5 - PRODUCTS

5.01 EQUIPMENT

A. Equipment

1. The generator set shall be a Kohler model 250REZXB with a 4UA10 alternator. It shall provide 325.00 kVA and 260.00 kW when operating at 120/208 volts, 60 Hz, 0.80 power factor. The generator set shall be capable of a 130°C Standby @40C rating while operating in an ambient condition of less than or equal to 77 °F and a maximum elevation of 500 ft above sea level. The standby rating shall be available for the duration of the outage. Provide weatherproof enclosure.

B. Engine

1. The minimum 14.6 liter displacement engine shall deliver a minimum of 402 HP at a governed engine speed of 1800 rpm, and shall be equipped with the following:
   a. Electronic isochronous governor capable of 0.5% steady-state frequency regulation
   b. 24-volt positive-engagement solenoid shift-starting motor
   c. 45-ampere automatic battery charging alternator with a solid-state voltage regulation
   d. Positive displacement, full-pressure lubrication oil pump, cartridge oil filters, dipstick, and oil drain
   e. Dry-type replaceable air cleaner elements for normal applications
   f. The engine shall be turbocharged and fueled by Natural Gas
   g. The engine shall have a minimum of 8 cylinders and be liquid-cooled
2. The engine shall be EPA certified from the factory
3. The generator must accept rated load in one-step.

C. Cooling System

1. The engine shall be liquid-cooled by a closed loop, unit mounted radiator rated to operate the generator set at full load at an ambient temperature of 50 degrees C (122 degrees F). The radiator fan and other rotating engine parts shall be guarded against accidental contact.

D. Standard Air Cleaner

1. The air cleaner shall provide engine air filtration which meets the engine manufacturer's specifications under typical operating conditions.

E. Battery

1. Each genset requires a BCI group 31 batteries which must meet the engine manufactures' specifications for the ambient conditions specified in Part 1 Project Conditions and shall comply with the NFPA requirements for engine cranking cycles. Each battery shall be rated according to SAE Standards J-537 with a minimum cold cranking amp of 950 amps and a minimum reserve capacity of 185 Minutes at 80F. The battery plates shall be constructed of a Calcium-Lead alloy to provide long waterless operation and extended battery life. The battery elements must be anchor-locked with full-frame grids and tight-packed commercial plates to resist the effects of vibration. The battery must contain a handle to aid in lifting and the case must be constructed of polypropylene to resist breakage and extend service life. Removable cell covers shall be provided to allow for checking of electrolyte specific gravity.
2. Battery rack and battery cables capable of holding the manufacturer's recommended batteries shall be supplied.

F. Controller

1. Decision-Maker® 6000 Controller
   a. The generator set controller shall be a microprocessor based control system that will provide automatic starting, system monitoring, and protection. The controller system shall also provide local monitoring and remote monitoring. The control system shall be capable of PC based updating of all necessary parameters, firmware, and software.
   b. The controller shall be mounted on the generator set and shall have integral vibration isolation. The controller shall be prototype and reliability tested to ensure operation in the conditions encountered.
2. Codes and Standards
   a. The generator set controller shall meet NFPA 110 Level 1 requirements and shall include an integral alarm horn as required by NFPA.
   b. The controller shall meet NFPA 99 and NEC requirements.
   c. The controller shall be UL 508 listed.
3. Applicability
   a. The controller shall be a standard offering in the manufacturer's controller product line.
   b. The controller shall support 12-volt and 24volt starting systems.
   c. The controller's environmental specification shall be: -40°C to 70°C operating temperature range and 5-95% humidity, non-condensing.
   d. The controller shall mount on the generator or remotely within 40 feet with viewable access.
4. Hardware Requirements
   a. Control Panel shall include:
      (1) A run-off/reset-auto three position selector switch and three pushbuttons for OFF, AUTO and RUN
      (2) Emergency Stop Switch. The controller mounted, latch type remote stop switch shall be red in color with a "mushroom" type head. Depressing the stop button will immediately stop the generator set and lockout the generator set for any automatic remote starting.
      (3) Twelve indicating lights (LED):
         (a) System Ready - green
         (b) Not in Auto - yellow
         (c) Programming Mode - yellow
         (d) System Warning – yellow
         (e) System Shutdown – red
         (f) Off – Red
         (g) Auto – Green
         (h) Run – Yellow
         (i) Open – Green

(j) Close – Red
(k) Generator Power – Red
(l) Sync - Green

(4) Digital Display. The digital display shall be a vacuum fluorescent display with two lines of alphanumeric, with 2 lines of data and 20 characters. The display shall be viewable in all light conditions. The display shall display status of all faults and warnings. The display shall also display any engine faults. The 16-button keypad gives the user information access and local programming capability.

(5) Sixteen-position snap action environmentally sealed tactile-feel membrane keypad for menu selection and data entry.

(6) For ease of use, an operating guide shall be printed on the controller faceplate.

(7) Alarm Horn. The controller shall provide an alarm horn that sounds when any faults or warnings are present. The horn shall also sound when the controller is not in the AUTO mode.

(8) Panel lights shall be supplied as standard.

(9) Alarm Off. This button will silence the alarm horn when the unit is AUTO.

(10) A keyed switch shall be supplied for locking and unlocking of controller function.

(11) Lamp Test Button. When this button is depressed, it shall test all controller lamps.

5. Control Functional Requirements

a. The generator controller shall display and monitor the following engine and alternator functions and allow adjustments of certain parameters at the controller:

(1) Field-programmable time delay for engine start. Adjustment range 0-5 minutes in 1 second increments.

(2) Field-programmable time delay engine cool down. Adjustment range 0-10 minutes in 1 second increments.

(3) Capability to start and run at user-adjustable idle speed during warm-up for a selectable time period (0-10 minutes), until engine reaches preprogrammed temperature, or as supported by ECM-equipped engine.

(4) The idle function including engine cooldown at idle speed.

(5) Real-time clock and calendar for time stamping of events.

(6) Output with adjustable timer for an ether injection starting system. Adjustment range, 0-10 seconds

(7) Output for shedding of loads if the generator set reaches a user programmable percentage of its kW rating. Load shed shall also be enabled if the generator set output frequency falls below 59 Hz.

(8) Programmable cyclic cranking that provides up to 30 seconds of programmable cyclic cranking and up to 60 seconds rest with up to 6 cycles.

(9) The capability to reduce controller current battery draw, for applications where no continuous battery charging is available. The controller vacuum fluorescent display should turn off automatically after the controller is inactive for 5 minutes.

(10) Control logic with alternator protection for overload and short circuit matched to each individual alternator and duty cycle.

(11) Control logic with RMS digital voltage regulation. The system shall have integral microprocessor based voltage regulator system that provides +/- 0.25% voltage regulation no-load to full load with three phase sensing. A separate voltage regulator is not acceptable. The digital voltage regulator shall be applicable to single- or three-phase systems. The system shall be prototype tested and control variation of voltage to frequency. The voltage regulator shall be adjustable at the controller with maximum +/- 20% adjustable of nominal voltage.

(12) The capability to exercise the generator set by programming a running time into the controller. This feature shall also be programmable through the PC software.

(13) Alternator thermal overload protection. The system shall have integral alternator overload and short circuit protection matched to each alternator for the particular voltage and phase configuration.

(14) Control function shall include output voltage adjustment.
(15) Battle switch function selection to override normal fault shutdowns, except e mergency stop and over speed shutdowns.
(16) The control shall detect the following conditions and display on control panel:
- (a) Customer programmed digital auxiliary input ON (any of the 21 inputs available)
- (b) Customer programmed analog auxiliary input out of bounds (any of 7 inputs for ECM equipped engines and 5 inputs for non ECM engines)
- (c) Emergency stop
- (d) Exceed Alternator Thermal Limit
- (e) High coolant temperature
- (f) High oil temperature
- (g) Controller internal fault
- (h) Locked rotor - fail to rotate
- (i) Loss of ECM communications
- (j) Loss of speed sensor signal
- (k) Low battery voltage
- (l) Low coolant level
- (m) Low coolant temperature
- (n) Low fuel level
- (o) Low oil pressure
- (p) Master switch error
- (q) NFPA common alarm
- (r) Oil pressure gauge signal loss
- (s) Overcrank
- (t) Overcurrent
- (u) Overspeed with user-adjustable level, range 60-70 Hz systems and 55-70 Hz on 50 Hz systems.
- (v) Overvoltage with user adjustable level, range 105% to 135%
- (w) Overfrequency with user adjustable level, range 102% to 140%
- (x) Underfrequency with user adjustable level, range 80% to 90%
- (y) Undervoltage with user adjustable level, range 70% to 95%
- (z) Coolant temperature signal loss

(17) Conditions resulting in generator warning (generator will continue to operate):
- (a) Alternator protection activated
- (b) Auto synch disabled
- (c) Battery charger failure
- (d) Battle switch (fault shutdown override switch)
- (e) Circuit breaker close attempts fault
- (f) Circuit breaker close fault
- (g) Circuit breaker current fault
- (h) Circuit breaker open fault
- (i) Circuit breaker common fault
- (j) Common protective relay
- (k) Customer programmed digital auxiliary input on (any of the 21 inputs available)
- (l) Customer programmed analog auxiliary input on (any of the 7 inputs available on ECM engines and 5 inputs for non ECM engines)
- (m) Dead bus sensing fault
- (n) De-rate active
- (o) Emergency power system (EPS) supplying load
- (p) External circuit breaker trip
- (q) First on fault
- (r) Frequency matched
- (s) Genset parameter warning
- (t) Genset serial number warning

(u) Ground fault detected - detection by others
(v) High battery voltage - Level shall be user adjustable. (Range 29-33 volts for 24-volt systems.)
(w) High coolant temperature
(x) High oil temperature
(y) Key switch locked
(z) Key switch unlocked
(aa) Load shed common
(bb) Load shed kW over
(cc) Load shed underfrequency
(dd) Loss of AC sensing
(ee) Low battery voltage - level shall be user adjustable (Range 20-25 volts for 24-volt systems.)
(ff) Low coolant temperature
(gg) Low oil pressure
(hh) Low fuel level or pressure
(ii) Maintenance due
(jj) Master switch in auto
(kk) NFPA 110 common alarms
(ll) Overcurrent
(mm) Phased matched.
(nn) Speed sensor fault
(oo) Starting aid delay
(pp) Synch timeout
(qq) Voltage matched
(rr) Underfrequency
(ss) Weak battery

(18) Available user functions resulting in a generator warning (generator will continue to operate). These functions shall be available pending engine and fuel type:
(a) Analog auxiliary input
(b) ECM yellow alarm
(c) Idle mode digital auxiliary input
(d) Intake air temperature
(e) Digital auxiliary input
(f) Low coolant level
(g) Low fuel level
(h) Low fuel pressure

(19) Conditions resulting in generator shutdown:
(a) Alternator protection
(b) Controller setup error
(c) Critical overvoltage
(d) Defined common fault
(e) Emergency stop
(f) EEPROM write failure
(g) Field overvoltage
(h) Frequency selection error
(i) High coolant temperature
(j) High oil temperature
(k) Internal fault
(l) kW selection error
(m) Locked rotor
(n) Loss of AC sensing
(o) Loss of ECM communication
(p) Loss of field
(q) Low coolant level

(r) Low coolant temperature
(s) Low oil pressure
(t) Master switch error
(u) Master switch open
(v) Master switch to off
(w) NFPA 100 fault
(x) No coolant temperature signal
(y) No oil pressure signal
(z) Overcrank
(aa) Overspeed
(bb) Overcurrent
(cc) Overcurrent voltage regulator
(dd) Overfrequency
(ee) Overpower
(ff) Overvoltage
(gg) Phase selection error
(hh) Remote shutdown
(ii) Reverse power
(jj) Reverse kVAR
(kk) Starter motor "A" failure
(ll) Starter motor "B" failure
(mm) Time delay circuit breaker trip to shutdown
(nn) Underfrequency
(oo) Undervoltage
(pp) olt switch error

(20) Available user functions resulting in a generator shutdown. These functions shall be available pending engine and fuel type:
(a) Analog auxiliary inputs
(b) Digital auxiliary inputs
(c) ECM red alarm
(d) Intake air temperature

6. Control Monitoring Requirements
a. The generator set shall have alarms and status indication lamps that show non-automatic status and warning and shutdown conditions. The controller shall indicate with a warning lamp and or alarm and on the digital display screen any shutdown, warning or engine fault condition that exists in the generator set system. The following alarms and shutdowns shall exist as a minimum:
(1) All monitored functions must be viewable on the control panel display.
(2) The following generator set functions shall be monitored:
(a) All output voltages - single phase, three phase, line to line, and line to neutral, 0.25% accuracy
(b) All single phase and three phase currents, 0.25% accuracy
(c) Output frequency, 0.25% accuracy
(d) Power factor by phase with leading/lagging indication
(e) Total instantaneous kilowatt loading and kilowatts per phase, 0.5% accuracy
(f) kVARS total and per phase, 0.5% accuracy
(g) kVA total and per phase, 0.5% accuracy
(h) kW hours
(i) A display of percent generator set duty level (actual kW loading divided by the kW rating)
(3) Engine parameters listed below shall be monitored: (*available with ECM equipped engines)
(a) Coolant temperature both in English and metric units
(b) Oil pressure in English and metric units
(c) Battery voltage

(d) RPM
(e) Lube oil temperature*
(f) Lube oil level*
(g) Crankcase pressure*
(h) Coolant level*
(i) Coolant pressure*
(j) Fuel pressure*
(k) Fuel temperature*
(l) Fuel rate*
(m) Fuel used during the last run*
(n) Ambient temperature*

(4) Operational records shall be stored in the control beginning at system startup.
(a) Run time hours
(b) Run time loaded hours
(c) Run time unloaded hours
(d) Number of starts
(e) Factory test date
(f) Last run data including date, duration, and whether loaded or unloaded
(g) Run time kilowatt hours

(5) The following operational records shall be a resettable for maintenance purposes:
(a) Run time hours
(b) Run time loaded hours
(c) Run time unloaded hours
(d) Run time kilowatt hours
(e) Days of operation
(f) Number of starts
(g) Start date after reset

(6) The controller shall store the last one hundred generator set system events with date and time of the event.

(7) For maintenance and service purposes, the controller shall store and display on demand the following information:
(a) Manufacturer's model and serial number
(b) Battery voltage
(c) Generator set kilowatt rating
(d) Rated current
(e) System voltage
(f) System frequency
(g) Number of phases

(8) The controller shall support a variety of maintenance parameters including:
(a) Unloaded hours since lost maintenance
(b) Loaded hours since last maintenance
(c) kW-Hours since last maintenance
(d) Last maintenance date
(e) Number of starts since last maintenance
(f) Minutes of operation since last maintenance
(g) Programmable maintenance reminder (1-999 hours)
(h) Message to indicate maintenance reminder
(i) Programmable digital output for maintenance reminder

7. Inputs and Outputs
a. Inputs
(1) There shall be 21 dry contact inputs that can be user-configured to shut down the generator set or provide a warning.
(2) There shall be 7 user-programmable analog inputs for ECM-equipped engines (5 for non-ECM engines) for monitoring and control.
(3) Each analog input can accept 0-5 volt analog signals

(4) Resolution shall be 1:10,000 for analog input measurement
(5) Each input shall include range settings for 2 warnings and 2 shutdowns.
(6) All warning and shutdown values shall be accessible and adjustable on the control panel display.
(7) All free input assignments (digital and analog) shall be user selectable.
(8) Additional standard inputs required:
(a) Input for an external ground fault detector. Digital display shall show "ground fault" upon detection of a ground fault.
(b) Reset of system faults.
(c) Remote two-wire start.
(d) Remote emergency stop.
(9) Digital input (1 of 21) Utility Circuit Breaker, auxiliary closed position contacts.
(10) Idle mode enable.

b. Additional Digital Inputs Available as Standard
(1) Battery charger fault
(2) Battle switch
(3) Field overvoltage
(4) First on enable
(5) Frequency trim enable
(6) Generator circuit breaker - auxiliary
(7) Generator circuit breaker, overcurrent trip switch (OTS)
(8) High oil temperature
(9) Idle mode active (ECM models only)
(10) kVAR raise/lower
(11) PF raise/lower
(12) kW raise/lower
(13) Load enable
(14) Low coolant level
(15) Low coolant temperature
(16) Low fuel warning
(17) Low fuel shutdown
(18) Speed raise/lower
(19) Synch enable
(20) Utility circuit breaker auxiliary
(21) Voltage raise/lower
(22) Voltage trim enable

c. Outputs
(1) All NFPA 110 Level 1 outputs shall be available.
(2) Thirty outputs shall be available for interfacing to other equipment
(3) All outputs shall be user-configurable from a list of 25 functions and faults
(4) These outputs shall drive optional dry contacts.
(5) A programmable user-defined common fault output with over 40 selections shall be available.
(6) All functions listed in warnings and shutdowns shall be available as an output

8. Communications (Modbus protocol)
a. If the generator set engine is equipped with an ECM (engine control module), the controller shall communicate with the ECM for control, monitoring, diagnosis, and meet SAE J1939 standards.
b. Industry standard Modbus communication shall be available.
c. A Modbus master shall able to monitor and alter parameters, and start or stop a generator.
d. The controller shall have the capability to communicate to a personal computer (IBM or compatible) running Windows XP, or Windows 7 or later.
e. Communications shall be available for serial, CAN, and Ethernet bus networks.
f. A variety of connections shall be available based on requirements:

(1) A single control connection to a PC.
(2) Multiple controls on an intranet network connected to a PC.
(3) A single control connection to a PC via phone line.
(4) Multiple controls to a PC via phone line.
(5) Any 2 or 3 hardware ports shall be used simultaneously
(a) RS-485 (non-isolated)
(b) RS-485 (isolated)
(c) RS-232

g. Generator and transfer switch controls shall be equipped with communications modules capable of connecting to the same communication network.
h. The capability to connect up to 128 controls (any combination of generator sets and transfer switches) on a single network shall be supported.
i. Cabling shall not be limited to the controller location.
j. Network shall be self-powered.
k. The controller shall be capable of communicating controller to controller, without additional inputs from an external source.
l. The controller shall be capable of communicating with a master control panel that provides generator and load management capability.
m. The controller shall have been factory prototype tested as part of the complete paralleling system:
(1) Decision Maker 6000 - Paralleling Controller
(2) MCP 3000 - Master Control Panel
(3) Load distribution switchboards
(4) Motorized circuit breakers

9. Synchronization
a. The controller shall monitor the voltage on two phases at the output side of the generator circuit breaker.
b. The controller shall recognize a dead bus.
c. The controller shall communicate with all other controllers and use first-on logic to determine which generator will close to the dead bus first.
d. The controller shall recognize a live bus.
e. The controller shall be configurable for automatic synchronization to a live bus.
f. The controller shall support 3 common forms of synchronizing, Automatic (synch and close breaker), Test-Check (synch - no closure) and Permissive (no active synch, allow manual closure if in synch).
g. The controller shall have adjustable parameters for acceptable synchronization.
h. The controller shall have adjustable control parameters for achieving synchronism; voltage match gain, frequency match gain, phase match gain.
i. The controller shall have integral speed and voltage, raise/lower control for manual synchronizing.
j. The controller shall be capable of accepting digital inputs (contact closure) for speed and voltage raise/lower.
k. The controller shall have front panel input capability for speed and voltage, raise and lower.
l. The controller shall have a programmable synchronizing time delay, 10 to 600 seconds.
m. The controller shall announce a fail to synch fault when synchronization is not achieved within the programmed time delay.
n. The controller shall actively maintain synchronizing efforts to achieve synchronization even after the time delay has expired.
o. The controller shall have a control means to disable a generator from closing to a dead bus (first on enable) when such operation is desired (i.e. a similar emergency generator).
p. The controller shall be capable of actively displaying the synchronizing parameter values for both the generator and the bus when synchronizing; voltage, frequency and phase.
q. The controller shall be capable of displaying the phase rotation (ABC or CBA) for both the

generator and the bus.

r. The controller shall be capable of paralleling generators that are of different kW rating, fuel type and/or alternator.

s. The controller shall prevent closure to the bus when phase rotation does not match the generator.

t. The controller shall communicate to all other controllers the status of its generator breaker (closed or open) to prevent closure to a dead bus when a breaker is closed.

u. The controller shall communicate to all other controllers the status of the utility breaker (closed or open) to prevent closure to a dead bus when the utility breaker is closed.

10. Circuit Breaker Control

a. The controller shall be capable of operating the circuit breaker to apply electricity to the parallel electrical bus.

b. The controller system shall have a normally closed contact (fail safe) that will keep the generator breaker tripped until such conditions are met to allow closure.

c. The controller system shall have a normally open contact to provide an energizing signal to close the generator circuit breaker.

d. The controller system shall have normally open contact for control of a contactor.

e. The energizing time, for breaker closure, shall be user programmable between 0.1 and 10 seconds.

f. There shall be a programmable re-close time delay, 0.5 to 10 seconds.

g. The controller shall allow a programmable, 1-100, number of closure attempts.

h. The controller will announce a Fail to Close warning when closure is not detected after 1 closure attempt.

i. The controller will announce a First on Fail warning when closure is not detected after 1 closure attempt when closing to a dead bus.

j. The controller will announce a Close Attempts Fault when the number of attempts exceeds the setting (max attempts).

k. The controller will monitor current to detect a failure to open the generator circuit breaker.

l. The controller will keep the generator running until the generator circuit breaker is seen open in order to keep the bus live to prevent other devices from closing to this bus without synchronizing.

m. The controller shall accept open commands (digital input or front panel button) to trip the generator breaker on demand.

n. The controller shall accept close commands (digital input or front panel button) to close the generator breaker on demand, when synchronized and/or a dead bus is detected.

11. Protective Relays

a. The controller shall provide a standard set of protective relay functions with programmable limits and time delays.

(1) Over Voltage (59)
- (a) User Adjustable Range, 100% to 130%
- (b) User Adjustable Range Time Delay, 0- 120 seconds

(2) Under Voltage (27)
- (a) User Adjustable Range, 70% to 100%
- (b) User Adjustable Time Delay, 0- 120 seconds

(3) Over Frequency (81O)
- (a) User Adjustable Range, 100% to 140%
- (b) User Adjustable Time Delay, 0- 120 seconds

(4) Reverse Power (32R)
- (a) User Adjustable Range, 0% to 50%
- (b) User Adjustable Time Delay, 0- 120 seconds

(5) Over Power (32O)
- (a) User Adjustable Range, 90% to 150%
- (b) User Adjustable Time Delay, 0- 120 seconds

(6) Loss of Field (40 Reverse VARS)
(a) User Adjustable Range, 10% to 100%
(b) User Adjustable Time Delays, 0- 120 seconds
(7) Over Current with Voltage Range
(a) User Adjustable Range, 100% to 200%
(b) User Adjustable Time Delay, 0- 120 seconds

12. Communications (RBUS protocol)
    a. If the generator set engine is equipped with an ECM (engine control module), the controller shall communicate with the ECM for control, monitoring, diagnosis, and meet SAE J1939 standards.
    b. Kohler proprietary RBUS communication shall be available.
    c. A RBUS shall be able to monitor and alter parameters, and start or stop a generator.
    d. The controller shall have the capability to communicate to a personal computer (IBM or compatible) and appropriate application software.
    e. A variety of connections shall be available based on requirements:
        (1) A single control connection to a PC via USB
        (2) Internet connection via Ethernet
    f. Generator and transfer switch controls shall be equipped with communications modules capable of connecting to the same communication network.

G. Generator Overcurrent and Fault Protection

1. The generator shall be provided with a factory installed, 100% rated line circuit breaker rated at 0.00 amperes that is UL489 listed. Line circuit breakers shall be sized for the rated ampacity of the loads served by the breaker per the NEC.
2. The circuit breaker(s) shall incorporate an electronic trip device with the following characteristics:
3. Adjustable long time delay
4. Adjustable short time delay *[As applicable]*
5. Instantaneous
6. Load side lugs shall be provided from the factory. The line circuit breaker shall include auxiliary contacts, shunt trip, undervoltage trip, alarm switch, and overcurrent switch functionality. Load side breaker connections made at the factory shall be separated from field connections.
7. The shunt trip device shall be connected to trip the generator breaker when the generator-set is shut down by other protective devices.
8. When GFI is required per the NEC, additional neutrals shall be factory installed, and the alarm indication shall be integrated with the generator-set alarms.
9. Barriers to provide segregation of wiring from an emergency source to emergency loads from all other wiring and equipment, if required by the NEC, shall be provided.

H. Alternator

1. The alternator shall be salient-pole, brushless, 2/3-pitch, with 4 bus bar provision for external connections, self-ventilated, with drip-proof construction and amortisseur rotor windings, and skewed for smooth voltage waveform. The ratings shall meet the NEMA standard (MG1-32.40) temperature rise limits. The insulation shall be class H per UL1446 and the varnish shall be a vacuum pressure impregnated, fungus resistant epoxy. Temperature rise of the rotor and stator shall be limited to 130°C Standby @40C. The PMG based excitation system shall be of brushless construction controlled by a digital, three phase sensing, solid- state, voltage regulator. The AVR shall be capable of proper operation under severe nonlinear loads and provide individual adjustments for voltage range, stability and volts-per-hertz operations. The AVR shall be protected from the environment by conformal coating. The waveform harmonic distortion shall not exceed 5% total RMS measured line-to-line at full rated load. The TIF factor shall not exceed 50.
2. The alternator shall have a maintenance-free bearing, designed for 40000 hour B10 life. The alternator shall be directly connected to the flywheel housing with a semi-flexible coupling between the rotor and the flywheel.

3. The generator shall be inherently capable of sustaining at least 300% of rated current for at least 10 seconds under a 3-phase symmetrical short circuit without the addition of separate current-support devices.
4. Motor starting performance and voltage dip determinations shall be based on the complete generator set. The generator set shall be capable of supplying 590.00 LRKVA for starting motor loads with a maximum instantaneous voltage dip of 35%, as measured by a digital RMS transient recorder in accordance with IEEE Standard 115. Motor starting performance and voltage dip determination that does not account for all components affecting total voltage dip, i.e., engine, alternator, voltage regulator, and governor will not be acceptable. As such, the generator set shall be prototype tested to optimize and determine performance as a generator set system.

I. Vibration Isolation

1. Vibration isolators shall be provided between the engine-alternator and heavy-duty steel base.

5.03 ACCESSORIES

A. Battery rack and battery cables capable of holding the manufacturer's recommended batteries shall be supplied.

B. The generator set shall be supplied with a 10-ampere automatic float/equalize battery charger capable of charging both lead-acid and ni-cad type batteries, with the following features:

1. Automatic 3-stage float to equalization charge
2. Voltage regulation of 1% from no to full load over 10% AC input line voltage variations
3. Battery charging current Ammeter and battery voltage voltmeter with 5% full-scale accuracy
4. LED lamp for power ON indication
5. Current limited during engine cranking, short circuit, and reverse polarity conditions
6. Temperature compensated for ambient temperatures for -40°C to 60°C
7. UL 1012 Listed
8. CSA Certified

C. The generator shall be supplied with a thermostatically controlled strip heater to prevent the accumulation of moisture and dampness and to maintain the stator windings above the dew point. The heater shall be wired to be "on" at all times that the generator set is not operating.

D. The generator set shall be supplied with a common failure relay to provide means of signaling fault and/or shutdown conditions.

1. The common failure relay shall remotely signal auxiliary faults, emergency stop, high engine temperature, low oil pressure, overcrank, and over speed via one single-pole, double-throw relay with 10 amps at 120 VAC contacts.
2. The relay contacts shall be gold flashed to allow use of low current draw devices (100ma @ 28VDC min.).
3. Once energized the relay shall remain latched until the system is reset by the main controller switch.

E. Supply flexible fuel lines to provide a flexible connection between the engine fuel fittings and the fuel supply tank piping and for the fuel return lines from the injector pump per engine manufacturer's recommendations. Flex line shall have a protective steel wire braid to protect the hose from abrasion.

F. Block Heater - The block heater shall be thermostatically controlled, 6,000 watt, with isolating valves, to maintain manufacturers recommended engine coolant temperature to meet the start-up requirements of NFPA 99 and NFPA 110, Level 1.

G. Supply a Modbus to Ethernet Converter that provides one RJ45 jack for standard Ethernet 10/100 connection, and a terminal block for RS-485 connection, and is powered by 12 VDC. The Baud rate on the Modbus RTU side shall be selectable 9600 or 19200. The converter shall support Simple Network Management Protocol (SNMP) users to poll or issue trap commands.

5.04 SOURCE QUALITY-CONTROL

A. Non-Conforming Work.

1. To ensure that the equipment has been designed and built to the highest reliability and qualitystandards, the manufacturer and/or local representative shall be responsible for three separate tests: design prototype tests, final production tests, and site tests.
   a. Design Prototype Tests. Components of the emergency system, such as the engine/generator set, transfer switch, and accessories, shall not be subjected to prototype tests because the tests are potentially damaging. Rather, similar design prototypes and preproduction models shall be subject to the following tests:
      (1) Maximum power (kW)
      (2) Maximum motor starting (kVA) at 35% instantaneous voltage dip.
      (3) Alternator temperature rise by embedded thermocouple and/or by resistance method per NEMA MG1-32.6.
      (4) Governor speed regulation under steady-state and transient conditions.
      (5) Voltage regulation and generator transient response.
      (6) Harmonic analysis, voltage waveform deviation, and telephone influence factor.
      (7) Three-phase short circuit tests.
      (8) Alternator cooling air flow.
      (9) Torsional analysis to verify that the generator set is free of harmful torsional stresses.
      (10) Endurance testing.
   b. Final Production Tests. Each generator set shall be tested under varying loads with guards and exhaust system in place. Tests shall include:
      (1) Single-step load pickup
      (2) Safety shutdown device testing
      (3) Rated Power @ 0.8 PF
      (4) Maximum power
      (5) Upon request, a witness test, or a certified test record sent prior to shipment.
   c. Site Tests. The manufacturer's distribution representative shall perform an installation check, startup, and building load test. The engineer, regular operators, and the maintenance staff shall be notified of the time and date of the site test. The tests shall include:
      (1) Fuel, lubricating oil, and antifreeze shall be checked for conformity to the manufacturer's recommendations, under the environmental conditions present and expected.
      (2) Accessories that normally function while the set is standing by shall be checked prior to cranking the engine. These shall include: block heaters, battery chargers, alternator strip heaters, remote annunciators, etc.
      (3) Generator set startup under test mode to check for exhaust leaks, path of exhaust gases outside the building, cooling air flow, movement during starting and stopping, vibration during operation, normal and emergency line-to-line voltage and frequency, and phase rotation.
      (4) Automatic start by means of a simulated power outage to test remote-automatic starting, transfer of the load, and automatic shutdown. Prior to this test, all transfer switch timers shall be adjusted for proper system coordination. Engine coolant temperature, oil pressure, and battery charge level along with generator set voltage, amperes, and frequency shall be monitored throughout the test.

PART 6 – GENERAL

6.01 SUMMARY

A. This section includes the following items from a single supplier:

1. Automatic transfer switch
2. Related Accessories as specified

B. Related Requirements

1. It is the intent of this specification to secure an automatic transfer switch that has been prototype tested, factory built, production-tested, and site-tested together with all accessories necessary for a complete installation as shown on the plans and drawings and specified herein.
2. It is the intent of this specification to secure anautomatic transfer switch that has been tested during design verification, in production, and at the final job site. The automatic transfer switch will be a commercial design and will be complete with all of the necessary accessories for complete installation as shown on the plans, drawings, and specifications herein. The equipment supplied shall meet the requirements of the National Electrical Code and applicable local codes and regulations.
3. All equipment shall be new and of current production by an international, power system manufacturer of generators, transfer switches, and paralleling switchgear. The manufacturer shall be a supplier of a complete and coordinated system. There will be single-source responsibility for warranty, parts, and service through a factory-authorized representative with factory-trained technicians.

6.02 SUBMITTALS

A. Action Submittals

1. Product Data
   a The submittal shall include specification sheets showing all standard and optional accessories to be supplied; schematic wiring diagrams, dimension drawings, and interconnection diagrams identifying by terminal number each required interconnection between the generator set, the transfer switch, and the remote annunciator panel if it is included elsewhere in these specifications.
2. Shop Drawings
3. Samples

B. Informational Submittal

1. Certificates
2. Test and Evaluation Reports
3. Manufacturer's Instruction
   a. Source Quality Control Submittals
   b. Field or Site Quality Control
   c. Manufacturer's Report
   d. Special Procedure Submittal
   e. Qualification Statement

C. Closeout Submittals

1. Maintenance Contracts
2. Operation And Maintenance Data
3. Bonds
4. Warranty Documentation

5. Record Documentation
6. Software

D. Maintenance Material Submittals

1. Literature
2. Spare Parts
3. Extra Stock Materials
4. Tools

6.03 QUALITY ASSURANCE

A. Regulatory Agency

1. The automatic transfer switch shall conform to the requirements of the following codes and standards:
   a. UL 1008 - Standard for Transfer Switch Equipment
   b. IEC 947-6-1 Low-voltage Switchgear and Control gear; Multifunction equipment; Automatic Transfer Switching EquipmentEN55011, Limits and Methods of Measurement of Radio Interference Characteristics of Industrial, Scientific and Medical Equipment.
   c. NFPA 70 - National Electrical Code
   d. NFPA 99 - Essential Electrical Systems for Health Care Facilities
   e. NFPA 110 - Emergency and Standby Power Systems
   f. IEEE Standard 446 - IEEE Recommended Practice for Emergency and Standby Power Systems for Commercial and Industrial Applications
   g. NEMA Standard ICS 10-2005, Electromechanical AC Transfer Switch Equipment.
   h. EN61000-4-4 Fast Transient Immunity Severity Level 4
   i. EN61000-4-5 Surge Immunity Class 4 (voltage sensing and programmable inputs only)
   j. IEEE 472 (ANSI C37.90A) Ring Wave Test
   k. IEC Specifications for EMI/EMC Immunity (CISPR 11, IEC 1000-4-2, IEC 1000-4-3, IEC 1000-4-4, IEC 1000-4-5, IEC 1000-4-6, IEC 1000-4-8, IEC 1000-4-11)
   l. CSA C22.2 No. 178 certification
2. Qualifications
   a. The automatic transfer switch shall be produced by a manufacturer who is ISO 9001 certified for the design, development, production and service of its complete product line.
   b. A manufacturer who has produced this type of equipment for a period of at least 10 years and who maintains a service organization available twenty-four hour a day throughout the year shall produce the automatic transfer switch.
3. Manufacturers
   a. The automatic transfer switch shall be furnished by a single manufacturer who shall be responsible for the design, coordination, and testing of the complete system. The entire system shall be installed as shown on the plans, drawings, and specifications herein.
   b. The manufacturer shall maintain a national service organization of employing personnel located throughout the contiguous United States. The Service center's personnel must be factory trained and must be on call 24 hours a day, 365 days a year.
   c. The manufacturer shall maintain records of each switch, by serial number, for a minimum of 20 years.

6.04 FIELD OR SITE CONDITIONS

A. Ambient Conditions

1. Automatic transfer switch shall operate in the following conditions without any damage to the unit or its loads.
   a. Ambient Temperature: -4 to 158 Degrees F
   b. Relative Humidity: 5% to 95% noncondensing

PART 7 - PRODUCTS

7.01 OWNER-FURNISHED OR OWNER-SUPPLIED

A. New Products

7.02 EQUIPMENT

A. Equipment

1. Furnish and install an automatic transfer switches system(s) with 4-Pole / 4-Wire, Switched Neutral,
2. 800 Amps, 208V/60Hz. Each automatic transfer shall consist of an inherently double throw power transfer switch mechanism and a microprocessor controller to provide automatic operation. All transfer switches and controllers shall be the products of the same manufacturer.

B. Manufacturer

1. Automatic transfer switches shall be Kohler Bypass/Isolation - Programmed Transition (KAP)/KAP-DCVC-#S. Any alternate shall be submitted for approval to the consulting engineer at least 10 days prior to bid date. Alternate bids shall include a line-by-line clarification of the specification marked with "D" for deviation; "E" for exception, and "C" for comply.

C. Construction

D. Enclosure

1. The ATS shall be furnished in a NEMA 3R enclosure.
2. All standard door mounted switches and indicating LEDs shall be integrated into a flush-mounted, interface membrane or equivalent in the enclosure door for easy viewing & replacement. The panel shall be capable of having a manual locking feature to allow the user to lockout all membrane mounted control switches to prevent unauthorized tampering. This cover shall be mounted with hinges and have a latch that may be padlocked. The membrane panel shall be suitable for mounting by others when furnished on open type units.

7.03 OPERATION

A. Operators

1. A two-way bypass-isolation switch shall provide manual bypass of the load to either source and permit isolation of the automatic transfer switch from all source and load power conductors. All main contacts shall be manually driven.

2. Power interconnections shall be silver-plated copper bus bar. The only field installed power connections shall be at the service and load terminals of the bypass-isolation switch. All control inter-wiring shall be provided with disconnect plugs.
3. Separate bypass and isolation handles shall be utilized to provide clear distinction between the functions. Handles shall be permanently affixed and operable without opening the enclosure door. Designs requiring insertion of loose operating handles or opening of the enclosure door to operate are not acceptable.
4. Bypass to the load-carrying source shall be accomplished with no interruption of power to the load (make before break contacts). Designs which disconnect the load when bypassing are not acceptable. The bypass handle shall have three operating modes: "Bypass to Normal," "Automatic," and "Bypass to Emergency." The operating speed of the bypass contacts shall be the same as the associated transfer switch and shall be independent of the speed at which the manual handle is operated. In the "Automatic" mode, the bypass contacts shall be out of the power circuit so that they will not be subjected to fault currents to which the system may be subjected.
5. The isolation handle shall provide three operating modes: "Closed," "Test," and "Open." The "Test" mode shall permit testing of the entire emergency power system, including the automatic transfer switch with no interruption of power to the load. The "Open" mode shall completely isolate the automatic transfer switch from all source and load power conductors. When in the "Open" mode, it shall be possible to completely withdraw the automatic transfer switch for inspection or maintenance to conform to code requirements without removal of power conductors or the use of any tools.
6. When the isolation switch is in the "Test" or "Open" mode, the bypass switch shall function as a manual transfer switch.
7. Designs requiring operation of key interlocks for bypass isolation or ATS(s) which cannot be completely withdrawn when isolated are not acceptable.

B. Controls

1. A four line, 20 character LCD display and dynamic 4 button keypad shall be an integral part of the controller for viewing all available data and setting desired operational parameters. Operational parameters shall also be available for viewing and control through the communications interface port or USB. The following parameters shall only be adjustable via a password protected programming on the controller:
   a. Nominal line voltage and frequency
   b. Single or three phase sensing
   c. Operating parameter protection
   d. Transfer operating mode configuration (Standard transition, Programmed transition, or Closed transition)

C. Voltage and Frequency

1. Voltage (all phases) and frequency on both the normal and emergency sources shall be continuously monitored, with the following pickup, dropout, and trip setting capabilities (values shown as % of nominal unless otherwise specified):

	Parameter	Dropout/Trip	Pickup/Reset
a.	Under voltage	75 to 98%	85 to 100%
b.	Over voltage	106 to 135%	95 to 100% of trip
c.	Under frequency	95 to 99%	80 to 95%
d.	Over frequency	01 to 115%	105 to 120%
e.	Voltage unbalance	5 to 20%	3 to 18%

2. Repetitive accuracy of all settings shall be within ± 0.5% over an operating temperature range of -20°C to 70°C.
3. An adjustable dropout time for transient voltage and frequency excursions shall be provided. The time delays shall be 0.1 to 9.9 seconds for voltage and .1 to 15 seconds for frequency.
4. Voltage and frequency settings shall be field adjustable in 1% increments either locally with the display and keypad, remotely via the communications interface port or USB.

5. The controller shall be capable of sensing the phase rotation of both the normal and emergency sources. The source shall be considered unacceptable if the phase rotation is not the preferred rotation selected (ABC or BAC). Unacceptable phase rotation shall be indicated on the LCD; the service required LED and the annunciation through the communication protocol and dry contacts. In addition, the phase rotation sensing shall be capable of being disabled, if required.
6. The controller shall be capable of detecting a single phasing condition of a source, even though a voltage may be regenerated by the load. This condition is a loss of phase and shall be considered a failed source.
7. Source status screens shall be provided for both normal & emergency to provide digital readout of voltage on all 3 phases (phase to phase and phase to neutral), frequency, and phase rotation.

D. Time Delays

7.04 SOURCE QUALITY CONTROL

A. Test and Inspection

1. Upon request, the manufacturer shall provide a notarized letter certifying compliance with all of the requirements of this specification including compliance with the above codes and standards. The certification shall identify, by serial number(s), the equipment involved. No exceptions to the specifications, other than those stipulated at the time of the submittal, shall be included in the certification.
2. The ATS manufacturer shall be certified to ISO 9001 International Quality Standard and the manufacturer shall have third party certification verifying quality assurance in design/development, production, installation and servicing in accordance with ISO 9001.

END OF SECTION