

N. GENERATOR SPECIFICATION

GENERAL

SCOPE

1. PROVIDE COMPLETE FACTORY ASSEMBLED GENERATOR SET EQUIPMENT WITH DIGITAL (MICROPROCESSOR-BASE) ELECTRICAL GENERATOR SET CONTROLS, DIGITAL GOVERNOR, AND DIGITAL VOLTAGE REGULATOR.
2. PROVIDE FACTORY TEST, STARTUP BY A SUPPLIER AUTHORIZED BY THE EQUIPMENT MANUFACTURER(S), AND ON-SITE TESTING OF THE SYSTEM.
3. THE GENERATOR SET MANUFACTURER SHALL WARRANT ALL EQUIPMENT PROVIDED UNDER THIS SECTION, WEATHER OR NOT IS MANUFACTURED BY THE GENERATOR SE MANUFACTURER, SO THAT THERE IS ONE SOURCE FOR WARRANTY AND PRODUCT SERVICE. TECHNICIANS SPECIFICALLY TRAINED AND CERTIFIED BY THE MANUFACTURER TO SUPPORT THE PRODUCT AND EMPLOYED BY THE GENERATOR SET SUPPLIER SHALL SERVICE THE GENERATOR SETS.

ACCEPTABLE MANUFACTURERS

1. ONLY APPROVED BIDDERS SHALL SUPPLY EQUIPMENT PROVIDED UNDER THIS CONTRACT. EQUIPMENT SPECIFICATIONS FOR THIS PROJECT ARE BASED ON GENERATOR SETS MANUFACTURED BY CUMMINS POWER GENERATOR WITH MICROPROCESSOR-BASED CONTROLS. EQUIPMENT BY OTHER SUPPLIERS THAT MEETS THE REQUIREMENT OF THIS SPECIFICATION ARE ACCEPTABLE, IF APPROVED NOT LESS THAN 2 WEEKS BEFORE SCHEDULED BID DATE. PROPOSALS MUST INCLUDE A LINE BY LINE COMPLIANCE STATEMENT BASED ON THIS SPECIFICATION.

PRODUCTS

GENERATOR SET

1. RATING
 - A. THE GENERATOR SET SHALL OPERATE AT 1800 RPM AND AT A VOLTAGE 208 VOLTS AC, THREE PHASE, 4-WIRE, 60 HERTZ.
 - B. THE GENERATOR SET SHALL BE RATED AT 100KW, 125KVA AT 0.8 PF, RATING, BASED ON SITE CONDITIONS OF: ALTITUDE 300FT., AMBIENT TEMPERATURES UP TO 122 DEGREE F (50 DEGREES C).
 - C. THE GENERATOR SET RATING SHALL BE BASED ON EMERGENCY/STANDBY SERVICE.

ENGINE AND ENGINE EQUIPMENT

2. COOLANT HEATER
 - A. ENGINE MOUNTED, THERMOSTATICALLY CONTROLLED, COOLANT HEATER(S) FOR EACH ENGINE. HEATER VOLTAGE SHALL BE AS SHOWN ON THE PROJECT DRAWINGS. THE COOLANT HEATER SHALL BE UL499 LISTED AND LABELED.
 - B. PROVIDED A MINIMUM 12 AMP BATTERY CHARGER FOR EACH GENERATOR SET BATTERY BANK. GENERATOR SETS INCORPATING TWO BATTERY BANKS SHALL BE PROVIDED WITH TWO CHARGERS CONNECTED TOGETHER AND OPERATING IN PARALLEL, WITH ALARM OUTPUT(S) CONNECTED IN PARALLEL. THE CHARGER(S) SHALL INCLUDE THE FOLLOWING CAPABILITIES.
3. AC GENERATOR
 - A. THE AC ALTERNATOR SHALL BE; SYNCHRONOUS, FOUR POLE, 2/3 PITCH, REVOLVING FIELD, DRIP-PROOF CONSTRUCTION, SINGLE PRE-LUBRICATED REGREASABLE BEARING, AIR COOLED BY A DIRECT DRIVE CENTRIFUGAL BLOWER FAN, AND DIRECTLY CONNECTED TO THE ENGINE WITH FLEXIBLE DRIVE DISC. ALL INSULATION SYSTEM COMPONENTS SHALL MEET NEMA MG1 TEMPERATURE LIMITS FOR CLASS F INSULATION SYSTEM. ACTUAL TEMPERATURE RISE MEASURED BY RESISTANCE METHOD AT FULL LOAD SHALL NOT EXCEED ____ DEGREES CENTIGRADE.

4. OTHER EQUIPMENT TO BE PROVIDED WITH THE GENERATOR SET.

A. PROVIDE AND INSTALL A 20-LIGHT LED TYPE REMOTE ALARM ANNUNCIATOR WITH HORN, LOCATED AS SHOWN ON THE DRAWINGS OR IN A LOCATION THAT CAN BE CONVENIENTLY MONITORED BY FACILITY PERSONNEL. THE REMOTE ANNUNCIATOR SHALL PROVIDE ALL THE AUDIBLE AND VISUAL ALARMS CALLED FOR BY NFPA STANDARD 110 FOR LEVEL 1 SYSTEMS FOR THE LOCAL GENERATOR CONTROL PANEL. SPARE LAMPS SHALL BE PROVIDED TO ALLOW FUTURE ADDITION OF OTHER ALARM AND STATUS FUNCTIONS TO THE ANNUNCIATOR. PROVISIONS FOR LABELING OF THE ANNUNCIATOR IN A FASHION CONSISTENT WITH THE SPECIFIED FUNCTIONS SHALL BE PROVIDED. ALARM SILENCE AND LAMP TEST SWITCH(ES) SHALL BE PROVIDED. LED LAMPS SHALL BE REPLACEABLE, AND INDICATING LAMP COLOR SHALL BE CAPABLE OF CHANGES NEEDED FOR SPECIFIC APPLICATION REQUIREMENTS. ALARM HORN SHALL BE SWITCHABLE FOR ALL ANNUNCIATION POINTS. ALARM HORN (WHEN SWITCHED ON) SHALL SOUND FOR FIRST FAULT, AND ALL SUBSEQUENT FAULTS, REGARDLESS OF WHETHER FIRST FAULT HAS BEEN CLEARED, IN COMPLIANCE WITH NFPA110 3-5.6.2. THE INTERCONNECTING WIRING BETWEEN THE ANNUNCIATOR AND OTHER SYSTEM COMPONENTS SHALL BE MONITORED AND FAILURE OF THE INTERCONNECTION BETWEEN COMPONENTS SHALL BE DISPLAYED ON THE ANNUNCIATOR PANEL.

B. THE GENERATOR SET SHALL BE PROVIDED WITH A MOUNTED MAIN LINE CIRCUIT BREAKER, SIZED TO CARRY THE RATED OUTPUT CURRENT OF THE GENERATOR SET. THE CIRCUIT BREAKER SHALL INCORPORATE AN ELECTRONIC TRIP UNIT THAT OPERATES TO PROTECT THE ALTERNATOR UNDER ALL OVERCURRENT CONDITIONS, OR A THERMAL-MAGNETIC TRIP WITH OTHER OVERCURRENT PROTECTION DEVICES THAT POSITIVELY PROTECT THE ALTERNATOR UNDER OVERCURRENT CONDITIONS. THE SUPPLIER SHALL SUBMIT TIME OVERCURRENT CHARACTERISTIC CURVES AND THERMAL DAMAGE CURVE FOR THE ALTERNATOR, DEMONSTRATING THE EFFECTIVENESS OF THE PROTECTION PROVIDED.

5. OUTDOOR WEATHER-PROTECTIVE ENCLOSURE

A. THE GENERATOR SET SHALL BE PROVIDED WITH AN OUTDOOR ENCLOSURE, WITH THE ENTIRE PACKAGE LISTED UNDER UL2200. THE PACKAGE SHALL COMPLY WITH THE REQUIREMENTS OF THE NATIONAL ELECTRICAL CODE FOR ALL WIRING MATERIALS AND COMPONENT SPACING. THE TOTAL ASSEMBLY OF GENERATOR SET, ENCLOSURE, AND SUB-BASE FUEL TANK (WHEN USED) SHALL BE DESIGNED TO BE LIFTED INTO PLACE USING SPREADER BARS. HOUSING SHALL PROVIDE AMPLE AIRFLOW FOR GENERATOR SET OPERATION AT RATED LOAD IN AN AMBIENT TEMPERATURE OF 100F. THE HOUSING SHALL HAVE HINGED ACCESS DOORS AS REQUIRED TO MAINTAIN EASY ACCESS FOR ALL OPERATING AND SERVICE FUNCTIONS. ALL DOORS SHALL BE LOCKABLE, AND INCLUDE RETAINERS TO HOLD THE DOOR OPEN DURING SERVICE. ENCLOSURE ROOF SHALL BE CAMBERED TO PREVENT RAINWATER ACCUMULATION. OPENINGS SHALL BE SCREENED TO LIMIT ACCESS OF RODENTS INTO THE ENCLOSURE. ALL ELECTRICAL POWER AND CONTROL INTERCONNECTIONS SHALL BE MADE WITHIN THE PERIMETER OF THE ENCLOSURE.

B. ALL SHEET METAL SHALL BE PRIMED FOR CORROSION PROTECTION AND FINISH PAINTED WITH THE MANUFACTURERS STANDARD COLOR USING A TWO STEP ELECTROCOATING PAINT PROCESS,

C. ENCLOSURE SHALL BE CONSTRUCTED OF MINIMUM 12 GAUGE STEEL FOR FRAMEWORK AND 14 GAUGE STEEL FOR PANELS. ALL HARDWARE AND HINGES SHALL BE STAINLESS STEEL.

D. A FACTORY-MOUNTED EXHAUST SILENCER SHALL BE INSTALLED INSIDE THE ENCLOSURE. THE EXHAUST SHALL EXIT THE ENCLOSURE THROUGH A RAIN COLLAR AND TERMINATE WITH A RAIN CAP. EXHAUST CONNECTIONS TO THE GENERATOR SET SHALL BE THROUGH SEAMLESS FLEXIBLE CONNECTIONS.

E. THE ENCLOSURE SHALL INCLUDE THE FOLLOWING MAINTENANCE PROVISIONS:

1. FLEXIBLE COOLANT AND LUBRICATING OIL DRAIN LINES, THAT EXTEND TO THE EXTERIOR OF THE ENCLOSURE, WITH INTERNAL DRAIN VALVES

2. EXTERNAL RADIATOR FILL PROVISION.

F. PROVIDE A SUB-BASE FUEL TANK FOR THE GENERATOR SET, SIZED TO ALLOW FOR FULL LOAD OPERATION OF THE GENERATOR SET FOR 12 HOURS. THE SUB-BASE FUEL TANK SHALL BE UL142 LISTED AND LABELED. INSTALLATION SHALL BE IN COMPLIANCE TO NFPA37. THE FUEL TANK SHALL BE A DOUBLE-WALLED, STEEL CONSTRUCTION AND INCLUDE THE FOLLOWING FEATURES:

1. EMERGENCY TANK AND BASIN VENTS.
2. MECHANICAL LEVEL GAUGE.
3. FUEL SUPPLY AND RETURN LINES, CONNECTED TO GENERATOR SET WITH FLEXIBLE FUEL LINES AS RECOMMENDED BY THE ENGINE MANUFACTURER AND IN COMPLIANCE TO UL2200 AND NFPA 37 REQUIREMENTS.
4. LEAK DETECTION PROVISIONS, WIRED TO THE GENERATOR SET CONTROL FOR LOCAL AND REMOTE ALARM INDICATION.
5. HIGH AND LOW LEVEL FLOAT SWITCHES TO INDICATE FUEL LEVEL. WIRE SWITCHES TO GENERATOR CONTROL FOR LOCAL AND REMOTE INDICATION OF FUEL LEVEL.
6. BASIN DRAIN.
7. INTEGRAL LIFTING PROVISIONS.

OTHER REQUIRMENTS

1. SUBMITTALS
 - A. WITHIN 10 DAYS AFTER AWARD OF CONTRACT, PROVIDE SIX SETS OF THE FOLLOWING INFORMATION FOR REVIEW:
 1. MANUFACTURER'S PRODUCT LITERATURE AND PERFORMANCE DATA, SUFFICIENT TO VERIFY COMPLIANCE TO SPECIFICATION REQUIREMENTS
 2. A PARAGRAPH BY PARAGRAPH SPECIFICATION COMPLIANCE STATEMENT, DESCRIBING THE DIFFERENCES BETWEEN THE SPECIFIED AND THE PROPOSED EQUIPMENT.
 3. MANUFACTURER'S CERTIFICATION OF PROTOTYPE TESTING.
 4. MANUFACTURER'S PUBLISHED WARRANTY DOCUMENTS.
 5. SHOP DRAWINGS SHOWING PLAN AND ELEVATION VIEWS WITH CERTIFIED OVERALL DIMENSIONS, AS WELL AS WIRING INTERCONNECTION DETAILS.
 6. INTERCONNECTION WIRING DIAGRAMS SHOWING ALL EXTERNAL CONNECTIONS REQUIRED; WITH FIELD WIRING TERMINALS MARKED IN A CONSISTENT POINT TO POINT MANNER.
 7. MANUFACTURER'S INSTALLATION INSTRUCTIONS.
2. FACTORY TESTING
 - A. THE GENERATOR SET MANUFACTURER SHALL PERFORM A COMPLETE OPERATIONAL TEST ON THE GENERATOR SET PRIOR TO SHIPPING FROM THE FACTORY. A CERTIFIED TEST REPORT SHALL BE PROVIDED. EQUIPMENT SUPPLIED SHALL BE FULLY TESTED AT THE FACTORY FOR FUNCTION AND PERFORMANCE.
3. INTALLATION
 - A. EQUIPMENT SHALL BE INSTALLED BY THE CONTRACTOR IN ACCORDANCE WITH FINAL SUBMITTALS AND CONTRACT DOCUMENTS. INSTALLATION SHALL COMPLY WITH APPLICABLE STATE AND LOCAL CODES AS REQUIRED BY THE AUTHORITY HAVING JURISDICTION. INSTALL EQUIPMENT IN ACCORDANCE WITH MANUFACTURER'S INSTRUCTIONS AND INSTRUCTIONS INCLUDED IN THE LISTING OR LABELING OF UL LISTED PRODUCTS.

- B. INSTALLATION OF EQUIPMENT SHALL INCLUDE FURNISHING AND INSTALLING ALL INTERCONNECTING WIRING BETWEEN ALL MAJOR EQUIPMENT PROVIDED FOR THE ON-SITE POWER SYSTEM. THE CONTRACTOR SHALL ALSO PERFORM INTERCONNECTING WIRING BETWEEN EQUIPMENT SECTIONS (WHEN REQUIRED), UNDER THE SUPERVISION OF THE EQUIPMENT SUPPLIER.
 - C. EQUIPMENT SHALL BE INSTALLED ON CONCRETE HOUSEKEEPING PADS. EQUIPMENT SHALL BE PERMANENTLY FASTENED TO THE PAD IN ACCORDANCE WITH MANUFACTURER'S INSTRUCTIONS AND SEISMIC REQUIREMENTS OF THE SITE.
 - D. EQUIPMENT SHALL BE INITIALLY STARTED AND OPERATED BY REPRESENTATIVES OF THE MANUFACTURER.
 - E. ALL EQUIPMENT SHALL BE PHYSICALLY INSPECTED FOR DAMAGE. SCRATCHES AND OTHER INSTALLATION DAMAGE SHALL BE REPAIRED PRIOR TO FINAL SYSTEM TESTING. EQUIPMENT SHALL BE THOROUGHLY CLEANED TO REMOVE ALL DIRT AND CONSTRUCTION DEBRIS PRIOR TO INITIAL OPERATION AND FINAL TESTING OF THE SYSTEM.
4. TRAINING
- A. THE EQUIPMENT SUPPLIER SHALL PROVIDE TRAINING FOR THE FACILITY OPERATING PERSONNEL COVERING OPERATION AND MAINTENANCE OF THE EQUIPMENT PROVIDED. THE TRAINING PROGRAM SHALL BE NOT LESS THAN 4 HOURS IN DURATION AND THE CLASS SIZE SHALL BE LIMITED TO 5 PERSONS. TRAINING DATE SHALL BE COORDINATED WITH THE FACILITY OWNER.
5. SERVICE AND SUPPORT
- A. THE MANUFACTURER OF THE GENERATOR SET SHALL MAINTAIN SERVICE PARTS INVENTORY AT A CENTRAL LOCATION WHICH IS ACCESSIBLE TO THE SERVICE LOCATION 24 HOURS PER DAY, 365 DAYS PER YEAR.
 - B. THE GENERATOR SET SHALL BE SERVICED BY A LOCAL SERVICE ORGANIZATION THAT IS TRAINED AND FACTORY CERTIFIED IN GENERATOR SET SERVICE. THE SUPPLIER SHALL MAINTAIN AN INVENTORY OF CRITICAL REPLACEMENT PARTS AT THE LOCAL SERVICE ORGANIZATION, AND IN SERVICE VEHICLES. THE SERVICE ORGANIZATION SHALL BE ON CALL 24 HOURS PER DAY, 365 DAYS PER YEAR.
6. WARRANTY
- A. THE GENERATOR SET AND ASSOCIATED EQUIPMENT SHALL BE WARRANTED FOR A PERIOD OF NOT LESS THAN 5 YEARS FROM THE DATE OF COMMISSIONING AGAINST DEFECTS IN MATERIALS AND WORKMANSHIP.
 - B. THE WARRANTY SHALL BE COMPREHENSIVE. NO DEDUCTIBLES SHALL BE ALLOWED FOR TRAVEL TIME, SERVICE HOURS, REPAIR PARTS COST, ETC.

Division 16 – Electrical
Emergency/Standby Power Systems
Transfer Switches

Part 1. GENERAL

1.01 Scope

- A. Provide complete factory assembled power transfer equipment with field programmable digital electronic controls designed for fully automatic operation and including: surge voltage isolation, voltage sensors on all phases of both sources, linear operator, permanently attached manual handles, positive mechanical and electrical interlocking, and mechanically held contacts for both sources.
- B. The generator set manufacturer shall warrant transfer switches to provide a single source of responsibility for all the products provided. Technicians specifically trained to support the product and employed by the generator set supplier shall service the transfer switches.

1.02 Codes and Standards

- A. The automatic transfer switch installation and application shall conform to the requirements of the following codes and standards:
 - 1. CSA 282, Emergency Electrical Power Supply for Buildings
 - 2. NFPA70 – National Electrical Code. Equipment shall be suitable for use in systems in compliance to Article 700, 701, and 702.
 - 3. NFPA99 – Essential Electrical Systems for Health Care Facilities
 - 4. NFPA110 – Emergency and Standby Power Systems. The transfer switch shall meet all requirements for Level 1 systems.
 - 5. IEEE446 – Recommended Practice for Emergency and Standby Power Systems for Commercial and Industrial Applications.
 - 6. NEMA ICS10-1993 – AC Automatic Transfer Switches.
- B. The transfer switch assembly shall comply with the following standards:
 - 1. CSA C22.2, No. 14 – M91 Industrial Control Equipment.
 - 2. EN55011, Class B Radiated Emissions
 - 3. EN55011, Class B Conducted Emissions
 - 4. IEC 1000-4-5 (EN 61000-4-5); AC Surge Immunity.
 - 5. IEC 1000-4-4 (EN 61000-4-4) Fast Transients Immunity
 - 6. IEC 1000-4-2 (EN 61000-4-2) Electrostatic Discharge Immunity
 - 7. IEC 1000-4-3 (EN 61000-4-3) Radiated Field Immunity
 - 8. IEC 1000-4-6 Conducted Field Immunity
 - 9. IEC 1000-4-11 Voltage Dip Immunity.
 - 10. IEEE 62.41, AC Voltage Surge Immunity.
 - 11. IEEE 62.45, AC Voltage Surge.
 - 12. UL1008 – Transfer Switches. Transfer switches shall be UL1008 listed. UL1008 transfer switches may be supplied in UL891 enclosures if necessary to meet the physical requirements of the project.
- C. The transfer switch manufacturer shall be certified to ISO 9001 International Quality Standard and shall have third party certification verifying quality assurance in design/development, production, installation, and service, in accordance with ISO 9001.

1.03 Acceptable Manufacturers

Only approved bidders shall supply equipment provided under this contract. Equipment specifications for this project are based on microprocessor-based transfer switches manufactured by Cummins Onan. Equipment by other suppliers that meets the requirement of this specification are acceptable, if approved not less than 2 weeks before scheduled bid date. Proposals must include a line by line compliance statement based on this specification.

Part 2. PRODUCTS

2.01 Power Transfer Switch

A. Ratings

1. Refer to the project drawings for specifications on the sizes and types of transfer switch equipment, withstand and closing ratings, voltage and ampere ratings, enclosure type, and accessories. Unless otherwise noted on the drawings, transfer switches operating at 150VAC (line to neutral) and lower, and transfer switches serving exclusively 3-wire loads shall be 3 pole with solid neutral. All other transfer switches shall be 4 pole.
2. Main contacts shall be rated for 600 Volts AC minimum.
3. Transfer switches shall be rated to carry 100 percent of rated current continuously in the enclosure supplied, in ambient temperatures of -40 to +60 degrees C, relative humidity up to 95% (non-condensing), and altitudes up to 10,000 feet (3000M).
4. Transfer switch equipment shall have withstand and closing ratings (WCR) in RMS symmetrical amperes greater than the available fault currents shown on the drawings and at the specified voltage. The transfer switch and its upstream protection shall be coordinated. The transfer switch shall be third party listed and labeled for use with the specific protective device(s) installed in the application.

B. Construction

1. Transfer switches shall be double-throw, electrically and mechanically interlocked, and mechanically held in the source 1 and source 2 positions. The transfer switch shall be specifically designed to transfer to the best available source if it inadvertently stops in a neutral position.
2. Transfer switches rated through 1000 amperes shall be equipped with permanently attached manual operating handles and quick-break, quick-make over-center contact mechanisms. Transfer switches over 1000 amperes shall be equipped with manual operators for service use only under de-energized conditions.
3. Main switch contacts shall be high-pressure silver alloy. Contact assemblies shall have arc chutes for positive arc extinguishing. Arc chutes shall have insulating covers to prevent inter-phase flashover.
4. Transfer switch internal wiring shall be composed of pre-manufactured harnesses that are permanently marked for source and destination. Harnesses shall be connected to the control system by means of locking disconnect plug(s), to allow the control system to be easily disconnected and serviced without disconnecting power from the transfer switch mechanism.
5. Power transfer switch shall be provided with flame retardant transparent covers to allow viewing of switch contact operation but prevent direct contact with components that could be operating at line voltage levels.
6. Transfer switches designated on the drawings as 4-pole shall be provided with a switched neutral pole. The neutral pole shall be of the same construction and have the same ratings as the phase poles. All poles shall be switched simultaneously using a common crossbar. Substitute equipment using overlapping neutral contacts is not acceptable.
7. Transfer switches that are designated on the drawings as 3-pole shall be provided with a neutral bus and lugs. The neutral bus shall be sized to carry 100% of the current designated on the switch rating.

C. Connections

1. Field control connections shall be made on a common terminal block that is clearly and permanently labeled.

2. Transfer switch shall be provided with AL/CU mechanical lugs sized to accept the full output rating of the switch. Lugs shall be suitable for the number and size of conductors shown on the drawings.

2.02 Transfer Switch Control

- A. Operator Panel. Each transfer switch shall be provided with a control panel to allow the operator to view the status and control operation of the transfer switch. The operator panel shall be a sealed membrane panel rated NEMA 3R/IP53 or better (regardless of enclosure rating) that is permanently labeled for switch and control functions. The operator panel shall be provided with the following features and capabilities.
 1. High intensity LED lamps to indicate the source that the load is connected to (source 1 or source 2); and which source(s) are available. Source available LED indicators shall operate from the control microprocessor to indicate the true condition of the sources as sensed by the control.
 2. High intensity LED lamps to indicate that the transfer switch is "not in auto" (due to control being disabled or due to bypass switch (when used) enabled or in operation) and "Test/Exercise Active" to indicate that the control system is testing or exercising the generator set.
 3. "OVERRIDE" pushbutton to cause the transfer switch to bypass any active time delays for start, transfer, and retransfer and immediately proceed with its next logical operation.
 4. "TEST" pushbutton to initiate a preprogrammed test sequence for the generator set and transfer switch. The transfer switch shall be programmable for test with load or test without load.
 5. "RESET/LAMP TEST" pushbutton that will clear any faults present in the control, or simultaneously test all lamps on the panel by lighting them.
 6. The control system shall continuously log information on the number of hours each source has been connected to the load, the number of times transferred, and the total number of times each source has failed. This information shall be available via a PC-based service tool and an operator display panel.
 7. Vacuum fluorescent alphanumeric display panel with push-button navigation switches. The display shall be clearly visible in both bright (sunlight) and no light conditions. It shall be visible over an angle of at least 120 degrees. The Alphanumeric display panel shall be capable of providing the following functions and capabilities:
 - a) Display source condition information, including AC voltage for each phase of normal and emergency source, frequency of each source. Voltage for all three phases shall be displayed on a single screen for easy viewing of voltage balance. Line to neutral voltages shall be displayed for 4-wire systems.
 - b) Display source status, to indicate source is connected or not connected.
 - c) Display load data, including 3-phase AC voltage, 3-phase AC current, frequency, KW, KVA, and power factor. Voltage and current data for all phases shall be displayed on a single screen.
 - d) The display panel shall allow the operator to view and make the following adjustments in the control system, after entering an access code:
 - i. *Set nominal voltage and frequency for the transfer switch.*
 - ii. *Adjust voltage and frequency sensor operation set points.*
 - iii. *Set up time clock functions.*
 - iv. *Set up load sequence functions.*
 - v. *Enable or disable control functions in the transfer switch, including program transition.*
 - vi. *Set up exercise and load test operation conditions, as well as normal system time delays for transfer time, time delay start, stop, transfer, and retransfer.*
 - e) Display Real time Clock data, including date, and time in hours, minutes, and seconds. The real time clock shall incorporate provisions for automatic daylight savings time and leap year adjustments. The control shall also log total operating hours for the control system.
 - f) Display service history for the transfer switch. Display source connected hours, to indicate the total number of hours connected to each source. Display number of times transferred, and total number of times each source has failed.
 - g) Display fault history on the transfer switch, including condition, and date and time of fault. Faults to include controller checksum error, low controller DC voltage, ATS fail to close on transfer, ATS fail to

close on retransfer, battery charger malfunction, network battery voltage low, network communications error.

B. Internal Controls

1. The transfer switch control system shall be configurable in the field for any operating voltage level up to 600VAC. Provide RMS voltage sensing and metering that is accurate to within plus or minus 1% of nominal voltage level. Frequency sensing shall be accurate to within plus or minus 0.2%. Voltage sensing shall be monitored based on the normal voltage at the site. Systems that utilize voltage monitoring based on standard voltage conditions that are not field configurable are not acceptable.
2. Transfer switch voltage sensors shall be close differential type, providing source availability information to the control system based on the following functions:
 - a) Monitoring all phases of the normal service (source 1) for under voltage conditions (adjustable for pickup in a range of 85 to 98% of the normal voltage level and dropout in a range of 75 to 98% of normal voltage level).
 - b) Monitoring all phases of the emergency service (source 2) for under voltage conditions (adjustable for pickup in a range of 85 to 98% of the normal voltage level and dropout in a range of 75 to 98% of pickup voltage level).
 - c) Monitoring all phases of the normal service (source 1) and emergency service (source 2) for loss of a single phase.
3. All transfer switch sensing shall be configurable from a Windows 95, 98, or NT PC-based service tool, to allow setting of levels, and enabling or disabling of features and functions. Selected functions including voltage sensing levels and time delays shall be configurable using the operator panel. Designs utilizing DIP switches or other electromechanical devices are not acceptable. The transfer control shall incorporate a series of diagnostic LED lamps.
4. The transfer switch shall be configurable to control the operation time from source to source (program transition operation). The control system shall be capable of enabling or disabling this feature, and adjusting the time period to a specific value. A phase band monitor or similar device is not an acceptable alternate for this feature.
5. The transfer switch shall incorporate adjustable time delays for generator set start (adjustable in a range from 0-15 seconds); transfer (adjustable in a range from 0-120 seconds); retransfer (adjustable in a range from 0-30 minutes); and generator stop (cooldown) (adjustable in a range of 0-30 minutes).
6. The transfer switch shall be configurable to accept a relay contact signal and a network signal from an external device to prevent transfer to the generator service.
7. The control system shall be designed and prototype tested for operation in ambient temperatures from -40C to +70C. It shall be designed and tested to comply with the requirements of the noted voltage and RFI/EMI standards.
8. The control shall have optically isolated logic inputs, high isolation transformers for AC inputs, and relays on all outputs, to provide optimum protection from line voltage surges, RFI and EMI.

C. Control Interface

1. The transfer switch will provide an isolated relay contact for starting of a generator set. The relay shall be normally held open, and close to start the generator set. Output contacts shall be form C, for compatibility with any generator set.
2. Provide one set Form C auxiliary contacts on both sides, operated by transfer switch position, rated 10 amps 250 VAC.

2.03 Enclosure

- A. Enclosures shall be UL listed. The enclosure shall provide wire bend space in compliance to the latest version of NFPA70. The cabinet door shall include permanently mounted key type latches.
- B. Transfer switch equipment shall be provided in a NEMA 3R or better enclosure.
- C. Enclosures shall be the NEMA type specified. The cabinet shall provide code-required wire bend space at point of entry as shown on the drawings. Manual operating handles and all control switches (other than key-operated switches) shall be accessible to authorized personnel only by opening the key-locking cabinet

door. Transfer switches with manual operating handles and/or non key-operated control switches located on outside of cabinet do not meet this specification and are not acceptable.

Part 3. OPERATION

3.01 Open Transition Sequence of Operation

- A. Transfer switch normally connects an energized utility power source (source 1) to loads and a generator set (source 2) to the loads when normal source fails. The normal position of the transfer switch is source 1 (connected to the utility), and no start signal is supplied to the genset.
- B. Generator Set Exercise (Test) With Load Mode. The control system shall be configurable to test the generator set under load. In this mode, the transfer switch shall control the generator set in the following sequence:
 - 1. Transfer switch shall initiate the exercise sequence at a time indicated in the exercise timer program, or when manually initiated by the operator.
 - 2. The transfer switch shall issue a compatible start command to the generator set, and cause the generator set to start and run at idle until it has reached normal operating temperature.
 - 3. When the generator set has reached normal operating temperature or after an adjustable time period (whichever is shorter), the control system shall accelerate the generator set to rated voltage and frequency.
 - 4. When the control systems senses the generator set at rated voltage and frequency, it shall operate to connect the loads to the generator set by opening the normal source contacts, and closing the alternate source contacts a predetermined time period later. The timing sequence for the contact operation shall be programmable in the controller.
 - 5. The generator set shall operate connected to the load for the duration of the exercise period. If the generator set fails during this period, the transfer switch shall automatically reconnect the generator set to the normal service.
 - 6. On completion of the exercise period, the transfer switch shall operate to connect the loads to the normal source by opening the alternate source contacts, and closing the normal source contacts a predetermined time period later. The timing sequence for the contact operation shall be programmable in the controller.
 - 7. The transfer switch shall operate the generator set unloaded for a cooldown period, and then remove the start signal from the generator set. If the normal power fails at any time when the generator set is running, the transfer switch shall immediately connect the system loads to the generator set.
- C. Generator Set Exercise (Test) Without Load Mode. The control system shall be configurable to test the generator set without transfer switch load connected. In this mode, the transfer switch shall control the generator set in the following sequence:
 - 1. Transfer switch shall initiate the exercise sequence at a time indicated in the exercise timer program, or when manually initiated by the operator.
 - 2. The transfer switch shall issue a compatible start command to the generator set, and cause the generator set to start and run at idle until it has reached normal operating temperature.
 - 3. When the generator set has reached normal operating temperature or after an adjustable time period (whichever is shorter), the control system shall accelerate the generator set to rated voltage and frequency.
 - 4. When the control systems senses the generator set at rated voltage and frequency, it shall operate the generator set unloaded for the duration of the exercise period.
 - 5. At the completion of the exercise period, the transfer switch shall remove the start signal from the generator set. If the normal power fails at any time when the generator set is running, the transfer switch shall immediately connect the system loads to the generator set.

Part 4. OTHER REQUIREMENTS

4.01 Factory Testing. The transfer switch manufacturer shall perform a complete operational test on the transfer switch prior to shipping from the factory. A certified test report shall be available on request. Test process shall include calibration of voltage sensors.

4.02 Service and support

- A. The manufacturer of the transfer switch shall maintain service parts inventory at a central location which is accessible to the service location 24 hours per day, 365 days per year.
- B. The transfer switch shall be serviced by a local service organization that is trained and factory certified in both generator set and transfer switch service. The supplier shall maintain an inventory of critical replacement parts at the local service organization, and in service vehicles. The service organization shall be on call 24 hours per day, 365 days per year.
- C. The manufacturer shall maintain model and serial number records of each transfer switch provided for at least 20 years.