SECTION 26 36 23
AUTOMATIC TRANSFER SWITCHES

PART 1 - GENERAL

1.1 DESCRIPTION

This section specifies the furnishing, installation, connection, and testing of open-transition automatic transfer switches.

1.2 RELATED WORK

A. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General electrical requirements and items that are common to more than one section in Division 26.

B. Section 26 05 21, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW): Cables and wiring.

C. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personal safety and to provide a low impedance path for possible ground fault currents.

D. Section 26 05 33, RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS: Raceways for power and control wiring.

1.3 QUALITY ASSURANCE

A. Refer to Paragraph, QUALIFICATIONS, in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

B. A factory-authorized representative shall maintain a service center capable of providing emergency maintenance and repair services at the project site within a 8 hour maximum response time.

C. Automatic transfer switch, and annunciation control panels shall be products of same manufacturer.

1.4 FACTORY TESTS

A. Automatic transfer switches shall be thoroughly tested at the factory to ensure that there are no electrical or mechanical defects. Tests shall be conducted per UL standards. Factory tests shall be certified. The following factory tests shall be performed:

1. Visual inspection to verify that each ATS is as specified.
2. Mechanical test to verify that ATS sections are free of mechanical hindrances.
3. Insulation resistance test to ensure integrity and continuity of entire system.
4. Main switch contact resistance test.
5. Electrical tests to verify complete system electrical operation and to set up time delays and voltage sensing settings.

1.5 SUBMITTALS

A. Submit in accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

B. Shop Drawings:

1. Present sufficient information to clearly demonstrate compliance with drawings and specifications.
2. Include electrical ratings (including withstand), dimensions, weights, mounting details, conduit entry provisions front view, side view, equipment and device arrangement, elementary and interconnection wiring diagrams, factory relay settings, and accessories.
3. Complete nameplate data, including manufacturer's name and catalog number.
4 A copy of the markings that are to appear on the transfer switches when installed.

C. Manuals:

1. When submitting the shop drawings, submit companion copies of complete maintenance and operating and maintenance manuals, including technical data sheets, wiring diagrams and information, such as telephone number, fax number and web sites, for ordering replacement parts.
2. Two weeks prior to final inspection, submit four copies of a final updated maintenance and operating manual to the COTR.
   a. Include complete "As Installed" diagrams that indicate all pieces of equipment and their interconnecting wiring.
   b. Include complete diagrams of the internal wiring for each piece of equipment, including "As Installed" revisions of the diagrams.
   c. The wiring diagrams shall identify the terminals to facilitate installation, maintenance, operation, and testing.

D. Certifications:

1. When submitting the shop drawings, submit a certified test report from a recognized independent testing laboratory that a representative sample has passed UL 1008A prototype testing.
2. Two weeks prior to final inspection, submit four copies of the following to the COTR:
   a. Certification that no design changes have been made to the switch or its components since last certified by UL or tested by an independent laboratory.
   b. Certification by the manufacturer that the equipment conforms to the requirements of the drawings and specifications.

c. Certification that the withstand current rating has been coordinated with upstream protective devices.
d. Certification by the contractor that the equipment has been properly installed, adjusted, and tested in accordance with the manufacturer's recommendations.
e. A certified test report from an independent laboratory that a representative sample has passed the ANSI surges withstand test for transfer switches which incorporate solid-state components.

1.6 APPLICABLE PUBLICATIONS

A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only:

B. Institute of Electrical and Electronic Engineers (IEEE):

446-95.....Recommended Practice for Design and Maintenance of Emergency and Standby Power Systems

C37.90.1-02.....Surge Withstand Capability (SWC) Tests for Relays and Relay Systems Associated with Electric Power Apparatus

C62.41.1-02.....Guide on the Surges Environment in Low-Voltage (1000 V and Less) AC Power Circuits

C62.41.2.....Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits

C37.20.2.....Switchgear Assemblies

C57.13.....Standard Requirements for Instrument Transformers

C. National Electrical Manufacturers Association (NEMA):

250-03.....Enclosure for Electrical Equipment (1000 Volts Maximum)

ICS 6-06.....Enclosures

IC3 4-05.....Industrial Control and Systems: Terminal Blocks

MG 1-07.....Motors and Generators

SG-5.....Power Switchgear Assemblies

D. National Fire Protection Association (NFPA):

70–11.....National Electrical Code (NEC)

99-05.....Health Care Facilities

110-10.....Emergency and Standby Power Systems

E. Underwriters Laboratories, Inc. (UL):

50-95.....Enclosures for Electrical Equipment

508-99.....Industrial Control Equipment

891-05.....Dead-Front Switchboards

1008-96.....Transfer Switch Equipment
61010B-1.....Electrical Measuring and Test Equipment; Part 1: General Requirements

PART 2 - PRODUCTS

2.1 OPEN-TRANSITION MEDIUM VOLTAGE AUTOMATIC TRANSFER SWITCH

A. General:
   1. Comply with UL, NEMA, NEC, ANSI, IEEE, and NFPA.
   2. Automatic transfer switch is to be 3 pole, 5kV rated, draw-out construction, electrically operated, mechanically held open contact type, without integral overcurrent protection.
   3. Automatic transfer switches shall be completely factory-assembled and wired such that only external circuit connections are required in the field.
   4. Ratings:
      a. Phases, voltage, ampere rating, poles, and withstand current rating shall be as shown on the drawings.
      b. Transfer switches are to be rated for continuous duty at specified continuous current rating on 60Hz systems.
   5. Markings:
      a. Markings shall be in accordance with UL 1008A.
      b. Markings for the additional withstand test specified below shall be included in the nameplate data.
   6. Tests: Automatic transfer switches shall be tested in accordance with UL 1008A. The contacts of the transfer switch shall not weld during the performance of withstand and closing tests when used with the upstream overcurrent device and available fault current specified.
   7. Surge Withstand Test: Transfer switches utilizing solid-state devices in sensing, relaying, operating, or communication equipment or circuits shall comply with IEEE C37.90.1.

B. Manufacturer Qualifications: The manufacturer shall demonstrate a minimum of 5 years experience in the design, building, testing and service of this type of medium voltage equipment and be able to document their qualifications. Only suppliers with the demonstrated ability and experience to provide this type of system shall be acceptable.

C. Medium Voltage Automatic Transfer Switch Ratings: The rating of the transfer system shall be 4.16kV, 1200A, 250 MVA, 3 phase, 3 wire, 60 Hertz.

D. Medium Voltage Automatic Transfer Switch Testing:
   1. The equipment shall be factory tested to simulate a complete and integrated system. The circuit breakers supplied shall be installed

in their actual positions and electrically and mechanically tested. A narrative of the system operation shall be provided and shall be utilized when testing the equipment. Copies of the test reports shall be submitted to the engineer.

2. The following separate tests shall be performed on the switchgear:
   a. Dielectric Test...ANSI C37.20.2, 5.3.1
   b. Mechanical Test...ANSI C37.20.2, 5.3.2
   c. Grounding of Instrument Transformer Case Test...ANSI C37.20.2, 5.3.3
   d. Electrical Operation and Control Wiring Test...ANSI C37.20.2, 5.3.4.1
   e. Polarity Test...ANSI C37.20.2, 5.3.4.3
   f. Sequence Test...ANSI C37.20.2, 5.3.4.4
3. Warranty: The manufacturer shall warrant the equipment, accessories and operation for one (1) year from the date of final acceptance.

E. Medium Voltage Automatic Transfer Switch Construction:
1. Structure:
   a. The switchgear enclosure shall be made from 11-gauge sheet steel and shall meet the requirements for Seismic Zone 1, as outlined by the Uniform Building Code. Certificate of compliance is required. Suitable means of lifting shall be provided.
   b. All equipment bases shall be fabricated with an adequate number of anchor bolt holes designed to put the base in direct contact with the concrete pad when bolted.
   c. All switchgear doors shall be pan type and be provided with sufficient hinges and stiffeners to support the door and components for an absolute minimum deflection and wobbling when opening or closing. Doors must operate more than 90 degrees.
   d. An outer weatherproof, 14-guage minimum, enclosure with a minimum 6ft. wide isle, door, and switchable fluorescent lighting plus adequate ventilation shall enclose the switchgear. Enclosure shall be designed to withstand 80 MPH winds. Door shall be key lockable with key and lockset matching VA standard lockset.
2. Layout: All equipment shall be arranged in a logical manner to facilitate ease of operation and maintenance of the equipment.
3. Paint: The complete assembly shall be thoroughly cleaned and treated prior to painting. The unit shall be painted ANSI-61, light gray with paint suitable for outdoor locations in a color chosen by the COTR.

4. Bus:
   a. Main bus shall be rated 1200 amps and shall be fabricated from silver-plated copper. The maximum temperature rise allowed shall not exceed 65°C over a 40°C ambient. The bus shall be insulated to provide the applicable ANSI C37.20 Basic Insulation Level of 60KV BIL. Bus bracing will withstand the rated MVA short circuit current as calculated by incoming utility equipment and/or the worst case combination of Utility and generator contributions.
   b. A 1/4"x2" copper ground bus shall extend the full length of the switchgear and shall effectively ground all non-current carrying metallic parts. A bus joint shall be provided between each shipping split, and when removed, no ground bus will extend beyond the section side. Provisions shall be included to receive a site ground connection.
5. Wiring:
   a. Control wiring shall be 600 volt, 90 degrees C. switchboard type SIS, and minimum size No. 14. Use solderless compression type connectors for terminating all wires. Current transformer circuit terminations shall be ring tongue type, other circuits shall be locking spade type. For wiring from supervisory and annunciator devices to terminal blocks, U.L. recognized wire smaller than 14 AWG may be used. Control wires shall be permanently numbered on both ends with wire markers applied next to the terminals with the number visible. The low-level signal circuits shall be separated and provided with shielded wire to minimize electromagnetic cross talk and interference.
   b. Grommeted holes shall be provided between each of the vertical sections to allow control wiring to pass through. Wiring shall not be spliced and shall be free of abrasions and tool marks. The wires shall be neatly laced up and harnessed, and shall be supported to prevent sagging or breakage from weight or vibration. Wiring bundles shall be contained in covered metal or plastic gutters.
   c. All wiring to hinged doors shall be run through door terminal blocks. Terminal blocks shall be provided for all external connections and they shall be readily accessible in an area not exposed to hazardous bus or cables.
6. Safety:
   a. Components shall be enclosed within grounded metal enclosures.

b. Barriers will be provided to isolate major components as provided by ANSI C37.20.2. All connections shall be terminated in accessible areas.

c. Warning labels shall be provided with "DANGER HIGH VOLTAGE" for all access areas to power circuits.

7. Locks: Front doors shall be supplied with a lockable handle. All door locks shall be keyed alike to operate from a single key and one key shall be supplied for each lock. Full height doors will utilize latching at three (3) points to secure the door firmly when closed.

F. Medium Voltage Automatic Transfer Switch Components:

1. Transfer Controller:

a. The controller's sensing and logic shall be provided by a single built-in microprocessor for maximum reliability, minimum maintenance and the ability to communicate serially through an optional serial communication module

b. The single controller’s voltage sensing shall be true RMS type and shall be accurate to ± 1% of nominal voltage. Frequency sensing shall be accurate to ± 0.2%. The panel shall be capable of operating over a temperature range of - 20 to + 60 degrees C and storage from – 55 to + 85 degrees C.

c. The controller shall be connected to the transfer switch by an interconnecting wiring harness. The harness shall include a keyed disconnect plug to enable the controller to be disconnected from the transfer switch for routine maintenance. Sensing and control logic shall be provided on multi-layer printed circuit boards. Interfacing relays shall be industrial grade plug-in type with dust covers. The panel shall be enclosed with a protective cover and be mounted separately from the transfer switch unit for safety and ease of maintenance. The protective cover shall include a built-in pocket for storage of the operator’s manuals.

d. All customer connections shall be wired to a common terminal block to simplify field-wiring connections.

e. The controller shall meet or exceed the requirements for Electromagnetic Compatibility (EMC) as follows:

1) IEEE472 (ANSI C37.90A)...Ring Wave Test.

2) ENC55011 1991...Class A Conducted and Radiated Emission.

3) EN61000-4-2...Electrostatic Discharge Immunity, Direct Contact Air Discharge.

4) EN61000-4-3...Radiated Electromagnetic Field Immunity.

5) EN61000-4-4...Electrical Fast Transient Immunity.

6) EN61000-4-5...Surge Immunity.

7) ENV50141...HF Conducted Disturbances Immunity.

f. Controller Display and Keypad:

1) A four line, 20 character LCD display and 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 limited control through the serial communications input port. The following parameters shall only be adjustable via DIP switches on the controller:

a) Nominal line voltage and frequency

b) Single or three phase sensing

c) Operating parameter protection

g. Voltage, Frequency, and Phase Rotation Sensing:

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

Parameter	Sources	Dropout / Trip	Pickup / Reset
Undervoltage	N&E,3ϕ	70 to 98%	85 to 100%
Overvoltage	N&E,3ϕ	102 to 115%	2% below trip
Underfrequency	N&E	85 to 98%	90 to 100%
Overfrequency	N&E	102 to 110%	2% below trip
Voltage unbalance	N&E	5 to 20%	1% below dropout

2) Repetitive accuracy of all settings shall be within ± 0.5% over an operating temperature range of -20°C to 60°C.

3) Voltage and frequency settings shall be field adjustable in 1% increments either locally with the display and keypad or remotely via serial communications port access.

4) The controller shall be capable (when activated by the keypad or through the serial port) 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 CBA).

h. Time Delays:

1) An adjustable time delay of 0 to 6 seconds shall be provided to override momentary normal source outages and delay all transfer

and engine starting signals. Capability shall be provided to extend this time delay to 60 minutes by providing an external 24 VDC power supply.

2) A time delay shall be provided on transfer to emergency, adjustable from 0 to 60 minutes, for controlled timing of transfer of loads to emergency.
3) Emergency source failure time delay to ignore momentary transients during initial generator set loading - adjustable 0 to 60 seconds.
4) Two time delay modes (which are independently adjustable) shall be provided on re-transfer to normal. One time delay shall be for actual normal power failures and the other for the test mode function. The time delays shall be adjustable from 0 to 60 minutes. Time delay shall be automatically bypassed if the emergency source fails and the normal source is acceptable.
5) A time delay shall be provided on shut down of engine generator for cool down, adjustable from 0 to 60 minutes.
6) All time delays shall be adjustable in 1-second increments, except the extended parallel time, which shall be adjustable in .01 second increments.
7) The controller shall also include the following built-in time delays for optional Closed Transition and Delayed Transition operation.

2. Protective Relays:
   a. Door mounted protective relays shall be utility grade solid state with semi-flush mounting and drawout cases. They shall have standard built-in test features and targets where applicable. They shall be supplied with any special tools and test plugs required for normal calibration and maintenance.
   b. Utility Source Protective Relaying: Provide Schweitzer, SEL351S or equivalent.
   c. Generator Source Protective Relaying: Provide GE, SR489 or equivalent.
3. Circuit Breakers:
   a. The metal-clad switchgear shall include vacuum circuit breakers. The vacuum circuit breaker element shall be complete with operating mechanism, auxiliary switches and interlocks. A barrier shall separate the high voltage parts of the circuit breaker from the operating mechanism and control devices. The circuit breakers will be horizontal drawout type capable of being withdrawn on rails. The breakers shall be operated by a motor charged spring

stored energy mechanism. The stored energy mechanism shall be front accessible and will be charged normally by a universal motor and in an emergency by a manual handle. The primary disconnecting contacts will be silver plated copper.

b. Each circuit breaker shall contain three vacuum interrupters separately mounted. An integral contact wear gap indicator for each vacuum interrupter shall be easily visible. The current transfer from the vacuum interrupter moving stem to the breaker main conductor shall be a non-sliding design. The breaker shall be removable when the breaker is withdrawn for ease of inspection and maintenance.

c. The secondary disconnecting device shall provide connections for the control circuits between the circuit breaker unit and the housing and will consist of multiple plugs and socket contacts of the train line coupler type. The secondary disconnect shall automatically engage when the circuit breaker is placed in the "operating" position and be re-engaged manually when the unit is in the "test" position, without using a test jumper.

d. The breaker unit shall be moved between the "test" position and "operating" position by means of a levering device that is operated by a removable hand crank. The levering device shall be mechanically interlocked with the breaker closing mechanism so that a closed breaker cannot be removed from the "operating" position or cannot be closed when the levering device is between the "operating" position and the "test" position.

e. Interlocks will be provided to trip breakers upon insertion or removal from housing and to discharge stored energy mechanisms upon insertion or removal from the housing. The breaker will be secured positively in the housing between and including the operating and test positions.

f. A mechanical means shall be provided to prevent over-tightening a breaker when levered into the compartment.

4. Control Power Fuses (600V Class):

a. Fuses shall be mounted in locations where they are readily accessible. Pullout type fuses shall be provided for all primary circuits and shall be of the current limiting type.

b. Three (3) spare fuses of each type and ampere rating used in this equipment shall be supplied separately but shipped with the equipment.

5. Terminal Blocks: Terminal blocks shall be suitable for ring tongue terminals and provided with binding head screws, minimum size of screw 8/32. The terminal block rating shall be 600V.
6. Solid State Circuitry: Solid state controls, relays, timers or monitors shall meet the following specifications:
   a. Accuracy: ± 2% of set point.
   b. Temp Range: - 20°C to + 60°C operating (- 55°C to + 85° C Storage).
   c. Protection: Transient overvoltage withstand of 1500 volts peak, 1m sec. time constant.
   d. Ratings: Current ratings to exceed application of devices. Devices shall be UL listed.

G. Medium Voltage Automatic Transfer Switch Additional Features:
1. A three position momentary-type test switch shall be provided for the test / automatic / reset modes. The test position will simulate a normal source failure. The reset position shall bypass the time delays on either transfer to emergency or retransfer to normal.
2. A set of DPDT gold-flashed contacts rated 10 amps, 32 VDC shall be provided for a low-voltage engine start signal. The start signal shall prevent dry cranking of the engine by requiring the generator set to reach proper output, and run for the duration of the cool down setting, regardless of whether the normal source restores before the load is transferred.
3. Auxiliary contacts, rated 10 amps, 250 VAC shall be provided consisting of one contact, closed when the ATS is connected to the normal source and one contact closed, when the ATS is connected to the emergency source.
4. LED indicating lights (16-mm industrial grade, type 12) shall be provided; one to indicate when the ATS is connected to the normal source (green) and one to indicate when the ATS is connected to the emergency source (red).
5. LED indicating lights (16-mm industrial grade, type 12) shall be provided and energized by controller outputs. The lights shall provide true source availability of the normal and emergency sources, as determined by the voltage sensing trip and reset settings for each source.
6. The following features shall be built-into the controller, but capable of being activated through keypad programming or the serial port only when required by the user:
   a. Provide the ability to select “commit/no commit to transfer” to determine whether the load should be transferred to the emergency

generator if the normal source restores before the generator is ready to accept the load.

b. Terminals shall be provided for a remote contact that opens to signal the ATS to transfer to emergency and for remote contacts that open to inhibit transfer to emergency and/or retransfer to normal. Both of these inhibit signals can be activated through the keypad or serial port.

c. An Inphase monitor shall be provided in the controller. The monitor shall control transfer so that motor load inrush currents do not exceed normal starting currents, and shall not require external control of power sources. The in-phase monitor shall be specifically designed for and be the product of the ATS manufacturer.

d. The controller shall be capable of accepting a normally open contact that will allow the transfer switch to function in a non-automatic mode using an external control device.

7. Engine Exerciser - The controller shall provide an internal engine exerciser. The engine exerciser shall allow the user to program up to seven different exercise routines. For each routine, the user shall be able to:

   a. Enable or disable the routine.
   b. Enable or disable transfer of the load during routine.
   c. Set the start time
   d. Set the time of day
   e. Set the day of week
   f. Set the week of month (1st, 2nd, 3rd, 4th, alternate or every)
   g. Set the duration of the run.

   At the end of the specified duration the switch shall transfer the load back to normal and run the generator for the specified cool down period. A 10-year life battery that supplies power to the real time clock in the event of a power loss will maintain all time and date information.

8. System Status - The controller LCD display shall include a "System Status" screen which shall be readily accessible from any point in the menu by depressing the "ESC" key a maximum of two times. This screen shall display a clear description of the active operating sequence and switch position.

9. Controllers that require multiple screens to determine system status or display "coded" system status messages, which must be explained by references in the operator's manual, are not permissible.

10. Self-Diagnostics - The controller shall contain a diagnostic screen for the purpose of detecting system errors. This screen shall provide information on the status-input signals to the controller, which may be preventing load transfer commands from being completed.
11. Communications Interface – The controller shall be capable of interfacing, through an optional serial communication module, with a network of transfer switches, locally (up to 4000 ft.) or remotely through modem serial communications. Standard software specific for transfer switch applications shall be available by the transfer switch manufacturer. This software shall allow for the monitoring, control and setup of parameters.
12. Data Logging – The controller shall have the ability to log data and to maintain the last 99 events, even in the event of total power loss. The following events shall be time and date stamped and maintained in a non-volatile memory:
13. Event Logging:
    a. Data and time and reason for transfer normal to emergency.
    b. Data and time and reason for transfer emergency to normal.
    c. Data and time and reason for engine start.
    d. Data and time engine stopped.
    e. Data and time emergency source available.
    f. Data and time emergency source not available.
14. Statistical Data:
    a. Total number of transfers.
    b. Total number of transfers due to source failure.
    c. Total number of days controller is energized.
15. Communications Module - A full duplex RS485 interface shall be installed in the ATS controller to enable serial communications. The serial communications shall be capable of a direct connect or multi-drop configured network. This module shall allow for the seamless integration of existing or new communication transfer devices.
16. Auto/manual transfer switch – Transfer switch shall be provided with an automatic or manual operation mode selector switch.
17. Data Monitor for Normal and Emergency Sources - Furnish data monitors for normal and emergency sources to monitor all functions specified below.
    a. The Data Monitors shall be listed to UL 61010B-1, CSA, CE Mark, and industrially rated for an operating temperature range of -20°C to 60°C.
    b. The Data Monitor shall be accurate to 1% measured, 2% computed values and display resolution to .1%. Voltage and current for all

phases shall be sampled simultaneously to assure high accuracy in conditions of low power factor or large waveform distortions (harmonics).

c. The Data Monitor shall be capable of operating without modification at nominal frequencies of 45 to 66 Hz and over a control power input range of 20 – 32VDC.

d. Each Data Monitor shall be capable of interfacing with an optional communications module to permit information to be sent to central location for display, analysis, and logging.

e. The Data Monitor shall accept inputs from industry standard instrument trans-formers (120 VAC secondary PT's and 5A secondary CTS.) Direct phase voltage connections, 600 VAC and under, shall be possible without the use of PT's.

f. The Data Monitor shall be applied in single, 3-phase, or three & four wire circuits. A fourth CT input shall be available to measure neutral or ground current.

g. All setup parameters required by the Data Monitors shall be stored in non-volatile memory and retained in the event of a control power interruption.

h. The following metered readings shall be communicated by the Data Monitor, via serial communication, when equipped with optional serial communications module:

1) Current, per phase RMS and neutral (if applicable)
2) Current Unbalance %
3) Voltage, phase-to-phase and phase-to-neutral
4) Voltage Unbalance %
5) Real power (KW), per phase and 3-phase total
6) Apparent power (KVA), per phase and 3-phase total
7) Reactive power (KVAR), per phase and 3-phase total
8) Power factor, 3-phase total & per phase
9) Frequency
10) Accumulated Energy, (MWH, MVAH, and MVARH)

The following energy readings shall be communicated by the Data Monitor:

a) Accumulated real energy KWH
b) Accumulated reactive energy KVAH
c) Accumulated apparent energy KVARH

NOTE: For real and reactive energy reported values, separate total for energy flow from each source shall be stored, including the arithmetic sum.

i. Data Monitor Input/Output Options:
   1) Data Monitors shall be equipped with the following I/O:
      a) Provide (8) solid state status inputs.
      b) Provide four (4) relay output contacts.

2.2 SEQUENCE OF OPERATION

A. The specified voltage decrease in one or more phases of the normal power source shall initiate the transfer sequence. The automatic transfer switch shall start the engine-generator(s) after a specified time delay to permit override of momentary dips in the normal power source.

B. The automatic transfer switch shall transfer the load from normal to emergency source when the frequency and voltage of the emergency source have attained the specified percent of rated value.

C. Engine Start: A voltage decrease, at any automatic transfer switch, in one or more phases of the normal power source to less than the specified value of normal shall start the engine-generator(s) after a specified time delay.

D. Transfer to Emergency System Loads: Automatic transfer switches for Emergency System loads shall transfer their loads from normal to emergency source when frequency and voltage of the emergency source have attained the specified percent of rated value. Only those switches with deficient normal source voltage shall transfer.

E. Retransfer to Normal (All Loads): Automatic transfer switches shall retransfer the load from emergency to normal source upon restoration of normal supply in all phases to the specified percent or more of normal voltage, and after a specified time delay. Should the emergency source fail during this time, the automatic transfer switches shall immediately transfer to the normal source whenever it becomes available. After restoring to normal source, the engine-generator(s) shall continue to run unloaded for a specified interval before shut-down.

F. Exercise Mode: Transfer to emergency power source shall be accomplished by remote manual test switches on a selective basis.

2.3 REMOTE ANNUNCIATOR

A. Include the following functions for indicated automatic transfer switches:
   1. Indication of sources available, as defined by actual pickup and dropout settings of automatic transfer switch controls.
   2. Indication of switch position.
   3. Indication of switch in manual mode.
   4. Indication of failure of digital communication link.

B. Malfunction of remote annunciator or communication link shall not affect functions of automatic transfer switches.

C. Automatic transfer-switch sensing, or operating functions shall not depend on remote panel for proper operation.

D. Remote annunciation shall include the following features:

1. Digital Communication Capability: Matched to that of automatic transfer switches supervised.

2. Mounting: Surface, modular steel cabinet, unless otherwise indicated.

E. Interconnecting Communications Protocol and Media: Automatic transfer switch and the remote annunciator shall be interconnected by a dedicated network. Provide all media, raceways, hardware, software, and programming necessary to establish interconnection between automatic transfer switches and remote annunciator. All equipment shall share a common open communications protocol.

2.4 SPARE PARTS

Provide six control fuses for each automatic transfer switch.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install the automatic transfer switch in accordance with the NEC, as shown on the drawings, and as recommended by the manufacturer.

B. Anchor control and annunciator panel to wall.

C. Anchor automatic transfer switch to the slab with plated 0.5 in [12.5 mm] minimum dia. anchor bolts, or as recommended by the manufacturer.

D. Mount automatic transfer switch on concrete slab. Unless otherwise indicated, the slab shall be at least 4 in [100 mm] thick. The top of the concrete slab shall be approximately 4 in [100 mm] above finished floor. Edges above floor shall have 0.5 in [12.5 mm] chamfer. The slab shall be of adequate size to project at least 8 in [200 mm] beyond the equipment. Provide conduit turnups and adequate cable entrance space required for the equipment to be mounted. Seal voids around conduit openings in slab with water- and oil-resistant caulking or sealant. Cut off and bush conduits 3 in [75 mm] above the slab surface. Concrete work shall be as specified in Section 03 30 53, CAST-IN-PLACE CONCRETE.

E. Install control circuits to generator and program.

F. Install power monitor normal and emergency contact circuits to Building 27 control room.

G. Provide ATS annunciator and install generator annunciator in Building 27 control room.

H. Provide digital communications circuits for ATS annunciator from ATS and generator annunciator digital communications circuits from generator to Building 27 control room.

I. Set field-adjustable intervals and delays, relays, and engine exerciser.

3.2 ACCEPTANCE CHECKS AND TESTS

A. A factory-authorized service representative is required to inspect components, assemblies, and equipment installation, including connections, and to assist in testing.

1. Following completion of automatic transfer switch installation and after making proper adjustments and settings, site tests shall be performed by the manufacturer's representative in accordance with manufacturer's written instructions to demonstrate that each automatic transfer switch functions satisfactorily and as specified. Advise COTR of the site testing within five days prior to its scheduled date, and provide certified field test reports within 14 days following successful completion of the site tests. Test reports shall describe adjustments and settings made and site tests performed. Minimum operational tests shall include the following:
   a. Insulation resistance shall be tested, both phase-to-phase and phase-to-ground.
   b. Inspect for physical damage, proper installation and connection, and integrity of barriers, covers, and safety features.
   c. Verify that manual transfer warnings are properly placed.
   d. Perform manual transfer operation.
2. After energizing circuits, demonstrate the interlocking sequence and operational function for each automatic transfer switch at least three times.
   a. Simulate power failures of normal source to automatic transfer switches and of emergency source with normal source available.
   b. Simulate loss of phase-to-ground voltage for each phase of normal source.
   c. Verify time-delay settings.
   d. Verify pickup and dropout voltages by data readout or inspection of control settings.
   e. Verify proper sequence and correct timing of automatic engine starting, transfer time delay, re-transfer time delay on restoration of normal power, and engine cool-down and shut-down.
3. Ground-Fault Tests: Coordinate with testing of ground-fault protective devices for power delivery from both sources.
   a. Verify grounding connections and locations and ratings of sensors.
   b. Power failure of normal source shall be simulated by opening upstream protective device. This test shall be performed a minimum of five times.
   c. Power failure of emergency source with normal source available shall be simulated by opening upstream protective device for

emergency source. This test shall be performed a minimum of five times.

d. Low phase-to-ground voltage shall be simulated for each phase of normal source.
e. Operation and settings shall be verified for specified automatic transfer switch operational feature, such as override time delay, transfer time delay, return time delay, engine shutdown time delay, exerciser, auxiliary contacts, and supplemental features.
f. Manual and automatic transfer functions shall be verified.
g. When any defects are detected, correct the defects and repeat the test as requested by the COTR at no additional cost to the Government.

3.3 DEMONSTRATION

At the final inspection in the presence of COTR, demonstrate that the complete auxiliary electrical power system operates properly in every respect. Coordinate this demonstration with the demonstration of the engine-generator.

3.4 TRAINING

Furnish the services of a competent, factory-trained engineer or technician for one 4-hour period to instruct VA personnel in the operation and maintenance of the equipment, including review of the operation and maintenance manual, on a date requested by the COTR. Coordinate this training with that of the generator training.

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