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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
Preparing Activity: KSC

NASA/KSC-26 23 00.00 98 (October 2007)
Superseding
NASA/KSC-26 23 00.00 98 (April 2006)

References are in agreement with UMRL dated October 2007

Revised throughout - changes not indicated by CHG tags
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DIVISION 26 - ELECTRICAL

SECTION 26 23 00.00 98

LOW-VOLTAGE SWITCHGEAR

10/07

-- End of Section Table of Contents --

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SECTION 26 23 00.00 98

LOW-VOLTAGE SWITCHGEAR
10/07

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NOTE: This specification covers the requirements for switchgear and switchboards of special design or configuration.

For primary-unit substations, use Section 26 11 13.00 20 PRIMARY UNIT SUBSTATION; for secondary-unit substations, use NASA Section 26 11 16 SECONDARY UNIT SUBSTATIONS; for motor-control centers, use Section 26 24 19.00 40 MOTOR-CONTROL CENTERS; for power panelboards, use Section 26 24 16.00 40 PANELBOARDS.

Drawings must show switchgear/switchboard elevation, dimensions, devices, instruments, and installation.

Edit this guide specification for project specific requirements by adding, deleting, or revising text. For bracketed items, choose applicable items(s) or insert appropriate information.

Remove information and requirements not required in respective project, whether or not brackets are present.

Comments and suggestions on this guide specification are welcome and should be directed to the technical proponent of the specification. A listing of technical proponents, including their organization designation and telephone number, is on the Internet.

Recommended changes to a UFGS should be submitted as a Criteria Change Request (CCR).
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PART 1 GENERAL

1.1 REFERENCES

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NOTE: This paragraph is used to list the

publications cited in the text of the guide specification. The publications are referred to in the text by basic designation only and listed in this paragraph by organization, designation, date, and title.

Use the Reference Wizard's Check Reference feature when you add a RID outside of the Section's Reference Article to automatically place the reference in the Reference Article. Also use the Reference Wizard's Check Reference feature to update the issue dates.

References not used in the text are automatically deleted from this section of the project specification when you choose to reconcile references in the publish print process.

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The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM A 1008/A 1008M	(2007) Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardened

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2	(2007; Errata 2007) National Electrical Safety Code
IEEE C37.121	(1989; R 2006) American National Standard for Switchgear Unit Substations Requirements
IEEE C37.20.1	(2002; Amendment A 2005; Amendment B 2006) Standard for Metal-Enclosed Low-Voltage Power Circuit-Breaker Switchgear
IEEE C37.90	(2005) Standard for Relays and Relay Systems Associated With Electric Power Apparatus
IEEE C37.90.1	(2002) Surge Withstand Capability (SWC) Tests for Relays and Relay Systems Associated with Electric Power Apparatus
IEEE C57.12.28	(2005) Standard for Pad-Mounted Equipment - Enclosure Integrity
IEEE C57.12.29	(2005) Pad-Mounted Equipment - Enclosure Integrity for Coastal Environments
IEEE Std 4	(1995; Amendment A 2001) High Voltage

	Testing Techniques
IEEE Std 802.3	WARNING: Text in tags exceeds the maximum length of 300 characters

INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)

NETA ACCEPT	(2003) The NETA Acceptance Testing Specifications
NETA MAINT	(2005) Maintenance Testing Specifications for Electric Power Distribution Equipment and Systems

INTERNATIONAL ELECTROTECHNICAL COMMISSION (IEC)

IEC 61131-3	(2003) Programmable Controllers - Part 3: Programming Languages

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2005; TIA 2005) National Electrical Code

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FED-STD-595	(Rev B; Am 1) Colors Used in Government Procurement

UNDERWRITERS LABORATORIES (UL)

UL 1558	(1999; Rev thru Mar 2006) Metal-Enclosed Low-Voltage Power Circuit Breaker Switchgear
UL 467	(2004) Standard for Grounding and Bonding Equipment

1.2 SYSTEM DESCRIPTION AND GENERAL REQUIREMENTS

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NOTE: Provide NASA Section 26 05 00.00 40 COMMON WORK RESULTS FOR ELECTRICAL and Section 26 00 00.00 20 BASIC ELECTRICAL MATERIALS AND METHODS along with this specification.
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NASA Section 26 05 00.00 40 COMMON WORK RESULTS FOR ELECTRICAL and Section 26 00 00.00 20 BASIC ELECTRICAL MATERIALS AND METHODS apply to work specified in this section.

This specification details the requirements for electrical switchgear rated 600 volts and less.

1.3 SUBMITTALS

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NOTE: Review Submittal Description (SD) definitions in Section 01 33 00 SUBMITTAL PROCEDURES and edit the following list to reflect only the submittals

required for the project. Keep submittals to the minimum required for adequate quality control.

A "G" following a submittal item indicates that the submittal requires Government approval. Some submittals are already marked with a "G". Only delete an existing "G" if the submittal item is not complex and can be reviewed through the Contractor's Quality Control system. Only add a "G" if the submittal is sufficiently important or complex in context of the project.

For submittals requiring Government approval on Army projects, use a code of up to three characters within the submittal tags following the "G" designation to indicate the approving authority. Codes for Army projects using the Resident Management System (RMS) are: "AE" for Architect-Engineer; "DO" for District Office (Engineering Division or other organization in the District Office); "AO" for Area Office; "RO" for Resident Office; and "PO" for Project Office. Codes following the "G" typically are not used for Navy, Air Force, and NASA projects.

Choose the first bracketed item for Navy, Air Force and NASA projects, or choose the second bracketed item for Army projects.

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Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are [for Contractor Quality Control approval.][for information only. When used, a designation following the "G" designation identifies the office that reviews the submittal for the Government.] Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

Submit these items together with the NASA Section 26 05 73.00 40 OVERCURRENT PROTECTIVE DEVICES submittals which are referenced in this section.

SD-02 Shop Drawings

Submit connection diagrams and shop drawings for approval prior to switchgear fabrication indicating the relations and connections of the following items by showing the general physical layout of all controls, the interconnection of one system (or portion of system) with another, and internal tubing, wiring, and other devices.

Switchgear Assemblies

Buses

Switchgear Components including all control switches and auxiliary relays

[Control-Power Circuit Transfer Contactor]

Space Heaters

One-line diagrams of electrical equipment and system

Programmable Logic Controller

Sequence of Operation for all switchgear operational modes including [Local Only Mode, Remote-Automatic Mode, and Remote-Manual Mode][Local Only Mode, Remote-Manual Mode][Automatic Mode, Manual Mode][Manual mode]

Multi-function relays

Schematics and Wiring Diagrams

Switchgear Monitoring and Control System hardware, software, and interconnection drawings which include details of the power sources and communications pathways for devices accessed by KCCS

Switchgear Electrical Interlocks

Final Coating

Certificate of Compliance showing Switchgear Monitoring and Communication System hardware successfully communicate with existing Citect Software

Submit fabrication drawings for the following items consisting of fabrication and assembly details to be performed in the factory.

Switchgear Assemblies

Enclosures

Buses

Switchgear Components including all control switches and auxiliary relays

Weatherproof Enclosures

[Local/Remote Switches]

[Control-Power Circuit Transfer Contactor]

Switchgear Electrical Interlocks

Space Heaters

Submit Installation Drawings for the switchgear assemblies in accordance with paragraph, entitled "Installation," of this section. Include in drawings complete details of equipment layout and design.

Switchgear Foundation Data for switchgear assemblies must include plan dimensions of foundations and relative elevations, equipment weight and operating loads, horizontal and vertical loads, horizontal and vertical clearances for installation, and size and location of anchor bolts.

SD-03 Product Data

Submit manufacturer's catalog data for the following items:

Switchgear Assemblies

Enclosures

Buses

Switchgear Components including all control switches and auxiliary relays

[Local/Remote Switches]

Weatherproof Enclosures

[Control-Power Circuit Transfer Contactor]

Space Heaters

Programmable Logic Controller

Switchgear Monitoring and Control System hardware, software, and interconnection drawings which include details of the power sources and communications pathways for devices accessed by KCCS

Touch Screen

[Uninterruptible Power Supply]

Recommended Spare Parts List

SD-06 Test Reports

Submit Factory Test reports on switchgear assemblies in accordance with paragraphs, entitled "Factory Testing" of this section.

Submit Production test reports on switchgear assemblies for the following tests:

Dielectric Tests

Relay and Metering circuit performance tests

Mechanical Operation Tests

Complete Functional Testing of the entire system

Grounding of Instrument Transformer Casing Test

Electrical Operation and Control Wiring Tests including Circuit Continuity

Polarity Verification

Submit field test reports on switchgear assemblies in accordance with paragraphs, entitled "Field Testing," "Relay Settings and Tests," and "Field Testing for Communications," of this section.

Do not energize switchgear assemblies until recorded test data has been approved by the Contracting Officer.

SD-07 Certificates

Submit certificates showing the short circuit calculations and a table of short circuit fault currents at critical points in the electrical system.

Submit certificates to verify the qualifications of the Registered Professional Electrical Engineer.

[Submit certificate of Compliance showing successful completion of the certification testing as required by the paragraph, entitled "Certification Testing," of this section.]

Submit reports showing all protective device coordination curves. These curves must be computer generated using a coordination program with print-out in log-log format showing fault currents, pick-up points, device identifications, and current transformer ratios.

Submit reports showing all protective device recommended settings.

SD-08 Manufacturer's Instructions

Submit Manufacturer's Instructions for the Switchgear Assemblies including special provisions required to install equipment components and system packages. Include special notices detailing impedances, hazards, safety precautions, and installation instructions.

SD-10 Operation and Maintenance Data

Provide six (6) [bound][CD ROM's in PDF and/or CAD format] Operation and Maintenance Manuals for each switchgear assembly. Include in manuals the following data:

Multi-function Relays

Circuit Breakers

Trip Units

Contactors

[Control Switches]

Metering

Programmable Logic Controller

Touch Screen

[Uninterruptible Power Supply]

As-built Schematics

As-built wiring diagrams

As-built one-lines

Switchgear Operation Procedures

[Provide six (6) [bound][CD ROM's in PDF and/or CAD format] copies of the Switchgear Monitoring and Control Systems Manual for the switchgear assembly as follows:

Complete system description

All instruction leaflets and technical data

All software programs

Device address listing

Software data files

Function block program

All application software screens

Detailed start-up report, including a list of customer trained individuals

List of programming and monitoring software and hardware]

1.4 OPERATION AND MAINTENANCE DATA REQUIREMENTS

Include Operation and Maintenance Manuals for each switchgear assembly containing the following:

a. Instruction manuals for each device, including but not limited to multi-function relays, circuit breakers, trip units, contactors, [control switches], metering, touch screens, [uninterruptible power supplies (UPS)], spare parts lists, and Programmable Logic Controllers(PLC), furnished in the switchgear.

b. Maintenance Manuals for each device, including but not limited to multi-function relays, circuit breakers, trip units, contactors, [control switches], metering, touch screens, [UPS units], recommended spare parts list, and PLCs, furnished in the switchgear.

c. Final as-built schematics, as-built one-lines, and as-built wiring diagrams (full point-to-point wiring tags) for the switchgear.

d. Integral switchgear operation procedures detailing all switching modes including, but not limited to loss of one source, loss of both sources, closed transition loss of PLC, loss of touch screen.

e. Sequence of Operation for all switchgear operational modes including [Local Only Mode, Remote-Automatic Mode, and Remote-Manual Mode][Local Only Mode, Remote-Manual Mode][Automatic Mode, Manual Mode][Manual mode].

Provide Operation and Maintenance Manuals for the Switchgear Monitoring and Control System (SMCS) to include the following:

a. Instruction manuals for each device

b. Complete system description

c. All instruction leaflets and technical data

d. All software programs on CD ROM

e. Function block program and device address listing

f. Software data files and screens

g. Detailed start-up report including a list of customer trained individuals

h. List of programming and monitoring software and hardware

i. All application software screens

Provide two (2) original licensed copies of all software manuals with the final package.

1.5 DEFINITIONS

The Kennedy Complex Control System (KCCS) is a combination of hardware and software components that are used to monitor and control Power, HVAC, Water & Waste and Pneumatic Utilities across the Kennedy Space Center.

Citect is an Industrial Controls, Supervisor Control And Data Acquisition (SCADA) software application that is used to monitor and control the I/O devices connected to the KCCS network. The Citect application provides the Human Machine Interface (HMI) to display, trend, alarm and control and/or monitor the I/O points connected to or through the I/O devices. Information is transferred to and from the Citect server over a dedicated Ethernet controls network using Modbus TCP/IP as the preferred transportation protocol.

1.6 MANUFACTURER QUALIFICATIONS

Material and equipment to be provided under this specification must be the standard catalog product of a manufacturer regularly engaged in the manufacture of switchgear assemblies and their component parts and equipment. Equipment must be of the latest standard design for [indoor] [outdoor] service and must have been in repetitive manufacture for at least 150 units.

1.7 ENGINEER QUALIFICATIONS

Provide electrical power system's circuit loading requirements and analyses performed by a professional electrical engineer registered with one or more states of the United States of America. The professional electrical engineer must have conducted electrical coordination studies and tests for not less than five projects of comparable size and complexity. Perform all work by, or under the direct supervision of the registered professional electrical engineer. Submit certificates to verify the qualifications of the registered professional electrical engineer.

1.7.1 Engineering Services

An electrical engineer holding a valid state license as a professional engineer who specializes in relays and coordinating systems associated with electric-power apparatus for the manufacturer of the equipment, must coordinate all circuit-interrupting devices before the equipment is energized. Duties and responsibilities of the engineer must include the following work.

1.7.1.1 Preliminary Survey and System Coordination Study

Review all necessary short circuit calculations to determine the minimum and maximum values of short-circuit current for faults anywhere in the system. Review all values of fault current to be expected at each protective device shown on the one-line diagrams.

Prepare and provide One-line diagrams that indicate by means of single lines and simplified symbols the course and component devices of an electric circuit or system of circuits and their electrical characteristics.

Where the switchgear is being installed into an existing system the Engineer and/or Contractor must obtain current system one-lines from the Contracting Officer. The Engineer and/or Contractor must coordinate with the Contracting Officer to verify the system one-line diagrams two levels below the switchgear.

Inspect all equipment and verify that the intended function of each circuit-interrupting device and the manner in which it is connected provides a properly coordinated electrical power system under normal load and fault conditions.

Prior to shipment from the factory, check and compare wiring diagrams furnished by the manufacturer with actual connections of the equipment to verify that each device is properly connected to perform its intended function. Wiring changes required by this check must be made and re-verified prior to shipping the equipment.

1.7.1.2 Time/Current Curves and Settings

Plot time/current curves on a single sheet of graph paper or electronic format for those devices that are to operate selectively in series with each other using a common current scale, with current ratings at the lowest-voltage level. Plot curves progressively as each circuit is studied, starting with the device farthest from the source. Include within each curve on the graph a tolerance band and show the degree of coordination with each successive device. Coordinate adjustable and nonadjustable protective devices to operate on the minimum current that permits distinguishing between fault and load current in a minimum amount of time.

Select time and current settings for the adjustable devices that operate in sequence with the nonadjustable devices to isolate a fault with a minimum of disturbance to the unfaulted portion of the system.

PART 2 PRODUCTS

2.1 EQUIPMENT STANDARDS

Switchgear assemblies must conform to IEEE C37.20.1 and UL 1558.

2.2 CONSTRUCTION

2.2.1 Switchgear and Auxiliary Compartments

Switchgear assemblies and auxiliary equipment must be stationary, mounted in self-supporting, self-contained, sheet metal enclosures with front and rear hinged full size doors. Secure doors with knurled knob bolts. Provide the capability to lock doors with standard padlock type lock. Join sheet metal compartments together to form a continuous structure. Construct sheet metal barriers, enclosures, external covers and doors from cold-rolled carbon-steel sheets of commercial quality not less than 1.9 [_____] millimeter [14] [_____]-gage, with stretcher-level flatness in accordance with ASTM A 1008/A 1008M.

Unit sheet metal must enclose one or more vertically mounted power circuit breakers or auxiliary equipment in individual sheet metal compartments and a full height rear compartment. Provide housing of approximately2300 millimeter 90 inches high with individual ventilated front and rear-hinged panels and bolted top covers. Rear compartment must contain the main bus, main bus-tap connections, cable connections, and instrument transformers.

2.2.2 Compartment Details

Completely wire compartments with cable terminals, cable clamps, control bus, control power switch, and terminal blocks. Generate Schematics and Wiring Diagrams for each compartment. Make terminal blocks readily accessible for the external connections of metal-enclosed switchgear.

Run low-voltage wiring for controls and accessories to terminal blocks having numbered points, as indicated, to identify circuits. Run low-voltage wiring in conduit or wiring raceways to isolate the wiring from high-voltage circuits. Clearly identify all wiring connections.

Clearly identify and designate, by cubicle, all switchgear components, including but not limited to fuse blocks, push buttons, selector switches, indicating lights, and terminal blocks (i.e.: 1A, 1B, 2A, 2B, this being cubicle 1 device A, cubicle 1 device B, etc.) Identify device designation with a label, with a minimum 1/4 inch high lettering. Wiring between sections/cubicles must identify the end devices by section/cubicle number and device designation.

Provide terminal blocks with engraved plastic terminal strips with screw type terminals having letter designations and numbered terminal points. Terminal blocks in each section/cubicle used for the same wiring as the adjacent sections/cubicles must have the same letter designation preceded by the section/cubicle number. Terminal blocks associated with current transformers must be short circuiting type. Terminal blocks with sliding links are not allowed. Terminal blocks for multi-ratio current transformers must be wired with all taps and ground, one terminal block per current transformer. Wiring must be SIS Class insulation, sized No. 12 AWG at 120/240 panel with 20 amp breakers, No. 14 AWG for control, No. 12 AWG for potential leads, and No. 10 AWG for current leads. Terminate all current conductors with compression ring terminal lugs and control and

potential conductors with compression forked (with tabs) terminal lugs. Do not use male/female spade connectors. Final conductor leads for terminations on the switchgear heaters must be a minimum of 150 degrees high temperature wiring.

Locate at each end, wire marking for controls, metering, relaying, and accessory conductors. Wire markers must be white plastic tubing heat stamped with black block type letters. On all wire markers, indicate the device or equipment, including specific terminal numbers to which the other end of the wire is attached, and the terminal number to which the wire is directly attached (near end/far end marking).

Identify each compartment of the switchgear assembly by an identification plate engraved with circuit and function designations. Plate must be a minimum of 24 mm 1 inch high and 48 mm 2 inches long.

Removable elements of the same type and rating in the switchgear assembly must be physically and electrically interchangeable in corresponding compartments. Provide front-hinged panel suitable for mounting instruments, relays, control switches, and indicating lamps.

Barriers between a sectionalized bus with bus sectionalizing breakers in a compartment must be sheet steel not less than[3.1] [_____] millimeter [11] [_____] gage. Other covers, barriers, panels, and doors must be not less than [1.9] [_____] millimeter [14] [_____] gage.

Reinforce each compartment with structural members and weld together. Grind welds to a smooth flat surface before painting.

2.2.3 Mimic Bus

Provide mimic bus using 2.4 mm3/32 inch red plastic laminate. Mimic bus must show breakers and bus. Fasten to switchgear using stainless steel screws.

2.2.4 Buses

Switchgear assemblies must be completely bused utilizing electrical grade, high conductivity, solid copper bus bar having a rectangular cross section. Uniformly position and phase sequence main, riser and bus tap connections in accordance with IEEE C37.20.1. Support and brace buses to withstand both electrically and mechanically the short circuit current ratings, rated not less than 65,000 amperes symmetrical.

Provide silverplated termination and connection points on all bus bar used in the switchgear. Silver coating methods that do not use the flow of electrical current as part of the process are not acceptable. After plating the contact surface do not sand or abrade, clean only with a soft cloth immediately prior to final assembly.

All bus bar connections must be made using silicon bronze or Grade 5 steel bolts with wide flat silicon bronze or Grade 5 steel washers under the bolt head and nut. Tighten and check connections by use of a calibrated torque wrench. Other connection designs can be used with the written agreement of the Contracting Officer.

[Make main bus readily accessible for connection of future switchgear assemblies at either end. Main and auxiliary control drawout type connections must be silver-to-silver contact, positive pressure,

self-aligning, with enclosure-to-enclosure stationary mechanism when breaker is in drawout position.]

Voltage rating and insulation level of switchgear assemblies must be as specified and conform to IEEE C37.20.1.

Temperature limits for buses and bus-tap connections in switchgear assemblies must be in accordance with IEEE C37.20.1.

Extend a continuous rigid copper ground bus throughout the entire assembly and ground the stationary structure and equipment. Ground bus must be capable of carrying the rated short circuit current of the protective devices in the switchgear assembly for a minimum period of 30 cycles.

Metal-enclosed bus must be of non-segregated group phase construction. Include rigid insulated conductors and supports in a grounded metal enclosure with associated ventilation and space-heater enclosures, condensation barriers, expansion and connection joints, and fittings in accordance with IEEE C37.20.1.

Completely bus enclosures and transition cabinets with an insulated solid rigid copper bus bar of rectangular cross section. Uniformly position and phase sequence bus bar and connections within the enclosure for adaptation to metal-clad switchgear assemblies and power transformers, in accordance with IEEE C37.20.1.

Support and brace bus bar to withstand short-circuit stresses with momentary current ratings, in accordance with IEEE C37.20.1. Contact surfaces of all bus connections must be silverplated and bolted together to ensure maximum conductivity. Voltage and current ratings must conform to IEEE C37.20.1.

Insulating supports must consist of track-resistant, flame-retardant IEEE Class 130 electrical insulating materials. Voltage rating and insulation level must conform to IEEE C37.20.1.

2.2.5 Switchgear Assemblies

Provide general arrangement of the number of compartments and each compartment's components as shown.

[Include a metal-enclosed low-voltage power circuit breaker in bus sectionalizing switchgear compartments.]

[Provide drawout power circuit breakers with three-position operation:

a. Connected Position - Contacts are fully engaged. Breaker must be tripped before it can be racked into or out of this position.

b. Test/Disconnect Position - Position must allow for complete testing and operation of the breaker without energizing the primary circuit.

c. Withdrawn (Removed) Position - Places the breaker completely out of the compartment, ready for removal.

Drawout compartments must contain the mechanisms for racking the breaker on and off the bus. Provide a barrier that covers energized bus when the breaker is in the withdrawn position.]

[Secondary feeder switchgear compartments must include the following equipment:

[Metal-enclosed low-voltage power circuit breaker]

[Provisions for terminating cables of the metal-enclosed bus]]

[Auxiliary station power compartments must include the following:

[Control-power transformer and primary fuses]

[Circuit overload protection]

[Potential transformers for relaying purposes]

[Lamp ground detectors]

[Batteries and battery charger]

[Circuit breaker control transformer]]

[Auxiliary metering compartments must include the following:

[Current transformers]

[Ammeters and ammeter switches]

[Potential transformers]

[Voltmeters and voltmeter switches]

[Watt-hour meters]

[Reverse current directional relays]

[Lamp ground detectors]

[Cooling fans]]

[Auxiliary bus sectionalizing compartments must include the following:

[A contactor for automatic transfer of control power and auxiliary devices]

[Auxiliary control devices]

[Programmable Logic Controller]

[Uninterruptible Power Supply]]

[Fully equip switchgear compartments for future use to receive the removable element with complete bus connections, disconnecting devices, rails, and cell interlocks.]

[Provide filler compartments incidental to the switchgear assembly as empty compartments with [hinged] [bolted] cover plates.]

[Main and feeder power circuit breakers must be suitable for fully rated

[nonselective] [selective] trip systems in accordance with IEEE C37.121.]

[For switchgear with drawout circuit breakers supply a breaker lifting device for each switchgear.]

2.2.6 Weatherproof Construction

For outdoor applications, provide weatherproof NEMA Type 3R [walk-in] [non-walk-in] switchgear assembly enclosures, with ventilated [front] [and rear]-hinged doors, base, and roof sections. Access doors must be flanged and close against rubber or similar gasketing material. Provide ventilated openings with filtered covers and screened vents, attached using wing-nuts for protection against the weather and insects. Doors must be equipped with latch, stops, and have the ability to be secured with a standard padlock type lock.

Construct sheet metal weatherproof enclosures from carbon steel sheets of commercial quality, not less than [1.9] [_____] millimeter [14] [_____] gage. Reinforce each section with structural members and bolt together. Complete assembly must be structurally supported as indicated.

Provide unit construction type roof section with removable sloping cover and overhanging roof drip edge. Base section must be unit construction and support metal-enclosed switchgear [150] [_____] millimeter [six] [_____] inches above the concrete foundation.

[Switchgear enclosures must include a removable gasketed steel floor plate which must be drilled for conduit and cable during installation. Undercoat base frame, floor [and roof] of the switchgear with a heavy rubberized protective sealing material at least [0.79] [_____] millimeter [1/32] [_____] inch thick.] [Provide insulated interior roof ceilings.]

[Equip each enclosure subject to an outside or humid environment with thermostatically controlled electric space heaters and cooling fans to minimize condensation. Make provisions for terminating incoming and outgoing underground cables.]

[Walk-in enclosures must include a lighted front aisle.] Provide [Walk-in] [Non-walk-in] enclosures with a NEMA 5-20R receptacle at each end for service.

2.2.7 Switchgear Foundations

Submit Switchgear Foundation Data for switchgear assemblies. Include plan dimensions of foundations and relative elevations, equipment weight and operating loads, horizontal and vertical loads, horizontal and vertical clearances for installation, and size and location of anchor bolts.

2.3 SWITCHGEAR COMPONENTS

2.3.1 Power Circuit Breakers

[All switchgear, main, tie, and feeder breakers must be power circuit breakers and conform to NASA Section 26 05 73.00 40 OVERCURRENT PROTECTIVE DEVICES.]

[Air circuit breakers must be of the [manually] [electrically] operated type as indicated, conforming to NASA Section 26 05 73.00 40 OVERCURRENT PROTECTIVE DEVICES.]

2.3.2 Molded-Case Circuit Breakers

[Molded-case circuit breakers must conform to NASA Section 26 05 73.00 40 OVERCURRENT PROTECTIVE DEVICES.]

2.3.3 Instruments and Instrument Transformers

Indicating instruments, protective relays, current [and potential] transformers, [instrument transfer switches,] and [control-power transformers] must conform to the applicable requirements of NASA Section 26 05 73.00 40 OVERCURRENT PROTECTIVE DEVICES.

2.3.4 Control-Power Circuit Overcurrent Protection

Provide Branch-circuit breakers with circuit overload protection to compartment heater, lights, convenience outlets, transformer fans, and other devices.

2.3.5 Control-Power Circuit Transfer Contactor

****
NOTE: Delete this paragraph when the switchgear is single-ended.
****

[Design contactor for automatic transfer of control-power for 120/240-volt, single-phase, 60-Hz service with current rating. Make contactor the open type, two-pole, double-throw with solid neutral connections and must automatically transfer its load circuits to the alternate power supply upon loss of power in the normal supply. Device must be electrically operated and [electrically] [mechanically] held and obtain its operating current from the source to which the load is transferred. Provide contactors for automatic transfer of control power suitable for installation in metal-enclosed switchgear. [Provide two extra normally open and two extra normally closed contacts. One set of contacts must be wired to the PLC for status indication.]]

2.3.6 Service and Maintenance Devices

Include the following service and maintenance devices as a part of the switchgear:

A manual handle for operating the air and power circuit breaker isolating mechanism

Removable manual maintenance closing devices for air and power circuit breakers

Facilities for operating air and power circuit breakers in the test or removed position

Facilities for withdrawing air and power circuit breakers for inspection or maintenance

Test plugs and cable for meters and relays

A NEMA 5-20R receptacle at each switchgear end for service tools

2.3.7 Protective Relays and Devices

Protective relays and devices must test and comply with NASA Section 26 05 73.00 40 OVERCURRENT PROTECTIVE DEVICES and IEEE C37.90.1.

2.3.8 Circuit Breaker Control Switches

****
NOTE: Eliminate the Circuit Breaker Control Switches for shuttle projects.
****

[Control switch must be miniature rotary cam operated devices with individual stages, a dust-tight cover and contacts with a positive wiping action, and conform to IEEE C37.90. Make contacts silver-to-silver or an approved substitute which provides equal or superior performance. Contacts must have a rating adequate for the duty performed, but not be less than 600 volts, 20 amperes continuous. Provide circuit breaker control switches with a red and green target and a combination of maintained action and spring return type of operation. Provide pistol grip handle on circuit breaker control switch. Switch must be equipped with engraved plastic escutcheons identifying its function ("Breaker Control") and ("Trip/Close") position.]

2.3.9 Local/Remote Switches

****
NOTE: Eliminate the Local/Remote switches for shuttle projects (i.e. when circuit breakers can be controlled through a second device such as the power meters and not just the PLC).
****

[Install a manually operated, two position rotary snap-action switch with silverplated contacts to disengage all automatic and remote controls from the switchgear when in local mode. Locate this switch in the bus tie section of the switchgear.

Label the states of the switch "Local" and "Remote". Refer to paragraph, entitled "Local/Remote Operation." Provide at least two extra normally open and two extra normally closed sets of switch contacts. One set of contacts must be wired to the PLC for status indication.]

2.3.10 Indicator Lights

Indicator lights must comply with NASA Section 26 05 73.00 40 OVERCURRENT PROTECTIVE DEVICES. Make indicator light colors as follows and label according to the following functions:

Function	Color
Breaker Open	Green
Breaker Closed	Red
Power On	White - (Control Power)
[Local Only Mode	Green]
[[Remote-]Auto Mode	Blue]
[Remote-]Manual Mode	White
Auto Lockout	Amber

2.4 CONTROL SYSTEMS

Use a Programmable Logic Controller (PLC) to provide control functions. During maintenance or operations that require the PLC to be taken off-line, breakers must remain in the last state.

****
NOTE: Delete the bracketed information referring to double-ended functions in the following paragraphs when the switchgear is single-ended.
****

Main [and bus tie] breakers must be electrically operated remotely. [Electrically interlock so that only two of the three breakers can be closed for an extended amount of time when the automatic/manual transfer control function is in the manual position. Provide a separate hardware timer to trip the tie breaker if all three breakers are closed for a period, adjustable from 0 to 10 minutes.]

Main secondary breaker section must include undervoltage and phase-sequence relays with adjustable time-delay.

[Hardwire the sync-check relay(s) to mains and tie breaker control schemes for fail safe operation. Make these functions available even when the PLC outputs are disabled.]

[Provide a Control-Power Circuit Transfer Contactor for the automatic transfer of control power.]

Make each of the control power transformers capable of furnishing power [through the selective contactor] for the main breakers, [the bus tie breaker], feeder breakers, compartment heaters, interior lighting, utility outlets, battery chargers, [UPS units,]power meters, PLC, and other miscellaneous equipment.

The UPS must supply power to the power meters, trip units, shunt trip/closed coils, indicating and status lights, PLC, Touch Screen, and a receptacle in the controls compartment for the communications equipment such as the Ethernet hub and media converter. Clearly mark the receptacle on UPS power "UPS POWER" using a laminated plastic nameplate having 5 millimeter 3/16-inch high black letters on a white background.

[Perform timing and control for the automatic transfer using the PLC.] Use auxiliary relays only where breaker circuit loads exceed the rating of the PLC outputs. Only use auxiliary relays to directly connect one breaker circuit and provide no relay logic or timing functions. Auxiliary relays must be plug-in type relay with tubular terminals rated for 120 volt AC operation with vibration-resistant 10 ampere output contacts. Provide relay with pilot light and retainer clips. Bases must be octal, single tier with screw terminals.

[Design the switchgear transfer control to auto transfer load on loss of power on either of the two sources and provide automatic re-transfer on source return after an adjustable time period. The re-transfer operation must be open or closed transition, selectable from a video control/touch screen.]

[The touch screen controls must allow the user to enable/disable the automatic transfer function and initiate the appropriate changes to the PLC

logic to allow the selection of automatic re-transfer or not, and select between open or closed transition. The touch screen controls must also allow the user to change the time delays for the transfer scheme. These changes must not require the use of other equipment such as a laptop computer or additional PLC programming software.] Touch screen controls for operating breakers must require two step command, the first to initiate command and the second to confirm command.

[The selection of OPEN transition (selectable on touch screen) also sets electrical interlock functions, specifically, breakers are interlocked so that only two of the three breakers (mains and tie) can be electrically closed at the same time.]

[The selection of CLOSED transition (selectable on touch screen) also disables electrical interlock functions, specifically, breakers can be configured such that all three breakers (mains and tie) can be closed simultaneously for a limited duration. This protective function is intended to ensure the three breakers are not closed for an extended duration.]

Provide Touch Screen as follows:

a. Touch screen display must be impact and scratch resistant.

b. Color CRT with greater than or equal to 9 inch screen size.

c. Screen lockout for cleaning.

d. Field replaceable display capable of being replaced while in service.

[e. Provide one spare display.]

f. Touch screen communication functions with integrated PLC drivers for direct serial connection to PLC controller.

g. Simultaneous communication to multiple PLC's

h. Dual serial ports.

i. Windows based configuration software.

j. Support for third party graphics.

k. Dynamic object based graphics.

l. Bitmap graphics.

m. Software manuals.

o. Users manuals.

p. Interface cables.

q. Touch screen must be Magelis Touch Screen XBTF034510 or approved equal.

2.4.1 Local/Remote Operation

****

NOTE: Delete this entire subpart when there is no Local/Remote switch. There is no Local/Remote switch for shuttle projects (i.e when circuit breakers can be controlled through a second device such as the power meters and not just the PLC).

****

[If switchgear has a local/remote switch installed provide three operating modes: Local Only, Remote-Automatic, and Remote-Manual. Breakers must remain in last state when mode is changed except when going to the automatic mode. Control capability over the breakers must be only in the selected mode. Sync check, overcurrent and undervoltage feature must not be defeated in any mode.]

2.4.1.1 Normal Configuration

****

NOTE: Delete the following paragraph when the switchgear is single-ended.

****

[The normal configuration for each double-ended switchgear is with the main breakers in the closed position, the bus tie breaker in the open position, the PLC program in "Enable the Automatic Transfer" feature and the local/remote switch in the remote position.]

2.4.1.2 Local Only Mode

****

NOTE: Delete bracketed information referring to double-ended functions when the switchgear is single-ended.

****

[This mode is designed to give the operator at the switchgear complete and autonomous control of the switchgear.

When the Local/Remote switch is placed in the local position the control outputs of the PLC and all inputs and/or commands to the breaker from KCCS and the CM4000 power monitor must be disabled. This ensures that once in the local only mode, KCCS, the PLC, or any other communications network are not capable of operating the breakers nor changing the mode of operation. Provide a set of contacts for KCCS from the local/remote switch such that when the switch is in local position, a discrete signal is sent to KCCS. An indicator light visually seen on the inside of the switch gear must illuminate while in the local only mode. Switchgear Electrical Interlocks must be active for safe switchgear operations including closed transitions.

The following must occur when the operator has placed the Local/Remote switch in the local position:

a. Any remote commands to the breakers including the automatic functions (PLC) of the transfer scheme and the remote control through the CM4000 meters are disabled.

b. The outputs from the protective relays remain operable.

c. All breakers remain in their current state.

d. Mains [and Tie] OPEN functions operate directly from the control switches.

e. Mains [and Tie] CLOSE functions operate by the control switches after verification of the [sync-check relay and] respective breaker trip lockout device.

[f. Breaker control switches are electrically interlocked so that at no more than two of three breakers (two mains and tie) can be closed for an extended period of time. If the third breaker is called to close, the zero to ten minute hardware timer is initiated. At the end of the designated time setting the tie breaker opens.]

g. The control switch for each breaker must be operational only in the local mode.

h. A discrete indication is sent to KCCS via a set of contacts indicating the switchgear is in the local only mode.]

2.4.1.3 Remote-Automatic Mode

****
NOTE: Delete the Remote-Automatic Mode when the switchgear is single-ended.
****

[This mode is designed as the normal configuration for the switchgear and gives the PLC at the switchgear complete and autonomous control of the switchgear. Control of the PLC program must be by KCCS to allow KCCS to take control of the switchgear remotely through an Ethernet connection to the PLC. An indicator light visually seen on the front of the switchgear must illuminate while in the remote-automatic mode.

If KCCS has enabled the automatic transfer control feature and the local/remote switch is in the remote position, the breakers must remain in their current positions unless one of the following situations occur:

a. Loss of one source feeder:

(1) If the multifunction relay (relays 27, 47, 59, 81) for main A or main B detects phase voltage imbalance, loss of voltage, undervoltage, overvoltage or frequency, for a period adjustable from 5 to 120 seconds initially set at 10 seconds, the corresponding main breaker must open. After the main breaker has opened, the bus tie breaker must close. The switchgear must then act as a single ended switchgear.

(2) When voltage returns to the affected main all breakers must remain in the transferred state until a retransfer is initiated by the transfer scheme calling for an automatic closed transition retransfer. If the automatic retransfer scheme is not selected, retransfer must be by personnel at the site placing the remote/local switch in the local position, or remotely by KCCS disabling the automatic transfer control feature. A closed transition retransfer is allowed only through a sync check relay either by the transfer scheme, personnel at the site placing the remote/local switch in the local position, or remotely by KCCS disabling the automatic transfer control feature.

b. Loss of both source feeders:

(1) If the multifunction relay (relays 27, 47, 59, 81) detects phase voltage imbalance, loss of voltage, undervoltage, overvoltage or frequency on both sides simultaneously (plus or minus 3 seconds adjustable), the two main breakers must remain closed and the bus tie breaker must remain opened.

(2) If the voltage returns to the main to one side of the switchgear for a period adjustable from 1 to 120 seconds initially set at 60 seconds, the main on the other side must open and the bus tie breaker must close.]

2.4.1.4 Remote-Manual Mode

****
NOTE: Delete the bracketed information referring to double-ended functions when the switchgear is single-ended.
****

[This mode is designed to give the KCCS operator, at a remote location, complete control of the switchgear through an Ethernet connection to the PLC. An indicator light visually seen on the front of the switchgear must illuminate while in the remote-manual mode.

When [the KCCS operator remotely disables the automatic control feature and] the local/remote switch is in the remote position the breakers remain in their current positions and the following apply:

a. Mains [and Tie] OPEN functions operate directly from KCCS commands or the touch screen.

b. Mains [and Tie] CLOSE functions operate by KCCS or the touch screen after verification of the [sync-check relay, and] respective breaker trip lockout device.

[c. Breaker controls must be electrically interlocked so that at the most two out of three breakers can be closed for an extended amount of time. If two out of three breakers (the two mains and the bus tie) are closed and if the third breaker is called to close, the source feeders must be verified through the sync-check relays that each source feeder is synchronized before the third breaker is closed.]

d. A discrete indication is sent to KCCS via a set of contacts.]

2.4.2 Normal Configuration

****
NOTE: Delete the following paragraph when the switchgear has a local/remote switch and/or is single-ended.
****

[The normal configuration for each double-ended switchgear is with the main breakers in the closed position, the bus tie breaker in the open position, the PLC program in "Enable the Automatic Transfer" feature.]

2.4.3 Automatic Mode

****
NOTE: Delete the Automatic Mode when the switchgear has a local/remote switch and/or is single-ended.
****

[This mode is designed as the normal configuration for the switchgear and gives the PLC at the switchgear complete and autonomous control of the switchgear. The PLC program must be controlled by KCCS to allow KCCS to take control of the switchgear remotely through an Ethernet connection to the PLC. An indicator light visually seen on the front of the switchgear illuminates while in the automatic mode.

If KCCS has enabled the automatic transfer control feature the breakers remain in their current positions unless one of the following situations occur:

a. Loss of one source feeder:

(1) If the multifunction relay (relays 27, 47, 59, 81) for main A or main B detects phase voltage imbalance, loss of voltage, undervoltage, overvoltage or frequency, for a period adjustable from 5 to 120 seconds initially set at 10 seconds, the corresponding main breaker opens. After the main breaker has opened, the bus tie breaker closes. The switchgear then acts as a single ended switchgear.

(2) When voltage returns to the affected main all breakers remain in the transferred state until a retransfer is initiated by the transfer scheme calling for an automatic closed transition retransfer. If the automatic retransfer scheme is not selected, retransfer is made remotely by KCCS disabling the automatic transfer control feature. A closed transition retransfer is allowed only through a sync check relay either by the transfer scheme or remotely by KCCS disabling the automatic transfer control feature.

b. Loss of both source feeders:

(1) If the multifunction relay (relays 27, 47, 59, 81) detects phase voltage imbalance, loss of voltage, undervoltage, overvoltage or frequency on both sides simultaneously (plus or minus 3 seconds adjustable), the two main breakers remain closed and the bus tie breaker remains opened.

(2) If the voltage returns to the main to one side of the switchgear for a period adjustable from 1 to 120 seconds initially set at 60 seconds, the main on the other side opens and the bus tie breaker closes.]

2.4.4 Manual Mode

****
NOTE: Delete the Manual Mode when the switchgear has a local/remote switch.
****

****
NOTE: Delete the bracketed information referring to double-ended functions when the switchgear is single-ended.
****

[This mode is designed to give the KCCS operator, at a remote location, complete control of the switchgear through an Ethernet connection to the PLC. An indicator light visually seen on the front of the switchgear illuminates while in the manual mode.]

When [the KCCS operator remotely disables the automatic control feature] the breakers remain in their current positions and the following applies:

a. Mains [and Tie] OPEN functions operate directly from KCCS commands or the touch screen.

b. Mains [and Tie] CLOSE functions operate by KCCS or the touch screen after verification of the [sync-check relay, and] respective breaker trip lockout device.

[c. Breaker controls must be electrically interlocked so that at the most two out of three breakers can be closed for an extended amount of time. If two out of three breakers (the two mains and the bus tie) are closed and if the third breaker is called to close, the source feeders are verified through the sync-check relays that each source feeder is synchronized before the third breaker is closed.]

[d. A discrete indication is sent to KCCS via a set of contacts.]

2.5 PROGRAMMABLE LOGIC CONTROLLER

****
NOTE: Contact the Contracting Officer to determine what the current version of the Concept software is required.
****

Provide a Modicon Quantum PLC. The PLC must be programmed in accordance with IEC 61131-3 in function block format and provide timer, counter and relay logic functions for automatic transfer control. The PLC must be programmed using an IBM compatible Personal Computer and/or Laptop and Windows-based graphic software [Concept version 2.5][ ]. Power the PLC from the 120-volt UPS power via the control power.

Provide a complete and fully functional PLC system. Supply all devices, components, programming, materials, and other work necessary to form a complete, maintainable, and operable system at no additional cost to Government.

After the program is loaded the processor must have a minimum of 20 percent spare memory installed.

The status of latch relays and one-shots, and all data from timers, counters, and math functions, must be retained during any power outage.

Provide the processor with an RS-232C and RS-422 port for communication with computers, message displays, and other serial devices.

Locate the outputs of the PLC controlling circuit breakers on separate modules (each main breaker must be controlled from a separate output module). Provide chassis or racks for mounting all types of input and output modules. Provide a simple means to remove and insert the modules into the rack. Provide racks with a means of assuring all modules stay firmly in place.

Provide a minimum of [ten][_____] user defined inputs, wired to an accessible terminal strip. Provide fused terminals from control power source to be used as source for inputs.

Use sink type input modules. Use sourced output modules.

Provide spare I/O slots for expansion of a minimum of 20 percent inputs and 20 percent outputs above the system's initial requirements.

Physically shield the PLC from all devices with rectifiers including uninterruptible power supplies (UPS).

The PLC must communicate all registers to KCCS via an Ethernet connection using MODBUS via TCP/IP (Citect standard Modnet Driver). The Manufacturer must demonstrate that the PLC provided under this project communicates efficiently with the Citect software. For information on Citect software contact Citect Inc., 30000 Mill Creek Avenue, Suite 300, Alpharetta, Georgia, 30022, (770) 521-7511 (phone), (770) 521-7512 (fax).

2.6 SWITCHGEAR MONITORING AND CONTROL SYSTEMS

Provide a complete Switchgear Monitoring and Control System (SMCS) as described in this specification. This system is defined to include, but not to be limited to:

- PLC that monitors and controls remote devices
- Trip units
- Power meters
- Touch screen
- Device communication interface hardware
- Intercommunication wiring
- Software
- Startup and training services
- Ongoing technical support

This system must comply with the applicable portions of IEEE Std 802.3. The Manufacturer must demonstrate that the communications system provided under this project communicates efficiently with the latest version of Citect software. Include in demonstration multiple trip units, meters, a PLC, and a laptop with KCCS software. Provide two licensed copies of all software on CD ROM and all hardware necessary to modify and download the program for the touch screen.

Develop the Citect GUI screens to monitor and control the new data points on any new or modified switchgear that communicates to KCCS. The Government will integrate new screens into the existing KCCS network. The modifications to the project must include but not be limited to creating variable tags, alarm tags and trend tags, modifying/building "genies and super genies" and modifying/creating user interface screens.

The SMCS must use the indication and control inputs and outputs listed on

the design drawings. These inputs and outputs can also be obtained from the Contracting Officer.

2.6.1 Switchgear Communications

Wire the switchgear with Cat 6 cable and capable of supporting the following communications. Provide a minimum [Fiber Ready] six port Ethernet hub/switch at the switchgear for communication to the following Intelligent Electronic Devices (IEDs):

a. TCP/IP Modbus connection to switchgear Modicon PLC.

b. TCP/IP Modbus connection to each Square D Power Logic [CM-4000][_____] meter via ECC module.

[c. TCP/IP Modbus connection to a media converter.]

[d. TCP/IP Modbus connection to the trip unit interface.]

2.7 EQUIPMENT FINISH

****
NOTE: For all outdoor applications and all indoor applications in a harsh environment refer to Section 09 96 00 HIGH-PERFORMANCE COATINGS. High performance coatings are specified for all outdoor applications because ultraviolet radiation breaks down most standard coatings, causing a phenomena known as chalking, which is the first stage of the corrosion process. For additional information contact The Coatings Industry Alliance, specific suppliers such as Keeler and Long and PPG, and NACE International (NACE).
****

2.7.1 Protective Coatings

Verify the intended location of equipment, materials, and degree of continuous exposure to the KSC corrosive environment. The equipment finish must meet the requirements of IEEE C57.12.28 and IEEE C57.12.29. Holidays, sags, pinholes, blistering, solvent popping or rust as part of the finish are not acceptable. Provide smooth and even finish resistant to corrosion, sunlight and abrasion with high impact strength.

2.7.2 Surface Preparation

Steel parts must be free of weld slag and mill scale. Chemically clean, rinse, phosphate coat, rinse, and de-ionize switchgear enclosure in preparation for the powder coat.

2.7.3 Powder Coat

Coat the switchgear enclosure with a corrosion resistant thermosetting polyester coating applied by electrostatic powder spray. Apply a minimum coating of 2.5 mils uniformly and pinhole free.

2.7.4 Final Coating

Following the application and cure of the powder coat and the manufacturing

assembly of the switchgear enclosure, apply a final finish coat to the switchgear enclosure with silicone enamel, free from surface defects with a minimum 1.5 mil dry film thickness. The color of the final coating must be light gray in accordance with FED-STD-595 and must be approved by the Contracting Officer prior to shipping the switchgear from the factory.

NEMA 3R weatherproof enclosures, require, after the final coating, on the bottom and the bottom 6 inch 144 mm of the switchgear enclosure, a rubberized or coal tar protective coating at least 1 mm 1/32 inch thick.

2.8 SPACE HEATERS

****
NOTE: Space heaters prevent moisture build-up in ventilated compartments.

Wattage supplied by heaters is one-fourth of heater nameplate rating when 240-volt heaters are operated at 120 volts.
****

Equip each section of the switchgear assembly with externally energized space heaters to provide approximately 40 watts per square meter 4 watts per square foot of outer surface area. Heater power density must not exceed 4 watts per 650 square millimeter per square inch of heater element surface. Heaters must be rated at 240 volts for connection to 120 volts. Install heaters at the lowest portion of each space to be heated. Cover all terminals. Provide thermostats to regulate the temperature.

Install operable heaters at the time of shipment for use immediately upon arrival at the site, during storage, or before installation. Prominently mark connection locations on drawings and shipping covers. Provide temporary leads capable of plugging into a standard 120 volt, 20 amp receptacle for storage operation. Make connections easily accessible without having to remove shipping protection.

2.9 EXTERNAL VOLTAGE SOURCE

Group all externally powered wiring together as much as possible and connect to a terminal block marked with a laminated plastic nameplate having 5 millimeter 3/16 inch high white letters on a red background as follows:

DANGER - EXTERNAL VOLTAGE SOURCE

Externally powered wiring must include 120-volt unit space heaters.

2.10 UNINTERRUPTIBLE POWER SUPPLY

****
NOTE: When a Facility UPS is available delete this paragraph and use the Facility UPS.
****

[Provide an Uninterruptible Power Supply (UPS) system sized for a minimum of 15 minutes of battery backup for the control power loads. The UPS must be capable of operating in an ambient temperature of 0 to [40][60] degrees C (32 to [104][140] degrees F) and a relative humidity of 5 to 95 percent.

Mount the UPS in a spare compartment or cubicle.]

PART 3 EXECUTION

3.1 CERTIFICATION TESTING

Perform Certification Testing showing Switchgear Monitoring and Communication System successfully communicates with existing Citect Software prior to the approval of the switchgear. Compliance Certification Testing must include a government witness qualification demonstration of at least, but not limited to the following equipment if the proposed hardware has not been previously approved (current approved hardware is from Square D):

- Circuit breakers
- Trip units
- PLC
- Meters

Include in testing verification of the Citect Screens using a PC and the current Citect software.

3.2 FACTORY TESTING

Factory witness testing (source inspection), at Government's option, must occur at the switchgear manufacturer. The switchgear manufacturer must checkout the switchgear assembly as a connected system. The switchgear manufacturer must demonstrate that the communications system provided under this project communicates efficiently with the Citect software in accordance with the requirements in the paragraph, entitled "Switchgear Monitoring and Control Systems," of this section.

Tests on switchgear assemblies must include polarity verification, grounding of instrument transformer casing test, mechanical operation tests, electrical operation and control wiring tests including circuit continuity, relay and metering circuit performance tests, and dielectric tests. Conduct tests in accordance with IEEE Std 4, and UL 467.

Manufacturer must provide written test results for all tests performed. Submit test reports to the Contracting Officer prior to shipping equipment.

3.3 INSTALLATION

Installation must conform to IEEE C2 and NFPA 70.

Electrically and mechanically connect the complete assembly at the site from coordinated subassemblies shipped in complete sections from the manufacturer. Carefully align, level, and secure complete installation in conformance with the manufacturer's recommendations.

Carefully join separated switchgear assemblies to present a neat appearance,with main and ground bus joints tightened to manufacturer's recommended torque values. Handle assemblies with appropriate lifting devices.

Submit Installation Drawings for the switchgear assemblies. Include in drawings complete details of equipment layout and design.

3.4 FIELD TESTING

The switchgear manufacturer must provide the test equipment, labor and technical expertise for testing and checkout of the switchgear assembly as a connected system after it is installed. Provide manufacturer's written test results for all tests performed. Submit test reports including Certificate of Compliance to the Contracting Officer prior to energizing equipment. Replace any material, equipment or devices found to be defective at no cost to the Government.

Comply with NETA ACCEPT and NETA MAINT for electrical acceptance tests of transformers, switchgear, breakers, relaying, metering and all related material, including secondary current injection tests and manufacturers recommendations. Submit a testing procedure 30 calendar days prior to field testing. Include in testing procedure complete functional testing of the entire system which evaluates the functionality and performance of all control and automatic sequencing and operation of the switchgear.

Additional testing to those described in NETA ACCEPT and NETA MAINT are as follows:

[a. Demonstrate switchgear automatic transfer scheme, timing functions and interlocks for mains and tie breaker operate as specified.]

b. Remove all controls [and UPS power] from PLC/PC and verify when power is restored, programming automatically recovers with no anomalies. This test must ensure fully functional programming is restored and ready to operate on restoration of power to PLC/PC. Perform this test three separate times.

[c. Demonstrate control voltage automatic transfer relay and components until on properly.]

d. Functionally verify SMCS system through the Ethernet connection fully operational and all I/O functions are as specified.

[e. Demonstrate switchgear local/remote switch, if installed, operates as specified.]

Final acceptance is dependant upon the satisfactory performance of the equipment under test. Provide final test data to the Contracting Officer.

3.5 RELAY SETTINGS AND TESTS

Properly coordinate all circuit-interrupting devices before the switchgear assemblies are energized. Thoroughly inspect and adjust protective relays at the site in the presence of and at the discretion of the Contracting Officer.

3.6 FIELD TESTING FOR COMMUNICATIONS

3.6.1 Field Quality Control

Furnish the services of a manufacturer's representative to assist in starting-up and programming the system. The manufacturer's representative must be factory-trained and have a thorough knowledge of the software, hardware, and system programming. The manufacturer's representative must provide the following services:

a. Perform full functionality tests on the communications network from all IEDs to the Ethernet gateway.

b. Setting all the addresses of all devices in the equipment.

c. Verifying and troubleshooting the integrity of the data line.

d. Assisting the government in correcting any data line problems.

e. Configure the SMCS software to match the field devices.

3.6.2 Field Testing

Verify complete system operation including all hardware, software and communication devices. Verify networking performance with all interfacing systems by other manufacturers.

3.6.3 Manufacturers Certification

A qualified factory-trained manufacturer's representative must certify in writing that the equipment has been installed, adjusted and tested in accordance with the manufacturer's recommendations.

3.6.4 Training

Furnish the services of manufacturer representatives to train the owner's personnel in operation and programming of the system. The manufacturer representatives must be factory-trained and must have a thorough knowledge of the switchgear, PLC and touch-screen software, hardware and system programming. Include in the training session on the PLC and all controls:

a. Switchgear on-site training

(1) Full operation demonstrations of all functions.

(2) Breaker electrical and mechanical operations.

(3) Explanations and instructions for all protective devices.

b. Classroom on-site training for programming the touch screen.

3.6.5 After Start-up Support

The manufacturer must provide a 24-hour 800 telephone number manned with Engineers/Technicians expert in SMCS devices, software and communication system troubleshooting or capable of providing technical information. Provide this support at no cost to the Government for a period of five years.

3.7 ENERGIZING SWITCHGEAR ASSEMBLIES

Do not energize switchgear assembly until it is completely installed, tested, approved by the Contracting Officer, and ready for operation. Site testing must be conducted and approved by the Contracting Officer.

Using ammeter, voltmeter, and wattmeter or phase-angle meter, the values and polarities of voltage and current, measure and compare with those expected in the various relay circuits. Inspect and note all contact

positions of directional elements and the voltage relays.

After inspection and satisfactory tests have been completed on all active relay circuits under a no-load condition,perform an operational test with diverted load currents or simulated ground faults on each relay.

Prepare a comprehensive report with records of connections, electrical constants, settings, test values, operating performance, and failures or weaknesses found on test.

Tests and procedures for testing must be in accordance with paragraph, entitled "Field Testing," in this section and the manufacturer's recommendations. Upon completion of all testing and approval of the Contracting Officer, the switchgear must be energized, as approved by the Contracting Officer.

-- End of Section --