SECTION 26 13 13
MEDIUM-VOLTAGE CIRCUIT BREAKER SWITCHGEAR
METAL-CLAD, VACUUM, 5 kV-15 kV

PART 1 - GENERAL

1.1 SCOPE

A. This section includes medium-voltage, metal-clad circuit breaker switchgear and its associated auxiliary equipment. The equipment shall consist of ***[indoor] [outdoor, non-walk-in] [outdoor, Shelter-Clad, single-aisle, walk-in]*** switchgear with horizontal drawout, vacuum circuit breakers.

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions apply to this Section.

1.3 SUBMITTALS

A. Submit shop drawings and product information for approval and final documentation in the quantities listed according to the Conditions of the Contract. All transmittals shall be identified by purchaser name, purchaser location and purchaser's order number.

B. Approval documents shall include:
1. General arrangement drawing showing dimensioned elevation and floor plan, foundation details and one-line diagram
2. Panel arrangement drawing showing layout of devices on the panel doors
3. Three-line diagrams
4. Schematics
5. Nameplate engraving drawings
6. Electrical bill of material.

C. Final documents shall include:
1. Documents listed in 1.3.B above
2. Wiring diagrams
3. Recommended spare parts list for start-up support
4. Instruction manual.

1.4 QUALITY ASSURANCE

A. Manufacturer qualifications: The bidder must have at least 15-years experience in manufacturing medium-voltage metal-clad switchgear and circuit breakers. The manufacturer of the metal-clad switchgear assembly shall also be the manufacturer of the circuit breakers.

B. Comply with requirements of latest revisions of applicable industry standards, specifically including the following:
1. ANSI/IEEE C37.20.2 - Metal-Clad Switchgear
2. ANSI/IEEE C37.04 - Rating Structure for High Voltage Circuit Breakers
3. ANSI/IEEE C37.06 - Preferred Ratings for High Voltage Circuit Breakers
4. ANSI/IEEE C37.90 - Relays and Relay Systems.

1.5 DELIVERY, STORAGE AND HANDLING

A. Deliver in convenient shipping groups. Shipping groups shall not exceed 15 feet in length.

B. Circuit breakers shall be shipped inside their respective cells.

C. Aisle for the outdoor, Shelter-Clad, single-aisle switchgear shall be shipped ***[disassembled for erection in the field] [factory assembled].***

D. The accessory cabinet shall be shipped attached to the switchgear.

E. Bus bars with associated hardware for connections between shipping groups shall be shipped inside one of the units in which shall be installed.

F. Contractor shall store the equipment in accordance with manufacturer's recommendations.

G. Contractor shall install temporary heaters, if necessary, to prevent condensation during storage.

H. Contractor shall handle and move the switchgear in accordance with manufacturer's recommendations.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. ***[The metal-clad switchgear assembly shall be as manufactured by SIEMENS or approved equal. Approved manufacturers are as follows:***
   1. ***SIEMENS***
   2. ***.]***

2.2 RATINGS

A. System configuration: The switchgear shall be suitable for application in three-phase, ***[60 Hz] [50 Hz], [grounded-neutral] [ungrounded] [high-impedance grounded]*** system.

B. Electrical ratings:

   1. Circuit breaker and switchgear ratings shall be based on ***[MVA class and ANSI/IEEE C37.04-1979]*** or ***["constant kA" ratings and ANSI/IEEE C37.04-1999***]. The first six are MVA class and the second eight are constant kA rated. ***[Choose one of the 14 categories. Delete the other 13.]***
      a. ***[Interrupting class: 250 MVA***
         1.) ***Maximum design voltage (V): 4.76 kV***
         2.) ***Impulse withstand voltage: 60 kV***
         3.) ***Interrupting current (I) at maximum design voltage: 29 kA***
         4.) ***Voltage range factor (K): 1.24***
         5.) ***Maximum design voltage divided by K: 3.85 kV***
         6.) ***Interrupting current (IK) at V/K: 36 kA***
         7.) ***Short-time withstand current: 36 kA***
         8.) ***Momentary withstand and closing and latching current: 58 kA rms and 97 kA peak].***
      b. ***[Interrupting class: 350 MVA***
         1.) ***Maximum design voltage (V): 4.76 kV***
         2.) ***Impulse withstand voltage: 60 kV***
         3.) ***Interrupting current (I) at maximum design voltage: 41 kA***
         4.) ***Voltage range factor (K): 1.19***
         5.) ***Maximum design voltage divided by K: 4.0 kV***
         6.) ***Interrupting current (IK) at V/K: 49 kA***
         7.) ***Short-time withstand current: 49 kA***
         8.) ***Momentary withstand and closing and latching current: 78 kA rms and 132 kA peak].***
      c. ***[Interrupting class: 500 MVA***
         1.) ***Maximum design voltage (V): 8.25 kV***
         2.) ***Impulse withstand voltage: 95 kV***
         3.) ***Interrupting current (I) at maximum design voltage: 33 kA***
         4.) ***Voltage range factor (K): 1.25***
         5.) ***Maximum design voltage divided by K: 6.6 kV***
         6.) ***Interrupting current (IK) at V/K: 41 kA***
         7.) ***Short-time withstand current: 41 kA***

8.) ***Momentary withstand and closing and latching current: 66 kA rms and 111 kA peak].***

d. ***[Interrupting class: 500 MVA***
   1.) ***Maximum design voltage (V): 15 kV***
   2.) ***Impulse withstand voltage: 95 kV***
   3.) ***Interrupting current (I) at maximum design voltage: 18 kA***
   4.) ***Voltage range factor (K): 1.3***
   5.) ***Maximum design voltage divided by K: 11.5 kV***
   6.) ***Interrupting current (IK) at V/K: 23 kA***
   7.) ***Short-time withstand current: 23 kA***
   8.) ***Momentary withstand and closing and latching current: 37 kA rms and 62 kA peak].***

e. ***[Interrupting class: 750 MVA***
   1.) ***Maximum design voltage (V): 15 kV***
   2.) ***Impulse withstand voltage: 95 kV***
   3.) ***Interrupting current (I) at maximum design voltage: 28 kA***
   4.) ***Voltage range factor (K): 1.3***
   5.) ***Maximum design voltage divided by K: 11.5 kV***
   6.) ***Interrupting current (IK) at V/K: 36 kA***
   7.) ***Short-time withstand current: 36 kA***
   8.) ***Momentary withstand and closing and latching current: 58 kA rms and 97 kA peak].***

f. ***[Interrupting class: 1,000 MVA***
   1.) ***Maximum design voltage (V): 15 kV***
   2.) ***Impulse withstand voltage: 95 kV***
   3.) ***Interrupting current (I) at maximum design voltage: 37 kA***
   4.) ***Voltage range factor (K): 1.3***
   5.) ***Maximum design voltage divided by K: 11.5 kV***
   6.) ***Interrupting current (IK) at V/K: 48 kA***
   7.) ***Short-time withstand current: 48 kA***
   8.) ***Momentary withstand and closing and latching current: 77 kA rms and 130 kA peak].***

g. ***[Interrupting class: 40 kA***
   1.) ***Maximum design voltage (V): 4.76 kV***
   2.) ***Impulse withstand voltage: 60 kV***
   3.) ***Interrupting current (I) at maximum design voltage: 40 kA***
   4.) ***Voltage range factor (K): 1.0***
   5.) ***Short-time withstand current: 40 kA***
   6.) ***Momentary withstand and closing and latching current: 62 kA rms and 104 kA peak].***

h. ***[Interrupting class: 50 kA***
   1.) ***Maximum design voltage (V): 4.76 kV***
   2.) ***Impulse withstand voltage: 60 kV***
   3.) ***Interrupting current (I) at maximum design voltage: 50 kA***
   4.) ***Voltage range factor (K): 1.0***
   5.) ***Short-time withstand current: 50 kA***
   6.) ***Momentary withstand and closing and latching current: [78 kA] rms and [130 kA] peak].***

i. ***[Interrupting class: 63 kA***
   1.) ***Maximum design voltage (V): 4.76 kV***
   2.) ***Impulse withstand voltage: 60 kV***
   3.) ***Interrupting current (I) at maximum design voltage: 63 kA***
   4.) ***Voltage range factor (K): 1.0***
   5.) ***Short-time withstand current: 63 kA***
   6.) ***Momentary withstand and closing and latching current: 98 kA rms and 164 kA peak].***

j. ***[Interrupting class: 40 kA***
   1.) ***Maximum design voltage (V): 8.25 kV***
   2.) ***Impulse withstand voltage: 95 kV***
   3.) ***Interrupting current (I) at maximum design voltage: 40 kA***
   4.) ***Voltage range factor (K): 1.0***
   5.) ***Short-time withstand current: 40 kA***
   6.) ***Momentary withstand and closing and latching current: 62 kA rms and 104 kA peak].***

k. ***[Interrupting class: 25 kA***
   1.) ***Maximum design voltage (V): 15 kV***
   2.) ***Impulse withstand voltage: 95 kV***
   3.) ***Interrupting current (I) at maximum design voltage: 25 kA***
   4.) ***Voltage range factor (K): 1.0***
   5.) ***Short-time withstand current: 25 kA***
   6.) ***Momentary withstand and closing and latching current: 39 kA rms and 65 kA peak].***

l. ***[Interrupting class: 40 kA***
   1.) ***Maximum design voltage (V): 15 kV***
   2.) ***Impulse withstand voltage: 95 kV***
   3.) ***Interrupting current (I) at maximum design voltage: 40 kA***
   4.) ***Voltage range factor (K): 1.0***
   5.) ***Short-time withstand current: 40 kA***
   6.) ***Momentary withstand and closing and latching current: 62 kA rms and 104 kA peak].***

m. ***[Interrupting class: 50 kA***
   1.) ***Maximum design voltage (V): 15 kV***
   2.) ***Impulse withstand voltage: 95 kV***
   3.) ***Interrupting current (I) at maximum design voltage: 50 kA***
   4.) ***Voltage range factor (K): 1.0***
   5.) ***Short-time withstand current: 50 kA***
   6.) ***Momentary withstand and closing and latching current: 78 kA rms and 130 kA peak].***

n. ***[Interrupting class: 63 kA***
   1.) ***Maximum design voltage (V): 15 kV***
   2.) ***Impulse withstand voltage: 95 kV***
   3.) ***Interrupting current (I) at maximum design voltage: 63 kA***
   4.) ***Voltage range factor (K): 1.0***
   5.) ***Short-time withstand current: 63 kA***
   6.) ***Momentary withstand and closing and latching current: 98 kA rms and 164 kA peak].***

2. Circuit breaker rated interrupting time ***[five-cycles] [three-cycles].***

3. Switchgear main bus continuous current ***[1,200 A] [2,000 A] [3,000 A] [4,000 A].***

2.3 SWITCHGEAR GENERAL CONSTRUCTION

A. The switchgear enclosure shall be of metal-clad construction as described in ANSI/IEEE standards.

B. The switchgear shall be factory assembled into convenient shipping groups and tested. The switchgear shall be of a coordinated design so shipping groups shall be easily connected together at the site into a continuous lineup. Necessary shipping split connecting busbars, boots and hardware shall be furnished and shall be attached to the switchgear in the approximate locations where they shall be needed.

C. The switchgear assembly shall consist of one or more vertical sections, each of which shall have a main bus compartment and two vertically stacked equipment cells. The cells shall be arranged for circuit breakers or auxiliary devices or shall be blank as indicated in the detailed

specification. Each vertical section shall be provided with a low-voltage devices compartment located between the upper and lower cells at the front of the equipment.

D. Each main bus compartment shall contain copper bus bars ***[silver-plated at electrical connection points] [tin-plated at electrical connection points]***, three-phase, three-wire, fully insulated with fluidized bed epoxy coating or equivalent. Sleeve type insulation shall not be permitted. Bus connection joints shall be insulated with preformed PVC boots held together with nylon hardware for easy installation and removal during servicing. Copper bus bars shall be bead-blasted prior to applying epoxy coating to assure a proper bond between the epoxy and the bus bar, eliminating partial discharges. Each bus segment shall be individually high-potential tested prior to assembly. Taped joints are not permitted except in unusual joint configurations. The ground bus shall be bare ***[silver-plated] [tin-plated]*** copper; at least ¼ by two inches and shall extend the full length of switchgear.

E. Each circuit breaker compartment shall contain a racking mechanism, circuit breaker operated (not racking mechanism operated) automatic shutters and safety interlocks.

F. Each circuit breaker cell should be equipped with an integrated electrical circuit breaker racking system consisting of a fixed-mounted gear motor coupled to the drive shaft of the circuit breaker racking mechanism. The fixed-mounted gear motor shall be controlled and protected by a logic control module that receives local commands from a pendant (hand-held controller). The racking system must enable the racking of the circuit breaker to CONNECT, DISCONNECT and TEST positions via the control pendant. The control pendant must be equipped with circuit breaker position and alarm indication. The system should be equipped with the following features:
   1. Maintain all of the safety interlocks as required by IEEE Std. C37.20.2.
   2. User-friendly hand-held control pendant with easy to read display and controls.
   3. Control pendant shall provide clear light-emitting diode indication of the position of the circuit breaker in CONNECT, DISCONNECT and TEST positions.
   4. Controller logic shall sense interference issues during racking.
   5. If interference is detected, the racking mechanism will attempt to return the circuit breaker to the DISCONNECT position and clear indication via light-emitting diode will be shown on the control pendant.
   6. When plugged into a specific circuit breaker compartment, the control pendant will override any electronic system (i.e., HMI, SCADA or similar) for racking control.
   7. High-torque, fixed-mounted gear motor in the circuit breaker compartment shall provide smooth and efficient motion of the circuit breaker from CONNECT position to the TEST position, or to the DISCONNECT position.

G. Each circuit breaker cell shall also include:
   1. Hinged front panel.
   2. Primary and secondary disconnecting devices.
   3. Control circuit cutout device.
   4. Terminal blocks, control wiring and control power buses.
   5. Manual latch to retain circuit breaker in withdrawn position.
   6. Side wall mounted sliding type secondary disconnects to facilitate inspection of mating of contact from the front and easy accessibility for troubleshooting. Secondary disconnects using plug and socket arrangement with umbilical cord, as well as disconnects not visible for inspection, are not permitted.
   7. Provision shall be made for closed door racking with a manual racking handle. Mechanical position indication shall be visible with door closed.
   8. Racking mechanism shall be simple to install and operate. Racking mechanism using a chain to transmit motion from one side to the other side is not permitted. Provision for installing up to three padlocks shall be integral with the racking mechanism to assure positive position locking of the circuit breaker.

H. Each auxiliary cell shall include the following:
   a. Hinged front panel, suitable for relays and instruments

b. Necessary terminal blocks, control wiring and control power buses
c. Device markers.

I. Switchgear construction shall facilitate floor roll-out of circuit breakers in the lower cells. Guide channels shall be provided for smooth circuit breaker roll-in.

J. Each vertical ***[indoor]*** section shall be approximately 36” width x 98.5” depth x 95.25” height.

K. The steel used in the structure and panels shall be chemically cleaned, hot phosphate treated, rinsed and oven-dried and shall be given an electrostatically applied coat of ANSI 61 polyester paint.

L. Low-voltage device panel located inside the circuit breaker or auxiliary cells shall be painted high-gloss white for better visibility and ease of maintenance.

M. Enclosure ***[Pick one of the following three enclosure types. The paragraph selected should match the decision made in Section 1.1.A.]***

1. ***[The indoor enclosure shall be constructed of bolted sheet steel material.]***
2. ***[Outdoor, Shelter-Clad, single-aisle, walk-in enclosure. Single-aisle design shall consist of indoor type circuit breakers and auxiliary cells located in weatherproof steel housing having an operating aisle space of sufficient size to permit withdrawal of the circuit breakers for inspection, test and maintenance. The following shall be included:***
   a. ***Outdoor enclosure: Painted steel, weatherproof construction; integral structural-steel base frame with factory-applied asphalt undercoating; and equipped with the following features:***
      1.) ***Structural design and anchorage adequate to resist loads imposed by 100-M.P.H. wind***
      2.) ***[Adequate incandescent lighting controlled by means of three-way wall switches at each access door] [Fluorescent aisle lights with low-temperature ballasts, controlled by three-way wall switches at each access door]***
      3.) ***Space heaters in each vertical section, operating at ½ rated voltage, sized to prevent condensation***
      4.) ***Louvers equipped with screens and filters, arranged to permit air circulation while excluding exterior dust and rodents***
      5.) ***Aisle of sufficient width to permit circuit breaker withdrawal, disassembly and servicing in the aisle***
      6.) ***Aisle access doors at each end with outside padlocking provisions and interior panic bars***
      7.) ***Two duplex receptacles with integral ground fault protection, one at each aisle access door***
      8.) ***[Thermostatically controlled aisle heater] [Thermostatically controlled exhaust fan]***
      9.) ***[Thermally insulated aisle, walls and roof]***
      10.) ***Additional workspace [72”] [108”] [144”] wide at one end of the switchgear lineup for [battery system] [storage] [office area] [miscellaneous use]***
      11.) ***[Exterior door area lighting consisting of halogen fixtures] [Photocell operated]***
      12.) ***[Exterior rotating alarm light]***
      13.) ***[Battery operated exit signs above doors].***
3. ***[Outdoor, non-walk-in enclosure.***
   a. ***Non-walk-in design shall consist of indoor circuit breaker and auxiliary units located in a weatherproof, painted steel housing, with structural-steel base frame and factory-applied asphalt undercoating; and equipped with the following features:***

1.) ***Structural design and anchorage provisions adequate to resist loads imposed by 100-M.P.H. wind***
2.) ***Each unit equipped with an exterior full height hinged front door with provision for padlocking and two inner hinged doors***
3.) ***Space heaters in each vertical section, operating at ½ rated voltage, sized to prevent condensation***
4.) ***Louvers equipped with screens and filters and arranged to permit air circulation while excluding exterior dust and rodents***
5.) ***One lamp in each cell with one on-off switch per section***
6.) ***One utility duplex receptacle with integral ground fault protection in each section].***

2.4 COMPONENTS

A. Instrument transformers: Comply with ANSI/IEEE C57.13 and ANSI/IEEE C37.20.2.
1. Voltage transformers (VTs): Secondary voltage rating of 120 V and accuracy class of 0.3 with burdens of W, X and Y. The VTs shall be mounted on a rollout tray. Each tray must accommodate up to three VTs, with integrally mounted primary fuses. The auxiliary cell shall be equipped with automatic shutters and grounding fingers that remove any static charge from the windings before allowing operator access to the VTs.
2. Current transformers (CTs): Ratios as indicated; burden and accuracy class as per ANSI, suitable for connected relays, meters and instruments. The CTs shall be bushing mounted. Each circuit breaker bushing shall be able to accommodate two standard accuracy CTs or one high accuracy CT. The CT secondary wiring shall be connected to shorting terminal blocks with ring tongue terminations.
3. AC control power shall be furnished from: ***[Pick one of the next three paragraphs. Delete the others. Then, make decisions within the remaining paragraph.]***
a. ***[An internally mounted, dry-type transformer, including primary and secondary fuses. Control Power Transformer (CPT) shall be [15 kVA single-phase] [25 kVA single-phase] [50 kVA single-phase] [15 kVA three-phase] [30 kVA three-phase] [45 kVA three-phase]. Up to 15 kVA single-phase the CPT with its primary fuses shall be mounted on the drawout tray. Above 15 kVA single-phase the primary fuses shall be drawout tray mounted and the CPT shall be fixed mounted in the rear of the section.]***
b. ***[An externally mounted dry-type transformer, including primary fuses shall be drawout tray mounted in the switchgear. CPT shall be [75 kVA three-phase] [112.5 kVA three-phase].***
c. ***[Control power to be furnished by others.]***
4. Suitable automatic transfer scheme is required when control power transformers are provided on the incoming side of the main circuit breakers in double-ended installations, to transfer the secondary load should one incoming supply fail.

B. Multifunction digital-meters shall be UL-Listed or UL-Recognized, microprocessor-based units suitable for three- or four-wire systems. Units shall be mounted on the instrument compartment door and as follows:
1. For incoming monitoring for main circuit breakers, SIEMENS model ***[9200] [PAC3200] [9330] [9350] [9510] [9610]*** multifunction power meter with ***[Profibus] [Modbus] [DNP3.0]*** communication protocol shall be provided.
2. For feeder circuit breakers, SIEMENS model ***[9200] [PAC3200] [9330]*** multifunction power meter with ***[Profibus] [Modbus] [DNP3.0]*** communication protocol shall be provided.

C. Multifunction protective relaying. Microprocessor-based three-phase relays shall be UL-Listed or UL-Recognized and shall be provided as follows:
1. Main circuit breakers.
a. The relays shall be SIEMENS 7SJ63 or 7SJ64 bay controller or equivalent. The relays shall include the following protection functions: 50/51, 50N/51N, 67/67N, 27, 59, 81O/U and 25 (7SJ64 only).

b. The relays shall provide monitoring of the CT and VT circuits and alarm on circuit failure.
c. The relays shall provide a graphic mimic display visually indicating the position (open/closed) of the circuit breaker, protection function trip and metering data. Unlimited user-configurable Human Machine Interface (HMI) screens shall allow the user to create unique single-line displays with a simple tool or from an existing library.
d. The relays shall provide key locking to prevent unauthorized switching either local or remote.
e. The relays shall be capable of internally performing main-tie-main auto-transfer and auto-restore functions.
f. The relays shall have programmable logic capabilities to permit use in protection and control systems. Programming software must be compliant with IEC 61131 standard for PLC programming.
g. The relays shall have a modular communications processor to permit field change between Modbus RTU, Profibus-DP, Profibus-FMS, DNP3.0, IEC 60870-5-103 and IEC 61850 protocols. The relays shall be able to support either RS-485 or fiber-optic communications.
h. The relays shall provide complete sequence-of-events recording, time stamped in milliseconds. The relays shall provide oscillography (waveform) capture, with configurable pre- and post-fault data capture times.
i. The relays binary inputs shall be provided with chatter blocking and filter time. The chatter blocking shall effectively block a binary input indication and prevent the generation of indications when the signal cannot be interpreted. The filter time indicates how long a signal must be present before it shall be interpreted as an indication. This shall serve to suppress short, intermittent changes. These two features shall be available and settable separately for each binary input indication.
j. The relays shall provide four protection settings groups. Setting group changes shall be available locally through front function key and binary input; remotely through operator or service communication interface using a personal computer and via system interface (Profibus, Modbus, etc.).

2. Bus protection – full differential.
a. The relays shall be SIEMENS 7UT613 or equivalent. The relay shall be low-impedance percentage differential relays.
b. The relays shall have three restraint winding inputs.
c. The relays shall have a through-fault restraint setting to prevent tripping due to high-current external faults.
d. The relays shall have a CT monitoring element to block differential trip if a CT secondary circuit has failed and shall provide alarm function.
e. The relays shall provide complete sequence-of-events recording, time stamped in milliseconds. The relays shall provide oscillography (waveform) capture, with configurable pre- and post-fault data capture times.
f. The relay shall have the capability to be applied as single-phase bus relays.
g. The relays shall have modular communication for simple integration into SCADA systems. The communication protocol shall be ***[Profibus DP] [Modbus RTU] [DNP3.0] [IEC 61850].***

3. ***[Feeder protection with communications.***
a. ***The relays shall be SIEMENS 7SJ80 protective relay or equivalent. The relays shall provide the following functions: 50/51, 50N/51N, 67, 64, 87N, 37, 49, 46, 27, 59, 81O/U, 50BF, 46, 47, 25, 79 and 21FL.***
b. ***The relays shall monitor the CT circuits and alarm on circuit failure.***
c. ***The relays shall be capable of being used in a reverse interlocking bus protection scheme.***
d. ***The relays shall have nine programmable function keys to replace control switches.***

e. ***The relays shall have programmable logic capabilities to permit use in protection and control systems. Programming software shall be compliant with IEC 61131 standard for PLC programming.***
f. ***The relays shall have a modular communications processor to permit field change between IEC 61850, Modbus RTU, Profibus-DP, DNP3.0 and IEC 60870-5-103 protocols. The relays shall be able to support either RS-485 or fiber-optic communications.***
g. ***All relay terminal blocks including CT blocks shall be pluggable to assure ease of relay replacement and maintenance testing.***
h. ***The housing shall be a sealed dust proof environment for the relay internal electronics. Head build up must be dissipated through the surface area of the steel enclosure. The relays thus shall maintain their tested insulation characteristic standards per IEC, IEEE, even if deployed in harsh dusty environments.***
i. ***The relays must provide 20 flexible functions that shall be used to create additional protection functions to maximize application flexibility.]***

4. ***[Feeder protection – motor protection with communications.***
a. ***The relays shall be SIEMENS 7SK80 protective relay or equivalent. The relays shall provide the following protection functions: 50/51, 50N/51N, 67N, 67Ns, 50Ns, 59N/64, 37, 48, 66, 14, 51M, 49, 46, 27, 59, 81O/U, 50BF, 46 and 47.***
b. ***The relays shall have five RTD inputs.***
c. ***The relays shall have the option to connect 12 additional RTD inputs through an Ethernet connection.***
d. ***The relays shall provide trip circuit supervision of the feeder circuit breaker and alarm on trip circuit failure.***
e. ***The relays shall be capable of being used in a reverse (zone) interlocking bus protection scheme.***
f. ***The relays shall provide logic programmability to create starting schemes. For example, reduced voltage starting.***
g. ***The relays shall provide logic programmability to create failsafe tripping logic.***
h. ***The relays shall have nine programmable function keys to replace control switches.***
i. ***The relays shall have programmable logic capabilities to permit use in protection and control systems. Programming software must be compliant with IEC 61131 standard for PLC programming.***
j. ***The relays shall have a modular communications processor to permit field change between IEC 61850, Modbus RTU, Profibus-DP, DNP3.0 and IEC 60870-5-103 protocols. The relays shall be able to support either RS-485 or fiber-optic communications.***
k. ***All relay connectors including CT connectors shall be pluggable to assure ease of relay replacement and maintenance testing.***
l. ***The housing shall be a sealed dust proof environment for the relays' internal electronics. Heat build up must be dissipated through the surface area of the steel enclosure. The relays shall maintain their tested insulation characteristic standards per IEC, IEEE, even if deployed in harsh, dusty environments.***
m. ***The relays shall provide 20 flexible functions that can be used to create additional protection functions to maximize application flexibility.]***

5. Feeder protection – transformer protection.
a. The transformer differential protection relays shall be SIEMENS 7UT61 or equivalent. The relays shall provide the following protection functions: 87, 87N, 50/51, 50/51G, 49, 46 and 50BF.
b. The transformer differential relays shall have a through-fault restraint setting to prevent tripping due to high current external faults.

6. Generator circuit breaker protection – simple overcurrent with communications.
   a. The relays shall be SIEMENS 7UM623 series. The relays shall provide the following protection functions: 59, 51V, 81, 27, 32/32R, 40, 87G, 46 and 51G.
   b. The relays shall provide current differential protection for the generators.
   c. The relays shall monitor the CT and VT circuits and alarm on circuit failure.
   d. The relays shall have programmable logic capabilities to permit use in protection and control systems. Programming software shall be compliant with IEC 61131 standard for PLC programming.
   e. The relays shall recognize and alarm CT open circuit or short circuit conditions.
   f. The relays shall support either RS-485 or fiber-optic communications.
   g. The relays shall have modular communication for simple integration into SCADA systems. The communication protocol shall be ***[Profibus-DP] [Modbus RTU] [DNP3.0] [IEC 61850].***
7. Software / data information – relay software.
   a. The relay shall be configured through Windows based software current up to Windows XP Pro.
   b. The relays shall provide complete sequence-of-events recording, time stamped in milliseconds under all conditions. The relays shall provide oscillography (waveform) capture, with configurable pre- and post-fault data capture times. All internally and externally generated binary values shall be configurable to appear in the custom generated fault. Information containing time, date, interrupted current amps per phase, time in pickup, trip open, close or user programmed status points, etc., shall be displayed.
   c. Logging of system and protective events, last 200 events (accessible via front RS-232 communications port and rear service communications port used to connect to a personal computer having an RS-232 port or USB via conversion).
   d. Log of last eight faults (maximum five second record time) containing date and time stamps, pickup and tripping signals, interrupted current amps, voltage, etc. The analog quantities displayed in the oscillography shall have the option for viewing in either primary or secondary quantities.
   e. Fault records shall be in the industry standard Comtrade format that shall be imported or exported.
   f. The relay shall provide four protection settings groups. Setting group changes shall be available locally through front function key and binary input; remotely through operator or service communication interface using a personal computer and via system interface (Profibus DP, Modbus RTU, DNP3.0, IEC, etc.).
   g. All logging settings, annunciations, fault records, Binary I/O and LED assignments must have easy to print options and easy file transfer capabilities.
   h. Relay software shall have feature for archiving or retrieving an entire project that includes all subfolders and relay files in one simple to use feature.
   i. A measurement supervision feature shall be providing for monitoring external current and voltage transformers connected to the relay.
   j. The software shall have the capability of entering the settings in both primary and secondary quantities.
   k. The current transformer polarities shall be reversible using a setting in the software when it becomes necessary.
   l. The software shall include a commissioning tool for all hardware (BI/BO/LEDs) and SCADA mapped points.
   m. The software shall be compatible with earlier version relay firmware releases.
   n. The software shall have a capability to assign an IP address to the relay allowing for a web browser commissioning tool feature to view relay information online.

D. Provision for future circuit breakers: Equip compartments designated as “future” with rails, mounting brackets, supports, primary bushings, shutters and bus connections.

E. Control wiring: Factory installed, complete with bundling and protection where necessary and complying with the following:

1. Extra-flexible conductors for wires across hinges and for interconnections between shipping units. Control and secondary wiring shall be at least No. 14 AWG.
2. Conductors sized according to NFPA 70.
3. Internal wiring shall be carried in inter-unit wiring area, which protects the wires. The wires shall be bundled, tie-wrapped and secured to metal anchors. Wire ties with self sticking tape shall not be permitted.

2.5 VACUUM CIRCUIT BREAKERS

A. Vacuum circuit breakers: Drawout mounted units using three individual vacuum interrupters and including the following features:
1. Circuit breaker design shall operate at rated voltage to interrupt fault current within its rating within ***[five-] [three-]*** cycles of trip initiation.
2. Contact-wear indicator shall be readily visible from the rear of the circuit breaker.
3. Four minimum spare auxiliary contacts shall be provided. Additional contacts shall be provided on the cell wall as specified.
4. Operating mechanism shall be electrically charged, mechanically and electrically trip-free and stored-energy operated.
5. Closing velocity of moving contacts shall be independent of both control voltage level and operator.
6. Design of mechanism shall permit manual charging of mechanism.
7. Control power shall be ***[250 Vdc for closing and tripping] [125 Vdc for closing and tripping] [48 Vdc for closing and tripping] [230 Vdc for closing, 230Vac with capacitor tripping] [120 Vac for closing, 120 Vac with capacitor tripping].***
8. The operating mechanism shall be front accessible so that it is not necessary to work under the circuit breaker or tip it over in order to perform maintenance.
9. A single visual check, such as a contact erosion indicator, shall be sufficient to verify both spring pressure and contact wear. The contact erosion indicator shall be identical across all circuit breaker ratings. Confusing maintenance procedures, such as separate contact erosion and wipe measurements, shall not be permitted.
10. Circuit breaker tripping provisions shall include shunt trip coil for tripping with protective relays, lockout relays, control switch or manual command signal from the relay. The circuit breaker shall include mechanical push button for manual tripping.
11. Circuit breaker closing provisions shall include close (spring release) coil for closing by electrical signal from control circuitry, control switch or manual command signal from the relay. The circuit breaker shall include mechanical push button for manual closing.
12. Current transfer path from the interrupter moving stem to the circuit breaker pole-mounted finger cluster shall be flexible copper laminations with long mechanical life. Brush, roller or wiping contacts shall not be permitted.
13. Vacuum interrupters and circuit breaker shall be manufactured and warranted by the same manufacturer.
14. Vacuum interrupter design shall limit the chopping currents to below 5 A to obviate the need for surge protection against switching transients during fault interruption for most loads. Surge limiters shall be provided for feeders to motors having locked rotor current of less than 600 A.

B. The circuit breakers shall be floor rollout that permits convenient insertion and withdrawal of the vacuum circuit breakers in the lower cells (of switchgear not on a raised pad) without the use of lift truck, ramp or dolly.

C. Circuit breakers of equal ratings shall be interchangeable for the upper and lower cells.

D. ***[For 50 kA or lower ratings, the vacuum circuit breakers shall be designed to be used in switchgear cells of the same design and short-circuit rating but different voltage or continuous ratings, as long as the voltage and continuous current ratings of the circuit breaker shall be equal to or higher than required by the cell. 2,000 A and 3,000 A circuit breakers shall be designed to be used in 1200 A cells.]***

E. ***[For 63 kA rating, the vacuum circuit breakers shall be designed to be used in switchgear cells of the same design and short-circuit rating but different voltage or continuous ratings, as long as the voltage and continuous current ratings of the circuit breaker shall be equal to or higher than required by the cell. 2,000 A and 3,000 A circuit breakers shall be designed to be used in 1,200 A cells.]***

F. It shall be possible to test the circuit breaker in the TEST position inside the cell without the use of additional cables or couplers.

G. The switchgear manufacturer shall cycle each circuit breaker through at least 200 mechanical on-off operations as a part of routine production tests.

2.6 ACCESSORIES

A. Manual racking crank.

B. Manual spring charging crank.

C. ***[Circuit breaker test cabinet separately mounted and containing pushbuttons for circuit breaker closing and tripping, fuses and secondary coupler with cable approximately 9 feet long.]***

D. ***[Secondary test coupler to permit testing of circuit breaker outside the assembly.]***

E. ***[Circuit breaker lift truck for removing circuit breakers from the upper cells.]***

F. ***[Lift sling.]***

G. ***[Electric racking motor assembly and control station.]***

H. ***[Fifth wheel device for convenient handling of circuit breakers.]***

I. ***[Six spare fuses of each type and rating of fuse used. Include spares for voltage transformer fuses and control power fuses.]***

J. ***[One spare indicating lamp of each type installed.]***

K. ***[½ pint of touchup paint matching enclosure finish.]***

L. Contact lubricant.

M. ***[Ground and test device [for 50 kA or lower ratings], manually operated, suitable for phasing out, testing and grounding switchgear bus or feeder when the device is installed in place of circuit breaker shall include the following:***
   1. ***Six primary disconnect studs.***
   2. ***Padlock provisions on the doors of the test device in order to prevent access to a live circuit or a circuit that the user does not intend to ground or test.***
   3. ***Six test terminals isolated phase-phase and phase-ground with insulating barriers and accessible by means of hinge insulating cover.***
   4. ***Three single-pole three-position manually operable switches, suitable for connecting upper test terminals or lower test terminals to a common ground and including ground disconnect from connection to the switchgear ground bus system.]***

N. ***[Ground and test device [for 50 kA or lower ratings or for 63 kA rating], electrically operated, suitable for phasing out, testing and grounding switchgear bus or feeder when the device shall be installed in place of circuit breaker and shall include the following:***
   1. ***Interchangeable with drawout, medium-voltage circuit breakers to provide interlocked electrical access to either bus or feeder; electrically operated.***
   2. ***Remote-control station with [30] [40] [50] foot long coupler cable.***
   3. ***Suitable interlocks to facilitate safe procedures.***
   4. ***Test wells arranged to allow testing for presence of voltage on each of the 6 disconnects.***

5. ***Two devices shall be furnished, one for grounding the upper terminals and one for grounding the lower terminals through the power operated ground making switch.]***
6. ***[Optional - Ground and test device shall have interrupting capacity equal to that of the circuit breakers for which it is substituted.]***

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Electrical contractor or switchgear installer shall install switchgear in accordance with manufacturer's written instructions and the following specifications.

3.2 ADJUSTMENTS AND CLEANING

A. Remove debris from switchgear and wipe dust and dirt from all components.

B. Repaint marred and scratched surfaces with touch up paint to match original finish.

3.3 INSPECTION

A. Check tightness of all accessible mechanical and electrical connections to assure they are torqued to the minimum acceptable manufacture's recommendations.

B. Check all installed switchgear for proper grounding, fastening and alignment.

3.4 FIELD QUALITY CONTROL

A. Field inspection and testing shall be performed by ***[the installing contractor.] [a testing firm under separate contract to owner.]***

B. Visually inspect for physical damage.

C. Perform site tests as specified in manufacturers' instruction manuals.

D. Touch-up paint to repair any damaged surfaces using manufacturer-furnished paint. Leave remaining touch-up paint with owner.

E. Verify operation of interlocks.

F. Perform power-frequency withstand voltage tests in accordance with ANSI/IEEE C37.20.2, clause 6.5.

3.5 WARRANTY

A. Equipment manufacturer shall warrant that all goods supplied are free of non-conformities in workmanship and materials for one year from date of initial operation, but not more than 18 months from date of shipment.

3.6 START-UP SERVICE

A. Switchgear manufacturer shall provide a factory-authorized service representative for a period of two days to train Owner's maintenance personnel in the following:

B. Procedures and schedules related to startup and shutdown, troubleshooting, servicing and preventive maintenance.

C. Review data in the instruction manuals. Refer to Division 1 Section ***["Contract closeout."] ["Operation and maintenance data."]***

D. Schedule training with Owner with at least three week's advance notice.

3.7 ***[FIELD SERVICE***

A. ***Switchgear manufacturer's own field service office (same name as the manufacturer) shall be located not more than a three hour drive from the installation site.]***

END OF SECTION