SECTION 26 23 00
SMART LOW VOLTAGE SWITCHGEAR, ARC RESISTANT

PART 1 - GENERAL

1.1 SCOPE

A. This section defines arc resistant low voltage metal-enclosed switchgear assemblies with drawout circuit breaker elements for use in AC systems, rated 600 V or less.

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. ***[Related Sections (where applicable) include the following:***
   1. ***Section 26 xx xx - Medium Voltage Load Break Switches***
   2. ***Section 26 12 16 - Dry Type Substation Transformers***
   3. ***Section 26 12 19 - Liquid Type Substation Transformers***
   4. ***Section 26 09 13 – Electrical Power Monitoring and Control***
   5. ***Section 26 43 13 – Surge Protection Devices for Low-Voltage Electrical Power Circuits***
   6. ***Section 26 05 73 - Coordination Study]***

1.3 SUBMITTALS

A. Submit shop drawings and product data for approval and final documentation in the quantities listed according to the Conditions of the Contract. Customer name, customer location and customer order number shall identify all transmittals.

B. Documents for Approval: General arrangement drawings showing dimensioned elevation, floor plan, side view and foundation details, one-line diagram showing major features, nameplate legends, schematic diagrams and bill of material.

C. ***Final Documents: Record documentation to include those in 1.3.B and wiring diagrams, list of recommended spare parts, instruction and installation manuals [and certified test reports]***

D. Product Data: Include features, characteristics and ratings of individual circuit breakers and other components. Also, time-current characteristic curves for over current protective devices, including circuit-breaker trip devices and fusible devices.

1.4 RELATED STANDARDS

A. Comply with requirements of latest revisions of applicable industry standards, specifically including the following:
   1. ANSI/IEEE C37.20.1 – Metal-Enclosed Low Voltage Power Circuit Breaker Switchgear
   2. ANSI/IEEE C37.20.7 – Guide for Testing Metal-Enclosed Switchgear Rated up to 38kV for Internal Arcing Faults.
   3. ANSI/IEEE C37.50 – Test Procedure for Low Voltage AC Power Circuit Breakers Used in Enclosures
   4. ANSI/IEEE C37.51 – Conformance Testing of Metal-Enclosed Low Voltage AC Power Circuit Breaker Switchgear Assemblies
   5. ANSI/IEEE C37.13 – Low Voltage AC Power Circuit Breakers Used in Enclosures
   6. ANSI C37.16 – Preferred Ratings, Related Requirements and Application for Low Voltage Power Circuit Breakers and AC Power Circuit Protectors
   7. ANSI/IEEE C37.17 - Trip Devices for AC and General-Purpose DC Low Voltage Power Circuit Breakers
   8. UL 1558 – Metal-Enclosed Low Voltage Power Circuit Breaker Switchgear
   9. UL 1066 – Low Voltage AC and DC Power Circuit Breakers Used in Enclosures

10. NEMA SG5 – Power Switchgear Assemblies
11. NEMA SG3 – Low Voltage Power Circuit Breakers

B. ***[Manufacturer Seismic Qualification: The low voltage arc resistant switchgear shall meet and be certified to seismic requirements specified in the [IBC 2009 International Building Code] [CBC 2010 California Building Code] [ASCE American Society of Civil Engineers 7-10].***

1. ***The low voltage switchgear shall be compliant with IBC 2009 parameters:***
   a. ***Building Occupancy Category (as defined in Table 1.1 from ASCE 2010): [I] [II] [III] [IV]***
   b. ***Seismic Design Category: [A] [B] [C] [D] [E] [F]***
   c. ***Site Class: [A – Hard Rock] [B - Rock] [C – Very dense soil and soft rock] [D – Stiff soil profile] [E – Soft Soil Profile] [F – Soil vulnerable to potential failure or collapse under seismic loading] as defined in IBC 2006 Table 1613.5.2 Site Class Definitions***
   d. ***Ip – Importance Factor: [1.5 – Components must function after an earthquake for life safety purposes (Building Occupancy Code IV)] [1.25 - Buildings and structures that represent a substantial hazard to human life in the event of failure or that can cause substantial economic impact or mass disruption of day-to-day civilian life (Building Occupancy Code III)] [1.0 – Non-essential buildings. Function not life critical. (Building Occupancy Code I and II)]***
   e. ***Ss – Mapped Spectral Accelerations for Short Periods at 0.2 seconds – 180%g***
   f. ***Sds – 5% Damped Design Spectral Response Accelerations for Short Periods at 0.2 seconds – 1.2.***
   g. ***z/h – Height factor ratio: [___]*** **NOTE: Ratio is a calculated value equal to the floor the gear is installed on divided by 12. A 6th floor installation is a 0.5 value. A basement or ground floor installation is a 0.0 value.**
2. ***Equipment shall be designed to be located in a concrete and steel, moment-resisting frame building not exceeding 12 stories in height with a minimum story height of 10 feet.]***

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Manufacturer of this equipment shall have a minimum of 5 years experience producing similar electrical equipment. The manufacturer of the switchgear assembly shall be the same manufacturer as the breakers. The manufacturer shall be ISO 9001 or 9002 certified.

1.6 DELIVERY, STORAGE AND HANDLING

A. Deliver products in factory labeled packages. Shipping groups shall not exceed 15 ft. in length.

B. Circuit breakers shall be shipped inside their respective cells in which they were factory acceptance tested.

C. Store and handle in strict compliance with manufacturer's instructions and recommendations. Protect from potential damage from weather and construction operations. Store so condensation will not form on or in switchgear and if necessary, apply temporary heat where required to obtain suitable service conditions.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. The low voltage arc resistant switchgear shall be manufactured by Siemens, Type WL-Low Voltage Arc Resistant Switchgear or pre-approved equal. Approved manufacturers are as follows:
   1. SIEMENS - Type WL-Low Voltage Arc Resistant Switchgear

2. ***[ ]***

2.2 RATINGS

A. ***System Configuration: Switchgear suitable for application in three-phase, [60 Hz] [50 Hz], [3 wire] [4 wire] [grounded-neutral] [3 wire ungrounded] [3 wire high-impedance grounded] system.***

B. Electrical Ratings:
1. ***Nominal System Voltage: [600V] [480 V] [240 V] [208 V].***
2. Maximum Design Voltage: 635V
3. ***Maximum Short-Circuit Current: [100kA at 480V] [85kA at 600V]***
4. ***Main-Bus Continuous Current: [1600] [2000] [3200] [4000] [5000] [6000] A.***
5. ***Neutral Bus Continuous Current: [50] [100] percent of main phase bus.***

2.3 GENERAL REQUIREMENTS

A. Smart-Gear Low Voltage Switchgear. Each low voltage switchgear lineup shall be supplied with the following functionality:
1. CPU with factory programmed software that supports remote monitoring, configuration and control of embedded intelligent devices and structural monitoring devices.
2. Communication backbone linking embedded intelligent devices, CPU and HMI.
3. 22” touch screen HMI pre-configured and programmed with application specific graphical user interface (application specific elevation and one-line drawings) that act as user home page.
4. The HMI must communicate with the pre-programmed CPU and act as the local master. Using the touch screen HMI, the user must be able to navigate back and forth between the elevation and one-line views of the LVS lineup. Utilizing the elevation or one-line screens, the user must be able to select (touch) an embedded intelligent device (breaker, meter, relay, SPD, etc) and drill down to access screens that support monitoring, configuring and control of the intelligent devices.
5. Utilizing the touch screen HMI, the user must be able to access the following information and functions:
   a. LVS one-line view
      1.) Breaker status – open/closed/tripped
      2.) Breaker position – connect/test/disconnect
      3.) Dynamic Arc Flash Sentry (DAS) status – activated/deactivated
      4.) Bus status – dead/healthy/unhealthy
      5.) System alarm warning (when applicable)
   b. LVS elevation view
      1.) Breaker status – open/closed
      2.) Breaker position – connect/test/disconnect
      3.) Dynamic Arc Flash Sentry (DAS) status – activated/deactivated
      4.) Bus status – dead/healthy/unhealthy
      5.) System alarm warning (when applicable)
   c. Breaker control (Password or hardware enabled/disabled)
      1.) Open selected breaker
      2.) Close selected breaker
      3.) Activate DAS (arc flash maintenance mode)
      4.) De-activate DAS (arc flash maintenance mode)
      5.) Breaker status – open/closed (Info only)
      6.) Ready to close indication – OK/No (Info only)
      7.) Spring charge status – charged/discharged (Info only)
   d. Breaker monitoring
      1.) Breaker temperature (current temperature, time stamped minimum temperature and time stamped maximum temperature)
      2.) Cradle temperature (current temperature, time stamped minimum temperature and time stamped maximum temperature)

3.) Number of switching operations under load
4.) Number of switching operations caused by trips
5.) Number of short circuit trips
6.) Number of overload trips
7.) Number of ground fault trips
8.) Time until presumed overload trip
9.) Runtime meter
10.) Contact wear status
11.) Operation counter reading
12.) Rating plug (amperage)
13.) Voltage
    a.) L-N A phase
    b.) L-N B phase
    c.) L-N C phase
    d.) L-N Average
    e.) L-L A-B phases
    f.) L-L B-C phases
    g.) L-L C-A phases
    h.) L-L Average
    i.) Phase unbalance
    j.) Form factor
    k.) Peak factor
    l.) THD
14.) Amperage
    a.) A phase
    b.) B phase
    c.) C phase
    d.) Average
    e.) Neutral (if applicable)
    f.) Ground
    g.) Phase unbalance
    h.) THD
15.) Power
    a.) KW A
    b.) KVAR A
    c.) KVA A
    d.) KW B
    e.) KVAR B
    f.) KVA B
    g.) KW C
    h.) KVAR C
    i.) KVA C
    j.) KW total
    k.) KVAR total
    l.) KVA total
    m.) PF A phase
    n.) PF B phase
    o.) PF C phase
    p.) PF total
    q.) Frequency
16.) Energy
    a.) Active normal KWH
    b.) Active reverse KWH
    c.) Reactive normal KWH
    d.) Reactive reverse KWH
17.) Harmonic analysis (bar graph)

a.) Voltage (1st – 29th harmonic)
b.) Current (1st – 29th harmonic)

18.) Logs
a.) Event logs (1st – 10th events)

19.) Event time
20.) Event source
21.) Event reason
a.) Trip logs (1st – 5th events)

22.) Event time
23.) Event source
24.) Event reason
25.) Waveform capture
26.) 30-day load study

e. WL breaker configuration (Password and/or hardware enabled/disabled)
1.) Trip unit active parameter set – A (normal mode) / B (maintenance mode)
2.) Long-time pickup
3.) Long-time delay
4.) I4T Curve for LT
5.) Phase loss sensitivity
6.) Thermal memory
7.) Short-time pickup
8.) Short-time delay
9.) Short-time – Off/Trip
10.) I2T curve for ST
11.) Instantaneous pickup
12.) Instantaneous – Off/Trip
13.) Ground fault pickup
14.) Ground fault delay
15.) Grand fault alarm pickup
16.) Grand fault alarm delay
17.) Ground fault alarm – Off/Trip
18.) I2T curve for GF
19.) Neutral protection (amperage)
20.) Neutral protection – Off/Trip
21.) Arc flash hazard calculation
a.) 3 phase bolted fault current (user input)
b.) System voltage (user input)
c.) System grounding – Grounded System/Ungrounded System/High Resistance (user input)
d.) Arc flash arcing current (displays calculated value)
e.) Arc flash incident energy (displays calculated value)
f.) Arc flash hazard category (displays calculated value)
g.) Arc flash hazard boundary (displays calculated value)
h.) Box configuration value (displays default/assumed value)
i.) Conductor gap (displays default/assumed value)
j.) Working distance (displays default/assumed value)
k.) Distance x factor (displays default/assumed value)

22.) Waveform capture trigger settings
23.) 30-day load study activation settings

f. Documentation
1.) LVS as-built lineup drawings
a.) Bill of material
b.) General arrangement
c.) General information
d.) One-line
e.) Physical arrangement

f.) Schematics
2.) LVS installation manual
3.) Breaker operator manual
4.) Spare parts list

NOTE: The following Smart LVS functionality is optional and not included in the standard Smart LVS product offering. If digital meter, SPD or HRG monitoring is desired, those devices must be included in the LVS bill of material.

g. ***[WL breaker monitoring***
1.) ***Breaker door position – open/closed***
2.) ***Trip & close coil monitoring]***

h. ***[Digital meter monitoring***
1.) ***Voltage Va-n***
2.) ***Voltage Vb-n***
3.) ***Voltage Vc-n***
4.) ***Voltage Va-b***
5.) ***Voltage Vb-c***
6.) ***Voltage Vc-a***
7.) ***Current a phase***
8.) ***Current b phase***
9.) ***Current c phase***
10.) ***Apparent Power a phase (KVA)***
11.) ***Apparent Power b phase (KVA)***
12.) ***Apparent Power c phase (KVA)***
13.) ***Active Power a phase (KW)***
14.) ***Active Power b phase (KW)***
15.) ***Active Power c phase (KW)***
16.) ***Reactive Power a phase (KVAR)***
17.) ***Reactive Power b phase (KVAR)***
18.) ***Reactive Power c phase (KVAR)***
19.) ***Power Factor a phase***
20.) ***Power Factor b phase***
21.) ***Power Factor c phase***
22.) ***Frequency***
23.) ***Average Voltage Vph-n***
24.) ***Average Voltage Vph-ph***
25.) ***Average Current***
26.) ***Total Apparent Power (KVA)***
27.) ***Total Active Power (KW)***
28.) ***Total Reactive Power (KVAR)***
29.) ***Total Power Factor]***

i. ***[TPS 6 SPD monitoring (supplied at no additional cost if SPD is supplied)***
1.) ***Phase A status (OK/Event)***
2.) ***Phase B status (OK/ Event)***
3.) ***Phase C status (OK/Event)***
4.) ***Service (Not needed/Needed)]***

j. ***[High Resistance Grounding (HRG) (supplied at no additional cost if HRG is supplied)***
1.) ***System IG Current (0-100% of maximum ground current determined by grounding resistors)***
2.) ***System Status (Normal no fault/A phase low/B phase low/C phase low/All phases low/A phase faulted/B phase faulted/C phase faulted)***
3.) ***Pulse Status (On/Off)***
4.) ***Pulse Setup (Normal, interlock off/Inverted, interlock off/Normal, interlock on/Inverted, interlock on)***
5.) ***Activate Pulser (On/Off)***

6.) ***Feeder Status (OK, Faulted feeder/Feeder tripped/Test button pushed/Not available)***
7.) ***Feeder Igf (0-100% of maximum ground current)***
8.) ***Feeder Priority (1 – 50)]***

k. ***[LVS structural monitoring***
1.) ***Bus temperature***
2.) ***Cable temperature***
3.) ***Humidity***
4.) ***Smoke***
5.) ***Water (flooding)***
6.) ***Control power availability***

l. ***[Custom maintenance reports]***
m. ***[Breaker remote racking]***
n. ***[Bus differential protection]]***

B. The switchgear shall be factory assembled and tested and comply with applicable industry standards. It shall be a coordinated design so that shipping groups are easily connected together at the site into a continuous line-up. Necessary connecting materials shall be furnished. All power circuit breakers and assemblies shall be produced by a single manufacturer.

C. The switchgear assembly shall consist of one or more metal-enclosed sections in an indoor NEMA 1 enclosure.
1. End sections shall include provisions for main bus extension and installation of future vertical sections.
2. The design shall incorporate preformed steel channels, angles and structural components bolted together and reinforced to form a rigid, self-supporting assembly.
3. ***Fabricate enclosure with removable, [rear cover panels, secured by captive screws], [hinged rear doors with captive screws] [hinged rear doors with three-point latch and padlockable handle] to allow access to rear interior of switchgear.***

D. Front breaker doors and covers must be free of any ventilation openings.

E. ***Horizontal barriers are to be provided to form individual circuit breaker or metering compartments. Circuit breaker compartments are to be barriered from the bus compartment through a primary disconnect assembly. Each circuit breaker or metering compartment shall be provided with a hinged front door secured with hand-operated [pad-lockable] [key-lockable) rotary latches.***

F. Circuit breaker compartments shall include stationary primary contact disconnects that shall be silver-plated copper at the connection points and of one-piece construction.

1. The upper set of disconnects shall bolt directly to the main bus and, for feeder circuit breakers, the lower set shall extend to the rear cable area and shall be insulated where they pass through the main bus compartment.

2. Primary disconnects shall be sized for the maximum continuous current for the frame size of the circuit breaker which is located in the compartment.

3. Interlocks shall be provided to prevent a circuit breaker element of the incorrect frame size or interrupting rating from being inserted into the compartment.

4. Secondary control and communication connections, when required, shall be accessible from the front of the switchgear without exposing any power cables or bussing. The secondary control contacts shall be of the sliding contact design, silver plated and engage the drawout circuit breaker element in the “connected” and “test” positions.

G. All control wiring within the assembly shall be continuous and shall terminate on each end at a suitable terminal block. Control wiring shall be 14-gauge minimum, stranded type SIS and shall be laser printed every six inches with the wire origin and destination information.

1. Wire markings shall be laser imprinted with wire name as indicated on the wiring diagrams.

2. Terminals shall be insulated locking fork or ring tongue type except where connecting to components that do not accept these terminations. Control wiring for external connections shall be terminated in a separate front accessible compartment for ease of access.

H. Finish: Steel parts shall be prepared for painting by a five-stage wash system consisting of an alkaline cleaner, fresh water rise, iron phosphate treatment, fresh water rise and non-chromate sealer. After cleaning and stabilization, the steel parts shall be coated with a thermosetting polyester powder applied with electrostatic equipment at a nominal 2 mils dry film thickness and then cured properly. The paint finish shall have a pencil hardness of 2H, a salt spray rating as defined in ASTM B-117-73 of 600 hours. Paint color shall be ANSI 61 light gray.

I. Bus isolation barriers shall be arranged to isolate the buses on either side of each main and tie circuit breaker from each other.

J. ***[Incoming line isolation barriers shall be arranged to isolate the incoming line connections from the main horizontal and vertical bus].***

K. Main bus shall connect vertical sections and shall be uniform capacity the entire length of assembly. Vertical and horizontal bus bar shall utilize a channel shape design to maximize short circuit withstand capability and minimize heat rise. The main horizontal bus shall be run in a vertical, edge-to-edge arrangement for high short circuit strength. Access to the rear cable termination area shall be possible without reaching over the main and vertical bus.

1. ***Bus shall be [98 % minimum conductivity copper silver-plated over entire length of the bus bar] [98 % conductivity copper tin-plated over entire length of the bus bar].***
2. Feeder Circuit-Breaker Load Terminals: Plated copper bus extensions equipped with ***[mechanical] [compression]*** cable connectors for outgoing circuit conductors.
3. Ground Bus shall be copper of 98 % minimum conductivity, minimum size 1/4 by 3 inches.
4. Bus bracing shall be equal to the short circuit interrupting rating of the lowest rated circuit breaker applied in the assembly or 100kA minimum.
5. Provide for future extensions from either end of main phase, neutral and ground bus by means of predrilled bolt holes and connecting links.

L. Bus/Cable compartment barriers: Barriers shall be supplied to isolate the rear cable area from the main bus area.

M. Insulated bus bar shall consist of bus bars enclosed in factory-applied, flame-retardant UL recognized insulation system. Bolted bus joints shall be insulated with secure joint covers that can easily be removed and reinstalled.

N. ***[Low Voltage High-Resistance Grounding System] [Installed in the switchgear assembly] [Contained in separate NEMA 1 enclosure] for use on [480 V] [600 V] [wye] [delta] source.***

1. ***The high resistance neutral grounding equipment will contain the following equipment on an operator's panel on the front of the unit as standard:***
   a. ***Line Disconnect Switch***
   b. ***Test Push-button***
   c. ***A digital display unit containing the following functions:***
      - ***Fault Reset Push-button***
      - ***Green Light to Indicate "Normal" Operating Status***
      - ***Flashing red Light to Indicate "Fault" Status***
      - ***Red Light to Indicate "Harmonic" Status***
      - ***Fault reset push-button***
      - ***Alarm silence push-button***
      - ***Pulse on/off push-button***
      - ***Amber light to indicate "pulse" status***

- ***Indication of Under-Voltage condition***
- ***Indication of Under-Current condition***
- ***Ethernet/Modbus port for Communications***
- ***Software to Configure and Monitor system remotely***
- ***Software to Data Log / Trend abnormal conditions***
- ***Single set point Meter Relay***

2. ***Other standard equipment is as follows:***
   - ***a. Alarm Relaying for Local and Remote Annunciation***
   - ***b. Pulsing Contactor and Timer***
3. ***The relay to monitor fundamental voltage and current will incorporate an adjustable time delay function to avoid spurious alarms.***
4. ***The relay to monitor harmonic voltage and current will incorporate an adjustable time delay function to avoid spurious alarms.***
5. ***The optional portable ground detector will be a "split core" type ammeter with a multiple range switch. The clamp must be capable of enveloping a minimum 6" diameter. A short-circuiting switch should be provided, along with a carrying case.***

O. Arc Resistant General Construction:
1. Design tested and UL certified to comply with IEEE C37.20.7 (Guide for Testing Metal-Enclosed Switchgear Rated up to 38kV for Internal Arcing Faults)
2. Accessibility Type: 2B
3. Maximum Internal Arcing Short-Circuit Current: ***[100kA at 480V] [85kA at 600V]***
4. Maximum Arcing Duration: 500 ms
5. Indoor NEMA 1 enclosure
6. Sill channel base with arc plenum
7. Insulated/isolated bus bar system
8. ***[Removable rear panels secured with captive screws] [Hinged rear doors with captive hardware]***
9. Wires that connect directly to the bus bar cannot be brought directly into the front switchgear compartments (blank, auxiliary, breaker, etc) without current limiting fuses being integrated into the wiring circuit. The current limiting fuses must be located in the bus or cable compartment and not in the front compartments.
10. Shutters in power circuit breaker compartments
11. One-piece circuit breaker compartment doors with insert panels for fuses, indicating lights and control switches when required.
12. The arc resistant low voltage switchgear ***[shall not include an arc plenum and exhaust ductwork. A minimum of 118 inches (floor to ceiling) of unobstructed space above the low voltage switchgear shall be required.] [shall include an arc plenum and exhaust ductwork. Arc plenum and exhaust ductwork shall be tested in accordance with ANSI/IEEE C37.20.7].***

2.4 COMPONENTS

A. Instrument Transformers: Comply with IEEE C57.13.
1. Potential Transformers: Secondary-voltage rating of 120 V and NEMA accuracy class of 0.6 with burdens of W, X and Y.
2. Current Transformers: Ratios as indicated; burden and accuracy class suitable for connected relays, meters and instruments.

B. Multifunction Digital-Metering Monitors shall be UL-listed or recognized, microprocessor-based unit suitable for three or four wire systems. Units shall be mounted in the instrument compartment door and as follows:
1. Incoming monitoring or main breakers:
   a. The main(s) shall be monitored.
      1.) The metering shall be accomplished with a Siemens Model ***[[PAC3120] [PAC3220] [PAC4200] [9410] [9810]]*** digital meter.
2. Feeder breakers:

a. Each feeder circuit breaker shall be monitored.
   1.) ***[The metering shall be accomplished with a Siemens Model [PAC3120] [PAC3220] [PAC4200] digital meters on each feeder.]***
   2.) Each trip unit shall provide an LCD display for metering.

C. Provision for Future Devices: Equip future circuit breaker compartments with rails, mounting brackets, supports, necessary appurtenances and bus connections.

D. Control Power Supply: Control power transformer supplying 120-V control circuits through secondary disconnect devices are to be dry-type transformers with primary and secondary fuses.
   1. Transformers shall be mounted in auxiliary compartments.
   2. ***[Multiple source with control power transfer.] Two control power transformers located in separate compartments with necessary interlocking relays shall be provided.***
      a. ***Each transformer shall be connected to line side of associated main circuit breaker.***
      b. ***[Secondary windings connected through a relay or relays to control bus to affect an automatic control power transfer scheme.]***
   3. ***[(24) (48) (125) volt DC battery system]***

E. ***[Mimic Bus]: Continuous mimic bus applied to front of switchgear, arranged in single-line diagram format, shall indicate the arrangement of the circuit breakers in the power circuit.***

2.5 CIRCUIT BREAKERS

A. Circuit breakers shall comply with the requirements of IEEE/ANSI C37.13, C37.16, C37.17, C37.50, UL1066, NEMA SG3. All breakers shall be three-pole, 100% rated type WL low voltage power breaker manufactured by Siemens Industry, or approved equal.
   1. Circuit beaker element shall have connected, test and disconnected position indicators, spring charged/discharged indicators and circuit breaker open or closed and ready to close indicators all of which shall be visible to the operator with the compartment door closed. It shall be possible to rack the circuit breaker element from the connected to the disconnected position with the compartment door closed otherwise known as “through the door drawout”.
   2. Provide interlocks to prevent racking the circuit breaker unless the breaker is open.
   3. Raking handle shall be integral to the breaker.

B. Ratings: Interrupting up to 100 kA at 480V without fuses. Short time current ratings for each circuit breaker shall be as indicated on the drawings or data tables. Circuit breakers shall be 600-volt class.

C. Operating Mechanism: Mechanically and electrically trip-free, stored-energy operating mechanism with the following features:
   1. Normal Closing Speed: independent of both control and operator
   2. ***[Electrical operator, field installable with manual charging]***
   3. ***[Operations counter]***

D. Each low voltage power circuit breaker shall be equipped with self-powered, microprocessor-based trip-device to sense overload and short circuit conditions. The device shall measure true RMS current. The tripping system shall consist of Rogowski coil sensors on each phase, a release mechanism and the following features:
   1. Field Installable and interchangeable so that any trip unit can be used with any frame size circuit breaker. Trip units can be upgraded for future expansion in functionality, such as communication.
   2. Functions: Long time, short time and extended instantaneous protection function shall be provided {EIP} to allow the breaker to be applied at the withstand rating of the breaker with minus 0% tolerance so that there is no instantaneous override whatsoever. This feature shall furthermore allow the circuit breaker to be applied up to the full

instantaneous rating of the breaker on systems where the available fault current exceeds the breakers withstand rating. Each shall have an adjustable pick-up setting. In addition, long time and short time bands shall each have adjustable time delay. Short time function shall include a switchable I^2t ramp and optionally I^4t to improve co-ordination with fuses or inverse relays.

3. A software program shall be made available free of charge to support system co-ordination studies. The software will allow time current curves to be generated for the chosen settings.
4. Individual LED's shall indicate an overcurrent, short circuit or ground fault trip condition. The data shall be maintained for a minimum of 48 hours without the need for a separate battery.
5. Time-current characteristics shall be field adjustable locally or optionally remotely via a bus system ***[ModBus] [Profibus] [Ethernet].***
6. ***[Current Adjustability: Parameter settings and rating plugs on the trip units.]***
7. Pickup Points: 10 Long Time Settings.
8. Field Installable Ground-fault protection with at least three time-delay bands. Adjustable current pickup and an I^2t ramp. Arrange to provide protection for ***[three-wire] [four-wire]*** service.
9. ***[Field installable zone selective interlocking: Connections will be made between main, tie and feeder circuit breakers to ensure that the circuit breaker closest to the fault trips for short time and ground fault conditions.]***
10. ***[Field Installable Communications shall be provided per schedule]***
11. ***[An LCD graphical display with keypad shall be provided to simplify settings & viewing data locally.]***
12. ***[The option to remotely switch protection settings shall be provided whenever a generator is part of the power distribution system.]***
13. Field installable configurable ***[analog], [digital]*** output relays shall be available to connect directly to the trip unit.
14. ***[Waveform display option on LCD display.*** **ETU776 only*]***
15. Estimated contact wear shall be capable of being communicated remotely in addition to a local mechanical indication flag.

E. ***[MOC {mechanism operated cell switch} operated by the circuit breaker operating mechanism]***

F. ***Terminal Block Connections, shall be front mounted and utilize [Screw Type Terminals] [Ring Tongue Terminals] [Tension Spring Terminals]***

G. Padlocking Provisions: For installing at least three padlocks on each circuit breaker to prevent movement of the drawout mechanism.

H. Operating Handle: shall be built in complete with handle and integral to breaker. No external tools shall be required to rack the breaker

I. ***[Control Switch: One for each electrically operated circuit breaker.]***

J. ***[Key Interlocks: Mountings and hardware are included where future installation of key-interlock devices is indicated.]***

K. ***[Undervoltage Trip – field installable]: [Instantaneous] [Adjustable time-delay.]***

L. ***[Shunt-Trip – field installable]***

M. ***[Fused Circuit Breakers: Circuit breaker and fuse combinations must comply with requirements for circuit breakers and trip devices and include the following:]***

1. ***Fuses: NEMA FU 1, Class L current limiting, sized to coordinate with and protect associated circuit breaker.***
2. ***Blown-Fuse Trip Device: fused circuit breakers are to be equipped with blown fuse lockout devices to prevent closing the breaker if a fuse is blown or not present.***

Open-fuse status is indicated at the front of the circuit breaker or fuse drawout element.

N. ***[Indicating Lights: To indicate circuit breaker is open or closed, for electrically operated circuit breakers.]***

O. Modular communication and relaying accessories are to be available for retrofitting by the clients chosen engineer. It shall not be necessary for the manufacturers personnel to retrofit accessories

P. The following items must be capable of being changed in the field: main contacts, CT's, trip units, racking mechanism and all internal & external accessories

Q. ***[The main breaker shall have a Dynamic Arc Flash Sentry. The main breaker shall have a dual protective setting capability with graphic waveform display, similar to the Siemens WL breakers ETU776 trip unit. The main breaker shall allow the installer to set two different trip curves into one breaker. One curve shall be set for standard operating mode and the second curve, with instantaneous protection shall be set for arc flash mode. The switchgear shall be outfitted with a 24 VDC power supply, CubicleBus digital input module, annunciator panel with flashing light and a UPS power supply. The arc flash mode shall be actuated by a [keyed switch] [selector switch] [a light curtain installed behind the gear to sense open doors on the back of the panel] [remote control panel] [occupancy sensor]].***

R. ***[Isolation shutters shall be factory installed into all drawout circuit breaker compartments. Isolation shutters shall be able to be padlocked in the closed position after the breaker is removed.]***

2.6 ACCESSORIES

A. ***[Lifting yoke for circuit breakers]***

B. ***[Portable test set for testing all functions of circuit breaker, solid-state trip devices without removal from switchgear.]***

C. ***[Circuit-Breaker Removal Apparatus:***
1. ***[Overhead circuit breaker lifting device, shall be track mounted at the top front of the switchgear, complete with hoist and lifting yokes.]*** **NOTE: The overhead circuit breaker lifting device is not available in non-walk-in, outdoor enclosures.** ***[Portable, floor-supported, roller-base, elevating carriage arranged for moving circuit breakers in and out of compartments.]***

D. ***[Spare Fuses: Six, of each type and rating of fuse used. Include spares for potential transformer fuses and control power fuses.]***

E. ***[Spare Indicating Lights: One of each type installed.]***

F. ***[Touchup Paint: One-half pint of paint matching enclosure finish.]***

G. ***[Test Cabinet: Wall mountable cabinet to hold necessary equipment for testing electrically operated breakers.]***

H. ***[Infrared viewport(s): As required to facilitate external infrared scanning of rear cable compartment area.]***

I. ***[Remote Breaker Racking*** **- Siemens offers two types of Remote Breaker Racking. Delete one or both of these options below. (Bracket Mounted and/or SARRACS)**
1. ***[Bracket Mounted***
   a. ***A remote racking device shall be supplied to allow qualified personnel to rack Siemens Type WL breakers into Connect, Test and Disconnect positions from up to 30 feet away from the breaker and outside the arc flash hazard boundary.***

b. ***The remote racking device shall support utilization on any Frame Size 2 or Frame Size 3 WL breaker (including fuse carriage on fused Frame Size 3 WL breaker).***
c. ***The remote racking device shall be portable and weigh less than 30 pounds (excluding cables and remote-control panel).***
d. ***The remote racking device shall have integral torque overload sensing to prevent damage to the breaker racking mechanism.***
e. ***The remote racking device shall allow breaker to be racked to any position (disconnect, test, connect) regardless of the starting position of the breaker and without the need for user input as to the starting position.***
f. ***The 120v remote breaker racking device shall be attached to the factory mounted switchgear brackets (field retrofit capable) and secured by locking pins. No modification of the gear or circuit breakers shall be required for installation or operation.***
g. ***The remote racking device shall support field retrofit on Type WL Low Voltage Switchgear.]***

2. ***[SARRACS Cart***
a. ***Remote racking device shall consist of a Gear Motor mounted onto a mobile metal frame. The frame shall be equipped with wheel brakes. The Gear Motor shall be vertically adjustable via actuator control on the frame. The Gear Motor shall be laterally movable with linear spring loading. The Gear Motor shall incorporate a digital Encoder for position control and sensing. The Gear Motor controls shall be located in a control box mountable on the frame. The remote racking device shall be controlled from a portable Operators Station connected to the remote racking device by a 75-foot communications/control cable. The remote racking device shall be equipped with the following features:***
1.) ***Aluminum frame with powder coat protection***
2.) ***Rear mounted Rubber wheels, front mounted casters***
3.) ***Weatherproof control cabinet with duplex receptacle for power connection***
4.) ***120V power cord reel mounted on the frame***
5.) ***Three Phase Gear Motor with Digital Encoder to supply "Racking Power"***
6.) ***Single Phase to Three Phase Variable Frequency Drive to control and power the Gear Motor***
7.) ***Electrically Linear Actuator to supply vertical adjustment for the Gear Motor Assembly***
8.) ***Motor Carriage Position Sensor***
9.) ***Programmable Logic Controller (PLC) to control and monitor the system***
10.) ***Capacity to store 20 discrete breaker operating profiles***
11.) ***Touch Screen Operators Panel with ON/OFF Switch for Operator control and monitoring***
12.) ***Adapters for breakers with racking screws***
13.) ***Gravel wheels, large diameter***
14.) ***Interlock defeating adapters***
15.) ***UPS for operation in areas with no 120v power***
16.) ***Cover for dust prevention***
17.) ***Breaker position indicator lights]***

PART 3 - EXECUTION

3.1 EXAMINATION AND INSTALLATION

A. Examine elements and surfaces to receive switchgear for compliance with installation tolerances and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.

B. Install and anchor switchgear in accordance with manufacturer's instructions.

3.2 CONNECTIONS

A. Tighten bus joints, electrical connectors and terminals according to manufacturer's published torque-tightening values. Install equipment-grounding conductors for switchgear with ground continuity to main electrical ground bus.

3.3 ADJUSTING AND CLEANING

A. Set field-adjustable trip devices per coordination study.

B. Clean exposed surfaces using manufacturer recommended materials and methods. Touch-up damaged coating and finishes using non-abrasive materials and methods recommended by manufacturer. Eliminate all visible evidence of repair.

3.4 WARRANTY

A. Equipment manufacturer warrants 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 eighteen months from date of shipment.

3.5 ***[STARTUP SERVICES]***

A. ***Engage a factory-authorized service representative to perform startup service.***

B. ***Train Owner's maintenance personnel on procedures and schedules for energizing and de-energizing, troubleshooting, servicing and maintaining equipment and schedules.***

C. ***Verify that switchgear is installed and connected according to the Contract Documents.***

D. ***Verify that electrical control wiring installation complies with manufacturer's submittal by means of point-to-point continuity testing. Verify that wiring installation complies with requirements in Division [26] [16] Sections.***

E. ***Complete installation and startup checks shall be done in according to manufacturer's written instructions.***

END OF SECTION