

SECTION [26 28 11.11][16412]

MOLDED CASE CIRCUIT BREAKERS

Square D PowerPact™ Circuit Breakers by Schneider Electric

Schneider Electric Editor's Note: This guide specification is written in accordance with the Construction Specifications Institute (CSI) Master Format. This section must be carefully reviewed and edited by the architect or the engineer to meet the requirements of the project. Coordinate this section with other specification sections within the Contract Documents and Drawings. In order to properly use / edit this document, show formatting and hidden text by selecting ¶ on the menu or by typing (Ctrl+*) simultaneously. Except for these introductory paragraphs, green hidden text will not print. Text in red is optional. Red text in [brackets] denotes multiple options where one or more should be chosen. All red text should be edited and changed to black for final project conformation. In addition, these introductory paragraphs should be deleted or changed to hidden text. This specification may be used in whole or in part. It is intended that this document specify subcomponent products to be referenced by other specification sections or drawings for the furnishing of completed assemblies or systems. The Part 2 – Product subsections may also be copied into other specification sections in lieu of including this specification section in the Contract Documents. GENERAL

1.1 SUMMARY

- A. Scope: Provide labor, material, equipment, related services, and supervision required, including, but not limited to, manufacturing, fabrication, erection, and installation for molded case circuit breakers (also identified as MCCB) as required for the complete performance of the work, as shown on the Drawings, as specified herein, and as specified elsewhere for the assemblies or systems comprised of the components specified herein.
- B. Related Sections: Related sections include, but shall not be limited to, the following:
 - 1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
 - 2. Applicable general requirements for electrical Work specified within Division 26 Specification Sections apply to this Section.
 - 3. Refer to the equipment specification sections in which the circuit breakers will be installed for additional requirements. This may include but not be limited to the following specifications sections:
 - a. Intelligent Electrical Power Systems
 - b. Enclosed Switches and Circuit Breakers
 - c. Low Voltage Switchgear
 - d. Switchboards
 - e. Low Voltage Motor Control Centers

1.2 REFERENCES

- A. The publications listed below form a part of this Specification to the extent referenced. The publications are referred to in the text by the basic designation only. The edition/revision of the referenced publications shall be the latest date as of the date of the Contract Documents, unless otherwise specified.
 - 1. Canadian Standards Association (CSA):
 - a. C22.2 No.5, "Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures"
 - 2. US Federal Specifications and Standards
 - a. FED W-C-375E
 - 3. International Electrotechnical Commission (IEC):
 - a. IEC 60947-2, "Low-Voltage Switchgear and Controlgear - Part 2: Circuit-Breakers"
 - b. IEC 60947-3, "Low-Voltage Switchgear and Controlgear - Part 3: Switches"

4. International Organization for Standardization (ISO):
 - a. ISO 9001, "Quality Management Systems - Requirements"
5. Mexican ANCE Standards
 - a. NMX-J-266-ANCE
6. National Electrical Manufacturers Association (NEMA)
 - a. NEMA AB-1, "Low-voltage Circuit Breakers"
7. Underwriters Laboratories, Inc. (UL):
 - a. UL 489, "Low-voltage AC and DC Circuit Breakers"

1.3 DEFINITIONS

- A. Unless specifically defined within the Contract Documents, the words or acronyms contained within this specification shall be as defined within, or by the references listed within this specification, the Contract Documents, or, if not listed by either, by common industry practice.
1. ICCB: Insulated Case Circuit Breaker
 2. LVPCB: Low Voltage Power Circuit Breaker
 3. MCCB: Molded Case Circuit Breaker
 4. LSIG or combination of these letters: type of protection and available adjustments on certain trip units.
 - a. L: Long Time (overload protection, analogous to the inverse-time thermal trip of a thermal/magnetic breaker)
 - b. S: Short Time (short circuit protection of low level faults)
 - c. I: Instantaneous (short current protection of high level faults, analogous to the instantaneous magnetic trip of a thermal/magnetic breaker)
 - d. G: Ground Fault (equipment ground fault protection)
 - e. Therefore, LSIG = Long-time + Short-time + Instantaneous + Equipment Ground-fault Protection

1.4 SUBMITTALS

1. General: Submittals shall be in accordance with the requirements of Section [01 33 00][01300] Submittals and Section [26 00 00][1600] Electrical, in addition to those specified herein.
2. Submit sufficient information to determine compliance with the Contract Documents. Identify submittal data with the specific equipment tags and/or service descriptions to which they pertain. Submittal data shall be clearly marked to identify the specific model numbers, options, and features of equipment and work proposed.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Manufacturer shall be a firm engaged in the manufacture of specified products of types and sizes required, and whose products have been in satisfactory use in similar service for a minimum of ten years.
1. The manufacturer shall have a valid ISO 9001 certification and an applicable quality assurance system that is regularly reviewed and audited by a third party registrar. Manufacturing, inspection, and testing procedures shall be developed and controlled under the guidelines of the quality assurance system.
 2. The manufacturer or their representative shall have service, repair, and technical support services available 24 hours 7 days a week basis.

- B. All work performed and all materials used shall be in accordance with the National Electrical Code, and with applicable local regulations and ordinances. Process controllers, assemblies, materials, and equipment shall be listed and labeled by Underwriter's Laboratories or by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Prior to delivery to the Project site, ensure that suitable storage space is available to store materials in a well ventilated area protected from weather, moisture, soiling, extreme temperatures, humidity, and corrosive atmospheres. Materials shall be protected during delivery and storage and shall not exceed the manufacturer stated storage requirements.
- B. Deliver materials to the Project site in supplier's or manufacturer's original wrappings and containers, labeled with supplier's or manufacturer's name, material or product brand name, and equipment tag number or service name as identified within the Contract Documents.
- C. Inspect and report any concealed damage or violation of delivery storage, and handling requirements to the [Engineer][Contract Manager].

1.7 WARRANTY

- A. General: Refer to [Section 01 77 00 - Closeout Procedures] [Section 01770 - Closeout Procedures].
- B. Additional Owner Rights: The warranty shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to and run concurrent with other warranties made by the Contractor under requirements of the Contract Documents.

1.8 SPECIAL TOOLS AND SPARE PARTS

- A. The Contractor shall provide a recommended spare parts list with the following information provided as a minimum:
 - 1. Contact information for the closest parts stocking location to the Owner.
 - 2. Critical spare parts shall be identified as those parts being associated with long lead times and/or those being critical to the unit's operation.
 - 3. Maintenance spares shall be identified as being those parts required to regularly perform scheduled maintenance on the furnished equipment. These spares shall include, but shall not be limited to, consumable spares that are required to be exchanged during scheduled maintenance periods.
- B. Spare parts shall be provided for each type and size of unit furnished. At a minimum, the following shall be provided:
 - 1. Provide the minimum spare parts recommended by the manufacturer.
- C. Any manufacturer specific special tool, not normally found in an electrician's toolbox, required to remove and install recommended or furnished spare parts shall be furnished. At a minimum the following shall be provided:
 - 1. If available from manufacture, provide PC-based configuration software tool and a minimum of [one] communication interface cable for each type of cable required to connect a PC-based computer to the devices specified herein for configuration and programming.
 - 2. Electronic configuration files, in a media format acceptable by the Owner (e.g. CD, USB stick, etc.), updated to an as-installed and commissioned state.

- D. Spare parts shall be properly marked and packaged for long term storage. Printed circuit boards shall be provided in separate anti-static containers.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. [Basis-of-Design Product: Subject to compliance with requirements, provide PowerPact™ circuit breakers with thermal-magnetic or Micrologic electronic trip units by Schneider Electric.]
- B. Acceptable Products: Circuit Breakers specified herein shall be the product of a single manufacturer. Products and manufacturers specified are to establish a standard of quality for design, function, materials, and appearance. Products shall be modified as necessary by the manufacturer for compliance with requirements. Provide the following specified product and manufacturer without exception, unless approved as a substitute by addendum to the Contract Documents prior to the bid date:
 1. PowerPact Circuit Breakers by Schneider Electric
 2. [2nd manufacturer and model]
 3. [3rd manufacturer and model]

2.2 CIRCUIT BREAKERS

- A. Circuit breakers shall have voltage and interrupting ratings that meet the application requirements. Interrupting rating shall be available up to 200 kAIR without fuses. Circuit breakers shall be available in frame sizes as follows: B-frame (125A), H-frame (150A), J-frame (250A) Q-frame (225A) L-frame (600A), M-frame (800A), P-frame (1200A) and R-frame (3000A). There are also additional legacy frames FA/FH (100A) and LA/LH (400A) thermal-magnetic circuit breaker.
- B. Circuit breakers shall be constructed using glass reinforced insulating material.
- C. Current carrying components shall be completely isolated from the handle, and the accessory mounting area.
- D. Circuit breakers shall have an overcenter, trip-free, toggle-operating mechanism which shall provide quick-make, quick-break contact action. The circuit breaker shall have common tripping of all poles.
- E. From 125 A to 600 A rating frame, MCCBs breaking unit shall be made with a double rotary contact to limit let-through energy on the installation
- F. MCCBs shall be designed to trip the circuit breaker in the event of high-level short-circuit currents. This design shall be independent of the thermal-magnetic or electronic trip unit.
- G. The circuit breaker handle shall reside in a tripped position between ON and OFF to provide local trip indication. Circuit breaker escutcheon shall be clearly marked ON and OFF in addition to providing international I/O markings.
- H. The maximum ampere rating and UL, IEC, or other certification standards with applicable voltage systems and corresponding interrupting ratings shall be clearly marked on the face of the circuit breaker.
- I. Each circuit breaker shall be equipped with a push-to-trip button, located on the face of the circuit breaker to mechanically operate the circuit breaker tripping mechanism for maintenance and testing purposes.

- J. Circuit breakers shall be factory-sealed with a hologram quality mark or a tamper evident label and shall have a date code.
- K. MCCB's shall be able to receive a device for locking in the isolated position.
- L. [Circuit breaker/circuit breaker][Fuse/circuit breaker] combinations for series connected interrupting ratings shall be listed by UL as recognized component combinations.
- M. Any series-rated combination used shall be marked on the end use equipment along with the statement: "Caution - Series Rated System. _____ A Available. Identical Replacement Component is required".
- N. Electronic components shall withstand temperatures up to 221 °F (105 °C).
- O. Circuit breakers shall be UL-listed to accept field installable/removable mechanical type lugs (except Type QB/QD/QG/QJ). Lugs shall be UL-listed to accept solid and/or stranded [copper and aluminum conductors] [copper conductors only]. Lugs shall be suitable for [140 °F (60 °C) rated wire on 125 ampere circuit breakers and below] [167 °F (75 °C) rated wire] [194 °F (90 °C) rated wire, sized according to the 167 °F (75 °C) temperature rating in the NEC].
- P. Circuit breakers shall be capable of accepting bus connections.
- Q. For frame ratings, higher than 250 amperes, MCCBs shall be fitted with metallic filters to reduce effects perceptible from the outside during current interruption.
- R. For a given MCCB rated frame, MCCBs dimensions shall be the same whatever the AIR.
- S. P-frame (1200 amperes frame) shall be available in manually operated version and electrically operated version.
- T. The P-frame electrically operated version shall be of the stored-energy type only and will be equipped with anti-pumping function.
- U. The P and R-frame circuit breakers shall be equipped with a safety interlock which keeps the circuit breaker open if the trip unit is not installed.

2.3 TRIP UNITS

- A. MCCB's with frame ratings 150 to 400 amperes shall be equipped with [thermal magnetic] [electronic] trip units. MCCB's with frame rating 125 amperes shall be equipped with thermal magnetic trip units.
- B. MCCB's with ratings over 400 amperes shall be equipped with electronic trip units.
- C. Circuit breakers with permanent trip units shall be UL-listed for reverse connection without restrictive line and load markings and be suitable for mounting in any position.
- D. MCCBs with field interchangeable trip units shall have trip units that are easily interchangeable and easily secured to the MCCB.
- E. The trip units shall not augment overall circuit breaker volume.
- F. Thermal Magnetic (400 Ampere Frame and Below):
 1. "PowerPact Q-, B-, H- and J-Frame", FA, FH, FY, LA, and LH as manufactured by Square D by Schneider Electric.

2. Thermal trip elements shall be factory preset and sealed. Circuit breakers shall be true RMS sensing and thermally responsive to protect circuit conductor(s) in a 104 °F (40 °C) ambient temperature.
3. Circuit breaker frame sizes 250 amperes and above shall have a single magnetic trip adjustment located on the front of the circuit breaker
4. Where indicated on drawings, circuit breakers shall be equipped with a ground fault module (GFM) with 20 to 200 amperes sensitivity level or earth leakage module (ELM) with sensitivity ranges between 30 mA and 3 amperes, or approved equivalent.

G. Electronic Trip Circuit Breakers. Trip units shall be Micrologic.

1. "PowerPact H-, J-, L-, P-, and R-Frame" (15 to 3000 amperes) as manufactured by Square D by Schneider Electric.
2. Micrologic electronic trip unit shall be true RMS sensing.
3. Air core current transformers shall be used to ensure accurate measurements from low currents up to high currents.
4. Electronic trip unit shall be fitted with thermal imaging to protect intermittent short circuits or ground-faults.
5. The following monitoring functions shall be integral parts of electronic trip units:
 - a. A test connector shall be installed for checks on electronic and tripping mechanism operation using an external device.
 - b. LED for load indication at 105 percent.
 - c. LED for load indication at 90 percent of load for applications 600 amperes and smaller
 - d. LED for visual verification of protection circuit functionality for applications 600 amperes or smaller.
 - e. Optional: LED for trip indication for applications above 600 amperes.
 - f. Micrologic trip unit functions shall consist of adjustable protection settings with the capability to be set and read locally by rotating a switch.
 - g. Long-time pickup shall allow for adjustment to nine long-time pickup settings. This adjustment must be at least from 0.4 to 1 times the sensor plug (I_n), with finer adjustments available for more precise settings to match the application.
 - h. Adjustable long-time delay shall be in nine bands. At six times I_r , from 0.5 to 24 seconds above 600 amperes, and 0.5 to 16 seconds for 600 amperes and below.
 - i. Short-time pickup shall allow for nine settings from 1.5 to 10 times I_r .
 - j. Short-time delay shall be in nine bands from 0.1–0.4 I^2t ON and 0–0.4 I^2t OFF.
 - k. Instantaneous settings on the trip units with LSI protection shall be available in nine bands.
 - 1) Above 600 amperes, from 2 to 15 times I_n
 - 2) 600 amperes, from 1.5 to 11 times I_n
 - 3) 400 amperes from 1.5 to 12 times I_n
 - 4) 250 amperes and below, from 1.5 to 15 times I_n
 - l. Four-pole devices shall be equipped for neutral protection with a three-position setting; neutral not protected, neutral tripping threshold equal to half the phase value, and neutral threshold equal to the phase value.
 - m. Ground fault settings for circuit breaker sensor sizes 1200 amperes or below shall be in nine bands from 0.2 to 1.0 times I_n . The ground fault settings for circuit breakers above 1200 amperes shall be nine bands from 500 to 1200 amperes.
6. It shall be possible to fit the trip unit with a seal to prevent unauthorized access to the settings in accordance with NEC Section 240-6(b).
7. Trip unit shall provide local trip indication and capability to locally and remotely indicate reason for trip, i.e., overload, short circuit, or ground fault.
8. Neutral current transformers shall be available for four-wire systems.

9. Trip units shall have the capability to electronically adjust the settings locally and remotely to fine increments below the switch settings. Fine increments for pickup adjustments shall be 1 ampere. Fine increments for delay adjustments shall be one second
10. Trip units shall be available to provide real time metering. Metering functions shall include, but shall not be limited to, the following:
 - a. Current (phases, neutral, average, maximum)
 - b. Voltage (phase-to-phase, phase-to-neutral, average, unbalance)
 - c. Power (active [kW], reactive [kVAR], apparent [kVA], power factor)
 - d. Energy (active [kWh], reactive [kVAR], apparent [kVA])
 - e. Frequency
 - f. Total harmonic distortion (current, voltage)
 - g. Metering accuracy shall be 1.5 percent current (above 600 amperes), 1.0 percent current (600 amperes and below), 0.5 percent voltage, and 2 percent energy. This accuracy shall be total system, including, but not limited to, CT and meter.
11. Measurement chain shall be independent from the protection chain.
12. The measurements shall be displayed on the breaker itself and/or on a remote display and/or on a remote system via Modbus communication.
13. Connections from circuit breaker to remote display and/or communication module shall be plug-n-play via RJ45 connector. No special tools or programming shall be required.
14. **Optional features for applications 600 amperes and smaller, choose all that apply:**
 - a. **Zone Selective Interlocking**
 - b. **Contact wear indication**
 - c. **Operation, trip and alarm counters**
 - d. **Operating hours' counter**
 - e. **Load profile**
15. **Optional features for applications above 600 amperes, choose all that apply:**
 - a. **Inverse definite minimum time lag (IDMTL)**
 - b. **Zone selective interlocking**
 - c. **Protective relaying functions (Current unbalance, maximum demand current, reverse power, etc...)**
 - d. **Phase loading**
 - e. **Contact wear indication**
 - f. **Wave form capture**
 - g. **Data logging**

H. **Electronic Trip ET 1.0 Trip System (300 to 800 Amperes):**

1. "PowerPact M-Frame" (300 to 800 amperes) as manufactured by Square D by Schneider Electric.
 - a. The circuit breaker trip system shall be a microprocessor-based true RMS sensing design.
 - b. Sensor ampere ratings shall be as indicated on the drawings or schedules.
 - c. The integral trip system shall be independent of any external power source and shall contain no less than industrial grade electronic components.
 - d. Trip unit shall not be field-replaced.
 - e. ET 1.0 trip unit functions shall consist of adjustable instantaneous pickup with no intentional time delay.
 - f. The long time trip point setting shall be fixed and cannot be adjusted.
 - g. The instantaneous settings on the trip unit shall allow 2 to 10 times the sensor rating (In).
 - h. The trip unit shall have the capability for the adjustment to be set and read locally by a rotating switch.
 - 1) Ground fault protection shall not be provided.

2.4 Accessories:

- A. Circuit breakers shall be equipped with UL-listed electrical accessories as noted on the drawings or schedules or they may be field-installable.
- B. The addition of auxiliaries shall not increase the volume of the circuit breaker.
- C. B-frame (125 amperes) circuit breakers shall have auxiliary location and function easily identifiable outside the face plate through viewing windows.
- D. The addition of a motor mechanism module or a rotary handle, etc., shall not mask or block device settings.
- E. Electrical Auxiliaries: Electrical auxiliaries such as voltage releases (shunt trip and undervoltage) and indication switches as follows:
 - 1. Same field-installable auxiliary contacts for signaling different functions, such as open/ closed position, fault signal, electrical fault (including electrical leakage) signal. Auxiliaries shall be common for the entire H-, J-, L-, M-, P-, and R-frame range,
 - 2. Electrical auxiliaries shall be separated from power circuits,
 - a. Electrical auxiliaries shall be of the snap-in type and fitted with terminal blocks,
 - b. Electrical auxiliary function and terminals shall be permanently engraved on the case of the circuit breaker and the auxiliary itself.
 - 3. P and R-frame circuit breakers shall have coils designed for continuous duty.
- F. Equipment Ground Fault Protection Modules (Thermal Magnetic Circuit Breakers):
 - 1. "PowerPact H- and J-Frame" as manufactured by Square D by Schneider Electric.
 - a. Circuit breakers shall be equipped with a ground fault module (GFM) with 20 to 200 amperes sensitivity level or earth leakage module (ELM) with sensitivity ranges between 30 mA and 3 amperes, or approved equivalent.
 - b. Ground fault sensing system shall be modified zero sequence (GFM) or zero sequence (ELM) sensing type.
 - c. The ground fault system shall require no external power to trip the circuit breaker.
 - d. Companion circuit breaker shall be equipped with a ground fault shunt trip.
 - e. The ground fault sensing system shall be suitable for use on solidly grounded systems.
 - f. The ground fault sensing system shall be suitable for use on three-phase, three-wire circuits where the system neutral is grounded but not carried through the system or on three-phase, four-wire systems. ELM shall be suitable for use on three-phase, three-wire circuits only.
 - g. Ground fault pickup current setting and time delay shall be field adjustable. A switch shall be provided for setting ground fault pickup point. A means to seal the pickup and delay adjustments shall be provided.
 - h. The ground fault sensing system shall include, but shall not be limited to, a ground fault memory circuit to sum the time increments of intermittent arcing ground faults above the pickup point.
 - i. A means of testing the ground fault system to meet the on-site testing requirements of NEC Section 230-95(c) shall be provided.
 - j. Local visual ground fault trip indication shall be provided.
 - k. The ground fault sensing system shall be provided with zone selective interlocking (ZSI) communication capabilities compatible with other thermal magnetic circuit breakers equipped with ground fault sensing, electronic trip circuit breakers with integral ground fault sensing and external ground fault sensing systems as noted on the Drawings or schedules. ELM shall not be provided with ZSI capabilities.
 - l. The companion circuit breaker shall be capable of being group mounted.
 - m. The ground fault sensing system shall not affect interrupting rating of the companion circuit breaker.
- G. Motor Operating Mechanism:

1. It shall be possible to equip H-, J-, L-, and P-frame circuit breakers with a motor mechanism for electrical operation. An auto/manual switch in front shall, when set to the manual position, lock out electrical control; when set to auto, lock out the manual control. Remote indication of manual or auto mode shall be possible. It shall also be possible to seal the access to the auto control. Closing shall take place in less than 5 cycles (80 ms).
2. Following tripping due to electrical faults (overload, short circuit, earth fault), remote reset shall be inhibited. It shall however be possible if opening was initiated by a voltage release.
3. The operating mechanism shall be of the stored energy type only.
4. The addition of a motor mechanism or a rotary handle shall in no way affect circuit breaker characteristics.
5. Only three stable tripping mechanism positions (ON, OFF, and tripped) shall be possible with the motor mechanism.
6. Suitability for isolation shall be provided by positive contact indication (ON and OFF) in front of the motor mechanism module.

H. Handle Accessories:

1. Circuit breaker handle accessories shall provide provisions for locking handle in the ON and OFF position.
2. Circuit breakers through 1200 amperes shall have available rotary handle operators and 15 through 600 amperes shall have an open door shaft operating tool.
3. Circuit breakers through 125 amperes shall have an available side mounted (lateral) rotary handle operator.

I. Connection Accessories

1. Circuit breakers rated 15 – 600 amperes shall have mechanical lugs that can be installed without the use of any tools
2. Circuit breakers rated 15 – 1200 amperes shall have I-LINE connections available for high density group mounted applications
3. Circuit breakers rated 15 – 125 amperes shall be DIN-Rail mountable without any extra components or accessories
4. Circuit breakers rated 15 – 125 amperes shall have creep-compensating terminations that maintain clamping forces over time without retightening
5. Circuit breakers rated 15 – 125 amperes shall be UL listed to accept fine stranded wire
6. Circuit breakers shall have available voltage tap connections that are separate from the power connection
7. Circuit breakers through 1200 amperes shall have available PDC lugs and long terminal shields – for UL508 applications

2.5 Communicating Circuit Breaker Interface to Monitor, Control, and Maintain Electrical Equipment

A. General

1. The circuit breaker shall be equipped with a communicating interface that makes it possible to monitor and control protection units with information on their status, to deliver maintenance and equipment information using an open protocol such as Modbus TCP/IP or Modbus RS485 serial line:
 - a. Energy cost management: energy saving and optimization
 - b. Electrical distribution network management: protection, monitoring & control
 - c. Asset management: use optimization, predictive maintenance, equipment alarming

- d. Transmit data to the BMS or FTP Server
2. Communicating circuit breaker interface shall offer Ethernet TCP/IP 10/100 Mbps ports to be connected on the building Local Area Network (LAN) and shall offer a real time access to device data by using a standard internet web browser.

B. Characteristics, operating principle and indications

1. The following information shall be accessible for circuit breakers at all the layers of electrical distribution architecture (modular feeders up to incomer circuit breakers)
 - a. ON/OFF position (O/F) / trip indication (SD) / fault-trip indication (SDE)
 - b. Cradle management: Draw out position
2. The following commands shall be possible:
 - a. open / close / reset
3. When advanced trip units are used, the following information shall be accessible:
 - a. Instantaneous and demand values, maximum and minimum values, energy metering, demand current and power, power quality
 - b. Protection and alarm settings
 - c. Time-stamped trip and alarm histories and event tables
 - d. Maintenance indicators

C. Communicating Circuit Breaker Interfaces functions:

1. Energy management system shall offer main interface and secondary interfaces for energy management issue. Data shall be collected via Ethernet TCP/IP and ModBus networks by which communicating circuit breakers, I/O digital and analog input modules, pulse counter, power meter and energy meter will be connected to interface.
2. A switchboard display shall be connected via Ethernet TCP/IP network to the switchboard interface and shall offer a real time direct data access to monitor and control devices and load.
3. Ethernet communication interfaces will be compliant to Device Profile Web Service (DPWS) for discovery on the local area network (LAN).
4. Energy management interface shall offer direct access to data collection to monitor and control devices and load.
5. Energy management interface shall collect:
 - a. Data from communicating circuit breaker with embedded measurement capability
 - b. Pulse from metering pulse electrical, gas, water counters
 - c. Data from communicating energy meters or power meters
 - d. Logic state of technical devices or equipment
 - e. Device alarms with time logs
 - f. Temperature analog sensor value
6. Energy management interface shall display via web pages:
 - a. Energy consumption
 - b. Electrical data network monitoring
 - c. Alarms and events
 - d. Energy quality monitoring
 - e. Equipment or devices status (open, close, tripped, NA) and indication of fault types (LT, ST, instantaneous, ground fault) faulty phases, interrupted current
 - f. Operation and predictive maintenance monitoring
7. Energy management interface shall integrate simple control functions via web pages:
 - a. Load and devices via digital output
 - b. Orders of actuator

D. Communicating Circuit Breaker Interface features

1. The main interface enables an intelligent modular unit (IMU), for air or molded case circuit breakers to be connected to an Ethernet network and enables gateway to Modbus serial line connection.

2. An intelligent modular unit is a mechanical and electrical assembly containing one or more products to perform a function in a switchboard (incoming protection, motor command, and control). The modular units are easily installed in the switchboard.
3. The features of the main interface are:
 - a. Dual Ethernet port for simple daisy chain connection
 - b. Device Profile Web Service (DPWS) for discovery on the local area network (LAN)
 - c. Dual Universal Logic Plug (ULP) compliant for advanced connection with Air or Molded Case circuit breaker
 - d. Gateway for Modbus-SL connected devices
 - e. Embedded set-up web pages
 - f. Embedded monitoring web pages
 - g. Embedded control web pages
 - h. Built-in email alarm notification
 - i. The interface mounts on a DIN rail
 - j. A stacking accessory enables the user to connect several Modbus interface for air or molded case circuit breaker without additional wiring.
 - k. The interface must be always supplied with 24 Vdc using an UL listed and recognized limited voltage/limited current or a class 2 power supply with 3 A maximum.
 - l. The interface provides DC supply to the Modbus interfaces for Air or Molded Case circuit breaker and it is not necessary to supply them separately.
 - m. The interface indicates the status of the interface, the Ethernet communication dual color ports, ULP and Modbus connections by using LED on the front panel.
 - n. A locking pad on the front panel of the interface enables or disables to send the remote control commands over the Ethernet network to the interface, and to the other modules of the connected IMU.
 - o. Pre-defined applications add new functions to the IMU in a simple way:
 - 1) selection by the application rotary switch on the I/O application module, defining the application with pre-defined input/output assignment and wiring diagram
 - 2) no additional setting with the customer engineering tool required. The resources not assigned to the pre-defined application are free for additional user-defined applications: cradle management, breaker operation, cradle management and Energy Reduction Maintenance Setting (ERMS), light and load control and other custom for protection / control / energy management / monitoring.
 - p. The firmware can be updated using FTP connection or customer engineering tool.

E. Switchboard display

1. Energy management system shall integrate a switchboard display. Switchboard display will be connected to switchboard interface via Ethernet TCP/IP network to offer:
 - a. Real time display monitoring of devices
 - b. Simple control of devices and load.
 - c. Switchboard display shall integrate functions to monitor:
 - 1) Energy consumption
 - 2) Electrical network data
 - 3) Alarms and events
 - 4) Energy quality
 - 5) Equipment or devices status (open, close, tripped, NA) and indication of fault types (LT, ST, instantaneous, ground fault) faulty phases, interrupted current.
 - 6) Predictive maintenance monitoring contact wear rate, load profile, and the circuit breaker counter values

F. Operating and installation principles

1. Positioning, installation and connection of communicating interface
 - a. When the application requires the usage of several communicating interfaces:
 - 1) The interface enabling communication with the monitoring system (outside the switchboard) could be using a Modbus TCP/IP
 - 2) The other device interfaces inside the switchboard shall be using Modbus RS485 SL

- 3) The different device interface shall be interconnected by Modbus RS485 SL daisy chaining, inside the switchboard, using stackable connectors
 - 4) The device interfaces shall be positioned on DIN rail for quick viewing of the network set up and status
 - 5) The communicating interface shall be equipped with plug-in type input/output application module
 - 6) The interfaces / devices links shall preferably be of the prefabricated type with RJ45 connectors that allow the device to be connected to the interface in a single operation and with no risk of error
2. Operation of the communicating interface
 - a. The communicating interface shall be capable of being easily integrated into the installation's communication network with automatic adaptation of their communication parameters to match those of the network
 - b. They shall provide data to the supervisor in Modbus tables, at fixed addresses that require no configuration
 - c. The data shall be of the type described in chapter 3.2
 - d. The concentrators shall be capable of receiving from the supervisor, by writing in the Modbus table at fixed addresses
 - e. They shall be capable of having the orders executed by the control devices, after having taken into account the devices' current positions
 - f. The communicating interface should be able to monitor and control auxiliaries and devices using integrated web page
 - g. The communicating interface should be able to monitor analog temperature sensors
 3. Testing of the system in the switchboard
 - a. The manufacturer shall supply a (software) tool for overall testing of the system, within the limits of the switchboard: the entire data transmission and control chain between the modular devices and all of the concentrators, including communication.
 - b. The test tool shall supply a report that includes the list of all the devices connected to each channel of the data concentrators as well as a diagram describing the configuration of the system with indication of the associated Modbus addresses.
 4. Operation and maintenance
 - a. Product measurement and communication capability shall offer operating assistance function:
 - 1) Status of circuit breaker operations: Open/Close/Tripped/NA
 - 2) Indication of fault types (LT, ST, instantaneous, ground fault) faulty phases, interrupted current
 - 3) Trips history
 - 4) Alarms history
 - 5) Events history (setting changes, test...)
 - 6) These functions and indicators shall be available by remote display, communication or Engineering tool
 - b. The main interface web pages and switchboard display allow the authorized group to:
 - 1) Execute one or more reset commands per device type
 - 2) Control the following applications remotely:
 - a) Circuit breaker operations: Open/Close
 - b) Reset input counters, reset output counters, light control, load control, user-defined output control
 - 3) To provide maintenance log information:
 - a) The date and time the entry was made and the name of the user who made it.
 - b) The maintenance counter information for the selected device: circuit breaker operation counters, trip and alarm counters, load profile, contact wear counters, and the cradle counters.
 - 4) To send and display alarms:
 - a) User shall be able to activate alarms based on measurement (I, V, F, P, Q, S, THD, CosPhi, FP, I_{demand}, P_{demand},) or counters
 - b) Alarms shall be time stamped
 - c) Alarms could activate a digital output for local indication

- d) These functions and indicators shall be available by remote display, communication or Engineering tool.

PART 3 - EXECUTION

3.1 GENERAL

- A. In addition to the requirements specified herein, execution shall be in accordance with the requirements of Specification Section [26 00 00][16010] and Drawings.

END OF SECTION [26 28 11.11][16412]