SECTION 26 09 13 - ELECTRICAL POWER MONITORING

PART 1 - GENERAL

1.1   RELATED DOCUMENTS

   A.   Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2   SUMMARY

   A.   This Section includes the following for monitoring of electrical power system:

        1.   Communication network and interface modules for RS-232, RS-485, Modbus TCP/IP and IEEE 802.3 data transmission protocols.

   B.   Related Sections include the following:

        1.   Division 26 Section "Electricity Metering" for equipment to meter electricity consumption and demand for tenant submetering.

1.3   DEFINITIONS

   A.   Ethernet: Local area network based on IEEE 802.3 standards.

   B.   Firmware: Software (programs or data) that has been written onto read-only memory (ROM). Firmware is a combination of software and hardware. Storage media with ROMs that have data or programs recorded on them are firmware.

   C.   HTML: Hypertext markup language.

   D.   I/O: Input/output.

   E.   KB: Short for kilobyte. When used to describe data storage, "KB" represents 1024 bytes.

   F.   KY Pulse: A term used by the metering industry to describe a method of measuring consumption of electricity that is based on a relay changing status in response to the rotation of the disk in the meter.

   G.   LAN: Local area network; sometimes plural as "LANs."

   H.   LCD: Liquid crystal display.

I.   Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less that 50 V or remote-control, signaling and power-limited circuits.

J.   Modbus TCP/IP: An open protocol for exchange of process data.

K.   Monitoring: Acquisition, processing, communication, and display of equipment status data, metered electrical parameter values, power quality evaluation data, event and alarm signals, tabulated reports, and event logs.

L.   PC: Personal computer; sometimes plural as "PCs."

M.   rms: Root-mean-square value of alternating voltage, which is the square root of the mean value of the square of the voltage values during a complete cycle.

N.   RS-232: A TIA standard for asynchronous serial data communications between terminal devices.

O.   RS-485: A TIA standard for multipoint communications using two twisted-pairs.

P.   TCP/IP: Transport control protocol/Internet protocol incorporated into Microsoft Windows.

Q.   THD: Total harmonic distortion.

R.   UPS: Uninterruptible power supply; used both in singular and plural context.

S.   WAN: Wide area network.

1.4   SUBMITTALS

A.   Product Data: For each type of product indicated.

    1.   Attach copies of approved Product Data submittals for products (such as switchboards and switchgear) that describe power monitoring and control features to illustrate coordination among related equipment and power monitoring and control.

B.   Shop Drawings: For power monitoring and control equipment. Include plans, elevations, sections, details, and attachments to other work.

    1.   Outline Drawings: Indicate arrangement of components and clearance and access requirements.
    2.   Block Diagram: Show interconnections between components specified in this Section and devices furnished with power distribution system components. Indicate data communication paths and identify networks, data buses, data gateways, concentrators, and other devices to be used. Describe characteristics of network and other data communication lines.
    3.   Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

    4.   Wiring Diagrams: Power, signal, and control wiring. Coordinate nomenclature and presentation with a block diagram.

    5.   UPS sizing calculations for workstation.

C.   Software and Firmware Operational Documentation:

    1.   Self-study guide describing the process for setting equipment's network address; setting Owner's options; procedures to ensure data access from any PC on the network, using a standard Web browser; and recommended firewall setup.

    2.   Software operating and upgrade manuals.

    3.   Software Backup: On a magnetic media or compact disc, complete with Owner-selected options.

    4.   Device address list and the set point of each device and operator option, as set in applications software.

    5.   Graphic file and printout of graphic screens and related icons, with legend.

D.   Software Upgrade Kit: For Owner to use in modifying software to suit future power system revisions or power monitoring and control revisions.

E.   Software licenses and upgrades required by and installed for operating and programming digital and analog devices.

F.   Qualification Data: For Installer and manufacturer.

G.   Field quality-control test reports.

H.   Operation and Maintenance Data: For power monitoring and control units, to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

    1.   Operating and applications software documentation.

    2.   Software licenses.

    3.   Software service agreement.

    4.   PC installation and operating documentation, manuals, and software for the PC and all installed peripherals. Software shall include system restore, emergency boot diskettes, and drivers for all installed hardware. Provide separately for each PC.

    5.   Hard copies of manufacturer's specification sheets, operating specifications, design guides, user's guides for software and hardware, and PDF files on CD-ROM of the hard-copy submittal.

I.   Other Informational Submittals:

    1.   System installation and setup guides, with data forms to plan and record options and setup decisions.

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1.5   QUALITY ASSURANCE

   A.   Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

   B.   Manufacturer Qualifications: A firm experienced in manufacturing power monitoring and control equipment similar to that indicated for this Project and with a record of successful in-service performance.

   C.   Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.6   COORDINATION

   A.   Coordinate features of distribution equipment and power monitoring and control components to form an integrated interconnection of compatible components.

      1.   Match components and interconnections for optimum performance of specified functions.

   B.   Coordinate Work of this Section with those in Sections specifying distribution components that are monitored or controlled by power monitoring and control equipment.

1.7   SOFTWARE SERVICE AGREEMENT

   A.   Technical Support: Beginning with Substantial Completion, provide software support for two years.

   B.   Upgrade Service: Update software to latest version at Project completion. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include the operating systems. Upgrade shall include new or revised licenses for use of software.

      1.   Provide 30-day notice to Owner to allow scheduling and access to system and to allow Owner to upgrade computer equipment if necessary.

1.8   EXTRA MATERIALS

   A.   Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

      1.   Addressable Relays: One for every 10 installed. Furnish at least one of each type.
      2.   Data Line Surge Suppressors: One for every 10 of each type installed. Furnish at least one of each type.

PART 2 - PRODUCTS

2.1   MANUFACTURERS

   A.   Basis-of-Design Product: Subject to compliance with requirements, provide a
        comparable product by one of the following:

        1.   Schneider Electric – Provide Powerlogic PM800 (to match existing devices)

2.2   FUNCTIONAL DESCRIPTION

   A.   Instrumentation and Recording Devices: Monitor and record load profiles and chart
        energy consumption patterns. Connect to existing campus Head End.

        1.   Calculate and Record the Following:

              a.   Load factor.
              b.   Peak demand periods.
              c.   Consumption correlated with facility activities.

        2.   Measure and Record Metering Data for the Following:

              a.   Electricity.

   B.   Software: Calculate allocation of utility costs.

        1.   Automatically Import Energy Usage Records to Allocate Energy Costs for the
              Following:

              a.   At least 15 departments processes.

        2.   Verify utility bills and analyze alternate energy rates.

   C.   Power Quality Monitoring: Identify power system anomalies and measure, display,
        and record trends and alarms of the following power quality parameters:

        1.   Voltage regulation and unbalance.
        2.   Continuous three-phase rms voltage.
        3.   Periodic max./min./avg. samples.
        4.   Harmonics.
        5.   Voltage excursions.

   D.   Emergency Load Shedding. Preserve critical loads or avoid total shutdown due to
        unforeseen loss of power sources according to the following logic:

        1.   Determine system topology.
        2.   Evaluate remaining loads and sources.
        3.   Shed loads in less than 100 ms.

E.   Demand Management:

1.   Peaking control.
2.   Load interlocking.
3.   Load shedding.
4.   Load trimming.

F.   System: Report equipment status and power system control.

2.3   SYSTEM REQUIREMENTS

A.   Monitoring and Control System: System and application software, connected to data transmission network.

B.   Surge Protection: For external wiring of each conductor entry connection to components to protect components from voltage surges originating external to equipment housing and entering through power, communication, signal, control, or sensing leads.

1.   Minimum Protection for Power Lines 120 V and More: Auxiliary panel suppressors complying with requirements in Division 26 Section "Transient-Voltage Suppression for Low-Voltage Electrical Power Circuits."
2.   Minimum Protection for Communication, Signal, Control, and Low-Voltage Power Lines: Comply with requirements as recommended by manufacturer for type of line being protected.

C.   Addressable Devices: All transmitters and receivers shall communicate unique device identification and status reports to monitoring and control clients.

D.   Interface cabling for metering system to be provdied by electrical contractor and coordinated with metering manufacturer. Tie-in locations are existing in certain electric rooms, exact tie-in point to be coordinated with MMC Facilities Engineering.

2.4   OPERATING SYSTEM

A.   Software: Configured to run on a portable laptop computer, a single PC, or a PDA, with capability for accessing a single meter at a time. System is connected to a LAN. Modbus TCP/IP, RS-232, and RS-485 digital communications. Configured for a server and multiple client PCs, each with capability for accessing multiple devices simultaneously. Ethernet, Modbus TCP/IP, RS-232, and RS-485 digital communications.

B.   Operating System Software: Connect new devices to existing.

2.5   APPLICATIONS SOFTWARE

   A.   Basic Requirements:

      1.   Fully compatible with and based on the approved operating system.
      2.   Password-protected operator login and access; three levels, minimum.
      3.   Password-protected setup functions.
      4.   Context sensitive on-line help.
      5.   Capability of creating, deleting, and copying files; and automatically maintaining a directory of all files, including size and location of each sequential and random-ordered record.
      6.   Capability for importing custom icons into graphic views to represent alarms and I/O devices.
      7.   Automatic and encrypted backups for database and history; automatically stored and encrypted with a nine-character alphanumeric password, which must be used to restore or read data contained in backup.
      8.   Operator audit trail for recording and reporting all changes made to user-defined system options.

   B.   Workstation Server Functions:

      1.   Support other client PCs on the LAN and WAN.
      2.   Maintain recorded data in databases accessible from other PCs on the LAN and WAN.

   C.   Data Formats:

      1.   User-programmable export and import of data to and from commonly used Microsoft Windows spreadsheet, database, billing, and other applications; using dynamic data exchange technology.
      2.   Option to convert reports and graphics to HTML format.
      3.   Interactive graphics.
      4.   Option to send preprogrammed or operator designed e-mail reports.

   D.   Metered Data: Display metered values in real time.

   E.   Equipment Documentation: Database for recording of equipment ratings and characteristics; with capability for graphic display on monitors.

   F.   Graphics: Interactive color-graphics platform with pull-down menus and mouse-driven generation of power system graphics, in formats widely used for such drafting; to include the following:

      1.   Site plan.
      2.   Floor plans.
      3.   Equipment elevations.
      4.   Single-line diagrams.

G.   User-Defined Monitoring and Control Events: Display and record with date and time stamps accurate to 0.1 second, and including the following:

    1.   Operator log on/off.
    2.   Attempted operator log on/off.
    3.   All alarms.
    4.   Equipment operation counters.
    5.   Out-of-limit, pickup, trip, and no-response events.

H.   Trending Reports: Display data acquired in real-time from different meters or devices, in historical format over user-defined time; unlimited as to interval, duration, or quantity of trends.

    1.   Spreadsheet functions of sum, delta, percent, average, mean, standard deviation, and related functions applied to recorded data.
    2.   Charting, statistical, and display functions of standard Windows-based spreadsheet.

I.   Alarms: Display and record alarm messages from discrete input and controls outputs, according to user programmable protocol.

    1.   Functions requiring user acknowledgment shall run in background during computer use for other applications and override other presentations when they occur.

J.   Waveform Data: Display and record waveforms on demand or automatically on an alarm or programmed event; include the graphic displays of the following, based on user-specified criteria:

    1.   Phase voltages, phase currents, and residual current.
    2.   Overlay of three-phase currents, and overlay each phase voltage and current.
    3.   Waveforms ranging in length from 2 cycles to 5 minutes.
    4.   Disturbance and steady-state waveforms up to 512 points per cycle.
    5.   Transient waveforms up to 83,333 points per cycle on 60-Hz base.
    6.   Calculated waveform on a minimum of four cycles of data of the following:

        a.   THD.
        b.   rms magnitudes.
        c.   Peak values.
        d.   Crest factors.
        e.   Magnitude of individual harmonics.

K.   Data Sharing: Allow export of recorded displays and tabular data to third-party applications software.

L.   Tenant or Activity Billing Software:

    1.   Automatically compute and prepare tenant bills, activity demand and energy-use statements based on metering of energy use and peak demand integrated over user-defined interval.
    2.   Intervals shall be same as used by electric utilities, including current vendor.

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3. Import metered data from saved records that were generated by metering and monitoring software.
4. Maintain separate directory for each tenant's historical billing information.
5. Prepare summary reports in user-defined formats and time intervals.

M. Reporting: User commands initiate the reporting of a list of current alarm, supervisory, and trouble conditions in system or a log of past events.

1. Print a record of user-defined alarm, supervisory, and trouble events on workstation printer.
2. Sort and report by device name and by function.
3. Report type of signal (alarm, supervisory, or trouble), description, date, and time of occurrence.
4. Differentiate alarm signals from other indications.
5. When system is reset, report reset event with same information concerning device, location, date, and time.

2.6 COMMUNICATION COMPONENTS AND NETWORKS

A. Transient Voltage Surge Suppression and Electromagnetic-Interference Immunity: Include in solid-state equipment. Comply with IEEE C37.90.

B. Network Configuration: High-speed, multi-access, open nonproprietary, industry standard communication protocol; LANs complying with EIA 485, 100 Base-T Ethernet, and Modbus TCP/IP.

2.7 POWER MONITORS

A. Separately mounted, permanently installed instrument for power monitoring and control.

1. Enclosure: NEMA 250, Type 1.

B. Environmental Conditions: System components shall be capable of withstanding the following environmental conditions without mechanical or electrical damage or degradation of operating capability:

1. Indoor installation in non-air-conditioned spaces that have environmental controls to maintain ambient conditions of 0 to 122 deg F (minus 18 to plus 50 deg C) dry bulb and 20 to 90 percent relative humidity, noncondensing.

C. rms Real-Time Measurements:

1. Current: Each phase, neutral, average of three phases, percent unbalance.
2. Voltage: Line-to-line each phase, line-to-line average of three phases, line-to-neutral each phase, line-to-neutral average of three phases, line-to-neutral percent unbalance.
3. Power: Per phase and three-phase total.
4. Reactive Power: Per phase and three-phase total.

5. Apparent Power: Per phase and three-phase total.
6. Power Factor: Per phase and three-phase total.
7. Displacement Power Factor: Per phase and three-phase total.
8. Frequency.
9. THD: Current and voltage.
10. Accumulated Energy: Real kWh, reactive kVARh, apparent kVAh (signed/absolute).
11. Incremental Energy: Real kWh, reactive kVARh, apparent kVAh (signed/absolute).
12. Conditional Energy: Real kWh, reactive kVARh, apparent kVAh (signed/absolute).

D. Demand Current Calculations, per Phase, Three-Phase Average and Neutral:

1. Present.
2. Running average.
3. Last completed interval.
4. Peak.

E. Demand Real Power Calculations, Three-Phase Total:

1. Present.
2. Running average.
3. Last completed interval.
4. Predicted.
5. Peak.
6. Coincident with peak kVA demand.
7. Coincident with kVAR demand.

F. Demand Reactive Power Calculations, Three-Phase Total:

1. Present.
2. Running average.
3. Last completed interval.
4. Predicted.
5. Peak.
6. Coincident with peak kVA demand.
7. Coincident with kVAR demand.

G. Demand Apparent Power Calculations, Three-Phase Total:

1. Present.
2. Running average.
3. Last completed interval.
4. Predicted.
5. Peak.
6. Coincident with peak kVA demand.
7. Coincident with kVAR demand.

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H. Average Power Factor Calculations, Demand Coincident, Three-Phase Total:

1. Last completed interval.
2. Coincident with kW peak.
3. Coincident with kVAR peak.
4. Coincident with kVA peak.

I. Power Analysis Values:

1. THD, Voltage and Current: Per phase, three phase, and neutral.
2. Displacement Power Factor: Per phase, three phase.
3. Fundamental Voltage, Magnitude and Angle: Per phase.
4. Fundamental Currents, Magnitude and Angle: Per phase.
5. Fundamental Real Power: Per phase, three phase.
6. Fundamental Reactive Power: Per phase.
7. Harmonic Power: Per phase, three phase.
8. Phase rotation.
9. Unbalance: Current and voltage.
10. Harmonic Magnitudes and Angles for Current and Voltages: Per phase, up to 31st harmonic.

J. Power Demand Calculations: According to one of the following calculation methods, selectable by the user:

1. Thermal Demand: Sliding window updated every second for the present demand and at end of the interval for the last interval. Adjustable window that can be set in 1-minute intervals, from 1 to 60 minutes.
2. Block Interval with Optional Subintervals: Adjustable for 1-minute intervals, from 1 to 60 minutes. User-defined parameters for the following block intervals:

    a. Sliding block that calculates demand every second, with intervals less than 15 minutes, and every 15 seconds with an interval between 15 and 60 minutes.
    b. Fixed block that calculates demand at end of the interval.
    c. Rolling block subinterval that calculates demand at end of each subinterval and displays it at end of the interval.

3. Demand Calculation Initiated by a Synchronization Signal:

    a. Signal is a pulse from an external source. Demand period begins with every pulse. Calculation shall be configurable as either a block or rolling block calculation.
    b. Signal is a communication signal. Calculation shall be configurable as either a block or rolling block calculation.
    c. Demand can be synchronized with clock in the power meter.

K. Sampling:

1. Current and voltage shall be digitally sampled at a rate high enough to provide accuracy to 63rd harmonic of 60-Hz fundamental.

2. Power monitor shall provide continuous sampling at a rate of 128 samples per cycle on all voltage and current channels in the meter.

L. Minimum and Maximum Values: Record monthly minimum and maximum values, including date and time of record. For three-phase measurements, identify phase of recorded value. Record the following parameters:

1. Line-to-line voltage.
2. Line-to-neutral voltage.
3. Current per phase.
4. Line-to-line voltage unbalance.
5. Line-to-neutral voltage unbalance.
6. Power factor.
7. Displacement power factor.
8. Total power.
9. Total reactive power.
10. Total apparent power.
11. THD voltage L-L.
12. THD voltage L-N.
13. THD current.
14. Frequency.

M. Harmonic Calculation: Display and record the following:

1. Harmonic magnitudes and angles for each phase voltage and current through 31st [harmonic. Calculate for all three phases, current and voltage, and residual current. Current and voltage information for all phases shall be obtained simultaneously from same cycle.
2. Harmonic magnitude reported as a percentage of the fundamental or as a percentage of rms values, as selected by user.

N. Current and Voltage Ratings:

1. Designed for use with current inputs from standard instrument current transformers with 5-A secondary and shall have a metering range of 0-10 A.
2. Withstand ratings shall be not less than 15 A, continuous; 50 A, lasting over 10 seconds, no more frequently than once per hour; 500 A, lasting 1 second, no more frequently than once per hour.
3. Designed for use with voltage inputs from standard instrument potential transformers with a 120-V secondary.

O. Accuracy:

1. Comply with ANSI C12.20, Class 0.5; and IEC 60687, Class 0.5 for revenue meters.
2. Accuracy from Light to Full Rating:

a. Power: Accurate to 0.25 percent of reading, plus 0.025 percent of full scale.
b. Voltage and Current: Accurate to 0.075 percent of reading, plus 0.025 percent of full scale.

     c.   Power Factor: Plus or minus 0.002, from 0.5 leading to 0.5 lagging.

     d.   Frequency: Plus or minus 0.01 Hz at 45 to 67 Hz.

P.   Waveform Capture:

    1.   Capture and store steady-state waveforms of voltage and current channels; initiated manually. Each capture shall be for 3 cycles, 128 data points for each cycle, allowing resolution of harmonics to 31st harmonic of basic 60 Hz.

    2.   Store captured waveforms in internal nonvolatile memory; available for PC display, archiving, and analysis.

Q.   Input: One digital input signal(s).

    1.   Normal mode for on/off signal.

    2.   Demand interval synchronization pulse, accepting a demand synchronization pulse from a utility demand meter.

    3.   Conditional energy signal to control conditional energy accumulation.

R.   Outputs:

    1.   Operated either by user command sent via communication link, or set to operate in response to user-defined alarm or event.

    2.   Closed in either a momentary or latched mode as defined by user.

    3.   Each output relay used in a momentary contact mode shall have an independent timer that can be set by user.

    4.   One digital KY pulse to a user-definable increment of energy measurement. Output ratings shall be up to 120-V ac, 300-V dc, 50 mA, and provide 3500-V rms isolation.

    5.   One relay output module(s), providing a load voltage range from 20- to 240-V ac or from 20- to 30-V dc, supporting a load current of 2 A.

    6.   Output Relay Control:

     a.   Relay outputs shall operate either by user command sent via communication link or in response to user-defined alarm or event.

     b.   Normally open and normally closed contacts, field configured to operate as follows:

      1)   Normal contact closure where contacts change state for as long as signal exists.

      2)   Latched mode when contacts change state on receipts of a pickup signal; changed state is held until a dropout signal is received.

      3)   Timed mode when contacts change state on receipt of a pickup signal; changed state is held for a preprogrammed duration.

      4)   End of power demand interval when relay operates as synchronization pulse for other devices.

      5)   Energy Pulse Output: Relay pulses quantities used for absolute kWh, absolute kVARh, kVAh, kWh In, kVARh In, kWh Out, and kVARh Out.

      6)   Output controlled by multiple alarms using Boolean-type logic.

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S.   Onboard Data Logging:

1.   Store logged data, alarms, events, and waveforms in 800 KB of onboard nonvolatile memory.
2.   Stored Data:

a.   Billing Log: User configurable; data shall be recorded every 15 minutes, identified by month, day, and 15-minute interval. Accumulate 24 months of monthly data, 32 days of daily data, and between 2 to 52 days of 15-minute interval data, depending on number of quantities selected.
b.   Custom Data Logs: Three user-defined log(s) holding up to 96 parameters. Date and time stamp each entry to the second and include the following user definitions:

1)   Schedule interval.
2)   Event definition.
3)   Configured as "fill-and-hold" or "circular, first-in first-out."

c.   Alarm Log: Include time, date, event information, and coincident information for each defined alarm or event.
d.   Waveform Log: Store captured waveforms configured as "fill-and-hold" or "circular, first-in first-out."

3.   Default values for all logs shall be initially set at factory, with logging to begin on device power up.

T.   Alarms.

1.   User Options:

a.   Define pickup, dropout, and delay.
b.   Assign one of four severity levels to make it easier for user to respond to the most important events first.
c.   Allow for combining up to four alarms using Boolean-type logic statements for outputting a single alarm.

2.   Alarm Events:

a.   Over/undercurrent.
b.   Over/undervoltage.
c.   Current imbalance.
d.   Phase loss, current.
e.   Phase loss, voltage.
f.   Voltage imbalance.
g.   Over kW demand.
h.   Phase reversal.
i.   Digital input off/on.
j.   End of incremental energy interval.
k.   End of demand interval.

U. Control Power: 90- to 457-V ac or 100- to 300-V dc.

V. Communications:

1. Power monitor shall be permanently connected to communicate via Modbus TCP via a 100 Base-T Ethernet.
2. Local plug-in connections shall be for RS-232 and 100 Base-T Ethernet.

W. Display Monitor:

1. Backlighted LCD to display metered data with touch-screen selecting device.
2. Touch-screen display shall be a minimum 21-inch diagonal, resolution of 128 by 1024 RGB pixels, 256 colors; NEMA 250, Type 1 display enclosure.
3. Display four values on one screen at same time.

a. Current, per phase rms, three-phase average and neutral.
b. Voltage, phase to phase, phase to neutral, and three-phase averages of phase to phase and phase to neutral.
c. Real power, per phase and three-phase total.
d. Reactive power, per phase and three-phase total.
e. Apparent power, per phase and three-phase total.
f. Power factor, per phase and three-phase total.
g. Frequency.
h. Demand current, per phase and three-phase average.
i. Demand real power, three-phase total.
j. Demand apparent power, three-phase total.
k. Accumulated energy (MWh and MVARh).
l. THD, current and voltage, per phase.

4. Reset: Allow reset of the following parameters at the display:

a. Peak demand current.
b. Peak demand power (kW) and peak demand apparent power (kVA).
c. Energy (MWh) and reactive energy (MVARh).

2.8 STANDALONE, WEB-ENABLED MONITORING AND CONTROL INSTRUMENT

A. Separately mounted, permanently installed instrument for power monitoring and control.

1. Enclosure: NEMA 250, Type 1.

B. Environmental Conditions: System components shall be capable of withstanding the following environmental conditions without mechanical or electrical damage or degradation of operating capability.

1. Indoor installation in non-air-conditioned spaces that have environmental controls to maintain ambient conditions of 0 to 122 deg F (minus 18 to plus 50 deg C) dry bulb and 20 to 90 percent relative humidity, noncondensing.

C.   Power-Distribution Equipment Monitor: Web enabled, with integral network port and embedded Web server with factory-configured firmware and HTML-formatted Web pages for viewing of power monitoring and equipment status information from connected devices equipped with digital communication ports.

D.   Communication Devices within the Equipment: Addressed at factory and tested to verify reliable communication with network server.

E.   Server Configuration:

1.   Initial network parameters set using a standard Web browser. Connect via a local operator interface, or an RJ-45 port accessible from front of equipment.
2.   Network server shall be factory programmed with embedded HTML-formatted Web pages that are user configurable and that provide detailed communication diagnostic information for serial and Ethernet ports as status of RS-485 network; with internal memory management information pages for viewing using a standard Web browser.
3.   Login: Password protected; password administration accessible from the LAN using a standard Web browser.
4.   Operating Software: Suitable for local access; firewall protected.

F.   Data Access:

1.   Network server shall include embedded HTML pages providing real-time information from devices connected to RS-485 network ports via a standard Web browser.

G.   Equipment Monitoring Options: Login shall be followed by a main menu for selecting summary Web pages that follow.

H.   Summary Web pages shall be factory configured to display the following information for each communicating device within the power equipment lineup:

1.   User-Configured Custom Home Page: Provide for the lineup, showing status-at-a-glance of key operating values.
2.   Circuit Summary Page: Circuit name, three-phase average rms current, power (kW), power factor, and breaker status.
3.   Load Current Summary Page: Circuit name, Phase A, B, and C rms current values.
4.   Demand Current Summary Page: Circuit name, Phase A, B, and C average demand current values.
5.   Power Summary Page: Circuit name, present demand power (kW), peak demand power (kW), and recorded time and date.
6.   Energy Summary Page: Circuit name, energy (kWh), reactive energy (kVARh), and time/date of last reset.
7.   Transformer Status Page: Transformer tag, coil temperatures, and cooling fan status.
8.   Motor-Control Center Status Page: Circuit name, three-phase average rms current, thermal capacity (percentage), and drive output frequency (Hz) contactor status.

9.   Specific Device Pages: Each individual communicating device shall display detailed, real-time information, as appropriate for device type.

   a.   Display historical energy data that shall be logged automatically for each device, as appropriate for device type.
   b.   Display historical data logged from each device in graphical time-trend plots. Value to be displayed on time-trend plot shall be user selectable. Time interval to be displayed on scale shall be for previous day or week.

10.   Export historical energy data to a PC or workstation through network using FTP (File Transfer Protocol).   Format exported data in a CSV (Comma Separated Variable) file format for importing into spreadsheet applications.

I.   Communications:

   1.   Power monitor: Permanently connected to communicate via Modbus TCP via an 100 Base-T Ethernet.
   2.   Local Plug-in Connections: RS-232 and 100 Base-T Ethernet.
   3.   Monitor Display: Backlighted LCD to display metered data with touch-screen selecting device.

2.9   WORKSTATION HARDWARE

A.   Environmental Conditions: System components shall be capable of withstanding the following environmental conditions without mechanical or electrical damage or degradation of operating capability:

   1.   Indoor installation in spaces that have environmental controls to maintain ambient conditions of 36 to 122 deg F (2 to 50 deg C) dry bulb and 20 to 90 percent relative humidity, noncondensing.

2.10   LAN CABLES

A.   Comply with Division 27 Section "Communications Horizontal Cabling."

2.11   LOW-VOLTAGE WIRING

A.   Low-Voltage Control Cable: Multiple conductor, color-coded, No. 20 AWG copper, minimum.

   1.   Sheath: PVC; except in plenum-type spaces, use sheath listed for plenums.
   2.   Ordinary Switching Circuits: Three conductors, unless otherwise indicated.
   3.   Switching Circuits with Pilot Lights or Locator Feature: Five conductors, unless otherwise indicated.

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PART 3 - EXECUTION

3.1   EXAMINATION

A.   Examine pathway elements intended for cables. Check raceways, cable trays, and other elements for compliance with space allocations, installation tolerances, hazards to cable installation, and other conditions affecting installation.

1.   Proceed with installation only after unsatisfactory conditions have been corrected.

3.2   CABLING

A.   Comply with NECA 1.

B.   Install cables and wiring according to requirements in Division 27 Section "Communications Horizontal Cabling."

C.   Wiring Method: Install wiring in raceway and cable tray except within consoles, cabinets, desks, and counters. Conceal raceway and wiring except in unfinished spaces.

D.   Wiring Method: Install wiring in raceway and cable tray except within consoles, cabinets, desks, and counters and except in accessible ceiling spaces and in gypsum board partitions where unenclosed wiring method may be used. Use NRTL-listed plenum cable in environmental air spaces, including plenum ceilings. Conceal raceway and cables except in unfinished spaces.

E.   Install LAN cables using techniques, practices, and methods that are consistent with specified category rating of components and that ensure specified category performance of completed and linked signal paths, end to end.

F.   Install cables without damaging conductors, shield, or jacket.

G.   Local 120V power to be provided from panels within electric rooms. Carry a new 20A-1P circuit breaker and 50'-0" of pipe and wire for each meter panel location.

3.3   IDENTIFICATION

A.   Identify components and power and control wiring according to Division 26 Section "Identification for Electrical Systems."

B.   Label each power monitoring and control module with a unique designation.

3.4   GROUNDING

A.   Comply with IEEE 1100, "Power and Grounding Sensitive Electronic Equipment."

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3.5   FIELD QUALITY CONTROL

A.   Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.

B.   Tests and Inspections:

1.   Electrical Tests: Use caution when testing devices containing solid-state components.
2.   Continuity tests of circuits.
3.   Operational Tests: Set and operate controls at workstation and at monitored and controlled devices to demonstrate their functions and capabilities. Use a methodical sequence that cues and reproduces actual operating functions as recommended by manufacturer. Submit sequences for approval. Note response to each test command and operation. Note time intervals between initiation of alarm conditions and registration of alarms at central-processing workstation.

   a.   Coordinate testing required by this Section with that required by Sections specifying equipment being monitored and controlled.
   b.   Test LANs according to requirements in Division 27 Section "Communications Horizontal Cabling."
   c.   System components with battery backup shall be operated on battery power for a period of not less than 10 percent of calculated battery operating time.
   d.   Verify accuracy of graphic screens and icons.
   e.   Metering Test: Load feeders, measure loads on feeder conductor with an rms reading clamp-on ammeter, and simultaneously read indicated current on the same phase at central-processing workstation. Record and compare values measured at the two locations. Resolve discrepancies greater than 5 percent and record resolution method and results.
   f.   Record metered values, control settings, operations, cues, time intervals, and functional observations and submit test reports printed by workstation printer.

C.   Correct deficiencies, make necessary adjustments, and retest. Verify that specified requirements are met.

D.   Test Labeling: After satisfactory completion of tests and inspections, apply a label to tested components indicating test results, date, and responsible agency and representative.

E.   Reports: Written reports of tests and observations. Record defective materials and workmanship and unsatisfactory test results. Record repairs and adjustments.

F.   Remove and replace malfunctioning devices and circuits and retest as specified above.

3.6   DEMONSTRATION

A.   Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain systems. Refer to Division 01 Section "Demonstration and Training."

1.   Train Owner's management and maintenance personnel in interpreting and using monitoring displays and in configuring and using software and reports. Include troubleshooting, servicing, adjusting, and maintaining equipment. Provide a minimum of 12 hours' training, (4) hours for each of (3) sessions on different days/times.

2.   Training Aid: Use approved final versions of software and maintenance manuals as training aids.

3.7   ON-SITE ASSISTANCE

A.   Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to three visits to Project during other-than-normal occupancy hours for this purpose.

END OF SECTION