

SECTION [26 09 26][26 24 16.16][16145]

[LIGHTING CONTROL PANELBOARDS][INTELLIGENT PANELBOARDS]

Square D Powerlink™ Panelboards 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.

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 and closing 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.

PART 1 - GENERAL

1.1 SUMMARY

- A. Scope: Provide labor, material, equipment, related services, and supervision required, including, but not limited to, manufacturing, fabrication, configuration and installation for [lighting control panelboards][intelligent panelboards] (also identified as lighting control panelboards, intelligent panelboards, LP, iLP, PP, iPP or panelboard) as required for the complete performance of the Work, as shown on the Drawings, as 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. The following panelboard information is typically depicted on the Drawings or with panelboard schedules: bus configuration, bus ratings, [interrupting ratings,] mounting/enclosure type, mains, feeder breakers, etc. Where not shown on or able to be derived from the Drawings or panelboard schedule, the minimum requirements specified herein shall be provided.
 - 4. Refer to specification Section 26 09 13 Electrical Power Management System for additional requirements.

1.2 REFERENCES

- A. General, Publications: 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. American Society of Civil Engineers (ASCE):
 - a. ASCE 7, "Minimum Design Loads for Buildings and Other Structures."
 - 2. American Society of Heating, Refrigerating, and Air Conditioning Engineers, Inc. (ASHRAE):
 - a. ASHRAE 135, "BACnet A Data Communication Protocol for Building Automation and Control Networks."
 - 3. California Code of Regulations (CCR):
 - a. CCR Title 24, "California Building Standards Code."
 - 4. Canadian Standards Association (CSA):

- a. C22.2 No. 5, "Molded Case Circuit Breakers, Molded Case Switches and Circuit Breaker Enclosures."
- b. C22.2 No. 29, "Panelboards and Enclosed Panelboards."
- c. C22.1, "Canadian Electrical Code, Part I" (CEC)
- 5. Federal Communications Commission (FCC):
 - a. FCC 47 CFR Part 15, "Radio Frequency Devices."
- 6. Federal Specifications (FS):
 - a. FS W-C-375, "Circuit Breakers, Molded Case, Branch Circuit and Service."
 - b. FS W-P-115, "Panel, Power Distribution."
- 7. International Code Council (ICC):
 - a. ICC-ES AC156, "Acceptance Criteria for Seismic Qualification by Shake-Table Testing of Nonstructural Components and Systems."
 - b. ICC IBC, "International Building Code."
- 8. National Electrical Manufacturers Association (NEMA):
 - a. NEMA AB 1, "Molded Case Circuit Breakers and Molded Case Switches."
 - b. NEMA KS 1, "Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum)."
 - c. NEMA PB 1, "Panelboards."
 - d. NEMA PB 1.1, "General Instructions for Proper Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less."
- 9. National Fire Protection Association (NFPA):
 - a. NFPA 70, "National Electrical Code," hereinafter referred to as NEC.
 - b. NFPA 5000, "Building Construction and Safety Code."
- 10. International Organization for Standardization (ISO):
 - a. ISO 9001, "Quality Management Systems - Requirements."
- 11. Telecommunications Industry Association (TIA):
 - a. TIA 568, "Commercial Building Telecommunications Cabling Standard."
- 12. Underwriters Laboratories, Inc. (UL):
 - a. UL 50, "Enclosures for Electrical Equipment, Non-Environmental Considerations."
 - b. UL 67, "Standard for Panelboards."
 - c. UL 98, "Standard for Enclosed and Dead-Front Switches."
 - d. UL 489, "Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures."

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.

1.4 SUBMITTALS

- A. General: Submittals shall be in accordance with the requirements of Section [01 33 00][01300] Submittals and Section [26 00 10][16010] Electrical Requirements, in addition to those specified herein.
 - 1. 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.

2. Deviations from the Contract Documents shall be indicated within the submittal. Each deviation shall reference the corresponding drawing or specification number, show the Contract Document requirement text and/or illustration, and shall be accompanied by a detailed written justification for the deviation.

- B. Operation & Maintenance (O&M) manuals shall be provided in accordance with the minimum requirements specified in Section [01 78 23][1780] Operation and Maintenance Data, Section [26 00 10][16010] Electrical Requirements and additional requirements specified herein.

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. Equipment, assemblies and materials 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. As a minimum, store indoors in clean, dry space with uniform temperature to prevent condensation. In addition, protect electronics from all forms of electrical and magnetic energy that could reasonably cause damage.
- 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.

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 [- NOT USED]

- 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 installed. 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 manufacturer, 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 MANUFACTURERS

- A. [Basis-of-Design Product: Subject to compliance with requirements, provide Square D Powerlink Intelligent Panelboard by Schneider Electric.]
- B. Acceptable Products: Panelboards 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. Square D Powerlink Intelligent Panelboard by Schneider Electric
 2. [2nd manufacturer and model]
 3. [3rd manufacturer and model]

2.2 GENERAL REQUIREMENTS

- A. System referenced herein shall be designed and manufactured according to the latest revision of the following specifications:
1. ASCE 7 (seismic compliance requirements).
 2. CCR Title 24, lighting control equipment shall be certified by the California Energy Commission.
 3. CSA C22.2 No. 5.
 4. CSA C22.2 No. 29.
 5. FCC emissions: Compliance with FCC emissions standards (FCC 47 CFR Part 15) specified in Part 15, Subpart J for Class A applications.
 6. FS W-C-375.
 7. FS W-P-115 (Type I Class 1).

8. ICC-ES AC156 (seismic testing protocol).
 9. ICC IBC (seismic compliance requirements).
 10. Electronic panelboard components shall meet or exceed levels specified below:
 - a. ESD Immunity: Level 4.
 - b. RF Susceptibility: Level 3.
 - c. Electrical Fast Transient Susceptibility: Level 3.
 - d. Electrical Surge Susceptibility (Power Line): Level 4.
 - e. Electrical Surge Susceptibility (Interconnection Lines): Level 3.
 11. NEMA PB 1.
 12. NEMA PB 1.1.
 13. NEMA AB 1.
 14. NEMA KS 1.
 15. NEMA compliance; applicable portions of NEMA standards pertaining to types of electrical equipment and enclosures.
 16. NEC compliance; applicable portions of the NEC including Articles 110-10 and 725.
 17. NFPA 5000 (seismic compliance requirements).
 18. UL 50.
 19. UL 67.
 20. UL 98.
 21. UL 489.
 22. UL compliance; applicable UL standards for panelboards, circuit breakers, and energy management equipment.
 23. New York City; panelboards shall be certified for use in New York City by the New York City authority.
- B. Intelligent panelboards shall use standard boxes, interiors, and trims. Panelboard shall not require different construction to accommodate control components. All control components shall install onto standard panelboard interiors. Control components shall not restrict field wiring in gutter space.
- C. All intelligent panelboards shall be provided with remotely operated circuit breakers and intelligent control bus providing interface to remotely operable circuit breakers. Panelboards shall accept a mix of standard and remotely operated circuit breakers.
- D. The intelligent panelboard system shall fully accommodate the separation of Class 1 and Class 2 control circuits as required by the NEC. The control bus shall be a UL-listed Class 1 control device for installation in the same panelboard gutter with field-installed power circuits. Intelligent panelboards using control bus devices that are not specifically listed as UL Class 1 shall be provided with physical barriers to completely separate field wiring from the control bus, circuit breaker connections, and all associated Class 2 wiring.
- E. Intelligent panelboard systems shall be comprised of master and optional sub-panel panelboards.
1. Master intelligent panelboards shall be further provided with a system power supply and a controller with integral time clock. Master panelboards shall not require manually setting a sub-panel address.
 2. Sub-panel panelboards shall obtain control power and control signals from the master panelboard or a separate, remotely-mounted controller and power supply.
 - a. Sub-panel panelboards shall be provided with an easily readable and settable numeric address wheel. Systems with binary-coded DIP-switch address selectors shall not be accepted.

- b. Panelboards marked as sub-panel panelboards shall contain the necessary busses and network hardware to allow connection of the sub-net wiring between panelboards.
 - c. Sub-panel panelboards shall contain a nameplate label, located on the panel trim indicating its designation and the designations and address of its associated master panel.
 - d. Sub-net wiring connections shall allow connection of wiring to a terminal that can be removed from the panel without interrupting the communications to other panelboards.
 - e. Powered sub-panel panelboards shall further include a power supply to extend capacity of the system.
- F. System Power Supply: The system power supply shall mount on the panelboard interior and [be fed directly from the panelboard bus without external wiring or fuses] [be fed from an external voltage source]. The power supply shall provide isolated Class 1 and Class 2 sources to allow field wiring to meet NEC requirements. Each power supply shall provide capacity for 8 control busses with 168 circuit breakers in up to 8 panelboards, and one controller.

2.3 REMOTELY OPERATED CIRCUIT BREAKERS

- A. Remotely operated branch circuit breakers shall provide overload and short circuit protection suitable for the location in the electrical system, as defined in the panelboard schedules. Remotely operated power switching devices shall have the following:
1. Integral branch circuit overcurrent protection as required by the NEC. Circuit breakers shall have a UL-listed interrupting rating sufficient for the application or UL-listed series connected ratings for the maximum available fault current at that point in the system. Submittals reflecting the use of relays or contactors to perform remote switching shall show evidence in writing that the relays or contactors are listed to withstand the available fault current.
 2. UL-listed SWD ratings for 15 ampere, 20 ampere, and 30 ampere 1-pole, 2-pole, and 3-pole branch devices, HID ratings, and HACR ratings.
 3. Handle operator that shall mechanically open the power switching device contacts when moved to the OFF position and disable the contacts from being remotely closed. Handle operator shall accept field-installable handle tie to allow application where a handle tie is required by the NEC.
 4. Manual override switch to enable or disable the remote operation of the device and allow circuit breaker handle to fully control the on/off state of the circuit breaker. Override shall fully disengage remote operation of the circuit breaker mechanism. Device utilizing one-shot or temporary overrides shall not be accepted.
 5. Visible flag that clearly indicates the status of the circuit breaker contacts with the panel trim installed. Flag shall indicate ON, OFF, and TRIPPED circuit breaker states. The visible flag shall be mechanical in nature, directly tied to the circuit breaker mechanism, and shall be provided in addition to any status indicator supplied by the system electronics.
 6. Voltage status signal to indicate the presence or absence of voltage at the load terminal as a true indication of the on/off status of the connected circuit to aid in identifying wiring errors, such as a back-feed or disconnected neutral conductor.
 7. Circuit to indicate the number of poles of the remotely operable circuit breaker.
 8. Integral control connector to simplify and speed installation and eliminate wiring errors such that the control connection is made automatically when installing the breaker in the panelboard. Connection to the breaker shall not introduce control wiring into the panelboard gutter space. Control connections shall be rated NEC Class 1 to eliminate the requirement for barriers in the gutter space such that control connections may reside with electrical power circuit conductors.
 9. Switching full load endurance rating of 200,000 open/close/open remote operations. Switching devices with lower ratings or no published ratings may be judged to be acceptable, but shall be provided with [100%][200%] spare switching devices for each circuit to ensure an equivalent total number of operations.

2.4 MASTER PANELBOARD CONTROLLER

- A. The master panelboard controller shall provide the following:
1. Logical control capability for 336 remotely controllable circuit breakers.
 2. Auxiliary control power source for powering external control devices such as occupancy sensors and low voltage photo sensors, as indicated on the Drawings.
 3. Programmable input timers to permit timed override periods.
 4. Adjustable blink notice.
 5. Event logging to track circuit breaker, input, and zone state; schedule periods; bus operational status; and circuit breaker on-time.
 6. Capability for accepting downloadable firmware without removing controller.
 7. Time scheduling including, but not limited to, the following:
 - a. Sixty-four (64) independent schedules, each configurable into 100 distinct periods.
 - b. Clock configurable for 12-hour (AM/PM) or 24-hour format. Clock shall retain time for at least 21 days in the absence of power. Clock back-up circuit shall be maintenance free.
 - c. Schedule periods settable to the minute.
 - d. 365-day calendar, with automatic daylight savings and leap year adjustments.
 - e. Day-of-week, day-of-month, day-of-year with one-time or repeating capability.
 - f. Ninety-six (96) special event periods with 14 pre-programmed holidays.
 - g. Astronomical tracker to automatically adjust sunrise and sunset times throughout the year.
 8. Sixteen hard-wired terminals configurable for either 16 two-wire inputs, eight three-wire inputs, or eight two-wire inputs with status feedback for pilot LED's (four Analog input terminals, each configurable to 0-5v, 0-10v, or 4-20ma with 256 possible thresholds). Configurations shall allow either momentary or maintained control devices to be attached. These inputs shall be configured according to the Owner's requirements and shall be capable of providing the following capabilities:
 - a. Two-hundred-fifty-six (256) communication inputs available for network connections.
 - b. Input synchronization service to synch inputs with other inputs, zones, time schedules, or remote sources. This synchronization service shall be used to control input state, input inhibit mode (enable/disable), or sync timers (enable/disable).
 - c. Boolean custom controls, including, but not limited to, configuring sources. Sources shall include, but shall not be limited to, inputs, time schedules, or status. Up to four sources shall be permitted in a custom configurable logic arrangement configured up to 256 zones.
 9. Zone priorities, assignable to each zone, such that the particular zone shall have priority over other zones. Zones priorities shall be capable of forcing all circuit breakers in the zone to an ON state or an OFF state depending on the particular configuration.
 10. Ethernet communications. Each panel controller shall allow networking with other master panel controllers in a peer-to-peer configuration using an Ethernet 100Base-T full duplex network.
 - a. Each panel controller shall support three (3) Ethernet ports communicating using Modbus TCP/IP and/or BACnet/IP protocols.
 - b. Each input connected to the controller shall be capable of controlling any branch circuit connected to any other controller.
 - c. A schedule programmed in one controller shall be capable of controlling any branch circuit connected to any other controller.
 - d. Means for setting initial Ethernet parameters via a local operator interface without having to employ special software or configuration tools.

- e. Each panel controller shall be capable of operating in a pass-through mode for Modbus connected devices, such as meters, whereby the information is automatically ported to the Modbus TCP/IP port without separate gateway devices.
11. Each panel controller shall incorporate a time synchronization service to update controller clock to a network time server. The time synchronization service shall incorporate both a primary and secondary source. The update interval shall be settable from 1 to 24 hours.
12. Embedded web server. Each panel controllers shall incorporate a web-enabled server for displaying information over a standard web browser. Web-accessible information shall include:
- a. A secure, password protected login screen for modifying operational parameters to ensure only authorized access. Password administration shall be accessible to authorized users via web page interface.
 - b. Separate web pages for each panel with the arrangement of circuit breakers on the page matching the physical appearance of the panel. Panel status pages shall also include, but shall not be limited to, circuit breaker nametags, pole configuration, location in panel, and actual contact state (on/off/tripped/manual) for the master panel and each associated sub-panel. The web page shall also provide the ability to observe circuit breaker on-time and blink information in real time.
 - c. Panel summary showing the master and sub-panel panelboards connected to the controller.
 - d. Controller summary showing controller diagnostic information.
 - e. Panel mimic screens for setting up controller parameters, input types, zones, and operating schedules. Mimic screens shall also allow direct circuit breaker control and zone overrides.
 - f. Alarm and email notification. Each master controller shall incorporate an alarm and automated email notification service. These services shall be capable of automatically initiating alarms based on preconfigured conditions and routing alarm alerts as directed by the Owner.
13. Alarms shall be configurable for the following parameters:
- a. Global alarms (power loss, non-responding circuit breakers, loss and restoration of sub-net communications, loss and restoration of serial port communications, and loss and restoration of Modbus TCP Ethernet commands).
 - b. Specific alarms (input status, zone status, circuit breaker status on-time (0 to 99,999 hours), and strike counter).
 - c. Email notification service shall include, but shall not be limited to, the ability to automatically route an email message to five individual email addresses. Within the body text of the email, provide a link that shall automatically redirect the user to the associated panelboard's status web page.
14. BACnet Conformance:
- a. Reference BACnet Standard, ASHRAE 135.
 - b. Each panel controller shall, at a minimum, support serial BACnet MS/TP and Ethernet BACnet/IP communications.
 - c. Each panel controller shall be able to communicate directly via BACnet RS-485 serial networks and Ethernet 100Base-T networks as a native BACnet device.
 - d. Each panel controller shall comply with Annex J of ASHRAE 135 for IP connections.
 - e. Each panel controller shall function as a BACnet application specific controller in accordance with Annex L of ASHRAE 135, and shall support the following BACnet interoperability building blocks:
 - 1) Data Sharing - Read Property - B.
 - 2) Data Sharing - Read Property Multiple - B.

- 3) Data Sharing - Write Property - B.
 - 4) Data Sharing - Write Property Multiple - B.
 - 5) Device Management - Dynamic Device Binding - B.
 - 6) Device Management - Dynamic Object Binding - B.
 - 7) Device Management - Device Communication Control - B.
 - 8) Device Management - Time Synchronization - B.
 - 9) Device Management - UTC Time Synchronization - B.
 - 10) Device Management - Reinitialize Device - B.
- f. Standard BACnet object types supported shall include, but shall not be limited to, analog value, binary value, multi-state value, and multi-state output.
15. Optical isolation: The controller shall provide a dedicated, optically-isolated RS-485 port for connection to Class 1 control busses in master and sub-panel panelboards. Systems without physical barriers between power and Class 2 circuits shall provide an optical isolator between controller and control uses and a separate power source to the controller.

2.5 NETWORKS:

A. Sub-Net:

1. Provide sub-net wiring between master and sub-panel panelboards as indicated on the Drawings. Sub-net wiring shall permit sub-panel panelboards to receive power and control data from the master panelboard. No more than eight control busses shall be connected to the sub-net. If a powered sub-panel panelboard with second power supply is provided, then no more than 16 control busses shall be connected to the sub-net.
2. Sub-net communications shall follow Class 1 wiring practices. Sub-net shall be allowed to occupy the same conduit, enclosure, or raceway as functionally associated Class 1 and power circuits. Communications conductors shall be Belden 27326 or equal having the same voltage rating as the branch circuit conductors.
3. Wiring distances shall not exceed the manufacturer's recommendations. Maximum subnet distance shall be 400 feet from the master panelboard in two directions for a total length of 800 feet.
4. Sub-net panelboards shall allow more than two control busses per panelboard.
5. Sub-net shall not require the field installation of termination resistors.

B. RS-232 and RS-485 Serial Network:

1. Provide serial communication wiring between master panelboards and other master panelboards or other building controllers as indicated on the Drawings.
2. Total RS-485 network length shall be up to 5000 feet (1524 m).
3. Connected devices shall support baud rates of 4800, 9600, 19200, 38400 76800, and 115200.
4. Network shall support up to 32 devices.
5. Serial communications shall allow the use of both RS-232 and RS-485 simultaneously with independent protocol configuration.
6. Network cable shall be shielded two-conductor twisted pair (Belden 9841 or equivalent), or shielded three-conductor with twisted pair (Belden 8723 or equivalent).

C. Ethernet Network:

1. Installing contractor shall coordinate work with the network administrator to assure that proper connection points are available. The installing contractor shall also secure static IP address for each individual master controller and power monitoring web server.
2. Network shall support Ethernet 100Base-T communications.

3. Communications wiring to master panelboards shall be Category 5 cable having eight-position eight contact (8P8C) modular plugs terminated using the T568A or T568B pin/pair assignments as defined in TIA 568.
 4. Shall utilize the three (3) Ethernet ports to create an independent Ethernet network.
- D. Future integration and service shall be promoted by using only open communication protocols between lighting control panelboards. An open protocol is one that has specifications published in the public domain and that is used by more than 10 manufacturers. Modbus (TCP/IP), Modbus (ASCII/RTU), BACnet IP, BACnet MS/TP, and DMX, are considered acceptable. Submittals listing any other protocol shall not be considered unless they demonstrate that these criteria are met. The same open protocol shall be used over all media that are part of the system, including, but not limited to, serial busses, the LAN, or other connections.
 - E. Installation of additional special purpose networks shall be minimized by using the existing facility Ethernet LAN to connect various lighting panelboards or groups of lighting panelboards as shown on the Drawings. Equipment shall be compatible with industry standard TCP/IP protocols.
 - F. Power monitoring metering devices as shown on the Drawings shall connect using the same network as the lighting control panelboards. The controller shall provide a pass-through mode for Modbus connected meters whereby the information shall be automatically ported to the Modbus TCP/IP port without separate gateway devices.
 - G. Communications wiring to master panelboards shall use Category 5 cabling. Installing Contractor shall coordinate work with the network administrator to assure that proper connection points are available. The installing Contractor shall also secure one static IP address for each master controller.

2.6 CONFIGURATION SOFTWARE [- NOT USED]:

- A. Configuration software shall be designed specifically for the lighting control system and supported by the manufacturer. Software shall support system configuration, printing of configuration records, and monitoring and control functions in a Windows environment. Support for remote system dial-up shall be incorporated into the software package.
- B. For basic setup and control, the software shall serve as a configuration and diagnostic utility. Basic features shall include, but shall not be limited to, support for configuring inputs, zones, circuit breaker actions, and time schedules. Software shall be able to monitor the status of the system and provide visual indication of input status, circuit breaker status, and operational parameters. Software shall be able to establish connections to the system through a controller RS232 port, RS485 port, and Ethernet front port. Support for remote system dial-up shall be incorporated into the software package.

2.7 PERSONAL COMPUTER WORKSTATIONS [- NOT USED]:

- A. The lighting panelboard system shall include, but shall not be limited to, personal computer workstations complete with software as specified in this Section. The workstations shall be pre-configured with software and configuration files. Workstations shall be ready to connect and operate when delivered to the job site.
- B. [The panelboard lighting control system shall include, but shall not be limited to,] [The Owner will insert] factory-supplied personal computer workstations. Each workstation shall consist of a 1.0 GHZ or higher CPU, 17 inch (432 mm) color monitor, Windows XP professional (as required to support manufacturer's software), internal modem, Ethernet network interface card, CD-ROM, 3.5 inch (89 mm) floppy drive, 128 Mbytes RAM, and a minimum of 10 Gbytes hard drive storage.

2.8 ROOM CONTROLS [- NOT USED]:

1. General

- a. Room controls shall use radio frequency (RF) technology. Room controls that require control wiring between sensors and control devices shall not be accepted. RF range between devices shall be at least 60 feet line-of-sight or 30 feet through walls constructed from typical materials.
 - b. RF communications shall be on an uncongested frequency band to prevent interference with control functions. Wireless controls operating in the 2.4 GHz or 900 MHz frequency bands shall not be accepted.
 - c. Wireless devices that use battery power sources shall be rated for at least 10-year battery life. Battery-powered wireless controls shall use standard, commonly available batteries. Batteries shall be field replaceable.
 - d. Wireless devices shall communicate with each other to implement lighting control applications without the use of a central controller.
2. Wireless Occupancy / Vacancy Ceiling Sensors
 - a. Provide ceiling mount PIR occupancy or vacancy sensors as shown on the drawings.
 - b. The sensor shall be mounted to the ceiling to detect the heat from people moving within an area to determine when the space is occupied. Multiple ceiling-mount methods shall be available for compatibility with different ceiling materials.
 - c. The sensor shall provide 360° coverage ranging from 324 ft² to 676 ft², depending on mounting height. Multiple sensors can be added for extended coverage. The sensor shall transmit the appropriate commands to associated dimming or switching devices to turn the lights on or off automatically.
 - d. The sensor shall have Auto-On/Auto-Off, Auto-On Low-Light/Auto-Off, and Manual-On/Auto-Off settings available. The Auto-On Low-Light feature shall turn lights on automatically only if there is less than approximately 10 lux (1 foot-candles) of ambient light.
 - e. The sensor lens shall illuminate during test mode to verify ideal locations. The sensor shall have front accessible test buttons for setup. The sensor shall have adjustable timeout periods of 1, 5, 15, and 30 minutes.
 3. Wireless Wall-Mount Occupancy / Vacancy Sensors
 - a. Provide wall mount PIR occupancy or vacancy sensors as shown on the drawings.
 - b. The sensor shall be mounted to the wall to detect the heat from people moving within an area to determine when the space is occupied. Multiple wall-mount methods shall be available to accommodate different mounting positions and angles.
 - c. Sensor models shall be available to provide: 180° field of view model with minor motion coverage = 1500 ft² and major motion coverage = 3000 ft²; 90° field of view model with minor motion coverage = 1225 ft² and major motion = 2500 ft²; and a hallway model with a long, narrow field of view with major motion coverage of up to 150 ft. Multiple sensors can be added for extended coverage. The sensor shall transmit the appropriate commands to associated dimming or switching devices to turn the lights on or off automatically.
 - d. The sensor shall have Auto-On/Auto-Off and Manual-On/Auto-Off settings available.
 - e. The sensor lens shall illuminate during test mode to verify ideal locations. The sensor shall have front accessible test buttons for setup. The sensor shall have adjustable timeout periods of 1, 5, 15, and 30 minutes.
 4. Wireless Daylight Sensors
 - a. Provide wireless daylight sensors as shown on the drawings.
 - b. The sensor shall be mounted to the ceiling to measure light in the space. Multiple ceiling-mount methods shall be available for compatibility with different ceiling materials.

- c. The sensor shall be capable of measuring ambient light levels in the range of 0 to 1600 lux (0 to 150 foot-candles). The sensor shall transmit the light level to associated dimming or switching devices to automatically control the lights in the space.
 - d. The sensor shall have front accessible test buttons for setup.
5. Wireless Keypads
- a. Provide wireless keypads as designated on the drawings.
 - b. Wireless keypads shall allow the user to control wireless devices from anywhere in the space. The wireless keypad shall require no external power or wiring.
 - c. Wireless keypads shall be adaptable for use: as a remote control, as a wall-mounted switch, or as a pedestal-mounted table top control. Wall mounted keypads shall accommodate stand-alone, wall box, or surface mounting applications. Wall box and surface mounted keypads shall be compatible with decorator faceplates.
 - d. Wireless keypads shall be available in choice of white, black, ivory, light almond, and gray colors.
 - e. Wireless keypads shall be available in 2 to 4 button configurations with buttons optionally labeled to raise/lower light level. Wireless keypads shall be available with optional nightlight (3-year battery life).
6. Wireless Wall-box Dimmers and Switches
- a. Provide wireless dimmers and switches as shown on the drawings.
 - b. Wireless dimmers and switches shall install into standard wall boxes and provide control of the connected load:
 - 1) Local control – Switches shall provide local on/off control of the connected load. Dimmers shall further allow fine-tuning of the light level by pressing and holding the dimming rocker until the desired light level is reached. Companion switches and dimmers may be connected to provide control from up to 9 additional locations.
 - 2) Remote control - Dimmers and switches shall receive and respond to commands transmitted by wireless occupancy/vacancy sensors, wireless daylight sensors, and wireless keypads.
 - c. Dimmers and switches shall have power failure memory so that the control will return to its previously set level prior to a power interruption.
 - d. Switches shall be available to provide control of lighting loads up to 8 amperes and fan loads up to 5.8 amperes at 120 volts or 3.0 amperes at 277 volts.
 - e. Dimmers shall be available to power CFL, LED, Halogen, Incandescent, Magnetic Low-Voltage, and Electronic Low Voltage lighting circuits up to 600 watts.
 - f. Dimmers and switches shall be available in choice of white, ivory, almond, light almond, gray, brown, and black colors. Dimmers and switches shall be compatible with decorator faceplates.
7. Wireless Receptacles
- a. Provide wireless receptacles as shown on the drawings.
 - b. The receptacle shall receive control signals from wireless keypads and occupancy/vacancy sensors. Receptacles shall be capable of switching general purpose loads up to 15 or 20 amperes. The receptacle shall use adaptive zero cross control to maximize relay life by switching at the point of minimum energy on the AC power curve.
 - c. Models of receptacles shall be available to provide either half-switching or dual switching of the controlled receptacle and any connected downstream receptacles.
 - d. Receptacles shall be available in choice of white, light almond, and black colors. Receptacles shall be compatible with decorator faceplates.

8. Wireless Relay Modules
 - a. Provide 5 ampere and 16 ampere wireless relay modules sized according to the ratings shown on the drawings.
 - b. Relay modules shall be rated for 120 or 277-volt operation. Relay modules shall be capable of switching general-purpose loads including but not limited to Incandescent, MLV, ELV, Resistive, Inductive, Magnetic fluorescent, and Electronic fluorescent lighting. Relay modules shall not require a minimum load. 16 ampere relay modules shall have motor load ratings of ½ HP at 120V and 1 12 HP at 277V. 5 ampere relay modules shall have motor load ratings of 1/6 HP at 120V and 1/3 HP at 277V.
 - c. Relay modules shall have power failure memory so that the control will return to its previously set level. Relay modules shall use adaptive zero cross control to maximize relay life by switching at the point of minimum energy on the AC power curve.
 - d. Relay modules shall mount to a junction box through a standard size knockout.
9. Wireless 0 - 10 Volt Dimming Module with Switching
 - a. Provide 0 - 10 volt dimming modules as shown on the drawings.
 - b. Dimming modules shall be rated for: 120 or 277-volt operation; 8-ampere switching; Control up to 60 mA of 0 –10 volt lighting fixtures controlled together. The 0 - 10 volt control link shall automatically source or sink to lighting fixtures.
 - c. Dimming module shall work with all ballasts and drivers that provide a current source that is compliant to IEC 60629 Annex E.2, and whose inrush current does not exceed NEMA410 standards for electronic ballast/drivers.
 - d. The 0 – 10-volt control link shall be rated NEC Class 2 that can be installed using NEC Class 1 or Class 2 wiring methods. The dimming module shall mount to a junction box through a standard size knockout. Class 1 control link applications may require the module to be installed inside an additional junction box.
10. Powerlink Interface Device
 - a. Provide Powerlink Interface Devices (PID) as shown on the drawings.
 - b. The PID shall provide a single closure output with normally open (NO) and normally closed (NC) dry contacts. The PID shall respond to control signals from wireless keypads, occupancy/vacancy sensors, or daylight sensor back to the Powerlink controller.
 - c. The PID shall operate from 24 volts DC Class 2 control power.
 - d. The PID shall provide screw tabs for surface mounting or mount to a junction box through a standard size knockout.

2.9 ENERGY MANAGEMENT METERING [- NOT USED]:

- A. For each panelboard indicated on the Drawings, provide power metering for main and branch circuits. Branch circuit metering CT's shall be arranged so that the branch circuit being metered is clearly associated with the metering CT.
- B. Power meter shall provide data using RS-485 Modbus RTU protocol. Data shall be updated at 1 second intervals.
- C. Main and individual branch circuit metering values shall include, but shall not be limited to, current, current demand, kilowatt hours, kilowatt demand, power factor, voltage, and frequency.
- D. Power metering shall monitor the following alarm parameters:
 1. Voltage over/under.
 2. Over/under currents.
 3. Phase loss.

2.10 ELECTRICAL POWER MANAGEMENT SYSTEM [- NOT USED]

- A. The equipment specified herein shall provide the necessary communications connectivity and functionality required to support the functionality of an Electrical Power Management System (EPMS). This shall include, but not be limited, to the following:
1. Communications connectivity using the specified Ethernet network and protocols of the EPMS and related EPMS connected equipment necessary to provide functionality. Equipment may be connected through a communications gateway as shown or specified; otherwise Ethernet and protocol connectivity shall be provided within the equipment.
 2. Compliance with Cyber security requirements.
 3. Remote EPMS application functionality for equipment configuration [and operational control]; electrical power monitoring; power quality monitoring, compliance and correction; and alarm monitoring with event log.
 4. Refer to the Electrical Power Management System specification section for additional requirements.
- B. Native EPMS software compatibility shall be fully factory-tested, and shall include the following characteristics.
1. Capability for pre-engineered, interactive graphical display screens to view and analyze real-time device data.
 2. Pre-mapping of registers to standard measurement names without the need for additional configuration or internal device registers.
 3. Automatic collection and logging of device data by EPMS software without additional configuration.
 4. Refer to the individual power and energy meter device requirements for EPMS monitoring of measured and calculated values, alarms, events, parameters and additional data as available from the device, as specified herein and within the Electrical Power Management System specification.

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 10][16010] and Drawings.
- B. Examine equipment exterior and interior prior to installation. Report any damage and do not install any equipment that is structurally, moisture, or mildew damaged.
- C. Verification of Conditions: Examine areas and conditions under which the work is to be installed, and notify the Contractor in writing, with a copy to the Owner and the Engineer, of any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected.
- D. Beginning of the work shall indicate acceptance of the areas and conditions as satisfactory by the Installer.
- E. Install equipment in accordance with reviewed product data, final shop drawings, manufacturer's written instructions and recommendations, and as indicated on the Drawings.
- F. Functional testing, commissioning, and first parameter adjusting shall be carried out by a factory trained manufacturer's representative field service engineer. Test and adjust controls and safeties. Replace

damaged or malfunctioning controls and equipment. Report to the Engineer any discrepancies or issues with the installation.

- G. Provide final protection and maintain conditions in a manner acceptable to the manufacturer that shall help ensure that the equipment is without damage at time of Substantial Completion.

END OF SECTION [26 29 16][26 24 16.16][16290]

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