SPECIAL SPECIFICATION

SECTION 16915S

<u>LIGHTING CONTROL EQUIPMENT</u>

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PART 1 - GENERAL

1.01   DESCRIPTION OF WORK

    A.   This section includes furnishing and installing of a complete, operational lighting control system, in accordance with this specification section and the project drawings. Components include, but are not limited to, dimmers, dimmer racks, occupancy sensors, photoelectric sensors, light sensor controller and dimmer control stations.

1.02   REFERENCES

    A.   National Fire Protection Association (NFPA):

        1. NFPA 70-National Electrical Code.

    B.   Underwriters Laboratories (UL):

        1. UL 1449 transient voltage withstand

1.03   SUBMITTALS

    A.   Provide submittals including but not limited to:

        1. Full system riser diagram(s) illustrating interconnection of system components, wiring requirements, back box sizes and any special installation considerations.

        2. Full set of printed technical data sheets.

        3. Detailed set of dimmer schedules.

        4. Detailed set of circuit and control schedules, including a complete list of all deviations from specifications.

1.04   QUALITY ASSURANCE

    A.   Manufacturer shall be one who has been continuously engaged in the manufacturer of lighting control equipment for a minimum of ten years. All dimmer and cabinet fabrication must take place in a U.S. manufacturing plant.

    B.   Proposed equipment shall be UL and C-UL listed, and/or CE marked (where applicable) and bear the appropriate labels.

1.05   SERVICE CONDITIONS

    A.   Design For Indoor Use.

    B.   Seismic Design per IBC 2000: Seismic Design Category D; Use Group 3; Site Class D.

    C.   Altitude: 6000 feet above sea leavel.

1.06   WARRANTY

    A.   Warrant design, materials and workmanship for at least one year after acceptance by Owner from Contractor.

PART 2 - PRODUCTS

2.01   MANUFACTURERS

    A.   Wattstopper

    B.   Mytech

    C.   Lithonia

    D.   Lutron

    E.   Electronic Theatre Controls

2.02   DIMMING RACK

    A.   Mechanical

        1.   The dimming rack shall be a surface or floor mounted, deadfront switchboard, constructed of 18-guage formed steel panels with a hinged, lockable full-height door containing an integral electrostatic air filter. Filter shall be removable for easy cleaning. The rack door shall have an opening to allow limited access to the control module face panel.

        2.   All rack components shall be properly treated and finished. Exterior surfaces shall be finished in fine textured, scratch-resistant, powder-based epoxy paint. Top, bottom, and side knockouts shall facilitate conduit entry.

        3.   The fully digital dimming rack shall be available with six or twelve dimmer module spaces and one control module space.

        4.   A single low-noise fan shall be located at the top of each rack. The fan shall draw all intake air through the integral electrostatic air filter, over the surfaces of the module housing and out the top of the rack. The fan shall maintain the temperature of all components at proper operating levels with dimmers under full load, provided the ambient temperature of the dimmer room does not exceed 40°C/104°F. In the event of an over-temperature condition, only the

affected dimmer module(s) shall shut down. An orange indicator LED will flash and an error message shall appear on the control module LCD.

5. Dimming racks shall be designed to allow easy insertion and removal of dimming and controller modules, within applicable safety regulations. Supports shall be provided for precise alignment of modules into power and signal connector blocks. With modules removed, racks shall provide clear front access to all load, neutral and control wire terminations.

6. Dimming racks shall support use of any combination of rack option cards designed to provide additional rack features and special purpose modules such as relay modules

7. Optional floor mounting stands shall be available for the 12-module rack.

B. Electrical

1. Dimmer racks shall be provided with voltage, phase and capacity ratings as shown in the drawings.

2. Dimming racks shall be supplied pre-wired by the manufacturer. The contractor shall be required to provide input feed, load, and control wiring.

3. Dimming racks shall be designed to support all wire terminations required for a complete system as shown in the drawings.

4. All dimming rack control wire connections shall be terminated via factory provided connectors.

5. Rack short circuit withstand and interrupting capability shall exceed the available short circuit currents shown on the one-line diagrams.

6. Load terminals shall accept a maximum #8 AWG wire.

2.03   CONTROLLER MODULES

A. Mechanical

1. The Controller Module (CM) assembly shall be designed for use in dimming racks.

2. The CM shall house the required processors to conform all functions required for each rack, as shown in the drawings.

3. The control module assembly shall utilize a backlit, nine-button membrane overlay and a two-line-by-20 character LCD for initial system configuration, testing and diagnostics. Dimming system configuration and program information shall be stored in flash memory, which does not require battery backup.

4. Dimming Processor

a. The dimming processor (d) shall be designed for use in the dimming racks.

b. Dimming processor shall utilize a microprocessor-based, solid-state technology to provide up to 24 configurable signal outputs.

    (1) Dimming processors shall respond to control changes in less than 25 milliseconds.

    (2) Dimmer output shall be regulated for incoming line voltages. The regulation shall adjust for both RMS voltage changes and deformations in the incoming AC waveform. Voltage shall be regulated specifically to 100, 120, 230 or 277 volts.

    (3) The dimming control module shall allow access to system control menus including the status screen, backup menu, architectural menu, test menu and configuration menu.

        a) The status screen shall display the current system operating condition. In normal operation the status screen will display "System OK". In an error condition, the status screen will display "Errors Exist". In an error condition, CM shall allow user to scroll through any errors present, such as internal buss error, 'No Zero" no power at boot-up, "Voltage Low", "Voltage High", or "Over Temp". If a backup look is active, the status screen shall display "Backup Active".

        b) The architectural menu shall allow programming of the architectural control system

        c) The test menu shall provide means of setting and or displaying level for each individual channel.

        d) The configuration menu shall allow the programming of individual dimmer circuits. Selectable elements include: module type, load type, address, and mode.

5. Architectural Station Processor

a. The architectural station processor (E) shall be designed for use in dimmer racks.

b. The processor shall utilize microprocessor based, solid state technology to provide multi-scene lighting control using network communications.

    (1) The communication network shall utilize polarity-independent, low-voltage Class II twisted pair wiring, type Belden 8471 (unshielded) or Belden 8719 (shielded) or equivalent. One # 14 AWG drain wire will be required for system not using grounded metal conduit. LCD stations, PC interface stations and portable stations connectors will also require (2) #16 AWG wires.

    (2) The communication network shall be topology free. Network wiring may be bus, loop, home run, or any combination of these.

(3) Communication wiring shall permit a total wire run of 1500' (500m) without a repeater. Repeater option modules shall be available to increase wiring maximums in increments of 1500'.

(4) The Architectural station processor shall allow limited configuration of the control system via the architectural menu. The architectural menu shall provide access to setup, disk and diagnostic menus.

    a) The setup menu shall allow configuration of station, zone, preset and location parameters.

    b) The "save to disk" command shall send current Unison architectural system configuration from processor to integral 3.5" floppy disk drive.

    c) The "load from disk" command shall load Unison configuration from 3.5" floppy disk drive to Unison processor.

    d) The diagnostic menu shall access diagnostic features including: update software, initialize flash memory, turn all zones off, display station neuron ID, display dimmer DMX level, activate macro, and stop macros.

(5) The architectural station processor shall be rated to drive 512 dimmers, 512 zones, 64 rooms, 640 presets, 32* stations and 4* LCD's. *Increase quantity of wall and LCD stations by adding repeater option module(s). **Increase qty. of dimmers by networking dimming racks.

(6) Architectural processor shall support functions such as station programming, macro sequencing, electronic lockout, room combine and astronomical time clock events. It shall provide all features shown in the drawings for each dimmer rack.

2.04 <u>DIMMER MODULES</u>

A. Mechanical

1. Dimmer modules shall be designed for use with dimming racks.

2. Dimmer modules shall consist of a heavy-duty, die-cast aluminum chassis with an integral faceplate. All parts shall be properly treated, primed and finished in fine-texture, scratch-resistant gray epoxy powder coat.

3. With the exception of the circuit breaker, the module shall contain no moving parts.

4. Each module shall be labeled with the manufacturer's name, catalog number and rating.

5. All electronic components (current/voltage sensors and indicators) shall be contained in a single field-replaceable housing.

B. Electrical

1. Each dimmer shall consist of the following components:

    a. One or two single-pole circuit breakers

        (1) Circuit breakers shall be fully magnetic so the trip current is not affected by ambient temperature.

        (2) Circuit breakers shall be rated for tungsten loads having an inrush rating of no less than 20 times normal current.

        (3) Circuit breakers shall be rated for 100 percent switching duty applications.

    b. A solid-state switching module

        (1) Each dimmer module shall use a solid-state relay (SSR) consisting of two silicon-controlled rectifiers (SCRs) in an inverse parallel configuration, and all required gating circuitry on the high-voltage side of an integral, opto-coupled control voltage isolator. Rectifiers, copper leads and a ceramic substrate shall be reflow soldered to an integral heat sink for maximum heat dissipation. Dimmers employing triac power devices, pulse transformers, or other isolating devices not providing at least 2,500V RMS isolation shall not be acceptable.

        (2) The SSR shall also contain a control LED, a thermistor for temperature sensing, and silver-plated control and load contacts.

        (3) The entire SSR shall be sealed in a plastic housing requiring only a screwdriver to replace.

        (4) Dimmer modules requiring disassembly, heat sink grease, or additional tools for repair shall not be acceptable.

    c. Toroidal filters

        (1) Dimmer modules shall include toroidal filters to reduce the rate of current rise time resulting from switching the SCRs. The filter shall limit objectionable harmonics, reduce lamp filament sing and limit radio frequency interference on line and load conductors.

        (2) Modules shall be available in models offering 200-500 microsecond filter rise times depending upon model. Rise time shall be measured at the worst case slew rate (about 50 percent) from 10 to 90 percent of the output waveform with the dimmer operating at full load.

    d. Power and control connectors

        (1) Modules shall not have any protruding pins subject to physical damage when the module is not installed.

        (2) Power efficiency for standard dimmers shall be at least 97 percent at full load with a no-load loss of 3V RMS.

(3) The dimmer shall accept hot patching of a cold incandescent load up to the full rated capacity of the dimmer.

(4) Standard AIC fault current protection shall be 10,000 at 120V and 14,000 at 277V.

2.05 LIGHT CONTROL STATIONS

A. Mechanical

1. Preset/Fader Stations

a. Preset/Fader stations shall operate using up to twelve programmable buttons and sixteen programmable faders with integral LEDs.

b. Fader stations shall utilize standard 45-millimeter slide potentiometers.

c. All Preset and Fader stations shall be available with white, ivory, gray or black faceplates, fader knobs, and buttons. All faceplates shall be designed for flush or surface mounting.

d. Station faceplates shall be constructed of ABS plastic and shall use no visible means of attachment.

e. The manufacturer shall supply backboxes for flush mounted half gang stations and for all surface mounted stations.

2. Infrared (Wireless) Controls

a. Unison IR stations shall consist of a combination of infrared transmitter and receiver station(s).

b. IR transmitters shall be mounted in a hand-held black plastic controller. Transmitter dimensions shall be 1.875" wide, 6.625" long and 0.60" deep.

c. IR Transmitters shall be available in seven or twelve button configurations. Custom transmitters may have up to 27 programmable buttons.

d. IR Receivers shall be designed to accept the infrared signal from a remote hand held IR transmitter. Receiver stations shall be available in flush- or surface- mounted back boxes with white, ivory, gray or black faceplates.

e. All Wireless Receiver station faceplates shall be constructed of ABS plastic and shall use no visible means of attachment.

f. Receiver stations shall have an integral response LED to indicate when signal has been received.

g. Receivers shall have a 60° reception angle and shall operate reliably within a 45' distance.

3. Connector Stations

   a. Connector stations shall provide an interface to a PC or portable stations.

   b. Connector stations shall be available in flush- or surface- mounted back boxes with white, ivory, gray or black faceplates.

   c. All station faceplates shall be constructed of ABS plastic and shall use no visible means of attachment.

4. Switch Interface

   a. The Switch Interface assembly shall be designed to provide 8-dry-maintained or momentary contact input or output signals for interface to associated systems.

   b. Switch Interface assemblies shall flush or surface mount in standard a 14"W x 11"H x 3"D back box. (Back box by ETC)

B. Electrical

   1. Control station wiring shall be compatible with the system being installed.

   2. Link power shall utilize low-voltage Class II unshielded twisted pair, type Belden 8471 or equivalent, and one #14 ESD drain wire (when not installed in grounded metal conduit).

   3. Network wiring may be bus, loop, home run or any combination of these.

   4. Network insulation displacement connectors shall be provided with all stations.

C. Functional

   1. The Control System shall be designed to allow control of lighting and associated systems via Preset/Fader, IR or Astronomical time clock controls. System shall allow the programming of presets, macros and time clock events.

      a. System presets shall be programmable via Preset/Fader, or Light Manager software.

         (1) Presets shall have a discrete fade time, programmable from zero to 1,000 hours with a resolution of one millisecond.

         (2) Presets shall be selectable via button, fader, IR transmitter, time clock event, macro activation or switch interface stations.

      b. System macros (sequences) shall be programmable via Light Manager system software.

         (1) Macro sequence steps shall include preset selection, wall status change, station property change (template), zone property change, timed delay, jump to macro, and stop macro.

(2) Macro sequences shall be activated by button, time clock event or Light Manager software.

c. System time clock events shall be programmable via Light Manager system software.

(1) Time clock events shall be assigned to system day types. Standard day types include: anyway, weekday, weekend, Sunday, Monday, Tuesday, Wednesday, Thursday, Friday and Saturday. System shall support programming of additional custom or special day types.

(2) Time clock events shall be activated based on sunrise, sunset, time of day or periodic event. System shall automatically compensate for regions using daylight savings time.

2. Station (Preset/Fader or IR) control components shall be designed to operate standard default or custom system functions. Components shall operate default functions unless re-assigned via Light Manager, the Windows-based configuration program.

a. Optional button functions include: preset selection, manual mode activation, record mode activation, station lockout, raise, lower, macro activation, cue light, or room join/separate.

b. Optional fader functions include manual master control, individual zone control, fade rate control or preset master control.

3. Stations (Preset/Fader and IR) shall allow programming of station and component electronic lockout levels via Light Manager

2.06 LIGHT MANAGER SOFTWARE

A. General

1. Light Manager software program shall be an application software package that facilitates off-line control system configuration.

2. Light Manager shall enable a computer to be connected on-line with a lighting control system for real time preset selection, editing and recording.

3. The software program shall be supplied complete with Operators Manual and software disk.

B. Control Features

1. Software setup shall include:

a. Configuration and Room Wizards

(1) The software shall provide easy step-by-step wizards to allow configuration of rooms, channels, walls and control stations.

(2) The program shall allow setup of all system parameters including quantity of rooms, dimmers, zones, presets and control stations. System limitations shall be based on system's Unison processor.

(3) System program shall support a graphic display of individual rooms, showing zones, presets, control stations and moveable wall placement. Systems with non-graphic displays shall not be acceptable.

(4) Software shall support the programming and operation of multi-sectioned rooms with moveable partitions.

(5) Light Manager shall support the custom programming of control station buttons and faders. Button function assignments shall include Preset (last action, pile on, or toggle), Off, Manual, Zone, Record, Raise, Lower, Wall (toggle or direct) Lockout (toggle or direct), No Action, and Macro. Button properties shall include Lockout Level and Legend. Fader assignments shall include Zone, Preset, Master, and Fade time. Fader properties shall include Lockout Level and Legend.

(6) Light Manager shall support the programming of station and component electronic security.

(7) Light Manager shall support the transfer of architectural system configurations via 3.5" disk to and from dimming and external processing racks.

b. Zone, Preset, Station and Wall Properties

(1) Light Manager shall support the configuration of system zone properties. Configurable zone properties shall include zone name, input mode (replace, snapshot, pile-on, or pass-through), dimmer to zone patch, and maximum and minimum zone levels.

(2) Light Manager shall support the configuration of system-preset properties. Configurable preset properties shall include preset name and fade time. Presets shall have a discrete fade time, programmable from zero to 1,000 hours with a resolution of one millisecond. Systems with lesser fade time resolution shall not be acceptable.

(3) Light Manager shall support the configuration of system station properties. Configurable station properties shall include station name, lockout level and template.

(4) Light Manager shall support the configuration of system wall properties. Configurable wall properties shall include wall name.

c. Time clock Events and Macros

(1) Light Manager software shall support the programming of Astronomical Time Clock (ATC) events for up to ten standard day types and up to 24 custom day types. ATC events include selection of presets or macros. ATC events shall be triggered by sunrise, sunset, time of day and/or periodically.

Lighting Control Equipment

(2) Light Manager software shall support the programming of multifunction macro sequences. Macros shall be activated via buttons on any Unison station, or via time clock event.

2.09 EXTERNAL DIMMER CONTROLLER

A. The external dimmer controller shall be designed to receive incoming signals from light control stations, motion detector and other compatible devices and interface them to the processors in the dimmer rack.

2.010 OCCUPANCY SENSORS

A. Offices

1. Occpancy sensors for installation in offices shall be wall switch box mounted type with passive infrared technology. They shall be rated for switching the lighting loads controlled.

2. These units shall provide 100% coverage for the rooms in which they are installed and shall provide effective desktop detection. They shall turn lights on when the room is occupied and off when unoccupied after an adjustable time delay. They shall include a manual "on" feature, a manual override "off" feature, and manual selection of two lighting levels.

B. CONFERENCE ROOMS

1. Occupancy sensors in conference rooms shall be dual technology type, utilizing passive infrared and ultrasonic technologies.

2. These sensors shall be able to communicate with the external dimmer controllers used in the lighting control system.

3. Sensors shall be designed and located to provide 100% coverage of conference rooms.

4. Provide any auxiliary devices, such as power supplies, required for a complete system.

2.09 PHOTOCELLS

A. Photocells shall be designed and installed to measure ambient outdoor light coming into the building through light wells.

B. Photocells shall be designed to communicate the measured light level to the light sensor controller module.

2.10 LIGHT SENSOR CONTROLLER MODULE

A. The light sensor controller module shall be designed to receive a light level signal from the photocell and provide dimming of lights in order to maintain pre-set adjustable lighting level in the affected area.

B.   The module shall operate in "open loop" mode, reacting to light from the light well only. The module shall include sufficient control adjustments to allow calibration to a desired lighting level during installation.

PART 3 - EXECUTION

3.01   INSTALLATION

A.   It shall be the responsibility of the Electrical Contractor to receive and store the necessary materials and equipment for installation of the lighting control equipment. It is the intent of these specifications and plans to include everything required for proper and complete installation and operation of the lighting control system, even though every item may not be specifically mentioned. The contractor shall deliver on a timely basis to other trades any equipment that must be installed during construction.

B.   The electrical contractor shall be responsible for field measurements and coordinating physical size of all equipment with the architectural requirements of the spaces into which they are to be installed.

C.   The electrical contractor shall install all lighting control and dimming equipment in accordance with manufacturer's approved shop drawings, making the necessary adjustments, calibrations and programming for satisfactory operation of the system. The manufacturer's personnel shall be used as required.

D.   Electrical Contractor shall install Owner-supplied inverter systems in accordance with manufacturer's instructions.

E.   All branch load circuits shall be live tested before connecting the loads to the dimmer system load terminals.

END OF SECTION