

Section 16510

Lighting Installation

SECTION 16510**LIGHTING INSTALLATIONS****I- GENERAL LIGHTING FIXTURES****PART 1 – GENERAL****1.01 Related Documents**

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

1.02 Summary

This section specifies the furnishing and installation of all indoor and outdoor lighting fixtures and all related fixtures, control gear and accessories.

1.02 Fixture Design Standards

The specification and the Drawings is a guide to the selection of lighting characteristics and lighting fixtures, giving general features of construction, materials, method of installation and conditions of operation. Unless otherwise specified, fixtures are to be manufacturer's standard series, designed and manufactured for the purpose and application required, generally in accordance with the Schedule of Lighting Fixtures and complying with the following standards:

- A. IEC
- B. Illuminating Engineering society(IES) of North America.

1.03 Design layout

Fixture layout has been determined from photometric data of specified fixtures to achieve desired level and uniformity of illumination. Reflected ceiling plans are to be checked to ensure exact positions of fixtures with respect to ceiling type, structural members, ducts, pipes and other installations. Such fixtures are to be located in coordination with final equipment layout so that illumination is as intended by the design

1.04 Submittals

- A. Equipment Data: Submit data for approval including, but not limited to, the following

Product data on each fixture, lamps and ballasts including manufacturer's name, catalogue number, rating and dimensions.
Photometric data for lighting calculations.

1.04 Submittals (cont'd)

- B. Shop Drawings: Submit drawings for approval including the following
- Exact position of each fixture on reflected ceiling plans, with indication of ceiling type.
 - Installation details including suspension and mounting provisions.
 - Wiring details, circuit and panel board references and lighting control arrangements.
- C. Samples: submit a complete sample of each fixture type, including color and texture samples of each fixture.

PART 2 - PRODUCTS**2.01 Lighting Fixtures**

- A. Lighting Fixture Construction - General
- 1) Generally construction and wiring of fixtures are to comply with the specifications, Regulations and Standards. Fixtures are to be fabricated, assembled and wired entirely at factory. Manufacturer's name, factory inspection sample and official quality label are to be fixed to each fixture supplied.
 - 3) Sheet Steel Housings to be not less than 0.6 mm thick, and thicker when required by the Specification or the Standards.
 - 4) Sheet Steel Reflectors to be not less than 0.5 mm thick.
 - 5) Aluminium Reflectors to be not less than 0.7 mm thick, unless otherwise approved.
 - 6) Fabrication metalwork is to be mitred, welded and ground smooth without tool marks or burrs. Flat metal parts are to be stiffened by forming grooves and edges during fabrication. Metal parts are to have finish free from irregularities.
 - 7) Rust-Proof Ferrous Base ferrous metal parts are to be bonderized (treated with corrosion resistant phosphate solution) and given an approved rust-inhibiting prime coat before application of final finish.
 - 8) Finish For Non-Reflecting Metal Surfaces approved baked enamel paint. Paint colour on fixture frames and trims is to be as specified or as selected by the Engineer.

2.01 Lighting Fixtures (cont'd)

- 9) Finish For Light Reflecting Surfaces white baked enamel paint having reflection factor not less than 85%. Mirror reflectors, where specified, are to be highly polished, anodized aluminium with reflection factors not less than 97%.
 - 10) Mechanical Resistance of Finish after finish has been applied on steel surfaces and cured, it is to withstand a 6 mm radius bend without showing signs of cracking, peeling or loosening from base metal.
 - 11) Heat Resistance finishes, wires and components inside fixtures are to be certified materials to resist the temperatures, or other conditions encountered in the fixtures.
 - 12) Wiring Inside Fixtures to be not less than 1.5 mm², and insulated to have acceptable characteristics to resist maximum temperatures inside fixtures. Wiring is to be terminated on screw type, fixed, insulating terminal blocks.
 - 13) Hinges fixture with visible frames and hinged diffusers are to have concealed hinges and catches, and stainless steel retaining clips.
 - 14) Suspension Aligners to be provided for pendant fixtures for axial, vertical and horizontal alignment. Vertical adjustment is to be minimum 25 mm.
 - 15) Recessed Fixtures to be constructed to fit into suspended ceilings without distorting fixture or ceiling. Plaster rings are to be provided for plaster or concrete ceilings.
 - 16) Outdoor Fixtures to be non-ferrous metal or specially treated material for outdoor use.
 - 17) Removal of parts for maintenance is to be possible without removing fixture housing.
- B. Fluorescent Fixtures
- 1) Lamp Holders: Heavyduty, moulded white plastic with non-corroding spring contacts.
 - 2) Lamp Holders for Industrial Fittings spring loaded turret type, heavy duty, dust protected.
 - 3) Ballasts Generally: Single, Two, Three or Four lamp ballasts may be used in any one fixture. Two - lamp ballasts are to be lead-lag, series type. Equipment is to be enclosed in sheet steel casing with corrosion resistant finish.

2.01 Lighting Fixtures (cont'd)

- 4) Ballast Thermosetting: Compound is not to soften, liquify or support combustion under any operating condition or upon ballast failure, and is to fill ballast enclosure and dampen vibrations. Temperature rise, under normal operating conditions is not to exceed 55 deg. C above maximum ambient temperature of 40 deg. C.
- 5) Ballast Protection: Each ballast is to have one-time external fuse and fuse holder rated in accordance with manufacturer's instructions.
- 6) Ballast type suitable to work with electronic starter, or dimming type, as stated in fixture description and as shown on the Drawings. Power factor corrected to above 0.9, having manufacturer's lowest case temperature. Sound rating is to be class "A".
- 7) Ballast Rating ballast is to be manufactured and certified for the specific lamp it controls and for operation from nominal power supply, with voltage and frequency equal to nominal voltage and frequency of distribution network.
- 8) Capacitors: Snap-Type connectors and fastening. Bolt type M8 for fixing to fixture.
- 9) Starters: To be selected in conjunction with respective ballast and lamp.
- 10) Electronic Ballasts for use on 26 mm and 38 mm diameter krypton or argon inertgas filled triphosphor. Tubes are to be used in conjunction with electronic dimming controls. Dimming is to be possible down to 5% of normal output. Ballasts are to be as manufactured by Helvar or Osram or other equal and approved, with minimum life expectancy in of 10000 hours.

C. Incandescent Lamp Fixtures

Incandescent Lamp Sockets: to comply with IEC 61 and IEC 238, high grade porcelain, Type E27 (ES) screw sockets for lamps not exceeding 200 W and type E40 (GES) screw sockets for lamps 300 W and over.

D. High Intensity Discharge Lamp Fixtures

- 1) Type fixtures are to be complete units including integral ballasts (and ignitors for HPS lamps) and lamps of required number and type, and are to have lighting distribution characteristics equivalent to model and manufacturer indicated in the fixture schedule on plans.

2.01 Lighting Fixtures (cont'd)

- 2) Accessories fixtures are to have mounting accessories as indicated on plans, such as suspension rods or chains, rails or brackets, and protective glass covers with gaskets for protection against dust and humidity or corrosive atmosphere predominant in specified location.
- 3) Ballasts And Ignition Devices are to be power factor compensated to at least 0.9 lagging, and type specially selected for lamp type and size used. Lamp is to be able to start with at least +/-10% variation from nominal line voltage and continue in normal operation with dips attaining 20% for four seconds. Compensation is to ensure there is no great increase in operating current during starting and that gear losses do not exceed 10% of normal wattage. RF suppression circuit is to be provided.

2.02 Lamp

- A. Rated Voltage of incandescent and PL lamps is to be equal to nominal voltage of distribution network. Lamps with different rated voltages are not acceptable.
- B. Incandescent Lamps for General Lighting Service (GLS) to have screw base type ES for lamps 200 W and below and type GES for lamps 300 W and above. Frosted lamps (IF) are to be used unless otherwise specified. Minimum rated life is to be 800 hours and luminous output above the following

950 lumens for 75 W lamps, 1350 lumens for 100 W lamps, 2200 lumens for 150 W lamps, 3100 lumens for 300 W lamps.
- C. Reflector Lamps (R) for indoor and outdoor use, with silver reflector and prismatic lens. Light beam is to be narrow (spot), wide (flood) or extra - wide (wide floor) as indicated in the fixture description.
- D. Tungsten-Halogen Lamps tubular, quartz, resistant to high temperatures. Guaranteed rated life is to be above 2000 hours and luminous output above the following.

9500 lumens for 500 W lamps.
22000 lumens for 1000 W lamps
4400 lumens for 2000 W lamps.

2.02 Lamp (cont'd)

- E. Straight Tubular Fluorescent Lamps to IEC 81 (SSA 138 and SSA 139) and, unless otherwise specified, are to be triphosphor and electronic starter operated type, bi-pin, rated as indicated in the fixture description and with improved fluorescent internal coating. Colour of light is to be "super quality white" equal to Philips No. 84 unless otherwise specified. Lamps are to be low energy type with tube diameter 26 mm. Guaranteed rated life is to be above 8000 hours and luminous output above the following

1300 lumens for 18 W lamps (600 mm long)

3200 lumens for 36 W lamps (1200 mm long)

5200 lumens for 58 W lamps (150 mm long)

- F. High Pressure Mercury Vapour Lamps to IEC 188, and to include quartz discharge tube in an internally coated void outer tube. Coating is to be yttrium vanadate phosphor with colour temperature of 3300 deg. K. Guaranteed rated life is to be above 8000 hours and luminous output above the following

3800 lumens for 80 W lamps.

6500 lumens for 125 W lamps.

14000 lumens for 250 W lamps.

- G. High pressure sodium lamps type SONT (tubular), with guaranteed average rated life (down to 80% output) above 10000 hours, and having initial luminous output above the following

15000 lumens for 150 W lamps

25000 lumens for 250 W lamps

50000 lumens for 400 W lamps

135000 lumens for 1000 W lamps

- H. Metal halide lamps comprising quartz discharge tube enclosed in clear tubular hard - glass outer bulb, operating on same principle as all gas discharge tubes with iodide additives indium, thalium and sodium in the mercury discharge, to increase intensity in three spectral bands; blue, green and yellow - red with high colour rendering, Lamps are to be IEC 188 with E40 base. Guaranteed average life is not to be less than 10000 hours and luminous outputs, after 100 hours burning, are to be above the following

32500 lumens for 400 W lamps

90000 lumens for 1000 W lamps

190000 lumens for 2000 W lamps.

Permissible base temperature is to be not greater than 250 deg. C, and maximum bulb temperature not greater than 550 deg. C. Lamp burning position of 2000 W, 220 V lamp is to be possible up to 75 degrees.

PART 3 - EXECUTION**3.01 Installation**

- A. Generally install fixtures level, aligned and parallel or square to building lines and at uniform height as shown on the Drawings or as approved by the Engineer. Make final height adjustment after installation..
- B. Fixture Support: Provide fixture and/or fixture outlet boxes with hangers, brackets and flanged bolted fittings, as necessary, to support weight of fixture. Submit details of hangers etc. and method of fastening for approval. Rigidly secure fixtures mounted on outlet boxes to fixture studs. Install hooks or extension pieces, when required, for proper installation. Provide one point of support in addition to the outlet box fixture stud for individually mounted fixtures longer than 600 mm.
- C. Stem Hangers: Provide two stem hangers for individually mounted pendant fixtures. Stems are to have suspension aligners and are to be of suitable length for suspending fixtures at required height.
- D. Suspended Ceilings: If ceiling construction is unable to support weight of fixtures without strain or deformation suspend fixtures directly from building structure.
- E. Solid Ceilings: Coordinate dimensions of recesses in ceilings with exact fixture dimensions and structural elements.
- F. Continuous Rows: Arrange fixtures so that individual fixtures can be removed without dismantling remaining fixtures.
- G. Cover Plates: Install cover plates over fixture outlet box or opening in ceiling or structure when left unused.
- H. Flush Recessed Fixtures: Install to completely eliminate light leakage within fixture and between fixture and adjacent finished surface.
- I. Ventilation: Keep ventilation channels free after fixture is installed, if required by the design of the fixture.
- J. Earth Metal frames of fixtures as described in section 16161 of the specification.
- K. Tightness: Ensure that enclosed fixtures are reasonably insect/dust tight when installed, and completely weather proof for installations subject to weather conditions.
- L. Lamps for Permanent: Installation Place new lamps in fixtures immediately prior to hand-over and when instructed by the Engineer. Lamps used for temporary service are not to be used for final lamping of fixtures.

3.02 Inspection and Tests on Site

- A. Visual Inspection: Check neatness of installation, uniformity of equipment and nameplates, etc.
- B. Illumination: Measurements to be taken at selected locations, to determine level and uniformity.
- C. Operation: Check lighting installations for operation including control and regulation equipment.
- D. Electrical Data: Measure power factor, current and voltage at start for installations with discharge lamps.

SECTION 16510**LIGHTING INSTALLATIONS****II - OUTDOOR AREA LIGHTING****PART 1 - GENERAL****1.01 Work Included**

Outdoor area lighting including, luminaries, columns, related power distribution and control, protective earthing and related builder's work including columns foundations, cable pits, cable trenches and ductwork.

1.02 Standards

Luminaries generally are to comply with IEC 598 and the applicable C.I.S.P.R. recommendations. Manufacturer is to verify compliance with these standards and the applicable local regulations and design standards.

1.03 Technical Requirements

Minor deviation from the Drawings may be considered for improvement in construction details, but no changes are to be made without the written approval of the Engineer.

1.04 Ambient Conditions

Unless otherwise specified, equipment is to be designed and derated for continuous and trouble-free service at 50 deg. C ambient temperature and 100% relative humidity, with temperature reaching 70 deg. C in direct sunlight and with high content of ultra-violet rays. Equipment is to withstand full load operation whilst exposed to sun.

1.05 Submittals

- A. Equipment Data: Submit complete data for approval including, but not limited to, the following
 - 1) Detailed literature, in English, for each type of luminaries or fixture, lamp and control gear including manufacturer's name, catalogue number, rating, material specification, overall dimensions, operating characteristics and principles, and any modification to a standard product if applicable.

1.05 Submittals (cont'd)

- 2) Detailed Specification and Drawings for each column type including shape, base/mounting flanges, bolts, nuts etc. cross-sections, design criteria and calculations, brackets, finishes, provisions for cabling, cut-out or circuit-breaker etc.
 - 3) Photometric data for lighting calculations including polar curves, coefficients of utilization, efficiency and depreciation factors.
- B. Shop and Construction Drawings: submit drawings for approval including, but not limited to, the following:
- Layout of equipment in exact positions with mounting and construction details, concrete foundation dimensions and reinforcement, routing and sections of duct banks and trenches, backfill and packing materials, earthing rods etc.
- Cabling and wiring diagrams, single line drawings, loads, phase distribution, protection and control, earthing and the like
- Calculations of illumination levels and glare, based on CIE methods.
- C. Samples submit fully equipped sample of luminaries or other materials or components if required by the Engineer.

PART 2 - EXECUTION**1.05 Submittals**

- A. Equipment
- Install equipment to be readily accessible for operation, maintenance and repair. Minor deviations from the Drawings may be made to accomplish this but no changes are to be made without the approval of the Engineer.
- B. Columns Bases: Install columns on concrete bases or as detailed on the drawings. Before commencement of construction, ensure that bases are suitable for column installation. Holding down and plumb adjusting nuts, washers, lockouts or nyloc nuts are to be stainless steel or cadmium plated.
- C. Columns: Erect columns so that luminaries are located on a line parallel to theoretical profile of road. Alignment of columns, both horizontally and vertically, is to be secured to the satisfaction of the Engineer. Brackets are to be set at 90 degrees to longitudinal axis of road.

1.05 Submittals (cont'd)

- D. Mounting Adjustments: After demonstration to the Engineer that specified lighting requirements have been met, carry out final setting and locking in position of the floodlights.
- E. Cabling, conduits, and Ductwork: Carry out in accordance with relevant sections of the Specification. Cable ducts are to be directly buried except at crossings with other service work or roads.
- F. Earthing: Carry out in accordance with Section 16161 of the Specification.

2.02 Inspection and Tests on Site

- A. Visual Inspection is to include inspection of condition of each piece of equipment, quality of workmanship, alignment, perpendicularly, labelling and like, all in conformance with the Specification.
- B. Insulation Resistance and Continuity Tests are to be carried out on each circuit and piece of equipment before energization, with circuit breakers in the open position and lamps not installed.
- C. Operational Tests are to be carried out on all circuit breakers and control gear, with lamps installed, including recording voltage at terminals of ballasts on final columns of each circuit and at distribution panel or the like.
- D. Performance tests are to be carried out after 100 hours normal operation and are to include measurement of lighting levels and uniformities on required illuminated surfaces.
- E. Other Tests are to be carried out as required by the Engineer to verify conformity with the Specification.
- F. Earthing Resistance Tests are to include measurement of earth electrode resistance at final points of circuits and continuity of protective conductors.
- G. Results of tests are to be recorded on site and signed by witness parties.
- H. Test Equipment and Labour: Provide equipment and labour including instruments and complete provisions for carrying out tests.

END OF SECTION

Section 16570

Architectural Lighting Control Systems

SECTION 16570**ARCHITECTURAL LIGHTING CONTROL SYSTEMS**
(CENTRAL SYSTEM)**PART 1 GENERAL****1.01 SUMMARY**

- A. The following specifications detail the minimum performance and related criteria for a lighting control system proposed for this project. Any deviations from this specification must be documented in writing and submitted to the Architect prior to the issuance of any contracts and must also include all associated cost savings or additions, including but not limited to equipment, equipment installation, power wiring labor and materials, programming, documentation and project management.

1.02 SECTION INCLUDES

- A. Provide, install and test an architectural lighting control system as specified herein for the areas indicated on the drawings, specifications and load schedule(s).

1.03 RELATED SECTIONS

- A. Section 16150 (Wiring Devices/Lighting Controls)
- B. Section 16580 (Ballasts)

1.04 REFERENCES

- A. Underwriters Laboratories Inc.
- B. ISO 9001 Quality Standard
- C. Canadian Standards Association
- D. NOM Certification Mark
- E. Harmonized European Standard (CE)
- F. American National Standards Institute
- G. Institute of Electrical and Electronic Engineers

1.05 SYSTEM DESCRIPTION

- A. System shall consist of factory pre-assembled dimming and switching panels, centralized preset lighting control(s), low voltage wall stations and/or control interfaces, and solid-state high frequency fluorescent dimming ballasts (where applicable). Additional items may also be required and are described herein and/or shown on the drawings.

1.06 SUBMITTALS

- A. Shall include a load schedule, which indicates the actual connected load and load type per circuit, circuits and their respective control zones, circuits that are on emergency (if applicable), and the capacity, phase, and corresponding circuit numbers (per the electrical drawings).
- B. Shall include a complete schematic of the system.
- C. Shall include catalog cut sheets with performance specifications including historical testing data demonstrating complete compliance to all of the specifications herein.
- D. Shall include all exceptions taken to the Specification.
- E. Manufacturer shall provide any additional information or factory demonstrations as required by Specifier to demonstrate conformance with Part 2 of this specification. All demonstrations are to be at a location, time and in a manner chosen by the Specifier.

1.07 QUALITY ASSURANCE

- A. Manufacturer shall have a minimum of 10 years continuous experience in the manufacturing of lighting controls.
- B. Lighting control system shall be UL, CSA, NOM or CE listed (where appropriate) specifically for the required loads (i.e. incandescent, magnetic and electronic low voltage, fluorescent, etc.). Manufacturer shall provide evidence of compliance on request.
- C. Manufacturer shall have their quality system registered to the ISO 9001 Quality Standard, including in-house engineering for all product design activities. Due to the exclusion of the Design Control element, ISO 9002 Registration is not acceptable.
- D. Manufacturer shall have component quality program in place to reduce defective levels to less than 100 PPM and provide documentation on request.
- E. Lighting control system shall meet IEC801-2, tested to withstand a 15kV electrostatic discharge without damage or loss of memory.
- F. Manufacturer shall provide software to simplify the design and installation of all lighting controls.
- G. Manufacturer shall be Year 2000 compliant for both their corporate operating systems and lighting control products.
- H. Lighting control system shall be bid separately from all other lighting equipment. Packages of lighting equipment and dimming systems shall not be acceptable.

1.08 PROJECT/SITE CONDITIONS

- A. Lighting controls shall operate in an ambient temperature range of 0°C (32°F) to 40°C (104°F) and 90% non-condensing relative humidity without the requirement of a regularly scheduled maintenance program for air filtration components.

1.09 WARRANTY

- A. Manufacturer shall provide a full two-year warranty, limited eight-year warranty on all equipment supplied inclusive of commissioning by a factory-employed engineer. Warranty shall cover 100% of the cost to repair or replace any parts required over the first two years, which are directly attributable to the manufacturer.

1.10 COMMISSIONING

- A. The contractor shall provide the manufacturer with 10 working days notice of the scheduled commissioning date.
- B. Upon completion of the installation, the system shall be completely commissioned by a factory-employed engineer. The check-out will be performed after all loads have been tested live for continuity and freedom from defects and that all control wiring has been connected and checked for proper continuity. The factory-employed engineer shall demonstrate and educate the owner's representative(s) on the system capabilities, operation and maintenance.
- C. Manufacturer shall offer extended warranty based upon successful factory commissioning.

PART 2 PRODUCTS**2.01 ACCEPTABLE MANUFACTURERS**

- A. LUTRON
- B. The listing of a manufacturer as "acceptable" does not imply automatic approval. It is the sole responsibility of the electrical contractor to ensure that any price quotations received and submittals made are for products/systems that meet or exceed the specifications included herein.

2.02 POWER PANELS

- A. Panels shall be UL listed or CSA, NOM or CE approved (where appropriate). Panels shall be wall or floor mounted NEMA grade, gauge as required by UL508. Contractor shall reinforce wall as required for wall-mounted panels.
- B. Panels shall be completely pre-assembled and factory tested by the manufacturer. The contractor shall be required to provide input feed wiring, load wiring, and control wiring. No other wiring or assembly by the contractor shall be permitted. All input feed, load, and control terminals shall be front accessible without the need to remove dimmer assemblies or other components.
- C. Unless the panel is a dedicated feed-through switching panel or otherwise indicated, panels shall contain branch circuit protection for each dimming assembly. Branch circuit breakers shall have the following performance characteristics:

1. Be UL listed under UL 489 or meet IEC 60898 as a molded case circuit breaker for use on lighting circuits.
 2. Contain a visual trip indicator and shall be rated at 6000 AIC (230V), unless otherwise noted.
 3. Be thermal-magnetic in construction for both overload and dead short protection. The use of fully magnetic breakers shall not be acceptable, even when used in conjunction with individual dimmer thermal cutouts.
 4. Be replaceable without moving dimmer assemblies or other components of the panel.
- D. Activation of a circuit protection device shall affect only the single dimmer that it is wired to protect.
- E. Panels shall be equipped with an electronic BYPASS feature which electronically switches lighting loads to full light output from any level by toggling the individual branch circuit breakers (for individual circuits) or main breaker (for all circuits) when there is no intensity data available from the control system.
- F. Panels which allow the dimmers to be loaded to greater than 80% of the wiring ampacity as specified by NEC shall not be acceptable.
- G. Panels requiring the neutral feeder to be sized larger than any individual phase feeder shall not be acceptable.
- H. Panels shall be shipped with each dimmer in a mechanical BYPASS position via a jumper bar inserted between the input and load terminals to allow dimming panel to be used as a temporary lighting panel with no threat to the dimmer. These jumpers shall carry the complete load current and shall be reusable at any time.
- I. Panels shall be capable of maintaining dimmers at current light levels in the event of a control failure. Systems that fail to off during a control failure are not acceptable.
- J. Panels shall be passively cooled via free-convection, unaided by fans. Systems that are fan dependent or fan assisted, or which recommend regularly scheduled maintenance for air filtration components are not acceptable.
- K. Panels shall provide a minimum of 52 square inches of cooling surface area for each semiconductor.
- L. Panel shall provide capability to electronically assign each circuit to any zone in the dimming system. Panels using mechanical switches, rewiring, or EPROMS shall not be acceptable. All circuits shall be capable of being operated (dimmed or switched where appropriate) from the panel.
1. Where indicated on the drawings, dimming and switching panel(s) shall be capable of operating under two optically isolated control systems. Panel shall be capable of auto-detecting between manufacturer's control protocol and DMX512 protocol for each control system. Panel response to control changes shall take no more than 25 milliseconds. Panel shall be capable of assigning each dimmer to either control system on a circuit by circuit basis. Panel shall also be capable of conditionally changing assignment from one system to the other.
- M. Multiple panels shall be capable of operating in one system.

- N. For panels fed with a normal/emergency feeder, panel shall include electronics to bring all circuits to an emergency full-on condition upon the loss of normal power and the subsequent presence of emergency power. Designated circuits shall be controlled simultaneously with other lighting circuits within the designated control zone during the presence of normal utility or generator power.
1. Panels listed as emergency shall have all circuits immediately go to a full-on condition. All dimmers shall operate at 100% of input voltage, bypassing any high-end trim. All local control stations are inoperable during this period. Once normal power is restored, all lighting zones shall revert back to their status prior to the emergency condition without requiring any action on the part of the user. Restoration to some other "default" level is not acceptable.
 2. This type of emergency full-on may be used with either a normal/emergency generator, a UPS or IPS system with true sinewave output and maximum of 10% THD. The generator, UPS, or IPS system must be capable of operating under no load conditions or a constant hot secondary utility feed where the emergency transfer occurs on the line side (upstream) of the dimming panel and requires that only a single normal/emergency feeder be brought to the Emergency Dimmer Panel.
 3. System shall be capable of meeting local jurisdictions requiring special conditions such as minimum light levels during normal operation or full function, even during emergency power.

2.03 MODULAR DIMMING ASSEMBLIES

- A. Dimmer shall be capable of withstanding inrush current of 50 times operating current. In addition, under fully-loaded operating conditions, all semiconductor devices shall operate at a minimum 20°C safety margin below the component temperature rating.
- B. A positive air gap switch shall be employed with each dimmer in the panel to ensure that the load circuits are open when the "off" function is selected from the control system.
1. Load shall be switched in a manner that ensures no arcing will occur at the mechanical contacts when power is applied to the load circuits.
- C. Each dimmer shall compensate for incoming line voltage variations such as changes in RMS voltage, frequency shifts, harmonics and line noise. Dimmer shall be capable of maintaining constant light level with no visible flicker under the following conditions:
1. $\pm 2\%$ change in RMS voltage/cycle
 2. ± 2 Hz change in frequency/second. Dimmers that do not regulate the dimmer output in real time shall be unacceptable.
- D. Each dimmer shall incorporate an electronic "soft-start" default at initial turn-on that smoothly ramps the lights up to the appropriate levels within 0.5 seconds.

- E. Once installed as part of a complete system, the semiconductor used to control the power furnished to the loads shall be both designed and tested to withstand surges, without impairment to performance, of 6000V, 3000A (equivalent to a near lightning strike) as specified by ANSI/IEEE std. C62.41. Upon request, the manufacturer shall provide a means to demonstrate conformance to this specification using the appropriate surge-generation equipment.
- F. One type of dimmer shall be used for all sources, line voltages, and frequencies. Systems requiring different types of modules shall not be acceptable. Dimmer shall be capable of electronic assignment to any source and any zone. Upon replacement of a dimmer, only that dimmer shall require replacement, and no re-programming shall be required.
- G. Filtering shall be provided for each dimmer so that current rise time shall be at least 350 μ sec as measured from 10-90% of the load current waveform and at least 525 μ sec as measured from 0-100% of the load current waveform at 50% rated dimmer capacity at a 90 \emptyset conduction angle. Current rise time shall be at least 400 μ sec as measured from 10-90% of the load current waveform and at least 600 μ sec as measured from 0-100% of the load current waveform at 100% rated dimmer capacity at a 90 \emptyset conduction angle. At no point should current rise faster than 30mA/msec.
- H. Dimmer output voltage shall be a minimum 95% of input voltage at maximum intensity setting.
- I. Dimmer shall include diagnostic LEDs to verify proper operation and assist in any system troubleshooting.

2.04 MODULAR SWITCHING ASSEMBLIES

- A. Assembly shall be capable of withstanding inrush current 50 times operating current. In addition, under fully-loaded operating conditions, all devices shall operate at a minimum 20 $^{\circ}$ C (68 $^{\circ}$ F) safety margin below the component temperature rating.
- B. A positive air gap switch shall be employed with each circuit in the power panel to ensure that the load circuits are open when the "off" function is selected from the control system.
- C. Relays shall be mechanically latching. Relays shall be of sealed construction type in order to prevent contact degradation.
- D. Once installed as a complete system, the relays used to control the power furnished to the loads shall be both designed and tested to withstand surges, without impairment to performance, of 6000V, 3000A (equivalent to near lightning strike) as specified by

ANSI/IEEE std. C62.41. Upon request, the manufacturer shall provide the means to demonstrate conformance to this specification using the appropriate surge-generation equipment.
- E. Relays shall be rated for 16 Amps continuous duty, for the following load types: resistive, tungsten/incandescent, inductive (magnetic low voltage, neon/cold cathode, magnetic fluorescent lamp ballasts), and capacitive (electronic low voltage, electronic fluorescent lamp ballasts, high intensity discharge). Relays rated only for resistive loads shall not be acceptable.

- F. Load shall be switched in a manner that ensures no arcing will occur at the mechanical contacts when power is applied to the load circuits.
- G. Average rated life of relay shall be at least 1,000,000 cycles.
- H. Assembly shall include diagnostic LEDs to verify proper operation and assist in any system troubleshooting.

2.05 SOURCES

- A. Dimming assemblies shall operate the following sources/load types with a smooth continuous Square Law dimming curve. Dimmers that have visible "steps" of light intensity throughout the control range shall not be acceptable. Dimmers shall also be capable of operating the following sources on a non-dim basis. Dimmers shall be electronically assigned to the appropriate load type/dimming curve and can be reassigned at any time. Universal-type dimmers that do not adjust the dimming curve shall not be acceptable.
 - 1. Incandescent, Tungsten and Magnetic Low Voltage Transformer
 - a. Dimmer shall contain circuitry specifically designed to control and provide a symmetrical AC waveform to the input of magnetic low voltage transformers.
 - b. Dimmer shall not cause a magnetic low voltage transformer to operate above the transformer's rated operating current and temperature.
 - c. Dimmer shall contain circuitry to control dioded lamps.
 - 2. Electronic Low Voltage Transformer
 - a. Dimming shall not adversely affect sound rating of the electronic transformers. In addition, no flicker or interaction shall occur at any point in the dimming range.
 - b. Dimmers shall provide the ability to dim lamps down to 0% (blackout). Minimum light levels shall be user adjustable in order to compensate for different loading of each dimmer.
 - 3. Fluorescent Electronic Dimming Ballast
 - a. Dimming ballasts and controls shall be provided by same manufacturer.
 - b. Refer to general section 16580 for dimming ballast specifications and performance.
 - c. See fixture schedule and/or load schedule for specific ballast model numbers.
 - 4. Neon and Cold Cathode
 - a. Dimmer shall provide the ability to dim lamps down to 10% of full light output when used with normal (low) power factor transformers.
 - b. The lamp performance over the range specified shall be continuous and free of flicker or striations.

- c. Neon/cold cathode lamps shall be manufactured with strict attention paid to proper lamp pressurization and exclusion of any impurities to ensure best dimming performance.
- d. Transformers shall be sized per transformer sizing tables developed by the dimming manufacturer.
- e. The electrical contractor is responsible for proper neon or cold cathode lamp and wiring installation.

2.06 CONTROLS

- A. Definitions: A "scene" or "preset" is a specific look or mood created by different lighting zones set at different intensities. A "zone" is one or more lighting circuits which are controlled together as a group.
- B. Control shall provide power failure memory. Should power be interrupted and subsequently returned, the lights will come back on to the same levels set prior to the power interruption without requiring any actions on the part of the user. Restoration to some other default level is not acceptable, unless specifically noted elsewhere.
- C. Wiring from dimming and switching panel(s) to centralized preset lighting control and wall stations, preset local lighting controls, and control interfaces shall be low voltage type Class 2 wiring (PELV).
- D. Faceplate shall attach using no visible means of attachment.
- E. Controls shall be engraved with appropriate zone and/or scene descriptions, furnished to the manufacturer prior to fabrication. Size and style of engraving type shall be determined by the Architect. Any silk-screened borders, logos, graduations, etc., shall use a graphic process that chemically bonds the graphics to the metal faceplate, resisting removal by scratching, cleaning, etc..
- F. Manufacturer shall ensure the following items regarding product color:
 - 1. Product color matches NEMA standard WD1, Section 2, and the maximum color deviation from this standard shall not exceed $\Delta E=1$, CIE L^*a^*b color space units. For non-NEMA colors, color match coordination shall be provided on request.
 - 2. Color variation of any control in the same product family shall not exceed $\Delta E=1$, CIE L^*a^*b color units.
 - 3. Visible parts shall exhibit ultraviolet color stability when tested with multiple actinic light sources as defined in ASTM D4674-89. Manufacturer to submit proof of testing upon request.
- G. Controls shall provide an immediate, local LED response upon button activation to indicate that a system command action has been requested. LED will remain lit contingent upon receiving system confirmation of the successful completion of the command.

2.07 CENTRALIZED PRESET LIGHTING CONTROL

- A. Where indicated on the drawings, control shall provide preset lighting scenes for up to 512 zones—expandable to 8,192 zones when using multiple control processors—in any combination of groups or areas. System set-up shall be via personal computer running Windows 3.1, Windows 95, or Windows 98.
- B. System set-up shall provide capability to:
1. assign dimmers to specific zones
 2. determine the number of areas
 3. define the number of zones and scenes per area
 4. define wallstation functionality on a button by button basis
 5. set the astronomic timeclock based on longitude, latitude, and daylight savings schedule
 6. label all areas, zones, scenes, and wall stations. Each area, scene, and zone name shall be designated by an alphanumeric display of up to 24 characters.
- C. Operating software shall additionally provide the capability to:
1. view the status of all areas
 2. create scenes
- D. System shall support printing the following summaries:
1. area overview (inclusive of scenes, zones, and wall stations)
 2. scene summary by area (inclusive of light levels of all zones for each scene)
 3. wallstation summary by area (inclusive of specific function for each wallstation)
- E. Control shall allow design of system off site and downloading upon installation or modifications after installation.
- F. Control shall also be capable of interfacing to other equipment via integral RS232 interface and/or modem (by others).
- G. Control shall be capable of operating with up to 96 wall stations, preset local lighting controls, and control interfaces—expandable to 1,536 when using multiple processors. Where indicated on drawings, use wall stations, preset local lighting controls, and control interfaces as required.
- H. An integral timeclock shall execute any of the following events: select preset scenes, lockout control stations, or unlock control stations. Commands can be in either real or astronomic (relating to sunrise/sunset) time. Timeclock shall automatically correct for daylight savings time and leap year where appropriate. There shall be a total of 10 timeclock schedules available per room or area (one per day of each week, plus three special schedules). Any special schedules which have been programmed shall be capable of being stored in a "calendar" format on a screen up to a year in advance for easy reference. The timeclock shall be capable of executing up to 600 events per day. The timeclock can be enabled or disabled for any area via either the set-up computer or local wallstation/control interface.

- I. Programmable sequencing shall allow up to four automatic lighting sequences to be programmed for each area. A sequence shall be defined as a series of steps, while a step shall be defined as the recall of a scene. The sequence shall be capable of executing up to 600 steps. Each step interval is adjustable for 1 second to 60 minutes. Program shall be capable of sequencing in a continuous loop, of one complete sequence and holding at the last scene, or of one complete sequence and return to the pre-sequence scene.
- J. An integral room template shall allow on-screen control definition of partitionable spaces. Template shall allow user to define if room is independent or combined with adjacent room(s) and lockout/unlock control stations.
- K. In the event that any of the communication lines to any of the dimmer and/or switching panels is interrupted for any reason, the lights controlled by those panels shall remain at their current levels until the interruption is cleared. In the event of a control station failure or interruption of a communication line to any of the controls, the lights controlled by those stations shall remain at their current levels.
- L. The complete control system shall have a full internal battery backup that can store all system memory for 1 year without power. It shall not be necessary to re-boot the system manually nor use any tape or floppy disc/hard drive to restore the system once power has been restored—system shall automatically return to its previous state.

2.08 HANDHELD PROGRAMMER (S)

- A. Handheld programmer shall provide the ability to change intensity and fade time for each zone in the lighting control system without the use of a PC. Unit shall provide current light level indication and a thumbwheel for light level adjustment. Unit shall have a zone finder button for easy identification of the zone being programmed. Unit shall be equipped with a 25' (76.2m) cord.

2.09 WALL STATIONS

Wallstation functions are configured through software. Functions listed are typical.

- A. Two Button Wallstation(s)
Control shall be capable of turning lighting on/off, reflecting door status of one or two partitions, enabling/disabling wall stations, starting/stopping one sequence, enabling/disabling timeclock, enabling security override, and fine-tuning of zones. Buttons shall provide green LED status feedback.
- B. Four Button Wallstation(s)
Control shall be capable of recalling preset light levels for four scenes, reflecting door status of up to four partitions, and selecting daylight control banks. Buttons shall provide green LED status feedback.
- C. Five Button Wallstation(s)
Control shall be capable of recalling preset light levels for four scenes plus 'off', and starting/stopping one to four sequences. Buttons shall provide green LED status feedback.

- D. Five Button Wallstation(s) with Raise/Lower
Control shall be capable of recalling preset light levels for four scenes plus 'off' and of fine-tuning light levels with master raise/lower, and starting/stopping one to four sequences. Buttons shall provide green LED status feedback LED status feedback.
- E. Architrave Two Button Wallstation(s)
Control shall be capable of recalling preset light levels for two scenes, changing door status of one or two partitions, enabling/disabling wall stations, starting/stopping one sequence, enabling/disabling wall stations, enabling security override, and fine-tuning of light levels. Buttons shall provide green LED status feedback. Control shall be no wider than 1.75". Manufacturer shall supply wallbox.
- F. Architrave Seven Button Wallstation(s)
Control shall be capable of recalling preset light levels for four scenes, each providing green LED status feedback, plus 'off' and of fine-tuning light levels with master raise and lower buttons. Control shall be no wider than 1.75". Manufacturer shall supply wallbox.
- G. Architrave Large Button Wallstation(s)
Control shall be capable of recalling preset light levels for four scenes, each providing green LED status feedback, plus 'off' and of fine-tuning light levels with master raise/lower. Control shall be no wider than 1.75". Manufacturer shall supply wallbox.
- H. European-Style, Two Button Wallstation(s)
Control shall be capable of recalling preset light levels for two scenes, changing door status of one or two partitions, enabling/disabling wall stations, starting/stopping one sequence, enabling/disabling wall stations, enabling security override, and fine-tuning of light levels. Buttons shall provide green LED status feedback. Control shall be no larger than 3.38" (86mm) square. Manufacturer shall supply wallbox.
- I. European-Style, Six Button Wallstation(s)
Control shall be capable of recalling preset light levels for four scenes, each providing green LED status feedback, plus 'off' and of fine-tuning light levels with master raise and lower buttons. Control shall be no larger than 3.38" (86mm) square. Manufacturer shall provide wallbox.
- J. European-Style, Ten Button Wallstation(s)
Control shall be capable of recalling preset light levels for eight scenes, each providing green LED status feedback, plus 'off' and of fine-tuning light levels with master raise and lower buttons. Control shall be no larger than 3.38" (86mm) square. Manufacturer shall provide backbox.
- K. Five Button Scene Selection Control(s) with Slim Buttons
Control shall be capable of recalling preset light levels for four scenes plus 'off', each providing amber LED status feedback, and of fine-tuning light levels with master raise and lower buttons -or- of recalling preset light levels for five scenes plus 'off' with full 'on' button.

- L. Ten Button Scene Selection Control(s) with Slim Buttons
Control shall be capable of recalling preset light levels for nine scenes plus 'off', each providing amber LED status feedback, and of fine-tuning light levels with master raise and lower buttons -or- of recalling preset light levels for ten scenes plus 'off' with full 'on' button.
- M. 15 Button Scene Selection Control(s) with Slim Buttons
Control shall be capable of recalling preset light levels for 14 scenes plus 'off', each providing amber LED status feedback, and of fine-tuning light levels with master raise and lower buttons -or- of recalling preset light levels for 15 scenes plus 'off' with full 'on' button.
- N. Six Button Scene Selection Control(s) with Large Buttons
Control shall be capable of recalling preset light levels for three scenes plus 'off' and of fine-tuning light levels with master raise and lower buttons -or- of recalling preset light levels for five scenes plus 'off', each providing amber LED status feedback.
- O. Nine Button Scene Selection Control(s) with Large Buttons
Control shall be capable of recalling preset light levels for six scenes plus 'off' and of fine-tuning light levels with master raise and lower buttons -or- of recalling preset light levels for eight scenes plus 'off', each providing amber LED status feedback.

2.10 PRESET LOCAL LIGHTING CONTROL(S)—INTEGRAL DIMMERS

- A. Dimmer shall be capable of operating at rated capacity without adversely affecting design lifetime.
- B. Dimmer shall mount individually in standard 2, 3, or 4 gang U.S. wallboxes.
- C. Dimmer shall incorporate an airgap switch which shall be operable without removing the faceplate. The airgap switch shall be capable of meeting applicable requirements of UL 20 and UL 1472 for airgap switches in incandescent dimmers.
- D. Dimmer shall meet IEC 801-2, tested to withstand 15kV electrostatic discharge without damage or loss of memory.
- E. Dimmer shall meet ANSI/IEEE Std. C62.41-1980, tested to withstand voltage surges of up to 6000V and current surges of up to 200A without damage or loss of memory.
- F. Dimmer shall meet the UL 20 limited short circuit test requirement for snap switches.
- G. Dimmer shall compensate for incoming line voltage variations such as changes in RMS voltage, frequency shifts, harmonics and line noise. Dimmer shall be capable of maintaining constant light level with no visible flicker under the following conditions:
 - 1. $\pm 2\%$ change in RMS voltage/cycle
 - 2. ± 2 Hz change in frequency/secondDimmers that do not regulate the dimmer output in real time shall be unacceptable.

- H. Dimmer shall utilize an LC filtering network to minimize interference with properly installed radio, audio, and video equipment.
- I. Separate power booster/interface shall increase dimmer capacity. Capacity shall range from 1000W/VA to 30,000W/VA. Quantities and sizes of each type of power booster/interface shall be provided to control each type of load shown on the load schedule and/or the drawings.
- J. Dimmer shall operate the following sources/load types with a smooth continuous Square Law dimming curve. Dimmers shall also be capable of operating these sources on a full conduction non-dim basis.
 - 1. Incandescent, Tungsten, Magnetic Low Voltage Transformer
 - 2. Lutron Tu-Wire Electronic Fluorescent Dimming Ballast
 - 3. Neon and Cold Cathode
- K. Dimmer shall operate the following sources/load types with a smooth continuous Square Law dimming curve through separate power interfaces.
 - 1. Electronic Low Voltage Transformer
 - 2. Fluorescent Electronic Dimming Ballast
- L. Minimum light levels shall be user adjustable in order to compensate for different sources and loading.
- M. Control shall provide 4 preset lighting scenes and 'off' for up to 6 control zones. Control shall be capable of storing an additional 12 preset lighting scenes which can be accessed via wall stations and/or control interfaces. Preset shall be set via easy-to use raise/lower switches, one raise and lower switch per zone. The intensity for each zone shall be indicated via an illuminated barograph, one barograph per zone. More than one zone may be proportionately raised or lowered at the same time. Programming of preset scenes shall be accomplished without the use of an 'enter' or 'store' button. Additionally, one or more zones may be temporarily overridden without altering the scene values which are stored in memory.
- N. Lighting levels shall fade smoothly between scenes at time intervals of 0 to 59 seconds or 1 to 60 minutes. The fade time shall be separately selectable for each scene and shall be indicated by a digital display for the current scene. Pressing a scene select button will illuminate the corresponding scene LED and simultaneously begin changing the barograph levels to reflect the currently selected scene. In the event that a preset scene with a fade time greater than 5 seconds is initially selected from an 'off' condition, the programmed fade time shall be temporarily overridden, unless otherwise noted, and the lights shall fade up to that scene over a five-second time span.
- O. Control shall be capable of being set locally, through a handheld programmer, and/or through a PC.
- P. Controls shall incorporate built-in wide angle infrared receiver, providing control via a separate wireless remote control transmitter from up to 15 meters away.

- Q. Control shall provide tamperproof protection of scenes using a minimum of four levels of electronic 'lockout' which prevent alterations of scene values stored in memory. Highest level of 'lockout' shall be capable of disabling manual control at the preset control.

2.11 PRESET CONTROL UNIT(S)

- A. Control shall mount individually in standard 2, 3, or 4 gang U.S. wallboxes.
- B. Control shall provide 4 preset lighting scenes and 'off' for up to 24 control zones. Control shall be capable of storing an additional 12 preset lighting scenes which can be accessed via wall stations and/or control interfaces. Preset shall be set via easy-to-use raise/lower switches, one raise and lower switch per zone. The intensity for each zone shall be indicated via an illuminated barograph, one barograph per zone. More than one zone may be proportionately raised or lowered at the same time. Programming of preset scenes shall be accomplished without the use of an 'enter' or 'store' button. Additionally, one or more zones may be temporarily overridden without altering the scene values which are stored in memory.
- C. Lighting levels shall fade smoothly between scenes at time intervals of 0 to 59 seconds or 1 to 60 minutes. The fade time shall be separately selectable for each scene and shall be indicated by a digital display for the current scene. Pressing a scene select button will illuminate the corresponding scene LED and simultaneously begin changing the barograph levels to reflect the currently selected scene. In the event that a preset scene with a fade time greater than 5 seconds is initially selected from an 'off' condition, the programmed fade time shall be temporarily overridden, unless otherwise noted, and the lights shall fade up to that scene over a five-second time span.
- D. Control shall be capable of being set locally, through a handheld programmer, and/or through a PC.
- E. Controls shall incorporate built-in wide angle infrared receiver, providing control via a separate wireless remote control transmitter from up to 15 meters away.
- F. Control shall provide tamperproof protection of scenes using a minimum of four levels of electronic 'lockout' which prevent alterations of scene values stored in memory. Highest level of 'lockout' shall be capable of disabling manual control at the preset control unit.

2.12 SLIDER CONTROL(S)

- A. Control shall mount individually in standard 1, 2, 3, 4, 5, 6, or 7 gang U.S. wallboxes.
- B. Slider control shall provide 'on' and 'off' for up to 12 control zones. Where indicated, control shall be capable of storing preset lighting scenes. The intensity for each zone shall be indicated by the position of the slider. More than one zone may be proportionately raised or lowered at the same time. Programming of preset scenes shall be accomplished without the use of an 'enter' or 'store' button. Additionally, one or more zones may be temporarily overridden without altering the scene values which are stored in memory. Control shall provide option for Master slider and shall retain "dimming profile".

- C. Lighting levels shall fade smoothly between scenes at time intervals of 0 to 59 seconds or 1 to 60 minutes. The fade time shall be separately selectable for each scene and shall be indicated by a digital display for the current scene. Pressing a scene select button will illuminate the corresponding scene LED and simultaneously begin changing the barograph levels to reflect the currently selected scene. In the event that a preset scene with a fade time greater than 5 seconds is initially selected from an 'off' condition, the programmed fade time shall be temporarily overridden, unless otherwise noted, and the lights shall fade up to that scene over a five-second time span.

2.13 INFRARED CONTROL(S)

- A. **Four Scene Wireless Remote Control(s)**
Wireless remote control shall be capable of recalling preset light levels for four scenes plus 'off' and of fine-tuning light levels with master raise/lower. Wireless remote control shall be used in conjunction with a compatible infrared receiver and scenes recalled shall be dependent on that receiver. Wireless remote control shall operate up to 15 meters within line-of-sight to that receiver. Wireless remote control shall operate at a frequency of 40 kHz and shall be 'learnable' by other variable frequency remote controls.
- B. **Eight Scene Wireless Remote Control(s)**
Wireless remote control shall be capable of recalling preset light levels for eight scenes plus 'off' and of fine-tuning light levels with master raise/lower. Wireless remote control shall be used in conjunction with a compatible infrared receiver and scenes recalled shall be dependent on that receiver. Wireless remote control shall operate up to 15 meters within line-of-sight to that receiver. Wireless remote control shall operate at a frequency of 40 kHz and shall be 'learnable' by other variable frequency remote controls.
- C. **Ceiling-Mounted Infrared Receiver(s)**
Control shall provide means for Four Scene Wireless Remote Control(s) and Eight Scene Wireless Remote Control(s) to recall preset light levels for up to four or eight scenes (dependent on remote control) plus 'off' and of fine-tuning light levels. Control shall be ceiling-mounted and shall provide 360° reception range for wireless remote controls within 15 meters of the control. Manufacturer shall supply mounting collar which shall be no larger than 2.19" (56mm) square.
- D. **Five Button Wallstation(s) with Infrared Receiver**
Control shall be capable of recalling preset light levels for four scenes, each providing green LED status feedback, plus 'off'. Control shall provide means for Four Scene Wireless Remote Control(s) and Eight Scene Wireless Remote Control(s) to recall preset light levels for up to four or eight scenes (dependent on remote control) plus 'off' and of fine-tuning light levels.
- E. **European-Style, Six Button Wallstation(s) with Infrared Receiver**
Control shall be capable of recalling preset light levels for four scenes, each providing green LED status feedback, plus 'off' and of fine-tuning light levels with master raise and lower buttons. Control shall provide means for Four Scene Wireless Remote Control(s) and Eight Scene Wireless Remote Control(s) to recall preset light levels for up to four or eight scenes (dependent on remote control) plus 'off' and of fine-tuning light levels. Control shall be no larger than 3.38" (86mm) square. Manufacturer shall supply wallbox.

- F. European-Style, Ten Button Wallstation(s) with Infrared Receiver
Control shall be capable of recalling preset light levels for eight scenes each providing green LED status feedback, plus 'off' and of fine-tuning light levels with master raise/lower. Control shall provide means for Four Scene Wireless Remote Control(s) and Eight Scene Wireless Remote Control(s) to recall preset light levels for up to four or eight scenes (dependent on remote control) plus 'off' and of fine-tuning light levels. Control shall be no larger than 3.38" (86mm) square. Manufacturer shall supply wallbox.

2.14 CONTROL INTERFACE (S)

- A. Contact Closure Interface(s)
Control shall provide two way interface between controls and dry contact closure devices such as from Timeclock Inputs, Building Management Systems, Fire Alarm Systems, Security Systems, and Occupancy Sensors. Control shall provide a minimum of five input and five output terminals. Input terminals must be able to accept maintained or momentary inputs with a minimum pulse time of 40msec. Inputs must have an on-state saturation voltage less than 2.0VDC and an off-state leakage current less than 10mA. Outputs must be capable of controlling other manufacturers' equipment. Customer provided output indicators must not exceed 200mA at 30VDC. Following functions shall be available and shall be set up in software: scene selection, panic mode, occupancy response, sequencing, zone and scene lockouts, and partitioning.
- B. RS232 Interface(s)
Control shall provide integration of four scene preset control to user-supplied PC or digital audiovisual equipment using RS232 serial communication. Control provides access to scene selections, scene lockout (prohibits manual light level changes), sequencing, zone lockout (prohibits permanent scene changes), and fine-tuning of light levels with individual zone raise/lower. Control shall provide status monitoring through button feedback and scene-status updates. Control must be mounted within 15 meters of the RS232 source.
- C. DXM512 Interface(s)
Control shall be capable of converting 32 zone intensities to 32 continuous DMX512 outputs. For DMX input, see section 2.02 L. 1.
- D. Daylighting Control(s)
Control shall automatically select preset light levels in response to ambient daylight. Control shall provide four thresholds for selection of light levels and shall provide four banks of preset light levels to select. Control shall be capable of photocell calibration, of averaging response for up to three photosensors, and of providing means for photosensor(s) input to override manual scene selects to ensure optimum light levels and energy savings.
- E. Room Assignor Control Panel(s)
Control shall be capable of accepting up to 32 contact closure inputs. Following functions shall be available and shall be set up in software: scene selection, panic mode, occupancy response, sequencing, zone and scene lockouts, and partitioning. Control shall provide a visual status.
- F. Handheld Programmer Jack(s)
Control shall provide access to local programming of the lighting control system from hand-held programmers.

2.15 SOURCE QUALITY CONTROL

- A. Equipment shall be 100% tested for proper operation at three different levels—printed circuit board, end of line, and for two hours at 40°C (104°F) ambient—prior to shipment from the factory. Manufacturers sampling at end-of-line shall not be acceptable.

PART 3 EXECUTION**3.01 INSTALLATION**

- A. Equipment shall be installed utilizing manufacturer's catalogue cut sheets and installation instructions and in accordance with these specifications.
- B. Contractor shall furnish all equipment, labor, system setup and other services necessary for the proper installation of the products/system as indicated on the drawings and specified herein. System setup shall include defining each dimmer's load type, assigning each load to a zone and setting the control functions.

3.02 MANUFACTURERS' FIELD SERVICES

- A. Upon completion of the installation, the system shall be completely commissioned by a factory-employed engineer. The check-out will be performed after all loads have been tested live for continuity and freedom from defects and that all control wiring has been connected and checked for proper continuity. The factory-employed engineer shall demonstrate and educate the owner's representative on the system capabilities, operation and maintenance.
- B. Manufacturer shall offer upgraded warranty based upon successful field commissioning.
- C. Manufacturer shall provide toll-free technical support hotline 24 hours per day, 7 days per week.
- D. Manufacturer shall be capable of providing on-site service support within 24 hours anywhere in the continental U.S.A., and within 72 hours anywhere in the world, except where special visas are required.
- E. Manufacturer shall offer a renewable service contract on a year to year basis which will include parts and factory labor as well as annual training visits.
- F. Service Contracts will be available for up to ten years from date of system commissioning.

END OF SECTION