SECTION 16570 – DIMMING SYSTEM

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. All of the Contract Documents, as listed on the Table of Contents and including General and Supplementary Conditions and Division 1, General Requirements, shall be included in, and made part of, this Section.

1.2 DESCRIPTION OF WORK

A. The work under this Section shall include furnishing and installing the architectural dimming system.

B. The work under this Contract shall also include all labor, materials, tools, equipment, transportation, insurance, temporary protection, supervision and incidental items essential for proper installation and operation, even though not specifically mentioned or indicated on the drawings, but which are usually provided or are essential for proper installation and operation of all systems as indicated on the drawings and specified herein.

C. The specifications and drawings describe the minimum requirements that must be met by the Electrical Subcontractor for the installation of all work as shown on the drawings and as specified hereinunder.

1.3 RELATED WORK

A. For work to be included as part of this Section, to be furnished and installed by the Electrical Subcontractor, refer to the Related Work section of Specification Section 16010.

B. Carefully examine all of the Contract Documents, criteria sheets and all other Sections of the specifications for requirements which affect work under this Section, whether or not such work is specifically mentioned in this Section.

1.4 REFERENCES

A. The entire lighting control system shall be U.L., CSA or CE listed as appropriate. Dimmers shall be U.L. and CSA Listed specifically for the required loads (i.e., incandescent, fluorescent, magnetic low voltage transformer). Manufacturer shall provide file card upon request.

B. Manufacturer shall maintain ISO 9001 certification.

1.5 QUALITY ASSURANCE

A. The manufacturers listed within this specification have been preselected for use on this project. No submittal will be accepted from a manufacturer other than specified.

B. To ensure system compatibility, all components of the dimming system including, panels, dimmers, dimming ballasts shall be the products of one manufacturer.

1.6 WARRANTY

A. Attention is directed to provisions of the General Requirements, Supplementary General Requirements, Section 01784 - Warranties and Section 16010 – Electrical Special Conditions regarding guarantees and warranties for the work under this Contract. WARRANTEE

B. The manufacturer shall warrant each new system for a period of two (2) years from the date of start-up of the equipment by one of the manufacturer's representatives, to be free from defects in the material and workmanship under the conditions of normal use and specified ambient temperature when installed and operated under the manufacturer's product specifications in accordance with the applicable National Electrical Code and Safety of Standards of Underwriter's Laboratory.

C. This warranty covers the diagnostics of problems with the dimming systems and the cost of labor for repair, replacement, or adjustment of any and all the manufacturer's components, as necessary to restore the dimming system to normal operation.

D. The warrantee shall cover the complete system as specified herein including, but not limited to:

1. Control panels
2. Dimmers
3. Electronics
4. Control stations
5. Fluorescent dimming ballasts
6. Motion sensors

E. This warranty shall not be required to cover:

1. Damage or malfunction diagnosed by the manufacturer's qualified service representative due to above, misuse, or accident, such as:

    a. Use of incorrect line voltages;
    b. Use of incorrect fuses;
    c. Failure to follow operating instructions provided by the manufacturer;
    d. Failure to maintain and operate equipment in accordance with applicable National Electrical code provisions, wand with Safety Standards of Underwriter's Laboratories;
    e. Failure to maintain equipment under specified ambient temperature;
    f. Vandalism

g. Fire, flood, “Acts of God”, and other problems beyond the control of the manufacturer.

2. Components and equipment external to the dimming system, such as:

a. Lamps
b. Lamp sockets and fixtures;
c. Wiring between ballasts and lamps;
d. Building wiring between the dimmer panels and the lamps;
e. Building between the controls and the control of dimmer panels;
f. Time clocks;
g. Audio-visual equipment;

3. Unauthorized repairs or adjustments.
4. The cost of repairing or replacing other property that is damaged when the dimming systems does not work properly.

1.7 QUALIFICATIONS

A. The manufacturer of the assembly shall be the manufacturer of the major components within the assembly.

B. For the equipment specified herein, the manufacturer shall be ISO 9001 certified.

C. The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of five (5) years. When requested by the Engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.

1.8 MANUFACTURERS

A. The following manufacturers shall be considered acceptable to supply the dimming system as herein specified:

1. Lutron Electronics Co., Inc.
2. Crestron

B. The listing of a manufacturer as "acceptable" does not imply automatic approval. It is the sole responsibility of the Electrical Subcontractor to ensure that any price quotations received and submittals made are for devices that meet or exceed the specifications included herein.

1.9 SUBMITTALS

A. Prepare and submit shop drawings in accordance with the requirements hereinbefore specified, and with the Shop Drawings, Product Data and Samples Section 01330 in the manner described therein, modified as noted hereinafter.

B. Submit complete manufacturer's product data of all materials and systems to the Architect for approval, consisting of complete product description and specifications, complete performance test data, complete preparation and installation instructions, and all other pertinent technical data required for complete product and product use information.

C. All shop drawings shall have clearly marked the appropriate specification number or drawing designation for identification of the submittal.

D. Disposition of shop drawings shall not relieve the Contractor from the responsibility for deviations from drawings or specifications unless he has submitted, in writing, a letter itemizing or calling attention to such deviations at time of submission and secured written approval from the Architect, nor shall such disposition of shop drawings relieve the Contractor from responsibility for errors in shop drawings or schedules.

E. The following information shall be provided with the shop drawing submittal:

1. Component list/bill of material.
2. Description of system operation
3. Manufacturers catalog data sheets for all components of the system, including, but not limited to:

    a. Cabinets
    b. Back boxes
    c. Control stations
    d. Dimming ballasts

4. Control schematics and wiring diagrams.
5. Conduit entry/exit locations.
6. Panel front view elevation.
7. Panel floor plan.

PART 2 - PRODUCTS

2.1 INTEGRAL DIMMING

A. Preset dimming control shall be capable of operating at rated capacity without adversely affecting design lifetime.

B. Preset dimming control shall mount individually in standard 2, 3, or 4 gang U.S. wallboxes.

C. Preset dimming control shall operate in an ambient temperature range of 0°C (32°F) to 40°C (104°F).

D. Preset dimming control shall incorporate an airgap switch relay which shall be accessible without removing the faceplate. The airgap switch shall be capable of meeting applicable requirements of U.L. 20 for airgap switches in incandescent dimmers.

E. Preset dimming control shall meet IEC 801-2, tested to withstand 15 kV electrostatic discharge without damage or loss of memory.

F. Preset dimming control shall meet ANSI/EEE Std. C62.41-1980, tested to withstand voltage surges of up to 6000V and current surges of up to 200A without damage.

G. Preset dimming control shall meet the U.L. 20 limited short circuit test requirement for snap switches.

H. Preset dimming control shall be voltage regulated.

I. Preset dimming control shall utilize an LC filtering network to minimize interference with properly installed radio, audio, and video equipment.

J. Minimum light levels shall be user adjustable in order to compensate for different sources and loading.

K. 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 shall be provided to control each type of load shown on the load schedule and/or the drawings.

2.2 SYSTEM REQUIREMENTS

A. The dimming system shall be capable of interfacing with the building audio/visual (A/V) control system. The dimming system shall have the capability to receive commands from the A/V system to select preset scenes, individual zones, etc.

B. The dimming system software shall be compatible with Windows NT operating system.

C. Communications

1. The dimming system shall incorporate 10baset Ethernet communications as an integral component to the controller.
2. System to include field-upgradeable 10baset Ethernet expansion card supporting TCP/IP communications.
3. Dimming system must provide complete diagnostic software package for remote maintenance. This software package shall allow low level diagnostics, program upgrades, dynamic operating system upgrades, signal activity monitor and complete Network analyzer with digital oscilloscope.
4. Dimming system shall support both TCP/IP and SNMP communications protocols.

5. Dimming system shall be able to support of 10 TCP/IP sockets open simultaneously.
6. Dimming system shall allow control via an internet browser such as Netscape Navigator for access via the local LAN/WAN/Internet. Such a platform provides independent access and provides seamless communications over the Internet.
7. Dimming system shall have the availability of control via interfaces such as HMTL, Java, Visual Basic, etc. through included lighting control Java objects and Activex software modules.
8. Dimming system shall support both 1-way RF and 2-way spread spectrum wireless control panels (touch panels, remote controls).

2.3 POWER PANELS

A. Panels shall be wall or floor mounted NEMA grade, constructed of sheet steel plates not less than #16 U.S. gauge. Contractor shall reinforce wall as required for wall-mounted panels.

B. Panels shall be completely pre-wired 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.

C. Unless the panel is a dedicated feed through switching panel or otherwise indicated, panels shall contain branch circuit protection for each dimming module. Branch circuit breakers shall have the following performance characteristics:

1. Be U.L. listed under U.L. 489 as a molded case circuit breaker for use on lighting circuits.

Upstream Transformer Size (kVA)	120 Volts	277 Volts
- <150	10,000	14,000
225 – 300	22,000	14,000
500	42,000	14,000
750	42,000	30,000
1,000	50,000	30,000
1,500	85,000	42,000
2,000	---	50,000
2,500	---	65,000
3,000	---	85,000

2. Contain a visual trip indicator and shall be have a short circuit rating of 30,000 AIC at 277 volts.

a. In order to achieve the above short circuit ratings, an upstream circuit breaker may be required to provide a series rating with the dimming panel circuit breakers. The Electrical Subcontractor shall coordinate with the dimming system manufacturer

and the switchgear manufacturer to assure short circuit ratings of the circuit breakers are achieved.

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 cut-outs.
4. Be switching duty (SWD) rated so that the loads can be switched off via the breakers.

D. Panels shall be shipped with each dimmer in a BYPASS position via a jumper bar inserted between the input and load terminals. These jumpers shall carry the complete load current and shall be reusable at any time.

E. Panels shall be cooled via free-convection, unaided by fans, and capable of continuous operation to all of these section specifications within an ambient temperature range of 0°C (32°F) to 40°C (104°F). To provide the utmost in reliability, panels which normally use cooling fans must have the panel capacity derated by 50%. A lesser derating shall be allowed providing that manufacturer can substantiate, via an independent test laboratory, that with no fans operating, and at full-rated dimmer capacity, the temperatures of the main semiconductors are at least 20°C below maximum temperature rating and the temperatures of the filter chokes are within the maximum allowable temperatures of these components at an ambient temperature of 40øC.

F. Panels shall have the following additional performance characteristics:

1. Be designed to prevent any foreign objects from coming in contact with any part of the panel which would be at an elevated temperature, such as the dimmer extrusions or heat fins.
2. Be designed to provide air flow across the heat sink areas and through the dimmer chassis. Panel sections which provide air flow only across heat sinks shall not be mounted one above another in order to allow for adequate heat dissipation.

G. 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.

1. Dimming panel shall be capable of operating under two optically isolated control systems. Panel shall be capable of auto detecting between system 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.

H. Multiple panels shall be capable of operating in one system.

I. For panels fed with a normal/emergency feeder, panel shall include electronics to bring all circuits to a full-on condition upon the loss of normal power and the subsequent presence of emergency power. Under normal operation, lighting connected to normal/emergency panel shall be controlled simultaneously with other lighting circuits within the designated control zone during the presence of normal utility or generator power.

1. Circuits listed as emergency shall 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 (restoration to some other “default” level is not acceptable).
2. This type of emergency full-on shall 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.
4. A positive air gap relay shall be employed with each card in the power panel to ensure that the load circuits are open when the "off" function is selected at a control station. These relays need not be integral to the module but must be integral to the panel. Lighting control manufacturer shall provide and warrant both the relays and the necessary control interface(s) as part of the control system.

2.4 MODULAR DIMMING CARDS

A. One type of modular dimming card shall be used for all sources. Systems requiring different types of modules or modular dimming cards shall not be acceptable.

B. All dimmers shall be voltage regulated so that a ±10% variation in line voltage shall cause no more than a ±5% variation in load voltage when dimmer is operating at 40V (5% light output).

C. Under full-load conditions in a 40ºC environment, all silicon thyristors shall operate at a minimum 20ºC safety margin below the component temperature rating.

D. The maximum allowable asymmetry in the load waveform shall be ± 1 VDC.

E. 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.

F. Once installed as part of a complete system, the silicon thyristors 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/EEE std. C62.41. Upon request, the manufacturer shall provide a means to demonstrate conformance to this specification using the appropriate surge-generation equipment.

G. Filtering shall be provided in each dimmer so that current rise time shall be at least 350msec at 50% rated dimmer capacity as measured from 10-90% of the load current waveform at a 90º conduction angle, and at no point rise faster than mA/sec. Manufacturers should note that additional filters may be required to meet this specification. These filters need not be integral to the dimming module, but must be integral to the dimming cabinet.

H. Dimmer output voltage shall be a minimum 95% of input voltage at maximum intensity setting.

I. Dimming assemblies 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. ±2% change in RMS voltage/cycle
2. ±2 Hz change in frequency/second

Dimmers that do not regulate the dimmer output shall be unacceptable.

2.5 SWITCHING MODULE

A. Relays shall be mechanically latching.

B. The voltage drop across the switching circuit shall not exceed 100 millivolts RMS when in the closed state. Power efficiency shall be in excess of 99 percent at full load RMS voltage.

C. Relays shall be rated for 16 Amp continuous duty, for the following load types: resistive (incandescent/tungsten), 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.

D. 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.

2.6 DIMMERS

A. Dimmers shall operate the each sources/load type with a smooth continuous Square Law dimming curve. Dimmers shall also be capable of operating these 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.

B. Incandescent, Tungsten and Magnetic Low Voltage Transformer

1. Dimmer shall contain circuitry specifically designed to control and provide a symmetrical AC waveform to the input of magnetic low voltage transformers.
2. Dimmer shall not cause a magnetic low voltage transformer to operate above the transformer's rated operating current and temperature.
3. Dimmer shall contain circuitry to control dioded lamps.

C. Electronic Low Voltage Transformer

1. No flicker or interaction shall occur at any point in the dimming range.
2. For integral dimming, an interface shall be required.

D. Fluorescent Electronic Dimming Ballasts

1. Dimmer shall be rated to control T-12, T-12 high output, T-8, T-5, T-5 high output and T-4 lamps. All lamps on the same circuit shall have the same current rating (i.e., T-8), but may be different lengths (i.e., 3' or 4'). Ballasts for fluorescent fixtures shall be Lutron Hi-lume "FDB". See fixture schedule and/or dimming schedule for specific ballast model numbers.
2. The dimming performance for all fluorescent dimmers shall be as follows:

    a. Manufacturer shall provide single, two or three lamp electronic dimming ballasts for fixtures indicated in the lighting fixture schedule
    b. Ballasts shall withstand 4000 volt surges as specified in ANSI C62.41.
    c. Ballast shall preheat lamp cathodes before applying arc voltage to ensure rated lamp life is not diminished.
    d. Ballasts shall internally limit inrush current to not exceed three amps at 277 volts or seven amps at 120 volts to avoid computer problems, nuisance circuit breaker trips, and control contact malfunctions.
    e. Light level output shall be continuous, even and flicker-free over the entire dimming range. Any perceived flicker by the Architect shall be corrected by the system manufacturer to the Architect’s satisfaction.
    f. Ballast shall be inaudible in a 27dB ambient throughout the dimming range.
    g. Ballast shall be capable of striking lamps at any light level. This shall be accomplished without first flashing to full light.
    h. Ballasts must comply with FCC Part 18 regulations for non-consure RF lighting devices.
    i. Ballasts shall have a minimum starting temperature of 10°C.
    j. Ballasts shall not be damaged by miswiring line voltage and control wire inputs.

3. Architectural dimming ballasts ("Hi-lume FDB")

    a. Dimming range of ballasts shall be from 100% to 1% light level for T-12, T-8 and T-5 standard and high output lamps, 100% to 5% light level for T-4 lamps.
    b. Ballast shall have a ballast factor equal to 0.93 throughout the entire dimming range. Magnitude of harmonic distortion shall not exceed 10% THD of current at full light output, lamp current crest factor less than or equal to 1.6.

2.7 CONTROL

A. General

1. 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.
2. Preset dimming 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. Restoration to some other default level is not acceptable, unless specifically noted elsewhere.

3. Wiring from dimming panel to preset dimming control and accessory control shall be low voltage type Class 2 wiring (SELV).

B. Preset Controllers

1. Preset controllers shall provide preset lighting scenes and off for up to 24 control zones. Control shall be capable of storing an additional 12 preset lighting scenes. Up to 64 zones may be tied together in one system.
2. Controls shall incorporate built-in wide angle infrared receiver, providing control via a separate wireless remote control transmitter from up to 50 feet away.
3. 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 bargraph, one bargraph per zone. More than one zone may be proportionately raised or lowered at the same time.
4. 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.
5. Lighting levels shall fade smoothly between scenes at time intervals of 0-59 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.
6. Pressing a scene select button will also light the corresponding scene LED and simultaneously begin changing the bargraph 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.

C. Accessory Control Options

1. Provide the following controls for use with the preset control(s) as shown on the drawings:

    a. Two Scene Entrance Control(s) shall be capable of recalling Scene One plus Off.
    b. Four Scene Control(s) shall be capable of recalling any one of four scenes, master raise/lower and Off. Control shall provide access to up to 16 scenes.
    c. Eight Scene Control(s) shall be capable of recalling any one of eight scenes, master raise/lower and Off. Control shall provide access to up to 16 scenes.
    d. Fine Tuning Control(s) shall allow the temporary override of a particular zone or zones from the preset light level.
    e. Wireless Infrared Transmitter(s) shall be capable of recalling any one of four preset scenes and Off. In addition, a master raise/lower shall be provided. The transmitter shall be manufactured by the dimming system manufacturer. The range of the transmitter to any single receiver shall be at least 50 feet.

        1) Wall receiver shall incorporate four scene select, master raise/lower, and off buttons.

2) Ceiling receiver shall provide 360ø view and an integral LED to provide feedback of proper IR signal.

f. Special Function Control(s) shall provide the following functions:

1) Sequencing shall allow the user to set up and operate a sequence of 4, 12, or 60 steps. A sequence shall be defined as a series of steps, while a step shall be defined as the recall of a scene. Each step interval is adjustable from 1 second to 60 minutes.
2) Zone lockout shall allow temporary changes without altering the light levels preset for each scene.
3) Scene lockout shall lockout the control, maintaining current scene and disabling all buttons on the preset dimming control.
4) Fade override shall set all fade times to zero.

g. Partition Control(s) shall provide two or four buttons for operating multiple preset units independently or in combination. Each button shall have a corresponding LED to indicate status of a specific partition or "door."
h. Photocell Interface Control(s) shall provide scene selection via daylight photosensor.
i. Equipment Interface(s) shall allow access to preset dimming control(s) via one of the following methods:

1) Isolated momentary/maintained dry contact closures. Where indicated on the drawings, each interface shall provide isolated maintained contact closures rated at 200mA at 30VDC for pilot light status feedback.
2) For use with four scene preset control, RS232 serial communication.
3) For use with four scene preset control, astronomic timeclock with 60 events/day and 4 schedules.
4) For use with multiple area centralized control, DMX512 interface with control of 32 continuous dimming zones via external DMX512 device.

2. Control Station Cover Plates

a. Custom engraved satin chrome wall plates shall be provided for each control station. The verbiage for the custom engraving will be determined by the Owner approximately 3 to 6 months after the Owner has moved into the building. The system manufacturer shall ship with the control stations white, unengraved plates for the Owner’s use until the verbiage for the final plates has been determined.
b. Faceplates shall attach using no visible means of attachment.

D. Fire Alarm Interface

1. A fire alarm interface shall be provided such that, upon receipt of an alarm signal from the fire alarm system, all lighting in the affected spaces shall go to 100% full bright.
2. Multiple signals may be received from the fire alarm system indicating different areas of the building in alarm.

PART 3 - EXECUTION

3.1 COOPERATION AND WORK PROGRESS

A. The Electrical work shall be carried on under the usual construction conditions, in conjunction with all other work at the site. The Electrical Subcontractor shall cooperate with the Architect, General Contractor, all other Subcontractors and equipment suppliers working at the site. The Electrical Subcontractor shall coordinate the work and proceed in a manner so as not to delay the progress of the project.

B. The Electrical Subcontractor shall coordinate his work with the progress of the building and other Trades so that he will complete his work as soon as conditions permit and such that interruptions of the building functions will be at a minimum. Any overtime hours worked or additional costs incurred due to lack of or improper coordination with other Trades or the Owner by the Electrical Subcontractor, shall be assumed by him without any additional cost to the Owner.

C. The Electrical Subcontractor shall furnish information on all equipment that is furnished under this Section but installed under another Section to the installing Subcontractor as specified herein.

D. The Electrical Subcontractor shall provide all materials, equipment and workmanship to provide for adequate protection of all electrical equipment during the course of construction of the project. This shall also include protection from moisture and all foreign matter. The Electrical Subcontractor shall also be responsible for damage which he causes to the work of other Trades, and he shall remedy such injury at his own expense.

E. Waste materials shall be removed promptly from the premises. All material and equipment stored on the premises shall be kept in a neat and orderly fashion. Material or equipment shall not be stored where exposed to the weather. The Electrical Subcontractor shall be responsible for the security, safekeeping and damages, including acts of vandalism, of all material and equipment stored at the job site.

F. The Electrical Subcontractor shall be responsible for unloading all electrical equipment and materials delivered to the site. This shall also include all large and heavy items or equipment which require hoisting. Consult with the General Contractor for hoisting/crane requirements. During construction of the building, the Electrical Subcontractor shall provide additional protection against moisture, dust accumulation and physical damage of the main service and distribution equipment. This shall include furnishing and installing temporary heaters within these units, as approved, to evaporate excessive moisture and ventilate it from the room, as may be required.

G. It shall be the responsibility of the Electrical Subcontractor to coordinate the delivery of the electrical equipment to the project prior to the time installation of equipment will be required; but he shall also make sure such equipment is not delivered too far in advance of such required installation, to ensure that possible damage and deterioration of such equipment will not occur. Such equipment stored for an excessively long period of time (as determined in the opinion of

the Architect) on the project site prior to installation may be subject to rejection by the Architect.

H. The Electrical Subcontractor shall erect and maintain, at all times, necessary safeguards for the protection of life and property of the Owner, Workmen, Staff and the Public.

I. Prior to installation, the Electrical Subcontractor has the responsibility to coordinate the exact mounting arrangement and location of electrical equipment to allow proper space requirements as indicated in the NEC. Particular attention shall be given in the field to group installations. If it is questionable that sufficient space, conflict with the work of other Subcontractors, architectural or structural obstructions will result in an arrangement which will prevent proper access, operation or maintenance of the indicated equipment, the Electrical Subcontractor shall immediately notify the Contractor and not proceed with this part of the Contract work until definite instructions have been given to him by the Architect.

3.2 INSTALLATION

A. Wiring from preset dimming control to dimming panel and accessory control shall be low voltage Class 2 (SELV) wiring.

B. The Electrical Subcontractor shall furnish all equipment, labor, system setup, and other services necessary for the proper installation of the devices 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.

C. Unless specifically noted or indicated otherwise, all equipment and material specified in Part 2 of this specification or indicated on the drawings shall be installed under this Contract whether or not specifically itemized herein. This Section covers particular installation methods and requirements peculiar to certain items and classes or material and equipment.

D. The Electrical Subcontractor shall obtain detailed information from manufacturers of equipment provided under Part 2 of this specification as to proper methods of installation.

E. The Electrical Subcontractor shall obtain final roughing dimensions and other information as needed for complete installation of items furnished under other Sections or furnished by the Owner.

F. The Electrical Subcontractor shall keep fully informed of size, shape and position of openings required for material and equipment provided under this and other Sections. Ensure that openings required for work of this Section are coordinated with work of other Sections. Provide cutting and patching as necessary.

G. All miscellaneous hardware and support accessories, including support rods, nuts, bolts, screws and other such items, shall be of a galvanized or cadmium plated finish or of another approved rust-inhibiting coating.

H. Throughout this Section where reference is made to steel channel supports, it shall be understood to mean that the minimum size shall be 1 5/8" mild strip steel with minimum wall thickness of 0.105", similar to Unistrut P1000 or equal products manufactured by Kindorf or Husky Products Co. Where reference to channel supports is made under "Lighting Fixtures" paragraph of this Section, the maximum length of span shall be 10'-0". If longer spans are required, the size and wall thickness of the steel channel support shall be as specifically approved by the Engineer.

3.3 MATERIALS AND WORKMANSHIP

A. All materials and equipment shall be new and unused and shall meet requirements of the latest Standards of NEMA, UL, IPCEA, ANSI and IEEE. Equipment shall have components required or recommended by OSHA, applicable NFPA documents and shall be UL listed and labeled.

B. Despite references in the specifications or on the drawings to materials or pieces of equipment by name, make or catalog number, such references shall be interpreted as establishing standards of quality for materials and performance.

C. Finish of materials, components and equipment shall not be less than Industry good practice. When material or equipment is visible or subject to corrosive or atmospheric conditions, the finish shall be as approved by the Architect.

D. Provide proper access to material or equipment that requires inspection, replacement, repair or service. If proper access cannot be provided, confer with the Architect as to the best method of approach to minimize effects of reduced access.

E. All work shall be installed in a neat and workmanlike manner and shall be done in accordance with all Local and State Codes.

F. The Owner will not be responsible for material, equipment or the installation of same before testing and acceptance.

3.4 QUALITY CONTROL

A. All fluorescent lamps shall be “burned-in” at full brightness for a minimum of 100 hours prior to being dimmed.

B. All components shall be inspected following U.S. military standard 105D or equivalent.

C. Equipment shall be fully tested for proper operation prior to shipment from the factory.

3.5 FIELD SUPPORT

A. Manufacturer shall be capable of providing on-site service support within 24 hours anywhere in the continental U.S.A., and within five business days anywhere in the world, except where special visas are required.

3.6 SYSTEM COMMISSIONING

A. The system manufacturer shall provide on-site, factory technicians to thoroughly inspect the dimming system installation and verify proper operation. The commissioning shall include three (3) separate visits to the project as defined below:

1. First Visit: Pre-Wire Inspection

a. Review all low voltage wiring requirements

1) Daisy chain
2) Maximum run lengths
3) Control and dimmer/switching panel links
4) Cable requirements

b. Review separation of power and low voltage/data wiring
c. Review wire labeling
d. Review information required on load schedules
e. Review dimmer/switching panel locations and installation
f. Review control locations and addressing
g. Review analog phone lines requirements and computer jack locations
h. Review load circuit wiring
i. Review connections to “equipment by others”
j. Develop project schedule, including:

1) Contractor completion dates
2) Building opening dates
3) End user training
4) Contact names and numbers

2. Second Visit: Start-Up of System and Installation of System Software/data

a. Verify proper connection of

1) Power feeds
2) Load circuits

b. Verify proper connection of all controls
c. Energize the main panel and download system data program
d. Verify proper connection of panel links (low voltage/data) and address panels

e. Download system panel data to dimming/switching panels
f. Check dimmer panel load types and currents and remove bypass jumpers
g. Verify system operation control by control, circuit by circuit
h. Verify proper operation of interfacing equipment.
i. Verify operation of PC and installed programs
j. Verify operation of PC modem and test dial up access if phone line provided
k. Program and provide fine-tune adjustments of the following for each individual area with the Owner, Architect and Lighting Consultant present.

1) All preset scene values for each area.
2) Time clock events and functions.
3) Programming sequences

l. The following individual areas requiring the fine-tuning indicated in the paragraph above include:
m. Obtain sign off on systems function

3. Third Visit: Operator/End-User Training

a. Upgrade systems software to the latest revision level, if necessary
b. Train the end users on system operation and software (Set-Up and Operate programs)

1) Database file management
2) How to set scene values
3) How to set timeclock events
4) How to change area, scene, and zone names
5) How to set sequences, if applicable

c. System maintenance and trouble shooting

1) Job telephone numbers
2) Who to call
3) Diagnostics available
4) Modem
5) Telephone support
6) Service visit

d. Persons to be available for this visit should include:

1) Manufacturer's Service Engineer
2) Electrical maintenance staff
3) System operators

B. The manufacturer shall carry in his bids sufficient time to accomplish the above requirements to the satisfaction of the Owner, Architect, Lighting Consultant and Engineer.

END OF SECTION