~~~~~ PROJECT NOTE ~~~~~~

ARCHITECT OF RECORD/ENGINEER OF RECORD IS RESPONSIBLE FOR REVIEWING THIS SPECIFICATION SECTION IN DETAIL FOR COORDINATION WITH THE PROJECT SCOPE OF WORK.

ALL "PROJECT NOTE" TEXT IS TO BE REMOVED FOLLOWING REVIEW OF THE CONTENT OF EACH NOTE BY THE ARCHITECT OF RECORD/ENGINEER OF RECORD.

EDIT THE DOCUMENT FOOTER TO INCLUDE THE PROJECT NAME AND NUMBER.

EDIT THE DOCUMENT HEADER TO INDICATE THE ARCHITECT OF RECORD PROJECT ISSUE" DATE. THE "CPS CONTROL" DATE SHOULD NOT BE EDITED.

ANY MODIFICATIONS TO THE TECHNICAL STANDARDS IN THIS SECTION - INCLUDING THE REMOVAL OR ADDITION OF MANUFACTURERS - MUST BE APPROVED BY CPS. REQUESTS FOR MODIFICATION ARE TO BE SUBMITTED TO THE DESIGN MANAGER DURING THE DESIGN PHASE FOR REVIEW AND APPROVAL.

~~~ END OF PROJECT NOTE ~~~~

SECTION 26 09 33
CENTRAL DIMMING CONTROLS

~~~~~ PROJECT NOTE ~~~~~~

THIS SECTION IS APPLICABLE WHERE ARCHITECTURAL DIMMING SYSTEMS AND CABINETS ARE SPECIFICALLY REQUIRED AND THE USE OF A LOW VOLTAGE SYSTEM IS NOT FEASIBLE OR PRACTICAL.

NORMALLY, AUDITORIUMS AND LARGE PERFORMING SPACES SHALL BE UTILIZE THE THEATRICAL LIGHTING SPECIFICATION SECTION.

AOR SHALL UTILIZE SECTION 26 09 36 MODULAR DIMMING SYSTEMS FOR LOW VOLTAGE DIMMING SYSTEMS SUCH AS ROOM CONTROLLERS, ETC.

THE USE OF THIS SECTION SHALL BE PRE-APPROVED BY CPS.

~~~ END OF PROJECT NOTE ~~~~

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Microprocessor-based central dimming controls with the following components:
   1. Control network.
   2. Master-control stations.
   3. Partitioned-space master-control stations.
   4. Wall stations.
   5. Dimmer cabinets.
   6. Manual switches and plates for controlling dimmers.

1.02 REFERENCE STANDARDS

A. 47 CFR 15 - Radio Frequency Devices current edition.
B. City of Chicago Building Code - Municipal Code of Chicago, Title 14B, Building Code 2019.
C. Chicago Electrical Code - Municipal Code of the City of Chicago, Building/Electrical Code Requirements 2018.

D. IESNA (LH) - Lighting Handbook. 2011.
E. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum) 2018.
F. NFPA 101 - Life Safety Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
G. UL 508 - Industrial Control Equipment Current Edition, Including All Revisions.

1.03 DEFINITIONS

A. Fade Override: The ability to temporarily set fade times to zero for all lighting scenes.
B. Fade Rate: The time it takes each zone to arrive at the next scene, dependent on the degree of change in lighting level.
C. Fade Time: The time it takes all zones to fade from one lighting scene to another, with all zones arriving at the next scene at the same time.
D. Low Voltage: As defined in the Chicago Electrical Code, a term for circuits and equipment operating at less than 50 V or for remote-control, signaling, and power-limited circuits.
E. Scene: The lighting effect created by adjusting several zones of lighting to the desired intensity.
F. SCR: Silicon-controlled rectifier.
G. Zone: A fixture or group of fixtures controlled simultaneously as a single entity. Also known as a "channel."

1.04 SUBMITTALS

A. Product Data: For each type of product indicated.
    1. For central dimming controls; include elevation, features, characteristics, and labels.
    2. For dimmer panels; include dimensions, features, dimmer characteristics, ratings, and directories.
    3. Device plates, plate color, and material.
    4. Driver combinations compatible with dimmer controls.
    5. Sound data including results of operational tests of central dimming controls.
    6. Operational documentation for software and firmware.

~~~~~ PROJECT NOTE ~~~~~~
LIGHTING CONTROL MANUFACTURER SENSOR LAYOUT AND TUNING SERVICE MAY BE SPECIFIED UNDER "LIGHTING CONTROL SYSTEM - GENERAL REQUIREMENTS".
~~~ END OF PROJECT NOTE ~~~~

B. Design Documents: Where Lighting Control Manufacturer Sensor Layout and Tuning service is specified in Part 2 under "GENERAL SYSTEM REQUIREMENTS", Lighting Control Manufacturer to provide plans indicating occupancy/vacancy and/or daylight sensor locations.
C. Shop Drawings: Detail assemblies of standard components, custom assembled for specific application on Project. Indicate dimensions, weights, arrangement of components, and clearance and access requirements.
    1. Include elevation views of front panels of control and indicating devices and control stations.
    2. Wiring Diagrams: Power, signal, and control wiring.
D. Operation and Maintenance Data: For central dimming controls with remote-mounting dimmers to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 01 78 00 - Closeout Submittals, include the following:
    1. Software manuals.
    2. Adjustments of scene preset controls, adjustable fade rates, and fade overrides.
    3. Operation of adjustable zone controls.
    4. Testing and adjusting of panic and emergency power features.
E. Warranty: Provide complete manufacturer's warranty information on all products provided.

1.05 QUALITY ASSURANCE

A. Source Limitations: Obtain central dimming controls from a single source with total responsibility for compatibility of lighting control system components specified in this Section, Section 26 27 26 - Wiring Devices, and Section 26 09 36 - Modular Dimming Controls.
B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in the Chicago Electrical Code by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
C. Comply with 47 CFR 15, Subparts A and B, for Class A digital devices.
D. Comply with NFPA 101.
E. Comply with City of Chicago Building Code and Chicago Electrical Code.
F. Comply with the IESNA (LH).

1.06 DELIVERY, STORAGE AND HANDLING

A. Effectively protect all materials, accessories, and components form any damage or injury from the time of fabrication until final Board acceptance.
B. Deliver equipment in fully enclosed vehicles after specified environmental conditions have been permanently established in spaces where equipment is to be placed.
C. Store equipment in spaces with environments controlled within manufacturer’s ambient temperature and humidity tolerances for non-operating equipment.

1.07 COORDINATION

A. Coordinate features of devices specified in this Section with systems and components specified in other Sections to form an integrated system of compatible components. Match components and interconnections for optimum performance of specified functions. Include coordination with the following:
    1. Section 26 27 26 - Wiring Devices.
    2. Section 26 09 23 - Lighting Control Devices
    3. Section 26 09 36 - Modular Dimming Controls
    4. Section 26 09 43 - Lighting Control System

1.08 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
    1. Coordinate the placement of lighting control devices with millwork, furniture, equipment, etc. installed under other sections or by others.
    2. Coordinate the placement of wall switch occupancy sensors with actual installed door swings.
    3. Coordinate the placement of occupancy/vacancy sensors with millwork, furniture, equipment or other potential obstructions to motion detection coverage installed under other sections or by others.
    4. Coordinate the placement of photo sensors for daylighting controls with windows, skylights, and luminaires to achieve optimum operation. Coordinate placement with ductwork, piping, equipment, or other potential obstructions to light level measurement installed under other sections or by others.
    5. Notify Architect/Engineer of Record of any conflicts or deviations from the contract documents to obtain direction prior to proceeding with work.
B. Pre-Wire Meeting: Conduct on-site meeting with lighting control system manufacturer prior to commencing work as part of manufacturer's standard startup services. Manufacturer to review with installer:
    1. Low voltage wiring requirements.
    2. Separation of power and low voltage/data wiring.
    3. Wire labeling.
    4. Where Lighting Control Manufacturer Sensor Layout and Tuning service is specified in under "LIGHTING CONTROL SYSTEM - GENERAL REQUIREMENTS", sensor locations to be reviewed in accordance with layout provided by Lighting Control

Manufacturer. Lighting Control Manufacturer may direct Contractor regarding sensor relocation should conditions require a deviation from locations indicated.

5. Control locations.
6. Load circuit wiring.
7. Connections to other equipment.
8. Installer responsibilities.

C. Sequencing:

1. Do not install lighting control devices until final surface finishes and painting are complete.

1.09 SOFTWARE SERVICE AGREEMENT

A. Technical Support: Beginning with Preliminary Acceptance, provide software support for two years.

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

1. Provide 30 days' notice to Board to allow scheduling and access to system and to allow Board to upgrade computer equipment if necessary.

1.10 EXTRA MATERIALS

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

1. Dimmers: Full-size units equal to three percent of amount installed for each size indicated, but no fewer than two units.
2. Fuses: Equal to three percent of amount installed for each size installed, but no fewer than three.
3. Switches: Minimum one of each type.
4. Switch Button Covers: equal to three percent of amount installed for each size indicated, but no fewer than three.

1.11 WARRANTY

A. Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of central dimming controls that fail in materials or workmanship within specified warranty period. Failures include damage from transient voltage surges.

1. Warranty Period: Cost to repair or replace any parts for two (2) years from date of Preliminary Acceptance.
2. Extended Warranty Period: Cost of replacement parts (materials only, f.o.b. (free on board) to the nearest shipping point to Project site), for eight (8) years, that failed in service due to transient voltage surges.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers:

1. Acuity Brands Lighting, Inc: https://www.acuitybrands.com/
2. Cooper Lighting Solutions, Inc: https://www.cooperlighting.com/
3. ETC Company; https://www.etcconnect.com/
4. Leviton Manufacturing Company, Inc: www.leviton.com .
5. Lutron Electronics Company, Inc: www.lutron.com/sle .
6. WattStopper: www.wattstopper.com/#sle.

2.02 GENERAL SYSTEM REQUIREMENTS

A. Compatibility: Dimming control components shall be compatible with other elements of lighting fixtures, drivers, transformers, and lighting controls.

B. Sensor Layout and Tuning: Include as part of the base bid additional costs for Lighting Control Manufacturer's Sensor Layout and Tuning service:
   1. Lighting Control Manufacturer to take full responsibility for wired or wireless sensor layout and performance for sensors provided by Lighting Control Manufacturer.
   2. Lighting Control Manufacturer to analyze the reflected ceiling plans, via supplied electronic AutoCAD format, and design a detailed sensor layout that provides adequate occupancy sensor coverage and ensures occupancy and daylight sensor performance per agreed upon sequence of operations. Contractor to utilize the layouts for sensor placement.
   3. During startup, Lighting Control Manufacturer to direct Contractor regarding sensor relocation, as required, should conditions require a deviation from locations specified in the drawings.
   4. Lighting Control Manufacturer to provide up to two additional post-startup on-site service visits, within one calendar year from date of Preliminary Acceptance to fine-tune sensor calibration per the agreed upon sequence of operations.

C. Line-Voltage Surge Suppression: Factory installed as an integral part of solid-state dimmers and control panels.
   1. Alternative Line-Voltage Surge Suppression: Comply with requirements in Section 26 43 00 - Surge Protective Devices for Category A and B locations.

D. Dimmers and Dimmer Modules: Comply with UL 508.
   1. Audible Noise and Radio-Frequency Interference Suppression: Solid-state dimmers shall operate smoothly over their operating ranges without audible lamp or dimmer noise or radio-frequency interference. Modules shall include integral or external filters to suppress audible noise and radio-frequency interference.

~~~~~ PROJECT NOTE ~~~~~~
RATINGS FOR DIMMERS AND DIMMER MODULES TO BE INDICATED ON DRAWINGS.
~~~ END OF PROJECT NOTE ~~~~

E. Dimmer or Dimmer-Module Rating: Not less than 125 percent of connected load unless otherwise indicated.

2.03 SYSTEM DESCRIPTION

A. Description: Microprocessor-based, solid-state controls consisting of control stations and a separately mounted dimmer cabinet.
   1. Operation: Change variable dimmer settings of indicated number of zones simultaneously from one preset scene to another when a slider is operated.
   2. System control shall include master station(s), wall stations, and dimmer panels.

~~~~~ PROJECT NOTE ~~~~~~
EDIT LIGHT SOURCES FOR LAMPS AND BALLASTS PER PROJECT SCOPE OF WORK. COORDINATE WITH BOARD AND ARCHITECTURAL SPECIFICATIONS. ONLY LED SHOULD BE USED ON NEW CONSTRUCTION.
~~~ END OF PROJECT NOTE ~~~~

   3. Each zone shall be configurable to control the following light sources:
      a. Line-voltage incandescent lamps.
      b. Low-voltage incandescent lamps.
      c. Non-dimmed loads.
      d. LED drivers.

~~~~~ ***PROJECT NOTE*** ~~~~~~
EDIT ACCESSORIES FOR ITEMS PER PROJECT SCOPE OF WORK. COORDINATE WITH BOARD AND ARCHITECTURAL SPECIFICATIONS.
~~~ ***END OF PROJECT NOTE*** ~~~~

4. Control of each zone shall interface with controls for the following accessory functions:
   a. Curtains and drapes.
   b. Blackout curtains.
   c. Projector screens.
   d. Project Lift.
   e. Monitor.
   f. Partitions.
5. Memory: Retain preset scenes and fade settings through power failures for at least 90 days by retaining physical settings of controls or by an on-board, automatically recharged battery.

2.04 CONTROL NETWORK

A. Dimmers shall receive signals from control stations that are linked to dimmer cabinet with a common network data cable.

B. Functions of network control stations shall be set up at master station that include the number and arrangement of scene presets, zones, and fade times at wall stations.
   1. Control Voltage: 10-V dc.
   2. Follow the USITT DMX 512 protocol for data transmission.

2.05 MASTER-CONTROL STATIONS

A. Functions and Features:
   1. Control adjustment of the lighting level for each scene of each zone, and adjustment of fade-time setting for each scene change from one preset scene to another. Controls shall use digital rocker switches with LCD graphic display of light level.
   2. Master channel shall raise and lower lighting level of all zones.
   3. Fade rate for each scene shall be adjustable from zero to 60 seconds.
   4. Fade override control for each scene.
   5. Recall each preset scene and allow adjustment of zone controls associated with that scene.
   6. Lockout switch to prevent changes when set.
   7. On and off scene controls for non-dim channel contactors.
   8. Emergency-control pushbutton to bypass all controls, turning all dimmers to full bright and turning on non-dim channel contactors.
   9. Master on and off switch; off position enables housekeeping controls.
   10. Housekeeping controls to turn on selected lighting fixtures for housekeeping functions.
   11. Pushbuttons for accessory functions.
   12. Enable and disable wall stations.
   13. Communications link to other master stations.
   14. Provide for connecting a portable computer to program the master station.
   15. Rear-illuminate all scene-select buttons.
   16. Show lighting-level setting and fade-rate setting graphically using LEDs or backlighted bar-graph indicator.

B. Mounting: Single, flush wall box with manufacturer's standard faceplate with hinged transparent locking cover.

2.06 PARTITIONED-SPACE MASTER-CONTROL STATION

A. Functions and Features:

1. Automatically combine and separate lighting and accessory function controls as spaces are configured with movable partitions; with controls for adjustment of the lighting level for each scene of each dimmer, and adjustment of fade-rate setting for each scene change from one preset scene to another.
2. Master controls shall accommodate partitioning the space into six adjacent rooms.
3. Manual controls to set up a minimum of six scenes for each room. Include wall stations in each room to control scenes.
4. Master channel to raise and lower the lighting level of all zones.
5. Adjustable fade rate for each scene from zero to 60 seconds.
6. Fade override control for each scene.
7. On and off scene controls for non-dim channel contactors.
8. Emergency-control pushbutton to bypass all controls, turning all dimmers to full bright and turning on non-dim channel contactors.
9. Master on and off switch; off position enables housekeeping controls.
10. Housekeeping controls to turn on selected lighting fixtures for housekeeping functions.
11. Pushbuttons for accessory functions.
12. Provide for connecting a portable computer to program the master station.
13. Rear-illuminate all scene-select buttons.
14. Show lighting-level setting and fade-rate setting graphically using LEDs or backlighted bar-graph indicator.

B. Custom Graphics. Include a graphical display of room configurations and the names for each. Indicate the current spaces configuration with LCD graphic or LED-illuminated indicators, and show which wall stations are active. Inactive wall stations shall be automatically deactivated.

C. Mounting: Single, flush wall box with manufacturer's standard faceplate with hinged transparent locking cover.

2.07 WALL STATIONS

A. Functions and Features:
1. Wall stations shall function as a submaster to a master station, containing limited control of selected scenes of the master station.
2. Controls to adjust the lighting level of each dimmer for each scene, and the fade time setting for each scene change from one preset scene to another.
3. Numbered pushbuttons to select scenes.
4. Pushbutton controls for accessory functions.

B. Mounting: Flush, wall box with manufacturer's standard faceplate.

C. Hand-held Cordless Control: Scene-select and accessory function pushbuttons using infrared or radio-frequency transmission.

2.08 DIMMER CABINETS

A. Factory wired, convection cooled without fans, with barriers to accommodate 120- and 277-V feeders and suitable to control designated lighting equipment or accessory functions.

B. Ambient Conditions:
1. Temperature: 60 to 95 deg F.
2. Relative Humidity: 10 to 90 percent, non-condensing.
3. Filtered air supply.

C. Dimmer Cabinet Assembly: NRTL listed and labeled.

D. Cabinet Type: Plug in, modular, and accepting dimmers of each specified type in any plug-in position.
1. Integrated Fault-Current Rating: 10,000-A RMS symmetrical.

E. Lighting Dimmers: Solid-state IGBT dimmers.
1. Primary Protection: Magnetic or thermal-magnetic circuit breaker, also serving as the disconnecting means.

2. Dimmer response to control signal shall follow the "Square Law Dimming Curve" specified in IESNA (LH) "IESNA Lighting Handbook." 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 based on load type are not acceptable.
3. Dimming Range: 0 to 100 percent, full output voltage not less than 98 percent of line voltage.
4. Dimmed circuits shall be filtered to provide a minimum 350-mic.sec. current-rise time at a 90-degree conduction angle and 50 percent of rated dimmer capacity. Rate of current rise shall not exceed 30 mA/mic.sec., measured from 10 to 90 percent of load-current waveform.
5. Protect controls of each dimmer with a fuse and transient voltage surge suppression.

F. Non-dim modules shall include relays with contacts rated to switch 20-A tungsten-filament load at 120-V ac and 20-A electronic ballast load at 277-V ac.

G. Accessory function control modules shall be compatible with requirement of the accessory being controlled.

H. Digital Control Network:
1. Dimmers shall receive digital signals from digital network control stations that are linked to the dimmer cabinet with a common network data cable.
2. Functions of digital network control stations shall be set up at the dimmer cabinet's electronic controls that include indicated number and arrangement of scene presets, channels, and fade times.

~~~~~ PROJECT NOTE ~~~~~~
EDIT BELOW PER PROJECT SCOPE OF WORK
~~~ END OF PROJECT NOTE ~~~~

I. Emergency Power Transfer Switch: Comply with UL 1008; factory pre-wired and pre-tested to automatically transfer load circuits from normal to emergency power supply when normal supply fails.
1. Transfer from normal to emergency supply when normal-supply voltage drops to 55 percent or less.
2. Retransfer immediately to normal on failure of emergency supply and after an adjustable time-delay of 10 to 90 seconds on restoration of normal supply while emergency supply is available.
3. Integrated Fault-Current Rating: Same value as listed for the panel.
4. Test Switch: Simulate failure of normal supply to test controls associated with transfer scheme.

J. Emergency Lighting Bypass Device: UL 924 listed and labeled solid state, electronic, relay-based device providing for luminaires connected to an emergency lighting branch circuit to be controlled, under “normal” operating conditions, and, upon loss of “normal” AC power, bypass all connected control functions and settings, forcing the connected emergency luminaires on to full brightness.
1. Remote Testing: Provides for a remote test input from a remote test switch, or fire alarm/security system alarm interface device.
2. Visual Feedback: LEDs provide indication of which AC power source (normal or emergency) is presently serving the connected load.

2.09 PORTABLE COMPUTER

A. Description: As recommended by master-control station manufacturer, to program master station and associated wall stations, and all interconnected master stations. Portable computer shall be laptop style with a battery runtime of at least two hours. Display shall be

an 11-inch interactive-matrix LCD and shall have required hardware, firmware, and software to program specified control functions of master-control stations.

B. Software shall be configured and customized by master-station manufacturer.

2.10 MANUAL SWITCHES AND PLATES

A. Switches: Modular, momentary pushbutton, low-voltage type.
   1. Color: White unless otherwise indicated.
   2. Integral Pilot Light: Indicate when circuit is on. Use where indicated.
   3. Locator Light: Internal illumination. Use where indicated.
   4. Wall Plates: Comply with requirements in Section 26 27 26 - Wiring Devices, finish, and color. Use multi-gang plates if more than one switch is indicated at a location.
   5. Legend: Engraved or permanently silk-screened on wall plate where indicated. Use designations indicated on Drawings.

2.11 CONDUCTORS AND CABLES

A. Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables.

B. Classes 2 and 3 Control Cable: Multi-conductor cable with stranded-copper conductors not smaller than No. 18 AWG. Comply with requirements in Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables.

C. Class 1 Control Cable: Multi-conductor cable with stranded-copper conductors not smaller than No. 14 AWG. Comply with requirements in Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables.

D. Unshielded, Twisted-Pair Data Cable: Category 6. Comply with requirements in Section 27 15 00 - Data Communications Horizontal Cabling.

PART 3 EXECUTION

~~~~~ PROJECT NOTE ~~~~~~
WIRING METHODS TO BE INDICATED ON DRAWINGS.
~~~ END OF PROJECT NOTE ~~~~

3.01 WIRING INSTALLATION

A. Comply with NECA 1.

B. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points. Separate power-limited and non-power-limited conductors according to conductor manufacturer's written instructions.

C. Size conductors according to lighting control device manufacturer's written instructions unless otherwise indicated.

D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

E. Install dimmer cabinets for each zone.

F. Protect installation from dust and debris of other construction activities.

3.02 IDENTIFICATION

A. Comply with requirements in Section 26 05 53 - Identification for Electrical Systems for identifying components and power and control wiring.

B. Label each dimmer module with a unique designation.

C. Label each scene control button with approved scene description.

3.03 FIELD QUALITY CONTROL

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

B. Tests and Inspections:

1. Continuity tests of circuits.
2. Operational Test: Set and operate controls to demonstrate their functions and capabilities in a methodical sequence that cues and reproduces actual operating functions.
    a. Include testing of dimming control equipment under conditions that simulate actual operational conditions. Record control settings, operations, cues, and functional observations.
3. Emergency Power Transfer: Test listed functions.

C. Remove and replace malfunctioning dimming control components and retest as specified above.

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

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

3.04 CLEANING

A. The contractor shall remove all paint spatters and other spots, dirt and debris from the equipment. Clean equipment and devices internally and externally using methods and materials recommended by the manufacturer.

3.05 CONTRACTOR STARTUP AND REPORTING

A. Contractor shall prepare and submit a complete set of record drawings, operation and maintenance data and certificates as outlined in this Section.

3.06 COMMISSIONING AND DEMONSTRATION

A. After system checkout and adjustment, the contractor shall operate the system for the review of the Board and architect. Necessary adjustments or modifications shall be made as required by the Board or Architect/Engineer of Record.

B. Engage a factory-authorized service representative to train Board's maintenance personnel to adjust, operate, and maintain central dimming controls. Laptop portable computer shall be used in training.

END OF SECTION