SECTION 16510 – LIGHTING

PART 1 – GENERAL

1.1 DESCRIPTION OF WORK:

A. Furnish and install all lighting luminaries, with all necessary accessories and lamps as shown, specified and/or scheduled.

1.2 RELATED SECTIONS:

A. See Section for Lighting Control Systems.

B. See Section 16010 or Section 16012 for requirements for submittals.

C. See Division 1 for allowances and Owner-furnished items to be installed under this Section.

1.3 ABBREVIATIONS:

A. H.I.D. – High Intensity Discharge (High Pressure Sodium, Mercury Vapor, Metal Halide).

1.4 SUBMITTALS:

A. Shop drawing submittals for luminaries shall include the following for each Luminaire: Complete construction details including all dimensions, complete description of materials used, complete electrical data (including operating voltage), photometric test report from an independent testing lab, complete description of finish, and manufacturer catalog cut sheet of lamp to be used.

PART 2 – PRODUCTS

2.1 LUMINAIRES:

A. Furnish and install luminaries as shown in the Lighting Fixture Schedule, or otherwise indicated on the drawings. Manufacturer catalog numbers shown are for general descriptive purposes only, and are intended only to establish the standard of quality.

B. Locations of luminaires on electrical drawings are diagrammatic. Verify location of luminaires with architectural drawings prior to installation. Conflicts between electrical and architectural drawings shall be referred to the Architect for resolution.

C. Provide luminaires complete with all options, accessories and other appurtenances required for a complete installation. Contractor shall verify type of ceiling and wall construction being installed, and provide luminaires properly configured for the type of construction.

D. All luminaires shall be UL listed for the application being installed.

E. Exit signs shall be furnished with 6" high letters with ¾" stroke. Verify color of signage required by local code authorities. Signs shall meet all NFPA, UL and local building code requirements.

F. Pendant stem mounted luminaires shall be furnished with ball aligner swivel, 30 degrees from vertical minimum, with swivel below canopy, with ½" diameter metal tube (stem).

G. Plastic lenses and shielding shall meet NFPA and local building code requirements for light transmitting plastics.

H. Metal luminaire housings shall be free of tool marks, dents, burrs and sharp edges. All metal parts shall be painted, galvanized or otherwise corrosion-resistant.

I. Reflector surfaces shall be finished specular, semi-specular, diffuse or painted as indicated. Specular finish materials shall have a minimum reflectance value of 83%. Semi-specular or diffuse finish shall have reflectance of 75% and white painted finish materials shall have reflectance of 88%.

J. Luminaire support wires shall be zinc-coated, soft temper ASTM A641/A641M steel, 12 gages.

2.2 BALLASTS AND TRANSFORMERS:

A. All ballasts and transformers used in luminaires shall be ETL approved and/or UL listed. Transformers for low-voltage lighting systems shall be UL listed for that application.

B. Interior ballast noise level essentially quiet in normal ambient noise level.

C. Ballasts provided to function without interruptions when operating in room ambient temperature of 80 degree F. and plenum operating temperature of 120 degree F.

D. Luminaires installed in environments with ambient temperature below 32 degree F shall be provided with ballast appropriately rated for the ambient environment.

E. Ballasts for each lamp type shall use a consistent form factor for all luminaires throughout the project using that lamp type.

2.3 FLUORESCENT BALLASTS:

A. Electronic Ballast: Rapid Start, Low THD:

1. Furnish fluorescent luminaires with rapid start lamps and rapid start high-frequency electronic ballasts.

2. Ballast shall be high frequency (20 KHZ or greater) operate lamp without detectable flicker and provide full light output. Ballast shall operate lamp within ANSI guidelines for lamp starting and lamp operation. Ballast shall be warranted for five (5) years. Ballast shall be "Universal Voltage" (able to operate 120V or 277V). Ballast shall incorporate circuiting to detect "end-of-life" of lamp and shut down ballast operation.

3. Ballast shall comply with FCC and NEMA limits governing EMI and RFI and shall not interfere with the operation of other electrical equipment. Total Harmonic Distortion shall be less than 10%. Power Factor shall be greater than 0.98%. Ballast/lamp system shall meet the following (T8 lamps are used to establish level of performance. Provide ballast required to properly operate lamp specified in luminaire schedule or as required by luminaire manufacturer):

a. T8 Lamps:

Configuration	Ballast Factor	Ballast Efficiency Factor
2-lamp	0.88	1.45
3-lamp	0.86	.92

b. Approved Ballast Manufacturers:

1) Advance, Universal or Osram/Sylvania, ESI, Howard Industries.

2.4 COMPACT FLUORESCENT BALLASTS:

A. Electromagnetic Ballast (13 watt or less):

1. Compact fluorescent luminaires with pre-heat type lamps (integral starter) shall be furnished with compatible electromagnetic ballasts.

2. Ballast shall be equipped with UL recognized non-PCB containing capacitor, and a core and coil protector. Ballast shall be high power factor, UL listed Class P, and shall operate lamps within ANSI guidelines for lamp starting and operation.

B. Electronic Ballast (13 watt and higher):

1. Compact fluorescent luminaires with rapid start lamps (without integral starter) shall be furnished with programmed rapid start electronic ballasts.

2. Ballasts shall be series wired, THD<10%, minimum starting temperature of 0°F, maximum case temperature of 70°C, and allow remote mounting up to 18 feet. Ballast factor to be 0.95-1.05 for Normal Light Output. Ballast input voltage shall be Universal Voltage (120V through 277V).

3. "Triple-tube" (aka. PLT, "hex" tube, or CFM) compact fluorescent lams shall be furnished with electronic ballast that will operate 26, 32, or 42 watt lamps.

4. Approved ballast manufacturers: Advance, ESI, Universal, Robertson, Osram/Sylvania.

2.5 HIGH INTENSITY DISCHARGE BALLASTS:

A. Metal Halide:

1. Furnish Metal Halide luminaires with Auto-Regulating or Constant-Wattage Auto transformer ballast. Ballast shall be high power factor (PF > 0.9) and operate lamp within ANSI standards for lamp starting and operation. Ballast shall regulate lamp power within 10% with line voltage variation of +/- 10% and shall keep lamp energized with line voltage drop not exceeding 30%.

2. Furnish pulse start luminaire/lamp system where indicated. Pulse start ballasts shall be linear-reactor on super CWA type.

B. Furnish High Pressure Sodium luminaires with Auto-Regulating ballast. High color-rendering High Pressure Sodium lamps shall be provided with magnetic regulating ballasts. Ballast shall be high power factor (PF > 0.9) and operate lamp within ANSI standards for lamp starting and operation. Ballast shall regulate lamp power within 3% with line voltage variation of +/- 10% and shall keep lamp energized with line voltage drop not exceeding 30%.

C. Approved HID Ballast Manufacturers:

1. Advance, Universal, Valmont, Venture, Howard Industries.

2.6 LAMPS:

A. Furnish lamps for all luminaires as specified in Luminaire Schedule, otherwise provide lamp as recommended by luminaire manufacturer.

B. Lamps shall be new, delivered to the project site in their original packing, and shall be of the same manufacturer for each luminaire type. Install lamps immediately prior to Owner's occupancy. Do not use lamps for construction purposes.

C. Warranty lamps as follows:

1. Incandescent – one month.

2. Fluorescent and HID – three months.

3. Warranty begins from date of substantial completion.

4. All lamps shall be free of defects and covered by an implied warranty based on industry – accepted lamp mortality. Lamps failing at a higher than normal rate shall be replaced upon determination of cause of failure or defeat.

D. Incandescent lamps:

1. Standard Shape A-lamp shall be medium base, 120 volt rated, inside frosted. Provide 120V lamps for dimmed circuits.

2. PAR lamps shall be medium base, 120 volt rated quartz-halogen.

3. Provide 120-volt lamps for dimmed circuits. Use infrared (IR) conserving lamps whenever possible.

4. Low-Voltage Quartz-Halogen lamps shall be 12 volt with cover glass. Use Infrared (IR) conserving lamps whenever possible.

5. MR-16 lamps shall have metalized reflector to minimize color shift between lamps. Osram/Sylvania "Titan", or G.E. "Constant Color Precise".

E. Fluorescent lamps:

1. All fluorescent and compact fluorescent lamps shall be compatible with ballast provided with luminaires to operate lamp within ANSI and NEMA guidelines. Provide lamps with low mercury content (federal EPA TCLP complaint a.k.a. "ECO" and "ALTO").

2. T8 lamp type: Lamps shall have an average rated life of 20,000 hours, minimum of 2800 lumens and 80 CRI.

3. Compact fluorescent (T4) lamp type: Compact fluorescent lamps shall either be single, double or triple tube type with 4-pin bases for operation on electronic and dimming ballasts. Where available, lamps shall contain end-of-life sensing to prevent overheating of lamp base and sockets. Lamps shall have a minimum CRI of 82.

4. Compact fluorescent (T5) lamp type: Lamps shall have a 2G11 base and operate on electronic ballasts. Lamps shall have a minimum CRI of 82.

5. Linear T5 fluorescent lamp type: All linear T5 fluorescent lamp types shall have miniature bi-pin bases, 20,000 hours average rated life, a minimum CRI of 82.

F. High Intensity Discharge (HID) Lamps:

1. All high intensity discharge lamps shall be operated on the appropriate ANSI designated electromagnetic ballast in accordance with ANSI C82.4.

2. Metal halide lamps: All metal halide lamps used in interior applications shall be coated, unless otherwise noted in the lighting fixture schedule. Otherwise, provide clear or coated lamp as recommended by luminaire manufacturer. All metal halide lamps used in open aperture luminaire shall contain a protective shroud/other suitable containment material for use in open fixtures (“O” rated).

3. High-pressure sodium lamps: All HPS lamps shall have an average rated life of 24,000 + hours. All HPS lamps shall have a lead-free solderless base, to provide superior electrical contact in lampholder throughout lamp life.

4. Low pressure sodium lamps: All LPS lamps shall have a non-metallic bayonet base for safe re-lamping, sodium retaining reservoirs, U-bend insulation to control lamp wattage rise, arc tube support system to protect arc tube from shock and vibration, uniform indium oxide heat reflecting coating, barium getter, triple coil electrodes and a fuse coil in the lamp base.

G. Approved Lamp Manufacturers:

1. General Electric, Osram/Sylvania, Philips, Venture.

2.7 EMERGENCY LIGHTING:

A. Provide luminaires and exit signs with self-contained battery power supplies as indicated. All equipment shall conform to UL924-Emergency Lighting and Power Equipment.

B. Battery shall be sealed, maintenance-free lead-acid type (indoors) or nickel-cadium (outdoors or unconditioned spaces) with 10-year nominal life. Unit shall incorporate a fully-automatic solid-state charger and automatic transformer relay to transformer to backup battery power supply upon failure of normal power.

C. Fluorescent emergency ballasts shall be self-contained battery-inverter units mounted within the luminaire housing. In emergency operation, lamps shall operate continuously for a minimum of 90 minutes. Once normal power is restored, the unit shall automatically transfer to charging mode. The ballast shall produce light output (minimum) as follows:

Lamp Type	Lumen Output
F32T8	1350 Lumens
FT40	900 lms
CFM42W/32W	750 lms
CFQ26W	600 lms

D. All emergency lighting equipment shall be equipped with means to test operation and an LED indicating battery status.

2.8 POLES AND STANDARDS:

A. Poles should conform to AASHTO LTS-3 standards for structural design. Poles shall be designed to withstand prevailing wind conditions with a gust factor of 1.3.

B. Pole manufacturer shall coordinate with luminaire manufacturer to ensure adequate strength to support the fixtures specified. Pole shall be furnished with all appropriate mounting hardware, fasteners and supports for installation of the luminaire (s).

C. All pole hardware and fasteners shall be stainless steel or other corrosion-resistant materials if stainless steel is not compatible with structural material.

D. Pole manufacturer shall provide a plywood or steel anchor-bolt template to assist installer in preparing pole foundation. Template shall indicate luminaire orientation to ensure proper light distribution.

E. Provide power-installed screw foundation where indicated. Screw foundation shall be fabricated with hot-dip galvanized structural steel (ASTM A36/A36M) of sufficient strength to support pole and luminaire. Mounting plate and bolts shall be coordinated to match pole.

F. All poles shall be provided with a wiring hand hole per National Electrical Code requirements.

G. All poles shall be provided with grounding lug bonded to metal components of the pole. The lug shall be accessible through the hand hole.

H. All poles shall be furnished with anchor bolt/base plate covers. Cover shall match pole material and finish.

I. Steel poles shall be pre-finished inside and out, either hot-dip galvanized or prime-coat enamel to prevent corrosion.

PART 3 – EXECUTION

A. Support luminaires from structure of the building, independent from the ceiling membrane or finish material. Luminaire shall be set level, plumb, and square with ceilings and walls.

B. Recessed lay-in luminaires in suspended grid ceilings shall be supported from the ceiling grid. Provide devices for securing the luminaire to the ceiling grid to comply with the National Electrical Code ("earthquake clips"). Provide independent support wires, anchored to structure above and attached to fixture at each corner.

C. Recessed luminaires in fire-rated ceiling assemblies shall be installed in accordance with the UL listing of the assembly.

D. Recessed luminaires (non lay-in or hard ceiling types) shall be supported by ¾" steel ceiling channel, or factory-supplied hanger bars one on each side of the luminaire, anchored to ceiling structure. Recessed luminaires heavier than 20 pounds shall have supplemental support anchored to the structure above the ceiling. Do not use conduit to support luminaire.

E. Provide recessed luminaires with appropriate frames, hardware and trim for the ceiling installed.

F. Install luminaires free and clear of structural and mechanical interferences above the ceiling. If location indicated on the drawing conflicts with other elements, notify the Architect for directions for remedial action.

G. Attach surface and pendant mounted luminaires to 3/16" fixture stud in outlet box. Luminaires in excess of 20 pounds shall have supplemental support anchored to the structure above the ceiling.

H. Luminaires surface mounted to grid-type ceilings shall be mounted with Caddy IDS type clips anchored to structure above.

I. Wall mounted luminaires shall be anchored to wall structure. Luminaire shall fully conceal the outlet box.

J. Wiring to luminaires shall be with flexible metallic conduit to junction box. Do not wire luminaire to luminaire unless noted otherwise, or if using manufactured wiring systems.

K. Individual flexible connections under 6 feet in length shall consist of 2 #14 and 1 #14 (ground) in flexible metallic conduit (for circuits 20A or less). Bond ground wire and conduit at each end.

L. Recessed luminaires in insulated ceilings shall be installed so that insulation is no less than 3 inches away from the fixture enclosure unless the luminaire is listed for direct contact with insulation (IC rated).

M. Provide equipment, labor and materials, as needed for final aiming of adjustable luminaires. Aiming shall take place immediately before final occupancy by the Owner.

N. Exterior pole-mounted luminaire with anchor base type poles shall be installed on a reinforced concrete foundation designed to withstand fixture weight and prevailing wind conditions. Conduit raceway shall be pre-set in the foundation and inside the pole.

O. Provide a copper-clad steel grounding rod, installed and bonded at each lighting pole.

P. Exterior pole-mounted luminaires with direct-embedment type poles shall be installed in carefully compacted earth per pole manufacturer's recommendations.

Q. All poles shall be installed so that the pole is plumb to the earth, with the bottom of the base flush to the foundation, paving, or finished grade, unless indicated otherwise. Verify soil conditions at each pole location to ensure adequacy of soil to support pole. Advise Architect if soil conditions are not adequate.

R. All pole-mounted luminaires shall have in-line fuse installed at the hand hole of the pole with weatherproof fuse holder. Provide sufficient slack in conductors to allow servicing outside of pole.

S. Reflectors, trim cones, and other visible trim of luminaires shall not be installed until completion of ceiling work, and shall be clean and free of dust, fingerprints, scratches, dents, etc. upon substantial completion.

END OF SECTION 16510