ITEM 670.95XXNN08 – SOLAR POWERED LIGHT EMITTING DIODE (LED)
DECORATIVE LUMINAIRE, ARM(S) AND POLE

DESCRIPTION
The work shall consist of furnishing and installing a solar powered light emitting diode (LED) decorative luminaire, pole with arm(s) and foundation in accordance with the contract documents and as directed by the Engineer.

This payment item shall include:
- LED type decorative luminaire at the designated wattage,
- Controller,
- Batteries,
- Solar panel,
- Cabinet,
- Pole,
- Arm(s),
- Wiring harness for the wattage and operating time up to 15 hours of peak light level per day, and
- Mechanical mounts to the pole for the luminaire, solar panel, and cabinet.

The foundation and conduit shall be paid for under separate payment items.

DEFINITIONS OR TERMS
Within this specification the following definition or terms apply:
Luminaire shall be defined as the entire light assembly including but not limited to the slipfitter, painted metal housing, reflector, refractor, LEDs, LED module, lens, terminal block, driver circuitry, a twist-lock three prong receptacle for a photo-electric control for a complete outdoor weatherproof unit ready for mounting.

LED module or LED array is the modular replaceable cluster of LEDs assembled together on a circuit board or assembly and inserted in the luminaire. One or more LED modules shall provide the illumination of the luminaire.

LEDs are the individual diodes that produce the illumination.

All provisions of Section 670 shall apply to this specification except as modified below:

MATERIALS
Electric Lamps - Specifications for the Chromaticity of Solid-State Lighting Products
ANSI C78.377

Electrical and Photometric Measurements of Solid-State Lighting Products
IESNA LM-79

Measuring Luminous Flux and Color Maintenance of LED Packages, Arrays and Modules
IESNA LM-80
1. **Luminaire**

The luminaire description of the proper size and type as shown on the plans shall be submitted for approval prior to being furnished.

The Off-state Power Consumption power draw of the luminaire (including PE or remote control devices) shall be minimal, under 2 watts, when in the off state.

The luminaires shall:
- Be light emitting diode (LED) type designed for outdoor use,
- Be modular in design,
- Be fully weatherproof,
- Be shock resistant,
- Be vandal resistant,
- Be constructed so to provide a complete self contained insect resistant,
- Operate on 12 volt DC or 24 volt DC power. The luminaire and batteries shall operate at similar voltages,
- Be “Dark-Sky Friendly” compliant, directing no illumination above horizontal,
- Provide Ingress Protection rating of IP-66 as detailed in IEC60529,
- Have an IESNA light distribution as specified on the plans. The luminaire shall be available in a Type II, III or IV light distribution measured per the requirements of IESNA LM-79,
- Have a minimum Color Rendering Index (CRI) of 65 - 70 as measured per the requirements of IESNA LM-79,
- Have a luminous performance not be less than 50 lumen/watt delivered, where the total light output is divided by the total power input,
- Be completely pre-wired, at the factory, requiring only the connection of the primary circuit wires to the electric power source for its operation,
- Be provided with a means to prevent accidental exposure of the inner electrical components and accidental separation of the component parts,
- Have metallic component parts made of a rust-resistant alloy or coated with an approved rust resistant finish. Weep holes shall be provided for drainage. Easy access to the LEDs and major electrical components shall be provided requiring no special tools to gain entrance for maintenance purposes,
- Contain a complete power assembly to which are mounted the necessary electrical components for DC operation, solid state starting, adjustable twistlock three prong receptacle for photo-electric control when specified, and a dead back terminal board with pressure type terminals.
  - The power assembly shall be capable of starting and operating the lamp at a temperature of minus twenty nine degrees Celsius to sixty degrees Celsius. The modular power assembly shall be readily removable as a single unit and utilize quick disconnect plugs.
- Be possible to mount on a metallic mast arm attached to the pole.
  - The metallic arm for holding the light assembly should be extended from the pole as shown on the plans and set at a suitable angle to maximize uniform illumination of
desired level over the specified area

**Luminaire LED**
The luminaire light source shall be high-intensity white LEDs.
- Multiple LEDs can be used.
- The light output from the white LED light source should be constant throughout the duty cycle.
- The color temperature of white LEDs used in the system should be in the Correlated Color Temperature (CCT) range of 4000 - 5000 degrees K as measured per the requirements of IESNA LM-79. Use of LEDs which emit ultraviolet light is not permitted.
- LED module(s)/array(s) and the luminaire shall deliver at least 70% of initial lumens, when in use for a minimum of 50,000 hours as measured per the requirements of IESNA LM-80.
- The LEDs should be mounted in a LED module or array that is suitable for outdoor use.
- Access to the LEDs shall be by a cast aluminum door. The door assembly shall be hinged to the unit and protected by a safety chain. The door shall be equipped with stainless steel pressure latches and weatherproof, bug resistant gaskets. The latches shall secure the lamp access door and hold it firmly against the gaskets. The latches and door assembly shall be designed so that tools are not required to gain entrance to the luminaire for re-lamping purposes.
- The luminaire’s LED passive cooling system shall consist of a heat sink with no fans, pumps or liquids and shall resist debris buildup.

**Luminaire Casing**
The luminaire casing shall have the following specifications:
- Precision die-cast aluminum for the specified wattage,
- Painted inside and out with a coat of baked on epoxy enamel, or polyester powder,
- Virtually pinhole free, leaving no exposed metal,
- Casing color shall be as specified on the contract plans and details; a color chip shall be provided for color approval, and
- Marked with the standard NEMA decal on the underside of the luminaire, so that the decal is visible from the ground. The decal shall indicate the type LED and wattage of the luminaire.

**Slipfitter with Bird Shields**
The slipfitter shall be suitable for mounting on a standard pipe bracket and capable of securely fastening flush to the mounting brackets without the need of separate mounting parts or rearrangement of mounting components. Leveling and clamping of the luminaire to the bracket shall be accomplished by the tightening of bolts and be capable of adjusting the luminaire at least three degrees above and below horizontal. Bird shields shall be supplied and installed on all slipfitter installations.

2. **Controller**

**General**
The controller shall monitor the luminaire light output, battery usage, charging and power consumption and provide a timer for time of day on-off operation. The controller shall manage
light output. The light output should remain constant with variations in the battery voltages.

The controller should have protection against battery overcharge and deep discharge conditions. The numerical values of the cut off limits must be specified, while submitting the samples for the testing purposes.

**Controller Electronics**
Electronics should operate at 12 VDC or 24 VDC and should have temperature compensation for proper charging of the battery throughout the year. The operating voltage shall match the luminaire voltage. The total electronic efficiency should be at least 80%.

Necessary lengths of wires, cables, switches suitable for DC use and fuses should be provided. Fuses should be provided to protect against short circuit conditions.

A blocking diode should be provided as part of the electronics, to prevent reverse flow of current through the Photovoltaic (PV) module(s), in case such a diode is not provided with the PV module.

Full protection against open circuit, accidental short circuit and reverse polarity should be provided.

**Controller Clock**
The controller clock shall provide time of day operation for powering the luminaire on at dusk and off at a specified time after continuous operation for a number of hours, adjusted for seasonal and daylight savings time operation. When specified in the contract documents, the controller clock shall be controlled by the optional Photo-Electric Cell.

**Controller Timer**
The controller timer shall be a multi-purpose digital single channel timer design specifically for lighting applications. It shall be programmable in AM/PM and 365 day format with a separate schedule for each day for the week. It shall have daylight saving or standard time, automatic leap year correction and astronomic 1-99 minute, plus or minus offset from sunrise to sunset. It shall have a manual ON/OFF override and a 30-day back up using a replaceable 9V lithium Battery.

3. **Battery**
The batteries shall be sized to power the luminaire for a minimum of six (6) days of fifteen (15) continuous hours of use. The batteries shall have an additional 30% excess storage capacity beyond the six (6) day requirement. Reduced battery capacity due to environmental temperature effects shall not exceed 20%.

The batteries shall be self-contained gel type or AGM deep cycle, maintenance free and provide power at 12 volts DC.

The batteries shall be wired to provide 12 VDC or 24 VDC power as needed. The solar panel and batteries shall be provided with similar operating voltages maximizing the panel capacity to
charge the batteries. The luminaire and batteries shall be provided with similar operating voltages.

Each battery shall not exceed 77 lbs.

The batteries shall be housed with the controller in the cabinet.

4. **Cabinet**

   The pole cabinet shall be:
   - Sized to house the controller, batteries and miscellaneous power equipment,
   - Constructed of aluminum alloy type 5052-H32 to provide a strong rigid construction,
   - Weatherproof with a NEMA 3R rating,
   - Constructed to accommodate the weight of the components enclosed, reinforced and heliarc welded for rigidity and mounting,
   - Welded with welds that are neatly formed and free of cracks, blowholes and other irregularities, and
   - Free of burrs on the inside and outside edges of the cabinet.

   Deviations to the cabinet design shall be reviewed and approved.

   **Doors and Door Hardware**

   The cabinet door shall:
   - Be constructed of type 5052-H32 aluminum alloy to provide a strong rigid construction,
   - Have openings double flanged on all four edges to increase strength around the openings and keep dirt and liquids from entering the enclosure when the doors are open, and
   - Have welds that are neatly formed and free of cracks, blowholes and other irregularities, and all inside and outside edges of the cabinet shall be free of burrs.

   **Door Hinges.** The door hinges shall have a stainless steel hinge pin, and no hinge leaves shall be exposed externally when the door is closed. The hinge pin shall be capped top and bottom by weld to render it tamper proof.

   **Door Restraint.** A door restraint shall be provided to prevent door movement in windy conditions. The doors shall be furnished with a gasket that satisfies the physical properties as found in UL508 table 21.1 and shall be a weather tight seal between the cabinet and door.

   **Door Latching Mechanism.** The door shall have a latch.

   **Door Handles.** Each door shall include one (1) stainless steel handle, keyed deadbolt type lock, and shall have provisions for a padlock when the handle is in the closed position. Two (2) keys shall be furnished with each lock.

   **Sun Shields.** A sun shield shall be provided on the top, the two sides and the doors of the Cabinet to reduce the cabinet internal ambient temperature, if required. The shield shall be in the form of aluminum sheets, mounted with tamper-proof hardware to the cabinets. The areas described above shall be covered, except for the handle and the padlock locations, and the top
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sun shield shall be crowned in a similar manner to the cabinet top.

Ventilation. The cabinet shall be provided with a passive ventilation system. Louvers shall satisfy the NEMA rod entry test for 3R ventilated enclosures. Exhaust air will be vented out between the top of the cabinet and door. The exhaust area shall be screened with a material having a minimum hole diameter of 1/8 in.

Cabinet Finish. The cabinet exterior including sun shields shall be finished as indicated in the plans. The Contractor shall submit a sample and description of the finish application process for approval. The cabinet shall be painted powder coated to a color as specified on the contract plans and details, a color chip shall be provided for color approval.

Cabinet Grounding. The grounding shall consist of a conduit through the foundation and shall be paid for under separate payment items.

5. Pole and Arm(s)
   The pole and arm(s) shall:
   • Be manufactured at the height, diameter and wall thickness necessary to support the lighting, battery cabinet and solar equipment,
   • Have an ornamental style and the architectural treatments that correspond with the decorative features shown in the contract documents, and
   • Be powder coated as specified in the contract documents (a color chip shall be submitted for approval prior to ordering).

Pole
   The pole shall accommodate a decorative luminaire with a single or twin arm, up to two solar panels atop the pole and a battery cabinet mounted 2 ft from the pole base. Each luminaire shall be furnished with an arm of the length specified on the plans. The pole shall be supplied with a breakaway transformer base that has a hinged panel to access the pole base wiring.

   The pole shall be supplied with a handhold, a wire inlet with bushing and ground lug at the cabinet elevation shown in the contract documents. Each pole shall be grounded through the foundation to a ground rod.

6. Solar Panels
   One or two solar panels shall supply the power to the batteries. This solar panel array shall
   • Be made of monocrystalline or polycrystalline solar cells.
   • Have an Ingress Protection rating of IP-65 as detailed in IEC60529.
   • Be properly sized for the total luminaire wattage for the daily operating time, geographic location, area sunlight intensity (insolation) associated losses and with 30% excess capacity.
   • The solar panel mount shall be adjustable horizontally and vertically to adjust toward the sun.

Operating Voltages
   The solar panel and batteries shall be provided with similar operating voltages maximizing the
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panel capacity to charge the batteries. The associated power calculations for the solar array and battery size and quantity shall be submitted for approval prior to being furnished.

Solar Panel Mount and Frame
The frame structure to be fixed on the pole to hold the solar panel module shall:
- Be metallic (with corrosion resistant paint),
- have provision to adjust its angle of inclination to the horizontal between 0 and 45, so that it can be installed at the specified tilt angle, and
- Have provisions to adjust for a 360 degree horizontal orientation, so that it can be installed at the specified orientation toward the sun.

BASIS OF MATERIAL ACCEPTANCE
Acceptance of all materials described in all applicable specifications will be based on manufacturer's certification of compliance with the measurement, performance and safety standards (listed above).

SUBMITTALS
The Contractor shall supply a color chip(s) prior to ordering any luminare, controller, cabinet, pole, arm or solar panel.

The Contractor shall supply catalog cuts of luminaires to ensure consistency with ornamental style and the architectural treatments shown in the contract documents. This shall be supplied for review and approval prior to ordering.

Shop drawings (described in CONSTRUCTION DETAILS) shall have luminaire documentation in the form of independent laboratory testing showing compliance with ANSI C78.377, IESNA LM-80, IESNA LM-79 and IEC 60529.

Quality Certification
The manufacturer of the white LED based solar lighting system are required to provide a detailed report on the tests performance by independent laboratory and the actually measured values of Solar Panel (photovoltaic) module, electronics, LEDs, luminaire and battery and other related parameters, as per Measurement/Performance/Safety Standards.

CONSTRUCTION DETAILS
The Solar Powered LED Decorative Luminaire of the type and wattage specified, complete with luminaire, controller, cabinet, batteries, pole, foundation, mast arm and solar panel arrays shall be installed and made operational according to manufacturer’s instructions and as shown in the contract documents. Solar Panels shall be mounted atop the pole, facing south at a 45 degree angle with the horizon and not interfere with the luminaires or mast arms. When installed, the cabinets shall be grounded in accordance with §608-3.12.

SHOP DRAWINGS
In addition to the requirements in §670-3.02, shop drawings shall:
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- Be signed by a licensed and registered Engineer,
- Include complete cut-sheets and shop drawing of all components, mounting procedures and calculations,
- Show structural compliance with specifications of the pole, mast arm, luminaire, solar panel array, cabinet and foundations,
- Show compliance with specifications regarding the power system and load calculations.

SUBMITTALS
An Operation, Instruction and Maintenance Manual should be provided, in English, with the solar street lighting system. The following minimum details must be provided in the manual:
1. White LED solar street lighting system - its components and expected performance
2. Photovoltaics (PV). The manufacturer, make, model number, country of origin and technical characteristics.
3. PV module
4. Clear instructions about mounting of PV module.
5. White LED Lights. The manufacturer, make, model number, country of origin, full binning number and technical characteristics of LEDs should be stated in the product data sheet and furnished with IESNA test results
6. Battery and electronics used
7. Charging and significance of indicators.
8. Clear instructions on controller operation, settings and trouble shooting.
9. Clear instructions on operation, regular maintenance and trouble shooting of solar street lighting system.
10. Name and address of the person or service center to be contacted in case of failure or complaint.

BASIS OF WORK ACCEPTANCE
Acceptance testing of the Solar Powered LED Decorative Luminaire system occurs after installation and final inspection and acceptance of the unit and shall last for a period of two (2) weeks. Any failure of the unit shall be repaired and defective components replaced by the contractor during this period at no expense to the State and the acceptance test shall restart for another two (2) week period.

METHOD OF MEASUREMENT
The work will be measured as the number of each Solar Powered Light Emitting Diode (LED), Decorative Luminaire, Pole with arm(s) furnished and installed.

BASIS OF PAYMENT
The unit price bid for each Solar Powered LED Decorative Luminaire, Pole with arm(s) shall include the cost of all materials, equipment and labor necessary to satisfactorily complete the work.

Payment schedule shall be as follows:

1. 75% of the bid price after installation and successful inspection by the Engineer
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2. 15% of the bid price after receipt of all documentation (manuals) and completion of the training.
3. 10% of the bid price after successful completion of acceptance testing.

Payment will be made under the following items:

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