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BY M3 INNOVATION

SECTION 16505 - OUTDOOR SPORTS FIELD LIGHTING (NEW SYSTEM)

PART 1 – GENERAL

1.1 SUMMARY

- A. Work covered by this section of the specifications shall conform to contract documents, engineering plans as well as state and local codes.
- B. The purpose of these specifications is to define the lighting system performance and design standards for insert name of school for the insert name of field(s) using an LED lighting source. The manufacturer / contractor shall supply the lighting systems to meet or exceed the standards set forth in these specifications.
- C. The lighting systems will be for the following venue(s):
 - 1. Baseball Field(s)
 - 2. Softball Field(s)
 - 3. Football Field(s)
 - 4. Track
 - 5. Multi-purpose field(s)
 - 6. Tennis Courts
- D. The primary goals of this lighting project are:
 - 1. **Guaranteed Light Levels:** Selection of appropriate light levels impact the safety of the players and the enjoyment of spectators. Therefore, light levels are guaranteed to not drop below specified target values for a period of 10 years.
 - 2. **Environmental Light Control:** Minimize spill light to adjoining properties and glare to the players, spectators and neighbors. No up-light is permitted in the design.
 - 3. **Life-cycle Cost:** To reduce operating costs, the preferred lighting system shall be energy efficient and cost effective to operate. System energy consumption is to be maintained over the life of the system and will not increase as the system ages.
 - 4. **Control and Monitoring:** To reduce system and labor costs and allow for optimal operational flexibility of the lighting system, the customer requires a wireless control system. The system shall be capable of on/off/dimming to reduce energy consumption. The system shall be accessible via Wi-Fi, cellular and/or

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LAN connectivity and permit multiple users on site/remote control and scheduling/health monitoring to detect and monitor system usage and outages.

5. Provide an upgradable, modular design, for future modification and capability

1.2 LIGHTING PERFORMANCE

- A. Illumination Levels and Design Factors: Playing surfaces shall be lit to an average target illumination level and uniformity as specified in the chart below. Lighting calculations shall be developed, and field measurements taken on the grid spacing with the minimum number of grid points specified herein.
- B. Average illumination level shall be measured in accordance with the latest IESNA Sports and Recreational Area Lighting requirements.
- C. Illumination levels shall not drop below desired target values in accordance with latest IESNA Sports and Recreational Area Lighting - Maintained Average Illumination standards and shall be guaranteed for the full warranty period as specified herein.

Area of Lighting	Average Target Illumination Levels	Maximum to Minimum Uniformity Ratio	Grid Points	Grid Spacing
Baseball Infield	50fc	2:1	25	30' x 30'
Baseball Outfield	30fc	2.5:1	88	30' x 30'
Softball Infield	50fc	2:1	25	20' x 20'
Softball Outfield	30fc	2.5:1	92	20' x 20'
Multi-purpose Field	30fc	2.5:1	84	30' x 30'
Bleachers	5fc	10:1	118	10' x 10'
Football Field	50fc	2:1	72	30' x 30'
Track	20fc	4:1	48	30' x 30'

- D. Hours of usage: Designs shall be based on the following hours of usage:

Area of Lighting	Annual Usage Hours	10 Year Usage Hours
All Fields/Zones	400	4,000

- E. Color Temperature: The lighting systems shall have a color temperature of 5000K and a CRI of ≥ 70 .
- F. Luminaires must be listed on the QPL of Design Lights Consortium® to ensure minimum quality and energy-efficiency standards are met for qualification in energy efficiency programs.

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- G. Mounting Heights and Locations: To ensure proper aiming angles for reduced glare and to provide better playability, minimum mounting heights shall be as described below. Higher mounting heights may be required based on photometric report to ensure the top of the field angle is a minimum of 10 degrees below horizontal.

# of Poles	Pole Designation	Pole Height
6	P1-P6	70'

1.3 ENVIRONMENTAL LIGHT CONTROL

- A. Light Control for Luminaires: All luminaires shall utilize asymmetric optics designed to minimize glare and spill light while maintaining quality light for aerial play.
- B. All Luminaires shall be installed as downlights, aimed within +/- 5° parallel to the surface.
- C. Spill Control: To minimize impact on adjacent properties, maximum horizontal spill shall not exceed 0.5fc 150' from the edge of the fields. All luminaires shall be dark sky compliant at installed aiming angles.
- D. Photometric Report: A photometric report shall be provided to demonstrate the capability of achieving the specified performance.
- E. All lighting designs shall comply with NFHS and UIL standards

PART 2 – SPORTS LIGHTING SYSTEM DESIGN AND CONSTRUCTION

2.1 ACCEPTABLE MANUFACTURERS

- A. All components shall be designed and manufactured as a system. Pole structure and luminaire modules shall be provided from the below approved manufacturer. All substitutions must provide a complete submittal package for approval 10 days prior to bid.
1. M3 Innovation
 2. Other equipment manufactures capable of meeting or exceeding the requirement of this specification.

2.2 LIGHT STRUCTURE SYSTEM

- A. General description: The entire sports lighting system (poles and modules) must be supplied by a single entity. The complete lighting system shall consist of the listed equipment as follows:
1. Poles
 - a. Concrete encased, wood poles, direct burial steel poles, or direct burial steel stub base poles are allowed.

2. Pole Top Assembly

- a. LED modules and pole mounting hardware shall be integrated with no exposed wiring.
- b. Entire pole top structure (including luminaire, crossarm, and all other supporting components) :
 - i. Shall not exceed a total weight of 150 lbs
 - ii. Shall not exceed a total length of 10 Ft
 - iii. Shall not exceed a total EPA of 5
 - iv. Shall withstand 150 mph wind speeds and maintain aiming alignment
- c. Shall be a modular system, with interchangeable capability of white, UV, and RGB modules.
- d. Certified to UL 844 and ANSI C136.31, 3G vibration requirements
- e. Operating temperature range: -40°C to +75°C
- f. IP Rating: IP66
- g. L70 lumen depreciation rating: >160,000 hours
- h. All structural components shall be manufactured from Aluminum with a copper content of <0.03%, and an iron content <0.11% to prevent corrosion and pitting, and enhance ductility.
- i. Luminaire shall include custom optical grade/impact resistant silicone lensing.

3. Pole Base Assembly

- a. All drivers and control electronics shall be mounted remotely approximately 10' above grade.
- b. Drivers shall be self-contained and field replaceable without certified electrician
- c. Drivers shall be connected electrically through a backplane Printed Circuit Board (PCB) assembly to eliminate miswiring, shock, and in field damage.
- d. Drivers must have built in redundancy with auto-compensation to maintain constant light levels on playing surface
- e. Shall provide auxiliary power (VDC) to operate and control integral sensors.
- f. Shall have provisions for integrated battery backup to operate emergency egress lighting.
- g. Surge protection shall be provided at each pole base assembly equal to or greater than 100 kA with thermally fused metal oxide varistors (MOVs) with in-series gas discharge tube technology.
- h. Shall include individual fixture fusing, that is easily reconfigured in-field for single phase, and 3-phase inputs.
- i. Shall accept full range input voltages from 208VAC-480AC

- j. Power factor ≥ 0.95
- k. Drivers shall have projected lifetime of 130K hours
- l. The enclosures shall include driver, controller, fusing, and surge protection for all luminaires. Safety disconnect per circuit for each pole structure must be located in the enclosure.
- m. Operating Temperature -40°C to $+45^{\circ}\text{C}$
- n. Efficacy of ≥ 140 lumens/watt

4. Harness

- a. Wire harness complete with an abrasion protection sleeve, strain relief, and plug-in connections.
- b. Mid-point strain relief shall be supplied for all harnesses greater than 80Ft in length.

5. Controls

The control and monitoring system shall provide instant on/off/dimming capabilities and meet the following specifications:

- a. All control electronics shall be mounted at base of pole for ease of upgrade and replacement
- b. Wired and Wireless control
- c. Individual modular control to reduce energy consumption
- d. Schedule/control system via Wi-Fi, LAN and/or cellular connectivity for remote operation
- e. Store up to 25 pre-programmed scenes for manual on site operation
- f. IOS and Android compatible wireless control for multiple users
- g. Allow multiple user accounts with ability to assign various system permission levels
- h. Ability to schedule recurring events at fixed times
- i. Capable of in-field firmware/software upgrades
- j. Onsite and/or remote commissioning

2.3 FOUNDATIONS

- A. The pole foundations shall be designed for allowable stresses in accordance with latest AASHTO standards. Foundation must be designed by Structural Engineer licensed in the State of New York. Installation and structure shall be based on wind speed criteria of these specifications.
- B. Concrete material for concrete foundations – all concrete shall have minimum compressive strength of 3000 psi at 28 days. Concrete shall have maximum

water/cement ratio of 0.5. Foundation installation shall be in accordance with the latest edition of ACI 336, Standard Specifications for the Construction of Drilled Piers.

- C. Foundation strength – any concrete portions of the pole in which steel components that provide tension strength are contained, shall be allowed to harden for a minimum of 28 days before stress loads of pole attachment are applied.
- D. Provide steel caissons where required to hold back collapse of augured hole and concrete backfill as recommended by the foundation design engineer.
- E. Include excavation and removal of materials other than normal soils such as rock, caliche, etc.

2.4 POLE STRUCTURE

- A. The poles shall be designed for allowable stresses in accordance with latest AASHTO Standard Specification for Structural Supports for Highway Signs, Luminaires and Traffic Signals.
- B. The pole structure shall consist of a modular pole assembly. This shall consist of no more than two shaft components. No single component shall weigh over 1500 pounds to allow handling by light duty equipment in order to minimize damage to site.
- C. Embedment shaft section shall be a single piece round tapered shaft section. The taper rate and material cross section properties shall match the adjoining section. The lower shaft section shall be embedded into the earth a minimum distance of 10% of the free-standing height of the structure plus 2' or as recommended by engineer. The shaft section shall be galvanized in accordance with ASTM A123 specifications. The entire embedded shaft portion shall also be externally coated with Corrocote II epoxy coating or coal tar epoxy up to 6" above the ground line. Concrete stub pole sections are not acceptable due to excessive weight.
- D. Each section of pole shaft material shall be of single-ply material and be made from a single sheet of steel with no circumferential welded splices. The pole shafts cross-section shall be round. The pole shaft sections shall be high-strength steel meeting the requirements of ASTM A570 GR65 (65 ksi yield) and/or ASTM A595 GR55 (55 ksi yield).
- E. Pole shaft sections shall be hot dip galvanized in accordance with the requirements of ASTM A123 specifications. Each shaft assembly must be completely coated, inside and out, in a single dip. Double dipping will not be permitted in compliance to USGA (United States Galvanizing Association) recommended practices and procedures to prevent acid entrapment. All miscellaneous connecting hardware shall be galvanized in accordance with ASTM A153 specifications.
- F. The structure shall be designed for the combined effective projected area (EPA) and weight of all applicable accessories (i.e. Mako modular system and other components such as camera and sensor module). Concrete poles or pole sections are not acceptable due to excessive weight and mobilization costs.
- G. Wind loads – structure shall be based on the latest specifications of AASHTO and designed to withstand wind speeds of enter windspeed.

2.5 SAFETY

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- A. All system components shall be UL listed for the appropriate application.
- B. System must be equipped with emergency egress and bleacher lighting, with integral standalone power, for power outage.

2.6 ELECTRICAL

- A. The electrical power requirements for the sports lighting system shall meet the following specifications:
 - 1. Maximum total voltage drop: Voltage drop to the disconnect switch located on the poles shall not exceed three (3) percent of the rated voltage.
 - 2. Energy Consumption: The total system kW consumption shall be insert kW kW or less.

PART 3 – EXECUTION

3.1 SOIL QUALITY CONTROL

- A. It shall be the contractor's responsibility to notify the owner if soil conditions exist other than those on which the foundation design is based, or if the soil cannot be readily excavated. Contractor may issue a change order request/estimate for the Owner's approval/payment for additional costs associated with:
 - 1. Providing engineered foundation embedment design by a registered engineer in the State of New York for soils other than specified soil conditions.
 - 2. Additional materials required to achieve alternate foundation.
 - 3. Excavation and removal of materials other than normal soils, such as rock, caliche, etc.

3.2 DELIVERY

- A. Timing: The equipment shall be on-site 4 to 6 weeks from receipt of approved submittals and receipt of complete order information.
 - 1. The entire system shall be delivered to the jobsite by the supplier.
 - 2. All Mako system material (poles, Mako light modules, controls) shall arrive on the same day.
 - 3. The contractor shall off-load all material and stage required material at each pole location to eliminate possibility of lost or damaged material.

3.3 FIELD QUALITY CONTROL

- A. Illumination Measurements: Upon substantial completion of the project and in the presence of the Contractor, Project Engineer, Owner's Representative, and Manufacturer's Representative, illumination measurements shall be taken and

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verified. The illumination measurements shall be conducted in accordance with the latest IESNA Sports and Recreational Area Lighting standards.

- B. Correcting Non-Conformance: If, in the opinion of the Owner or his appointed representative, the actual performance levels of the system are not in conformance with the requirements of the specifications and submitted information, the Contractor/Manufacturer shall be required to adjust to meet specifications and satisfy Owner.

3.4 WARRANTY AND GUARANTEE

- A. 10-Year Warranty: Manufacturer shall supply a signed warranty covering the entire system for 10 years from the date of shipment. Warranty shall cover guaranteed light levels and structural integrity of the system. Any parts, except fuses, found to be defective shall be replaced during the entire warranty period. System energy consumption is to be maintained for entire warranty period and will not increase as the system ages.
- B. Manufacturer shall maintain specifically funded financial reserves to assure fulfillment of the warranty for the full term. Warranty does not cover damage due to weather conditions, acts of God, accidents, misuse, misapplication, abuse, negligence, failure of owner's electrical service or unauthorized modification of any part of the product.
- C. Individual luminaire outages shall be repaired or replaced when the usage of any field is materially impacted by greater than 10%.

PART 4 – DESIGN APPROVAL

4.1 SUBMITTAL REQUIREMENTS

A. Sports lighting system shop drawings shall include:

Yes / No	Item	Description
	Equipment Layout	Drawing(s) showing field layouts with pole locations
	On Field Lighting Design	Lighting design drawing(s) showing: <ul style="list-style-type: none"> a. Field Name, date, file number, prepared by b. Outline of field(s) being lighted, as well as pole locations referenced to the center of the field (x & y), illuminance levels at grid spacing specified. c. Pole height, number of fixtures per pole, horizontal and vertical aiming angles, as well as luminaire information including wattage, lumens and optics. d. Height of light test meter above field surface. e. Summary table showing the number and spacing of grid points; average, minimum and maximum illuminance levels in foot candles (fc); uniformity including maximum to minimum ratio, coefficient of variance (CV), uniformity gradient (UG); number of luminaires, total system kilowatts; light loss factor.
	Photometric Report	A photometric report that shows aiming points to demonstrate the capability of the system to achieve the specified performance.
	Pole Structural Calculations	Pole structural calculations and foundation design showing foundation shape, depth backfill requirements, rebar and anchor bolts (if required). Pole base reaction forces shall be shown on the foundation drawing along with soil bearing pressures. Design must be stamped by a structural engineer in the State of New York.
	Foundation Drawings	Project specific foundation drawings stamped by a registered, licensed structural engineer in the State of New York. The foundation drawings must list the moment, shear (horizontal) force, and axial (vertical) force at ground level for each pole.
	Control & Monitoring System	Written definition and schematics for automated control system must be provided.

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	Standard Catalog 'Cut' Sheets	Luminaire specification sheets
	LM-79, LM-80 and TM-21 Reports	Submit all LM-79, LM-80, and TM-21 Reports
	IES Photometric File	Submit IES file for photometric model conformation

- B. Lay-down and mobilization plan shall include:
1. Method to secure light poles and assemblies prior to final installation to prevent roll-over. Contractor responsible to protect equipment from theft or vandalism.
 2. Lay down plan prior to any light pole deliveries. Lay down plan shall include temporary storage locations, rigging methods and delivery locations.
 3. Indicate the above on an 11" x 17" drawing and include with shop drawings.

- END OF SECTION -