SECTION 260500 - BASIC ELECTRICAL MATERIALS AND METHODS

1.1 SUMMARY

A. Supporting devices for electrical components, Electrical identification, Covers, brackets and supports, Electricity - Smart metering components, Concrete equipment bases, Cutting and patching for electrical construction, Touchup painting.

1.2 QUALITY ASSURANCE

A. Regulations: Carry out electrical work in accordance with the current issue of the local codes of practice, local power authority regulations and Requirements for Electrical Installations – IET Wiring Regulations (BS 7671) as published by the Institution of Engineering and Technology and IEC Standards.

B. Standards: unless otherwise specified, equipment and materials are to be manufactured and installed in compliance with the relevant recommendations of the following or other equal and approved standards:

1. IEC: The International Electro-Technical Commission.
2. ISO: The International Standardization Organization.
3. CENELEC: European Committee for Electrotechnical Standardization.
4. CCITT: The International Telephone and Telegraph Consultative Committee.
5. CCIR: The International Radio Consultative Committee.
6. CISPR: The International Special Committee on Radio Interference.
7. IET: The Institution of Engineering and Technology.
8. BS: British Standards.
9. CIE: International Commission of Illumination.
10. ITU: International Telecommunication Unit.
11. NEBS: Network Equipment Building System.
12. Saudi Electric Company (SEC) distribution material specifications
13. SASO: Saudi Standards, Metrology and Quality Organization
14. All applicable NEOM Standards/Specifications including “NEN-SCH-005_210508".

C. Local standards, where enforced and relevant, are to have precedence over the Standards, such as characteristics of power supply distribution.

1.3 PRODUCTS

A. Supporting devices;

B. Electrical identification;

C. Covers for trenches;

D. Brackets, supports, rails and tracks;

E. Concrete bases;

F. Equipment for electricity metering by employer;

G. Touchup paint.

END OF SECTION 260500

SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

1.1 SUMMARY

A. Low voltage (LV) feeder cables, branch circuit wiring, control and signal cables, termination, jointing and splicing.

1.2 QUALITY ASSURANCE

A. Standards: Wires and cables shall comply with IEC or other equally approved standards and shall bear the mark of identification of the Standards to which they are manufactured. Wires and cables not having this identification will be rejected.

1.3 PRODUCTS

A. Conductors and Cables:

1. Conductors: Copper.
2. Conductor Insulation: PVC or XLPE.
3. Multi-conductor Cable: Armored or unarmored.

B. Connectors and Splices: Factory fabricated.

C. Sleeve Seals: sealing elements, pressure plates, and connecting bolts and nuts.

D. Color Coding:

1. Neutral shall be blue.
2. Protective earth shall be green/yellow striped.
3. Phase colors shall be brown, black, grey or use color coding in accordance with local regulations and standards.

1.4 CONDUCTOR MATERIAL APPLICATIONS

A. Conductors: Cables and other feeders are to have stranded, annealed, electrolytic copper conductors, based on IEC 60228. Signal and control cables are to have similar type conductors unless otherwise specified. Flexible cords are to have finely stranded conductors. Conductors of single-core cables 25 mm2 and above are to be compacted. Multi-core cables, 35 mm2 and above, are to be sectoral shape.

B. Buried Cables: Cables buried directly in the ground are to be armored type, unless otherwise indicated in particular Sections of the Specification or on the Drawings.

C. Building wiring insulation is to be color coded or otherwise identified as required by the Regulations.

1.5 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Single Core PVC Insulated Non-Sheathed Cables (Building Wires): single conductor cables for wiring in conduit shall have annealed copper conductors, compacted, generally with concentric strands and insulated with moisture and heat resistant PVC/E to IEC 60227-1 and 3, and SASO

1319 and 1320, suitable for wet locations and for conductor temperature of 85/90 deg. C, and flame-retardant insulation to IEC 60332-1. Wires and cables shall be 450/750 V grade.

B. Multi-Core PVC Insulated Cables (0.6/1 kV): To have annealed, copper or aluminum conductors, compacted, insulated with PVC/TI3, moisture and heat resistant, suitable for wet locations and conductor temperatures of 85/90 deg. C to BS EN 50363-3 and SASO 1694, laid up, bedded with suitable filler and sheathed with flame retardant PVC/ST2. Armored cables shall have single layer of galvanized steel wire armor with flame retardant PVC/ST2 over-sheath. Cables shall comply with IEC 60502-1 IEC 60332-3, and IEC 60811.

C. Single Core PVC Insulated Non-Sheathed Cables (Protective Earth Cable): Single conductor cables used as protective earth shall have annealed copper conductors, compacted, generally with concentric strands and insulated with moisture and heat resistant PVC/E to IEC 60227-1 and IEC 60227-3, and SASO 1319 and 1320, suitable for wet locations and for conductor temperature of 85/90 deg. C, and flame-retardant insulation to IEC 60332-1. Cables shall be 450/750 V grade.

D. Single Core XLPE Insulated Feeder Cables (0.6/1 kV): Single-core circular stranded, annealed copper conductors, compacted, insulated with moisture and heat resistant cross-linked polyethylene (XLPE), suitable for wet locations and conductor temperatures of 90 deg. C. and flame-retardant PVC/ST2 over-sheath. Armored cables shall have taped bedding, single wire aluminum armor and flame-retardant PVC/ST2 over-sheath. Cables shall comply with IEC 60502-1, IEC 60332-3, and IEC 60811.

E. Multi-Core XLPE Insulated Feeder Cables (0.6/1 kV): Multicore annealed copper or aluminum conductors, compacted, XLPE insulated, for conductor temperature of 90 deg. C, laid up and bedded with suitable non-hygroscopic material compatible with the insulation and flame-retardant PVC/ST2 over-sheathed, color black. Armored cables shall have single layer of galvanized steel wire applied helically over extruded flame-retardant PVC/ST2 bedding (which may be an integral part of filling) and over-sheathed with flame retardant PVC/ST2, color black. Cables shall comply with IEC 60502-1, IEC 60332-3, and IEC 60811.

F. Flexible cable for connection to appliances, window fans, pendants etc. shall be 300/500 V grade to IEC 60227-5, class 5 to IEC 60228, three or four cores, with tinned finely stranded copper wires, heat resistant with PVC/E insulation and PVC/ST10 sheath. As an alternative, EPR insulation, twisted and sheathed with Chlorosulphonated Polyethylene (CSP) compound and with strengthening cord may be used.

G. Solar DC Cables shall have copper conductors, flexible type Class 5 to IEC 60228, low smoke zero halogen cross-linked insulation and cross-linked sheath to EN 50525-1 and IEC 61034. Solar DC cables shall have a nominal DC voltage of 1500 V and shall be flame retardant to IEC 60332-1. Solar DC cables shall comply with EN 50618 or IEC 62930.

1.6 FIELD QUALITY CONTROL

A. Cable tests shall be carried out in accordance with the requirements of the Regulations and Standards.

B. Insulation resistance for LV power and lighting installations shall be carried out in accordance with BS 7671 (“The IEE wiring Regulations”).

END OF SECTION 260519

SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

1.1 SUMMARY

A. This Section includes complete installations to earth every source of energy and to provide protective earthing and equipotential bonding, based on the TN-S system arrangement to achieve an earth resistance value: less than 5 ohms, including:
   1. Main earthing terminals or bars
   2. Main distribution boards, panelboards, lighting installations and wiring accessories
   3. Exposed conductive parts of electrical equipment
   4. Extraneous conductive parts
   5. Feeder and branch circuits
   6. Motor and appliance branch circuits
   7. Signal and communication systems
   8. Bonding to the lightning protection system.

1.2 QUALITY ASSURANCE

A. Quality Standard for Grounding and Bonding Materials and Equipment: IEC 60364-1, IEC 60364-51, IEC 60364-5-55 and IEC 6064-4-41: Electrical Installations in Buildings.

B. Latest edition for IET Wiring Regulations, BS 7671.

C. BS 7430: Code of Practice for Earthing.

D. TIA J-STD-607-A: Commercial Building Grounding and Bonding Requirements for Telecommunications.

E. SBC 401: Saudi Building Code.

F. IEC 62305, for interconnecting with the lightning protection system.

1.3 PRODUCTS

A. Earth electrode (rods, tapes etc.)

B. Main earthing terminals or bars.

C. Earthing, protective, and equipotential bonding conductors.

D. Accessories and termination fittings, bonding, welding kits and other materials.

E. Testing joints (test links).

F. Earth electrode is to consist of one or more earth rods, interconnected by buried earthing tape or cable. Combined resistance to ground of the whole network not to exceed 5 ohms. Distance between two rods is not to be less than the length of one rod or 3m.

G. Main earthing bar is to be provided at point of service entrance to which all earthing conductors, protective conductors and bonding conductors are to be connected. Two insulated main earthing conductors are to be provided, one at each end of the bar, connected via testing joints to the earth electrode at two separate earth pits.

H. Earth rod shall be copper clad steel, 14 mm diameter, 2.5 m length, extendible as necessary to obtain required earth resistance. Diameter of Earthing rods shall be based on Earthing calculation.

I. Buried earth conductors are to be bare annealed copper strip conductors 25 x 2.5 mm, or annealed stranded copper conductors 70 mm2 cross-section.

J. Testing joints (test links) are to be provided, in an accessible position, on each main earthing conductor, between earthing terminal or bar and earth electrode.

1.4 FIELD QUALITY CONTROL

A. Ground Resistance Testing.

END OF SECTION 260526

SECTION 260533 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

1.1 SUMMARY

A. Boxes and raceways including conduits, wireways, and related installations and accessories necessary to support and protect cables, feeders, sub-feeders, branch circuit wiring and wiring of low current systems, communications and signal cables.

1.2 QUALITY ASSURANCE

A. Conduits, wireways, cable trays and fittings shall be designed, constructed and installed to give safe installation and reliable mechanical protection for wires and cables in accordance with the Regulations.

1.3 PRODUCTS

A. Metal Conduit and Tubing: Rigid Heavy Gauge Steel, Flexible Steel, EMT.

B. Nonmetallic Conduit and Tubing: Rigid Heavy Gauge PVC.

C. Metal Wireways: Sheet metal.

1. Wireway Covers: Screw-cover or Flanged-and-gasketed type.

D. Nonmetallic Wireways: PVC.

E. Surface Raceways: Metallic galvanized steel or Non-metallic, rigid PVC.

F. Boxes, Enclosures, and Cabinets:

1. Outlet and Device Boxes: Metallic or Molded Plastic.
2. Floor Boxes: Cast metal.
3. Pull and Junction Boxes: Metallic galvanized steel or Non-metallic, rigid PVC.
4. Cabinets: Galvanized steel.

G. Handholes and Boxes for Exterior Underground Wiring: Concrete.

H. Sleeves for Raceways: Cast-iron pipe with integral waterstop.

I. Sleeve Seals: sealing element.

1.4 RACEWAY APPLICATION

A. Outdoors:

1. Exposed: Heavy Gauge Rigid steel, Liquid Tight Flexible.
2. Concealed, Aboveground: Heavy Gauge Rigid steel.
3. Above False Ceiling in Return Plenum: EMT.
4. Underground: uPVC, directly buried or with concrete encasement.
5. Connection to Vibrating Equipment: Flexible Steel.
6. Boxes and Enclosures, Aboveground: IP 54 (min.) to IEC 60529.
7. Underground Handholes and Boxes: Concrete with ductile iron covers.

B. Indoors:

1. Exposed: EMT or PVC.
2. Exposed and Subject to Severe Damage: Heavy Gauge Rigid steel.
3. Concealed: EMT or PVC.
4. Connection to Vibrating Equipment: Flexible Steel.
5. Damp or Wet Locations: Liquid Tight Flexible Steel.
6. Raceways for Distribution of Optical Fiber or Communications Cable: EMT.
7. Boxes and Enclosures: IEC 60529, IP 42 except in damp or wet locations IP 54 minimum.

C. Minimum Raceway Size: 20 mm diameter, unless otherwise shown on the Drawings.

D. Raceway Fittings: Compatible with raceways and suitable for use and location.

1. Rigid and Intermediate Steel Conduit: Threaded rigid steel conduit fittings.
2. PVC Externally Coated, Rigid Steel Conduits: Fittings listed for use with this type of conduit.
3. EMT: welded steel, non-threaded type, galvanized externally and protected internally with corrosion resistant enamel.
4. Flexible Conduit: Fittings listed for use with flexible conduit.

END OF SECTION 260533

SECTION 260536 - CABLE TRAYS FOR ELECTRICAL SYSTEMS

1.1 SUMMARY

A. Cable trays and cable ladders and related accessories necessary to support and protect power cables and low current systems, communications and signal cables.

1.2 QUALITY ASSURANCE

A. Standards: IEC 61537, ISO 1461, and ISO 12944-2.

1.3 PRODUCTS

A. Cable Trays and Ladders:

1. Trays: Heavy gauge perforated sheet steel, heavy duty, hot-dip galvanized after manufacture, minimum 1.5 mm thickness for cable trays up to 300 mm width and 2 mm thickness for cable trays exceeding 300 mm width, with sides not less than 60 mm depth for cable trays up to 300 mm width, 85 mm depth for cable trays exceeding 300 mm width and up to 600 mm width and 110 mm depth for cable trays exceeding 600 mm width with outwards return flanges
2. Ladders: Hot-dip galvanized after manufacture, fabricated from 2 mm mild carbon steel.
3. Cable trays / Ladders shall meet Class C / Y requirements as per IEC 61537 as a minimum.
4. Sizes: 150, 300, 450, 600 and 900 mm wide, and at least of 3 m length of section.
5. Earthing connector for trays or ladders shall be provided on each coupling between adjacent sections.
6. Cable trays / Ladders shall include bends, elbows, tees, couplings, bracket support and other accessories required for safety and protection of cable installations.
7. Finish of the cable tray/ladder used outdoors shall be certified to be UV stabilized.
8. Construction of cable trays shall be as per NEMA standard.

B. Cable Tray Accessories:

1. Covers: with similar materials.
2. Cable tray supports and connectors.
3. Earthing connectors.

C. Warning signs.

1.4 SOURCE QUALITY CONTROL

A. Tested for galvanizing according to EN ISO 1461.

END OF SECTION 260536

SECTION 260543 - UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS

1.1 SUMMARY

A. Underground conduits and ducts, duct banks, pull boxes and handholes, manholes, and other underground utility structures.

1.2 QUALITY ASSURANCE

A. Quality Assurance: HDPE ducts shall comply with BS 3506 or DIN 8062.

1.3 PRODUCTS

A. HDPE Ducts for Electrical and HDPE for Telecommunication cables Installations.

B. Covers for manholes and handholes: BS EN 124, checkered cast iron or cast steel, recessed type

C. Composite construction

D. Pull boxes

E. Underground, precast concrete utility structures

1.4 FIELD QUALITY CONTROL

A. Testing: By Contractor in the presence of the Engineer.

1.5 COMMISSIONING

A. Startup service.

END OF SECTION 260543

SECTION 260548 - VIBRATION AND SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS

1.1 SUMMARY

1.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage qualified structural professional engineer to design seismic and wind-load control system.

1.3 COMPONENTS

A. Elastomeric Isolation Pads: Single or multiple layers of sufficient durometer stiffness for uniform loading over pad area. Material to be oil and water resistant with elastomeric properties.

1. Sandwich Core Material: Resilient
2. Surface Pattern: Smooth, ribbed, or waffle pattern.
3. Infused nonwoven cotton or synthetic fibers.
4. Load-bearing metal plates adhered to pads.

B. Restraints - Rigid Type: Shop- or field-fabricated bracing assemblies made of ANSI/AISI S110-07-S1 slotted steel channels, ANSI/ASTM A53/A53M steel pipe, or other rigid steel brace member.

C. Restraints - Cable Type: ASTM A1023/A1023M galvanized or ASTM A603 galvanized-steel cables.

D. Restraint Accessories:

1. Hanger-Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod.
2. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

E. Anchor Bolts: Mechanical type, seismic rated.

F. Concrete Inserts: Preset concrete inserts that are seismically prequalified in accordance with ICC-ES AC446.

END OF SECTION 260548

260914.15 – SCADA FOR ELECTRICAL POWER SYSTEMS – BUILDINGS/FACILITIES SUBSTATION CONTROL SYSTEMS (SCS)

1.1 SUMMARY

A. A **Supervisory Control and Data Acquisition (SCADA)** system shall be provided for the supervision and control of the Low Voltage (LV) power distribution network, emergency standby generators, and various systems.

1.2 MINIMUM REQUIREMENTS

A. The **SCADA** system shall comprise all necessary devices and components for proper operation of the system and shall include the following as a minimum:

1. Servers, routers, switches, RTUs, etc. as necessary to implement a fully functional SCADA system.
2. Operator workstations.
3. Main display unit.
4. Report printer and alarm printer.

B. The **SCADA** system shall have the following features as a minimum:

1. Full monitoring, diagnostics and control of designated LV network components:

    a. Switchboards and Panelboards
    b. Motor controllers and Motor-Control Centers
    c. Generator sets
    d. Transfer switches
    e. Uninterruptible power supply systems
    f. Power factor capacitor banks
    g. Photovoltaic (PV) System equipment
    h. Electric Vehicle Supply Equipment (EVSE)

2. Automatically reconfigure and maintain the distribution network.
3. Data acquisition for metering and protection devices, sensors, and other intelligent electric devices.
4. Recording of events, Operator actions and measured values.
5. User-composed measurement groups for displaying real-time and historical trends.
6. Supervise servers, PLC/HMI/RTU communication links and connected workstations status.
7. Flexible filtering of events, alarms and historical data.
8. Graphical displays of information.
9. Reporting tools with standard report templates.
10. Web-based secure access.
11. The **SCADA** shall utilize the Project Structured Cabling Network and Data Communications Network Installations, for both IT & Security Networks – as applicable. This connectivity (including data outlets, equipment racks, etc..) shall form part of the Structured Cabling Network and Data Communications Network as applicable.

END OF SECTION 260914.15

SECTION 260923 - LIGHTING CONTROL DEVICES

1.1 SUMMARY

A. Time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.

1.2 PRODUCTS

A. Time Switches: Electronic, solid-state programmable units.

B. Outdoor Photoelectric Switches: Solid state, with dry contacts, up to 30-second time delay.

C. Indoor Photoelectric Switches: Ceiling or wall-mounted units; solid-state, light-level sensor with separate relay mounted on luminaire.

D. Indoor Occupancy Sensors: PIR, Ultrasonic or Dual-technology type, solid-state units with separate, externally mounted relay unit.

E. Outdoor Motion Sensors: Lighting fixture mounted or individually mounted for operation in temperatures from minus 40 to plus 54 deg C.

F. Lighting Contactors: Electrically operated and mechanically held.

G. Emergency Shunt Relay: Normally closed, electrically held, arranged for wiring in parallel, with manual or automatic switching contacts.

H. Control Cables:

1. Power Cables: Not smaller than 4 mm2.
2. Classes 2 and 3 Control Cables: Stranded-copper conductors, not smaller than No. 0.75 mm2.
3. Class 1 Control Cables: Stranded-copper conductors, not smaller than No. 0.75 mm2.

END OF SECTION 260923

SECTION 262413 - SWITCHBOARDS

1.1 SUMMARY

A. Main Distribution Board(s) work for low voltage (LV) distribution, ancillary mounting frames, fittings, cable termination accessories and supports rated 600 V and less.

B. Connection to BMS or SCADA system, including interface elements such as relays, transducers, etc.

1.2 QUALITY ASSURANCE

A. Quality Standards: IEC 61439-1, IEC 60947-2.

1.3 PRODUCTS

A. Configuration: Front and rear accessible.

1. Main Devices: Panel mounted
2. Branch Devices: Panel mounted
3. Enclosure: IP 31 steel
4. Bus Material: Copper
5. Form 3b with withdrawable Air Circuit Breaker (ACB) incomer and fixed molded case circuit breaker (MCCB) for ratings up to 1250A and fixed type ACB for ratings greater than 1250A.
6. Air Circuit Breaker (ACB): enclosed in steel structure, air ventilated, air break, quick make, quick break type, manually and electrically operated as deemed necessary, ratings above 1250A and equipped with trip unit.
7. Molded Case Circuit Breaker (MCCB): totally enclosed, molded case, manual and automatic operation, minimum frame of 160A and maximum frame of 1250A, thermal magnetic type for ratings below 250A frame size and electronic solid-state trip type for breakers above 250A.

B. Instrumentation:

1. Instrument Transformers
2. Main Device: Multifunction digital metering monitor.
3. Branch Device: Ammeter.
4. Accessories:

    a. Manufacturer's standard accessory set.
    b. Portable test set.
    c. Circuit-Breaker-Removal Apparatus: Fixed.

5. Spare-fuse cabinet

1.4 FIELD QUALITY CONTROL

A. Testing: By Contractor in the presence of the Engineer.

END OF SECTION 262413

SECTION 262416 - PANELBOARDS

1.1 SUMMARY

A. Distribution panelboards, lighting and appliance branch-circuit panelboards and overcurrent protective devices.

B. Connection to BMS or SCADA system, including interface elements such as relays, transducers, etc.

1.2 QUALITY ASSURANCE

A. Quality Standards: IEC 61439-1, IEC 60947-2, IEC60898.

1.3 PRODUCTS

A. General Requirements for Panelboards:

1. Enclosures: Flush or surface mounted.
   a. Indoor Dry and Clean Locations: IP 31 to IEC 60529
   b. Outdoor Locations: IP 55 to IEC 60529
   c. Front: Hinged cover
   d. Directory card

2. Incoming Mains Location: Bottom
3. Phase, Neutral, and Ground Buses: Copper
4. Conductor Connectors: Compression-type main and neutral lugs.
5. Service equipment label for panelboards incorporating one or more main service disconnecting and overcurrent protective devices.
   Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals.
6. The MCCB trip units shall be capable of Energy Monitoring without additional CTs and Meters.
7. All MCBs shall be provided with electronic power tag capable of metering, monitoring and measuring power in real time.

B. Distribution panelboards – Type MCCB:

1. Form 2a to IEC 61439-1&-2, and have a minimum rated insulation voltage of 690V and with 8 kV impulse withstand voltage, with ratings of main circuit breaker and busbars up to 400 A, 3-phase, 4-wire, with 2 or 3-pole branch circuit breakers, 100 A or 160 A or 250 A frame size.
2. Circuit breakers for DP’s shall be fitted with a plug-in base type of modular construction complete with its accessories; non-draw-out type.

C. Final Branch Circuit, power and sub distribution panelboards – Type MCCB:

1. Single phase or three phases with MCCB on branch circuits and main incoming, rated insulation voltage 500V as a minimum.,
2. Branch circuit breaker shall be 1, 2, or 3 poles, rated 100A frame size with trip ratings between 15A and 100A.
3. Main incoming circuit breaker shall be 100A or 160 A frame size.

D. Final Branch Circuit – Type MCB:

1. Single Phase type panelboards shall be suitable for 240 V maximum service voltage, single phase and neutral, with MCBs on branch circuits and main incoming. Single pole and double pole MCS shall have trip ratings between 6A and 125A.
2. Three Phase type panelboards shall be suitable for up to 415 V A.C maximum service voltage, 3 phase and neutral with MCBs on branch circuits and 3 or 4 pole MCCB or MCS main incoming. Triple pole branch circuit breakers shall have trip ratings between 6A and 125A while incoming circuit breakers shall have a frame size of 100A or 160A.

E. Feeder Pillar for external lighting: totally enclosed, dead front type, weatherproof and suitable for mounting outdoors, exposed to dust, rain and sunlight with IP55 degree of protection to IEC 60529, equipped with lighting contactors, photoelectric relays, timers, circuit breakers, inspection lighting and socket outlets.

F. Molded Case Circuit Breaker (MCCB): totally enclosed, molded case, adjustable type, manual and automatic operation, minimum frame of 160A and maximum frame of 1250A, thermal magnetic type for ratings below 250A frame size and electronic solid-state trip type for breakers above 250A. The MCCB trip units shall be capable of Energy Monitoring without additional CTs and Meters. Electronic trip units shall be capable of incorporating communications module for monitoring and control purpose. Alternatively, module shall be available to collect data through the system including data from sensors for environmental parameters communicate with cloud platform.

G. Miniature Circuit Breaker (MCB): thermal magnetic non-adjustable GFCI type, tested in accordance with IEC 60898-1, range from 6-125 A, number of poles (1,2,3 or 4). All MCBs shall be provided with electronic power tag capable of metering, monitoring and measuring power in real time.

H. Molded Case Switches (MCS): similar to circuit breakers but without overload/short circuit protection.

I. Switch Disconnectors: non-fusible, single throw type with AC-23 utilization category to IEC 60947- for AC motors, housed in separate metallic enclosures, with arc quenching devices on each pole.

J. Motor Circuit Protector: Molded Case, magnetic break type with adjustable instantaneous setting suitable for motor protection.

1.4 FIELD QUALITY CONTROL

A. Testing: By Contractor in the presence of the Engineer.

1.5 COMMISSIONING

A. Startup service.

END OF SECTION 262416

SECTION 262419 - MOTOR-CONTROL CENTERS

1.1 SUMMARY

A. Motor-control centers and panels rated 600 V

1.2 QUALITY ASSURANCE

A. Standard: IEC 61439-1 & NEMA ICS.

1.3 PRODUCTS

A. Wiring: NEMA ICS 19, Class II with factory wired interconnections between controllers, Type B with unit-mounted terminal blocks.

B. Enclosures: IP 55 for outdoor & wet areas, IP 42 for indoor areas.

C. Buses: Plated copper with half-size neutrals.

D. Magnetic Motor Controllers: full voltage, no reversing, across the line.

E. Control Source: Integral transformer.

F. Combination Controllers: Motor-circuit protector.

G. Reduced-Voltage Controllers: star-delta (for motors rating above 10 HP up to 50 HP) autotransformer or soft starter (for motor rating above 50 HP).

H. Integral Control Switch in Magnetic Controllers: Momentary push button (start-stop), Selector switch (hand-off-automatic).

I. Variable-Frequency Drive: shall include a converter and an inverter section.

J. Isolation transformer.

K. Multiple-motor controller.

L. Automatic reset/restart.

M. Power-interruption protection.

N. Manual bypass.

O. Integral disconnect.

P. Isolating switch.

Q. Feeder Overcurrent Protection: Molded-case circuit breaker.

R. Accessories.

1.4 FIELD QUALITY CONTROL

A. Testing: By Contractor in the presence of the Engineer.

1.5 COMMISSIONING

A. Startup service.

END OF SECTION 262419

SECTION 262726 - WIRING DEVICES

1.1 SUMMARY

A. Wiring devices, lighting switches, socket outlets, cord outlets, automatic and manual lighting control equipment, outlet boxes and plates, etc.

1.2 QUALITY ASSURANCE

A. Standards: BS, SASO, and IEC

1.3 PRODUCTS

A. Outlet Boxes: wiring devices back boxes and conduits pull boxes shall comply with BS 4662 / IEC 60670. Boxes shall be suitable for type of related conduit.

1. Metallic outlet boxes: recessed boxes shall be galvanized pressed steel, with knock-outs for easy installation.
2. Molded Plastic Outlet Boxes: shall be heavy gauge pressure molded plastic, minimum 2 mm thick and shall not be used outdoors.

B. Plates shall be square, rectangular or round to cover outlet box and to closely fit electrical devices, and with polished chromium plated recessed head fixing screws.

C. Switches:

1. Quick-make, quick-break type with silver alloy contacts in arc resisting molded base.
2. Single, two-way or intermediate, single pole or double pole, as needed.
3. General Lighting Switch: 10 A, 240 V a.c., rocker operated, grid-switch.

D. Socket Outlets:

1. Standard British Socket Outlet (230 V service): To BS 1363 / SASO 2203, polarized, grounding type, with three rectangular pin-holes (two poles and earth), rated 13 A, 250 V, switched, with robust shutter mechanism operated by earth pin.
2. Weatherproof Socket Outlet (230 V SERVICE): 13A, 250 V, 2 poles plus earth, to BS 1363, switched, enclosed in surface mounted cast-metal box and with cover comprising spring- retained gasket hinged cover. IP 56 for installation outdoors, and indoor wet areas.
3. Socket Outlets fed from UPS to have red rocker.
4. Power Socket Outlet (230 V service): To BS 546, polarized, grounding type, with three round pin-holes (two poles and earth), rated 16 A, 250 V, switched, with robust shutter mechanism operated by earth pin.
5. Power Socket Outlet (400 V service): Single outlet, 3P+E, 3 phases, polarized, earthing type, rated 32 A, 380/415 V, to IEC 60309, with splash proof cast metal box and hinged spring-return plate, and with matching plug 3P+E.

E. Disconnecting Switch:

1. Heavy duty, non-fused, air break, single throw, 600-V AC, safety type, housed in separate metallic enclosure with arc quenching devices on each pole, suitable for motor circuits or for service entrance disconnecting applications, 2,3 or 4 poles as necessary for the application.
2. Enclosure: Made of steel material, properly anti-corrosion treated and electrostatic coated. Enclosures shall comply with NEMA 250 type 1A for indoor general use installations,

NEMA 250 type 1A for indoor general use installations and NEMA 250 type 3R for outdoor installations.

F. Wiring Device Types/Finishes: Plastic, Metal, stainless steel, weatherproof, explosion proof, etc. depending on the application and as to be coordinated with Architect.

G. Photoelectric Cells: Omnidirectional cadmium sulfide, hermetically sealed, with 2:1 on/off adjustment possible by moving light level selector, set to operate at illuminance levels.

H. Lighting Contactors: double pole for single phase and neutral circuits, and triple pole for three phase circuits, mechanically held, electrically operated, and complying with IEC 60947-4-1, copper alloy contacts, IP 42 enclosure for indoor use or IP 65 enclosure for outdoor use.

I. Time switch: mechanical type, electrically rewound, with 24 hours dial and time adjustment and rated 10A, 250V.

END OF SECTION 262726

SECTION 262743 - ELECTRIC VEHICLE SUPPLY EQUIPMENT AND CHARGERS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes electrical vehicle supply equipment (EVSE) for electric vehicles charging of Mode 4 (D.C).

1.2 QUALITY ASSURANCE

A. Standards: SASO Technical Regulations for Electric Vehicles, IEC 62893, IEC 62196, IEC 61851, The IET Code of Practice for Electric Vehicle Charging Equipment Installation and CHAdeMO Standard.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENT

A. EVSE shall have the provisions to be interfaced with central monitoring system for monitoring and control.

B. The system shall be able to integrate with BMS system or demand-response program or billing system or a combination of any.

2.2 D.C. CHARGING STATIONS

A. EVSE shall be complete with power cabinets, charging posts, cooling system, associated cabling between the power cabinet and charging post, along with all necessary components for proper operation.

B. DC Charging station Floor/pedestal mounted, separate power cabinet and charging post or pole construction, high power D.C. EVSE having the following characteristic:

1. Fast Charging Mode 4
2. Nominal Input Voltage: 400 V, three phase, 60 Hz, 4 wires with earth.
3. D.C. charging power per power cabinet 22 kW as a minimum for common vehicle.
4. D.C. charging power per power cabinet 50 kW as a minimum for heavy vehicle.

C. DC Charging station for vehicles

1. D.C. charging power per charging post 22 & 50 kW as per application.
2. Maximum D.C. output voltage500 VDC.
3. Maximum D.C. output current: 65A & 125A.
4. Number of D.C. charging guns: 2.

END OF SECTION 262743

SECTION 262816 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

1.1 SUMMARY

A. Individually mounted switches and circuit breakers used for the following:

1. Service disconnect switches
2. Feeder and equipment disconnect switches
3. Feeder branch-circuit protection
4. Motor disconnect switches

1.2 QUALITY ASSURANCE

A. Standard: IEC 60947-3

1.3 PRODUCTS

A. Disconnect Switches:

1. Enclosed non-fused switch; IEC 60947-3, utilization category 22 for heating and lighting loads, category 23 for motor circuits.
2. Enclosures: General purpose sheet steel for indoor use IP 42 and weather-proof type cast-metal or sheet steel for outdoor installations IP 65.

B. Circuit Breakers.

1. Molded-Case Circuit Breakers: IEC 60947-2 utilization category B, sequence II.
2. (Service rating) for main distribution boards and sequence III (ultimate rating) for distribution & final branch circuit panel boards.

1.4 FIELD QUALITY CONTROL

A. Testing: By Contractor in the presence of the Engineer.

1.5 COMMISSIONING

A. Startup service.

END OF SECTION 262816

SECTION 263100 – PHOTOVOLTAIC ENERGY SYSTEM

1.1 SUMMARY

A. Photovoltaic system including Photovoltaic modules, DC combiners, DC cables, Inverters and all related accessories, connectors and mounting structures.

1.2 QUALITY ASSURANCE

A. PV Modules Standards: IEC 61215, IEC 61730, EC 60068-2-68, IEC 61701, IEC 6271, IEC TS 62804-1 and EN 50380

B. DC string combiner Standards: IEC 61439-1, IEC 61439-2, IEC 62548 and IEC 61000

C. Inverters Standards: IEC 62019, IEC 62477, EN 50530, IEC 61727, IEC 62116 and IEC 61000

D. DC cables Standards: EN 50618, IEC 60228, IEC 60332-1-2, IEC 60754, IEC 61034 and SEC standards

1.3 COMPONENTS

A. Photovoltaic modules:

1. PV modules shall be of Monocrystalline or polycrystalline type with 72 Cells.
2. PV modules shall have a minimum efficiency of 17% as a minimum at Standard Testing Conditions (STC).
3. PV modules shall be suitable for operation at system voltage up to 1000V DC as a minimum and 1500V as a maximum.
4. PV Modules shall be factory pre-wired with junction boxes, bypass diodes, output cables and connectors. Each module shall be equipped with 3 bypass diodes as a minimum.
5. PV modules in the entire plant shall be procured from the same manufacturer and shall be of the same model number with identical specifications in terms of nominal power rating, nominal I-V characteristics and coefficients.

B. DC Combiner Boxes

1. DC combiner boxes shall be suitable for system voltage up to 1000V or 1500V DC as applicable. DC combiner boxes shall have class II insulation.
2. DC combiner boxes shall be suitable for outdoor installation in ambient temperature (-25°C to +50°C), relative humidity (95% condensing), altitude up to 1000 m A.S.L.

C. DC Cables

1. DC Cables shall be rated 1000 V DC as a minimum for 1000 V systems and 1500 V as a minimum for 1500 V systems.
2. Conductor shall be copper, flame retardant with minimum cross section of 4mm2.

D. Inverters

1. Inverters shall be grid-tie type, string. Inverters shall be of 1000 V or 1500 V type. Inverters shall utilize maximum power point tracking (MPPT) technology in order to maximize the energy yield.

END OF SECTION 263100

SECTION 263213 - PACKAGED ENGINE GENERATORS

1.1 SUMMARY

A. This Section includes standby/emergency generators and temporary power plant installation comprising the following:

1. Package type low voltage prime biomass generating set(s) with associated auxiliaries, exhaust system, start-up system, cooling system, double fuel system, batteries and charger etc.
2. Outdoor type enclosure
3. Fuel storage and transfer system
4. Instrumentation, protection and control equipment
5. Inter-plant cabling and wiring
6. Earthing
7. Air inlet and outlet attenuators
8. Interface for connection to BMS or SCADA system, if any.

1.2 QUALITY ASSURANCE

A. Standards: Equipment and component parts to comply with ISO 3046, ISO 8528, IEC 60034, IEC 60085 and CISPR, or equivalent NEMA, ANSI, IEEE and DIN Standards and recommendations of ABGSM (Association of British Set Manufacturers) where such standards meet with or supersede the ISO and IEC Standards.

1.3 PRODUCTS

A. Generator set: 4-stroke cycle, 1800 rpm, Standby rated, class G2 to ISO 8528-1, able to operate on both biomass and light fuel diesel oil. Set to be complete with cooling system, lubricating oil system, exhaust system, electric starting system, storage battery (lead-acid, sealed-in-plastic type, complete with battery rack and inter-cell connectors); battery charger; electronic governor, instruments, protection and control equipment, etc.

B. Generators engine exhaust emission shall comply with EPA Tier 2 requirements and relevant regulations, or equivalent standard.

C. Fuel Storage: Day-tank, steel construction; with breather pipe, pumps, filters, and related instruments.

1.4 FIELD QUALITY CONTROL

A. Testing: By Contractor in the presence of the Engineer.

1.5 COMMISSIONING

A. Startup service.

END OF SECTION 263213

SECTION 263353 - STATIC UNINTERRUPTIBLE POWER SUPPLY

1.1 SUMMARY

A. On-line, static-type, continuous duty, solid state, double conversion uninterruptible power supply (UPS) system installation and static transfer switch.

1.2 QUALITY ASSURANCE

A. Quality Standard: IEC 62040, IEC 60950, IEC 60146, IEC 61000-4.

1.3 PRODUCTS

A. Performance Requirements:

1. Maximum Acoustical Noise: 60 dBA at 1.0 m
2. Maximum Load Crest Factor: 3:1
3. Variation of Output-Voltage with 100 Percent load step: Plus or minus 5 percent.
4. Output Frequency: 60 Hz, plus or minus 0.5 percent.
5. Limitation of Harmonic Distortion of Input Current to the UPS: THD to 5 percent, maximum.
6. Maximum Harmonic Content of Output-Voltage Waveform: less than 3 percent.
7. Minimum Overload Capacity of UPS at Rated Voltage: 125 percent of rated full load for 10 minutes, and 150 percent for 1 minute in all operating modes.
8. Input Power Factor: minimum 0.9 lagging at full load.

B. UPS System:

1. VFI-SS-111 to IEC 62040-3
2. Solid state devices
3. Surge Suppression
4. Capacity upgrade capability for future 25 percent increase
5. Ventilated cabinet
6. Output Circuit Neutral Bus, Conductor, and Terminal Ampacity: Rated phase current times a multiple of 1.73, minimum.

C. Components:

1. Rectifier/Charger unit: IGBT type, microprocessor based.
2. Inverter: IGBT technology.
3. Static bypass transfer switch
4. Maintenance Bypass/Isolation Switch
5. Battery: maintenance-free sealed valve regulated, lead acid.
6. Controls and Indications:
    a. Quantitative indications with plain-language messages on a digital LCD.
    b. Quantitative and basic status condition indications.
    c. Alarm indications.
    d. Controls: Inverter on-off, UPS start, battery test, alarm silence/reset, output-voltage adjustment.
    e. Emergency power off switch
7. Output distribution section for panelboards
8. Monitoring by remote status and alarm panel
9. Monitoring by remote computer
10. Battery Management System.

1.4 SOURCE QUALITY CONTROL

A. UPS and battery factory tested.

1.5 FIELD QUALITY CONTROL

A. Electrical Tests and Inspections: Perform tests and inspections according to manufacturer's written instructions to demonstrate condition and performance of each component of the UPS.

END OF SECTION 263353

SECTION 263533 - POWER FACTOR CORRECTION CAPACITORS

1.1 SUMMARY

A. Automatic power factor correction equipment rated 600V and less.

1.2 QUALITY ASSURANCE

A. Quality Standards: IEC 60831-1&-2, IEC 60871-1&-2 and IEC 60931-1&-2.

B. IEEE 18 and NEMA CP 1.

1.3 WARRANTY

A. Materials and Workmanship for Capacitor Cells: Five years.

1.4 PRODUCTS

A. Capacitor Cells: Dry metallized-dielectric, encapsulated type.

B. Capacitor-Bank Fuses: Current-limiting, non-interchangeable type.

C. Discharge resistors.

D. Fixed Capacitors: Integrally fused.

E. Automatic Power Correction Factor Units: Capacitor banks, contactors, controls, and solid-state, microprocessor-based controls installed independent enclosures and shall be sized to achieve 0.95 power factor as per SEC requirements.

1. Adjustable Target Power Factor: 0.80 lagging to unity.
2. Local Display: LED or LCD in door of enclosure.
3. Alarm indication.
4. Current transformer.
5. Main circuit breaker.
6. Remote monitoring components.

1.5 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect equipment installation and connections.

B. Inspection: Perform external and internal inspections of capacitor equipment for damage and for compliance with the Contract Documents and manufacturer's documentation. Check electrical and mechanical bolted connections for required torqueing.

C. Carry out and record tests.

END OF SECTION 263533

SECTION 263600 – TRANSFER SWITCHES

1.1 SUMMARY

A. Transfer switches rated 600 V and less.

1.2 QUALITY ASSURANCE

A. Standard: IEC 60947-6.

1.3 PRODUCTS

A. Mains failure automatic transfer switch (ATS).

B. ATS with manual bypass switches.

C. Type: Wall or floor mounted, galvanized sheet steel cubicle.

D. Mechanical and Electrical Interlocks: are to be provided in circuit breakers type.

E. ATS dedicated for fire pumps are to meet the requirement of NFPA 20.

F. Circuit Breakers are to be electrically and manually operated non-automatic type, conforming to IEC 60947-2 utilization category B, sequence II (service rating)

G. Enclosure: IP21 to IEC 60529.

1.4 FIELD QUALITY CONTROL

A. Testing: By Contractor in the presence of the Engineer.

1.5 COMMISSIONING

A. Startup service.

END OF SECTION 263600

SECTION 264113 - LIGHTNING PROTECTION FOR STRUCTURES

1.1 SUMMARY

A. Lightning protection for buildings and associated structures including air terminals, bonding plates, conductors, conductor straps, fasteners, grounding plates, grounding rods, rod clamps, splices and other components required for a complete system that meets the standards.

1.2 QUALITY ASSURANCE

A. Quality Standards:

1. IEC 62305" Protection against Lightning"
2. IEC 62561 "Lightning Protection System Components"

1.3 COMPONENTS

A. Air terminals, bonding plates, conductors, connectors, conductor straps, fasteners, earthing plates, earthing rods, rod clamps, splicers and other components required for a complete system, based on lightning protection risk assessment as per BS EN 62305 for defining the protection class.

B. Roof Conductors: 70 mm2 soft drawn stranded copper cable covered with PVC of approved color or bare, high conductivity, annealed copper strip, 25 x 3 mm.

C. Down Conductors: High conductivity, copper tape 25 x 3 mm or 70 mm2 soft drawn stranded copper cable, bare or covered with PVC of approved color.

D. Bonding Conductors: High conductivity, bare annealed copper tape, 20 x 3 mm minimum dimensions, or 50 mm2 soft drawn stranded copper cable covered with PVC of approved color.

E. Earth Rod: 16 mm diameter high strength, low carbon steel core of high tensile strength (600 N/mm2), with 99.99% pure electrolytic copper molecularly bonded into steel core, 0.25 mm minimum thickness. 2.4 minimum length of Rod.

F. Inspection (Earth) Pit: Precast concrete construction, with heavy duty cover and brass plate engraved 'Earth Pit Below' inset in cover.

G. Test Links: Two-bolt split-coupling, copper alloy, made to join two ends of down conductor specified. Plate indicating position and number of electrodes shall be fitted above each test link

H. Accessories: Supports, joints, fasteners, clamps, bonds, test links, etc., shall be copper or copper alloy

I. Copper Earth Electrode: Maximum resistance to earth of 10 Ohm.

J. Bonding of ground electrodes of all services: Bonding between the earth termination network of the lightning protection system and earth networks of all other services to ensure a common earthing system. Combined resistance to ground of whole network not to exceed 1 Ohm.

K. FIELD QUALITY CONTROL

Periodic Inspections: Perform periodic inspections during installation of lightning protection systems and at Substantial Completion.

END OF SECTION 264113

SECTION 264313 - SURGE PROTECTIVE DEVICES

1.1 SUMMARY

A. Factory installed or field-mounted SPDs for:

1. Low-voltage (up to 1000 V) power distribution and control equipment.
2. Telecommunications and Signal Processing Equipment.

1.2 QUALITY ASSURANCE

A. Codes and Standards:

1. IEC 61643-11
2. IEC 61643-21
3. IEC 61643-22
4. BS 7671 (IET Wiring Regulations – Latest Edition)
5. IEC 61000-6-3
6. IEC 61000-4-5

1.3 PRODUCTS AND MATERIALS

A. Maximum continuous operating voltage (Uc): 110% of the nominal system voltage as a minimum or the next higher rating.

B. Supply main’s frequency: 47 Hz and 63 Hz.

C. Galvanized and electrostatic painted enclosure with IP 54 degree of protection to IEC 60529.

D. Class I+II SPDs at incomer(s) of all MDB(s).

E. Class I SPDs at Roof mounted / outdoor equipment control panel.

F. Class II SPDs shall be installed at:

1. Distribution panels.
2. Incomer of ATS(s) fed from main distribution board / distribution panels.
3. Incomer of MCCs / MCPs fed from main distribution board / distribution panels.

G. Class III SPDs shall be installed at:

1. Power distribution units for server rooms.
2. Final distribution panelboards feeding sensitive equipment.
3. Outdoor luminaires installed at street lighting poles.

END OF SECTION 264313

SECTION 265100 - INTERIOR LIGHTING

1.1 SUMMARY

A. Interior lighting fixtures including lamps and drivers.

B. Emergency lighting units and Exit signs.

1.2 QUALITY ASSURANCE

A. Standards:

1. LED Fixtures:

a. IEC 60598 “Luminaires”.
b. IES LM-79-08 “Approved Method: Electrical and Photometric Measurements of Solid-State Lighting Products”.
c. IES LM-80-08 “Approved Method: Measuring Lumen Maintenance of LED Light Sources”.
d. IES TM-21-11 “Projecting Long Term Maintenance of LED Light Sources”.
e. EN 55015 “Limits and Methods of Measurement of Radio Disturbance Characteristics of Electrical Lighting and Similar Equipment”.
f. IEC 62471 “Photobiological Safety of Lamps and Lamp Systems”.

2. LED Drivers:

a. IEC 61347-1 “Lamp Control gear - Part 1: General and Safety Requirements”.
b. IEC 61347-2-13 “Lamp Control gear - Part 2-13: Particular Requirements for D.C. or A.C. Supplied Electronic Control gear for LED Modules”.
c. IEC 62384 “DC or AC Supplied Electronic Control Gear for LED Modules - Performance Requirements”.
d. IEC 61000-3-2 “Electromagnetic Compatibility (EMC) - Part 3-2: Limits - Limits for Harmonic Current Emissions (Equipment Input Current ≤ 16 A per Phase)”.
e. EN 55015 “Limits and Methods of Measurement of Radio Disturbance Characteristics of Electrical Lighting and Similar Equipment”.
f. IEC 61547 “Equipment for General Lighting Purposes - EMC Immunity Requirements”.

3. Lighting Levels:

a. Lighting levels and uniformities shall be in full compliance with the latest version of SLL code for lighting CIBSE and relative standards.

1.3 PRODUCTS

A. Lighting fixtures fabricated, assembled and wired entirely at factory.

B. Light Emitting Diode (LED): light source with color rendering index (CRI) greater than 90, efficacy of 80 lumens per watt for fixtures up to 15 W and 100 lumens per watt as a minimum, and rated life not less than 50,000 hours at 25 deg. C ambient temperature.

C. Each LED luminaire type binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.

D. Housing with adequate heat sink ensuring the overall fittings and the LEDs are kept relatively cool and any heat generated throughout the life of the fixture at the specified ambient temperature doesn't affect the guaranteed life time and / or luminaire performance.

E. Electronic LED Drivers: high efficiency, high power factor, suitable for operation at the ambient conditions specified for the project, with guaranteed rated life of 50,000 hours as a minimum.

F. LED driver shall be protected against electric shock, accidental contact with live parts, short circuit, overload and shall be earthed.

G. Emergency Lighting Units: LED Self-contained emergency lighting fixtures equipped with integrated sealed, maintenance-free, nickel-cadmium battery for 1.5 hours operation.

1.4 FIELD QUALITY CONTROL

A. Testing: By Contractor in the presence of the Engineer.

1.5 COMMISSIONING

A. Startup service.

END OF SECTION 265100

SECTION 265600 – EXTERIOR LIGHTING

1.1 SUMMARY

A. Exterior lighting units with luminaires (landscape lighting), light source, drivers, poles/support structures, and accessories and related power distribution and control, protective earthing and related builder's work including column foundations, cable pits, cable trenches and ductwork.

B. Standalone solar powered exterior LED lighting system consisting of fixtures using LED lamps and powered by PV system with the following components as a minimum to ensure proper operation of the system:

1. Exterior lighting fixtures, LED lamps, drivers.
2. Poles/support structures, and accessories.
3. PV modules.
4. Charge controllers.
5. Batteries.
6. Related power distribution and control.
7. Protective earthing.
8. Photoelectric sensor.

1.2 QUALITY ASSURANCE

A. Standards:

1. LED Fixtures and Poles: EN 40, IEC 60598, IES LM-79-08, IES LM-80-08, IES TM-21-11, EN 55015, IEC 62471, IEC 62031, IEC 62717, IEC 62722.
2. LED Drivers: IEC 61347-1 "Lamp Control gear, IEC 61347-2-13, IEC 62384, IEC 61000-3-2, EN 55015.
3. PV System: IEC 61215, IEC TS 62804-1, ANSI/UL 1703, EN 50380, IEC 61730, UL 1704, IEC 62446-1, IEC 61853-1, IEC 61724, IEC 60068-2-68, IEC 61701, IEC 62716, IEC 61000.
4. Batteries: UL 1642, UL 2054, IEC 61959, IEC 62133, IEC 62619.

1.3 COMPONENTS

A. Lighting Columns:

1. Tapered, formed sheet steel, single or double arm brackets, withstand velocity of 160 km/hr.

2. Smart poles - if required - shall be in line with Client Smart Strategy to be adopted in the project.

B. Road Lighting Luminaires:

1. LED luminaire conforming to Ministry of Transportation LED Lighting Specifications for Roads.

2. Totally enclosed, dust protected and splash proof, IP 54 to IEC 60529, housing required lamps, LED driver and accessories.

3. Driver to be mounted in separate compartment isolated from lamp, with enclosure IP65, single phase, 60 Hz with compensated power factor with at least 0.9 lagging.

4. Equipped with HRC fuse for protection of luminaire.

5. LED source specification as mentioned in Section 265100 - INTERIOR LIGHTING

6. Luminous efficacy shall be greater than 100 lumens per watt for luminaires with input power up to 100W and greater than 110 lumens per watt for luminaires with input power higher than 100W.

C. Solar Powered LED System:

1. Off-grid type.

2. PV modules: Mono-Crystalline type having minimum efficiency of 21% at Standard Test Conditions (STC).

3. Charge Controller: Maximum Power Point Tracking.

4. LiFePO4 Phosphate Battery System, to maintain required Lux level for at least 36 hours (3 nights, 12 hours per night) of average daily energy demand during cloudy and dusty days.

D. Photo-electric relays: solid state, with single-pole, double-throw dry contacts, with light level monitoring ranging from 0 to 2000 lux, with an adjustment for turn-on/turn-off levels and with time delay to prevent false operation. Relays to have weathertight housing, resistant to high temperatures and equipped with sun-glare shield and ice preventer.

1.4 REQUIRED LIGHTING LEVELS

A. The lighting levels along the access roads and outdoor parking area shall comply with CIE115 2010 (Lighting of road for motor and pedestrian traffic) and SLL code for lighting CIBSE respectively.

Roadway	**Lav (cd/m2)**	**U0**	**UL**	**TI%**
	0.5	0.35	0.4	15

Area	**Lux Level (lux)**	**Uniformity**
Parking/Under shades	20	0.25

1.5 FIELD QUALITY CONTROL

A. Testing: By Contractor in the presence of the Engineer.

1.6 COMMISSIONING

A. Startup service.

END OF SECTION 265600

SECTION 265700 - HELIPAD LIGHTING EQUIPMENT

1.1 SUMMARY

A. Requirements for supply, installation, testing & commissioning of helipad airfield lighting and associated auxiliary equipment including but not limited to lighting fixtures, counterpoise/earthing installations, bases, helipad power and control panel and illuminated wind cone.

1.2 REFERENCES

A. ICAO 9157-AN/901, Aerodrome Design Manual, Visual Aids, Part 4

B. ICAO 9157-AN/901, Aerodrome Design Manual, Electrical Systems, Part 5

C. ICAO 9157-AN/901, Aerodrome Design Manual, Frangibility, Part 6

D. ICAO Annex 14, Aerodromes, International Standards and Recommended Practices, Volume I Aerodrome Design and Operations

E. ICAO Annex 14, Aerodromes, International Standards and Recommended Practices, Volume II Heliports

F. ICAO - Procedures For Air Navigation Services (PANS), Aircraft Operations (OPS), Doc 8168 – OPS 1611

G. ICAO 9137-AN/898, Airport Operational Services, Part 8

H. ICAO 9137-AN/898, Airport Services Manual, Part 9

I. IEC, TS 61827, Electrical installations for lighting and beaconing of aerodromes - Characteristics of inset and elevated luminaires used on aerodromes and heliports

J. FAA, Advisory Circulars (AC), as referred to within the Specifications

K. General Authority of Civil Aviation (GACA) Regulations Section 14 Aerodromes

1.3 MATERIALS AND EQUIPMENT

A. HELIPAD FINAL APPROACH AND TAKE OFF AREA (FATO) LIGHTS

1. Inset Omni-directional white light is to be used for the lighting of the Final Approach and take off area (FATO) lighting and shall provide the GACAR and ICAO photometric performances.

B. HELIPAD AIMING POINT LIGHTS

1. Aiming point lights must form a pattern of at least six omnidirectional white lights as shown in Figure H-6, GACAR Part 138.

C. TOUCHDOWN AND LIFT-OFF AREA LIGHTS

1. Fixture shall be similar to “HELIPAD FINAL APPROACH AND TAKE OFF AREA LIGHTS”,

D. HELIPAD WIND DIRECTION INDICATOR

1. Wind direction indicator shall comply with GACAR Part 138 listed under clause 138.501.

E. HELIPAD BEACON

1. Wind direction indicator shall comply with GACAR Part 138 listed under clause 138.505.

F. HELIPAD POWER AND CONTROL PANEL

1. The helipad power and control panel shall be provide low voltage power distribution including protection for the helipad lighting systems as well as control arrangements for local and remote control of the lighting installations.

1.4 INSTALLATION

A. Installation of airfield lighting materials and equipment shall conform to GACAR, ICAO & FAA requirements, the manufacturer's instructions, and applicable codes. In the event of any conflicts, GACAR requirements shall take precedence.

END OF SECTION 265700