DIVISION 26 – ELECTRICAL

TABLE OF CONTENTS

SECTION 26 0530

WIRING METHODS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. All of the Contract Documents, as listed on the Table of Contents and including General and Supplementary Conditions and Division 01, General Requirements, shall be included in, and made part of, this Section.

1.2 DESCRIPTION OF WORK

A. The following general systems and equipment shall be provided as a minimum, but not necessarily limited to the following:

1. Conductors – medium voltage.
2. Conduit.
3. Manholes – precast.
4. Underground duct bank system.

1.3 RELATED WORK

A. For work to be included as part of this Section, to be furnished and installed by the Electrical Subcontractor, refer to the Related Work section of Specification Section 26 0510.

B. Carefully examine all of the Contract Documents, criteria sheets and all other Sections of the specifications for requirements which affect work under this Section, whether or not such work is specifically mentioned in this Section.

1.4 WARRANTY

A. Attention is directed to provisions of the General Requirements, Supplementary General Requirements and Section 26 0510 regarding guarantees and warranties for the work under this Contract.

1.5 SUBMITTALS

A. Prepare and submit shop drawings in accordance with the requirements hereinbefore specified, and with Section 01 3300 – Submittal Procedures in the manner described therein, modified as indicated in Section 26 0510 and as noted hereinafter.

B. All shop drawings shall have clearly marked the appropriate specification number or drawing designation, for identification of the submittal.

C. Disposition of shop drawings shall not relieve the Electrical Subcontractor from the responsibility for deviations from drawing or specifications, unless he has submitted in writing a letter itemizing or calling attention to such deviations at time of submission and secured written approval from the Engineer, nor shall such disposition of shop drawings relieve the Electrical Subcontractor from responsibility for errors in shop drawings or schedules.

D. Shop drawings shall include, but shall not be limited to, the following:

1. Conductors – medium voltage
2. Conduit.
3. Manholes – precast.

4. Underground duct bank system – routing.
5. Sleeve-seal systems.

PART 2 – PRODUCTS

2.1 CONDUCTORS – MEDIUM VOLTAGE

A. General

1. The medium voltage cable shall be single conductor, ethylene-propylene rubber (EPR) insulated, shielded and jacketed power cable for medium voltage applications, and shall be in accordance with NEC Article 328. Cables shall be UL listed and designated as MV-105. Cable shall be able to withstand a fault at the magnitude indicated in the short circuit study for at least 5 seconds.
2. The cable shall be in compliance with the latest applicable edition of the following Industry Standards:

    a. AEIC CS-8
    b. ICEA S-93-639/NEMA WC-74
    c. UL 1072
    d. NFPA 70

3. Each components of the cable assembly shall contain less than 300 ppm of lead.

B. Manufacturers

1. Medium voltage conductors shall be manufactured by one of the following:

    a. General Cable
    b. Southwire
    c. Superior Essex
    d. Okonite

C. Cable Description

1. Conductor: The Class B concentric copper conductor size shall be as listed on the drawings and meet ASTM B3, and ASTM B8 or ASTM B496.
2. Strand Screen: The strand screen shall consist of an extruded semiconducting Polymeric layer over the conductor.
3. Insulation: The high quality EPR compound shall be lead free thermosetting elastomer. The insulation shall comply with the referenced specifications and shall be as follows:

Rated Voltage (Phase to Phase) kV	Conductor Size AWG or MCM	Insulation Thickness (Mils)
15	2 – 1,000	220 (133%)

D. Insulation Shielding

1. The semi-conducting insulation shielding shall be triple extruded. The thermosetting material shall meet the requirements of the referenced specifications. Extruded semi-conducting thermoplastic systems will not be acceptable.

E. Metallic Shielding

1. The minimum non-magnetic, metallic shield shall conform to UL 1072, except that a helically applied copper tape shall be at least 5 mils thick and have a minimum lap of 25%.

F. Jacket

1. A PVC jacket shall be tightly extruded over the underlying core. The jacket shall be PVC and shall comply with the referenced specifications. The overall jacket shall be printed at intervals not exceeding 24" with the following information:

   a. Manufacturer's name
   b. Plant of manufacture (Designation Code)
   c. Trade name
   d. Insulation type and thickness
   e. Conductor size and type ("Cu")
   f. Maximum working voltage and insulation level
   g. UL Type designation of cable (MV-105)
   h. UL identification - ("UL")
   i. UL rating(s), as applicable
   j. Year of manufacture

G. Factory Tests

1. Tests on completed cable shall be in accordance with AEIC CS-8 and ICEA S-93-639. Certified test reports shall be provided at time of shipment. These certified copies shall include copies of actual production test values. If the cable is drawn from a previously manufactured inventory program, Certificates of Compliance and documentation of AEIC CS-6 Qualification shall be provided prior to shipment. The cable shall also be tested as described under Part 3 of these specifications.

H. Packaging

1. Each cable length shall be durably sealed before shipment to prevent entrance of moisture. Reels and reel markings shall comply with AEIC CS-8 and ICEA S-93-639. The Electrical Contractor shall provide the manufacturer with suitable shipping lengths subject to a ±0.5% tolerance.

I. Installation

1. New cables shall be pulled through existing and new ductbanks as indicated on the drawings. Cable tension shall be monitored and shall not exceed the manufacturer's limitations.
2. Extreme caution shall be exercised while pulling cable, since energized feeders shall be present in existing manholes and ductbanks.
3. Cable racks and porcelain insulators shall be installed in new manholes. The cable racks shall be bonded to the grounding system. Cables shall be properly racked in the manholes, utilizing the cable racks and porcelain insulators. In existing manholes, the existing cable racks shall be reviewed by the Owner. If cable racks are deemed inadequate, the Electrical Contractor shall furnish and install new cable racks and supports, as required, in each existing manhole and bond same to grounding system.

J. Cable Splicing and Termination Kits

1. Modular, Reconnectable Splice and Termination Kits

   a. Power cable spices and terminations for shielded solid dielectric plastic cables shall be factory engineered kits containing all necessary components to reinstate primary cable insulation, metallic shielding and grounding systems and overall jacket to the equivalent of the cable itself.
   b. Modular spices and terminations shall form a 600 ampere, separable, insulated connection. Splices shall be 15 kV and meet the requirements of ANSI/IEEE Standard 386.

c. When assembled on cables, the spice or termination shall be capable of passing the electrical test requirements of IEEE 48-1975, IEEE 404-1986 and water immersion test of ANSI-C 119.2-1974.

1) Splice and termination kit manufacturer shall provide a test report demonstrating compliance with the above requirement.

d. Splice and termination kit manufacturer shall provide on-site demonstrations for the Electrical Subcontractor and shall provide supervision of each splice.
e. Splices and terminations shall be manufactured by 3M or approved equal.

2. All "X" and "Y" joints shall have auxiliaries, lead sleeves, compound filled.
3. All joints and cables within manholes shall be fireproofed with 3M-77 or Ply-Arc tape.

2.2 METALLIC CONDUIT

A. General

1. Raceways for feeders shall be metallic, rigid metal conduit subject to the restrictions of the National Electrical Code.

B. PVC Coated Rigid Metal Conduit (PVC-RMC)

1. PVC-RMC shall be permitted under all conditions subject to the restrictions of the National Electrical Code.
2. All fittings shall be threaded.
3. PVC-RMC and threads shall be hot-dipped galvanized inside and out. the interior galvanizing shall be listed per UL-6. The exterior galvanizing shall be listed per UL6 as primary corrosion protection.
4. Thread protectors shall be used on the exposed threads of the PVC coated conduit.
5. PVC-RMC shall be utilized at penetrations into manholes. PVC Schedule 40 conduit shall be converted to PVC-RMC within 5’ of the manhole.
6. PVC-RMC conduits shall comply the following:

a. All sections of UL-6
b. ANSI C80.1
c. NEMA RN-1 2005 standard.

7. PVC-RMC shall be manufactured by Calbond, ABB / OCAL or equal.

2.3 PLASTIC CONDUIT

A. Direct buried plastic conduit shall be Schedule 40 and concrete encased in duct banks. Conduit shall be composed of PVC, UL listed and shall conform to NEMA Standards.

B. PVC Schedule 40 conduit shall be furnished in corrosive atmosphere areas.

C. All penetrations through floor slabs, foundation walls or manhole walls shall be rigid steel conduits.

D. PVC expansion and deflection fittings shall be rated for direct burial and concrete encasement and shall be made of neoprene jacket with stainless steel straps. Fittings used for PVC conduit expansion and deflection for up to 4” conduit shall be ABB NM-XD Series or equal.

E. Plastic conduit and fittings shall be manufactured by one of the following:

1. Allied/Heritage

2. Cantex
3. ABB / Carlon
4. Prime

2.4 MANHOLES, ELECTRIC

A. Furnish and install, where indicated on the drawings, heavy duty precast reinforced concrete manholes for telecommunications and power.

B. Manholes shall have minimum internal dimensions as indicated below:

1. Electric manholes: 12'-0" by 6'-0" with a minimum head room of 6'-0".

C. Concrete Minimum Compressive Strength

1. 5000 psi at 28 days in accordance with ASTM, reinforced in accordance with ASTM specification of H-20 loading.

D. Joints between sections shall have self-aligning V-grooves and asphaltic butyl compound joint sealant.

E. Precast units shall be manufactured by Oldcastle Precast Group, American Precast, or approved equal.

F. Manholes shall be completely water resistant. All openings and penetrations shall be provided with proper seals to prevent moisture and water penetration within the manhole.

G. Frames and covers shall be cast iron heavy duty type, suitable for H-20 street loading and have machined bearing surfaces. Electric manholes shall have a minimum clear opening of 36" diameter. The word Electric as applicable shall be cast on upper side of each cover. MasterSeal HLM500, liquid, cold-applied elastomeric waterproofing membrane system shall be provided on the exterior side of the manhole.

H. Masonry collar shall be provided with extension rings as necessary to match the new final grade elevations to allow a flush cover to grade installation.

I. Manholes shall be provided with the following accessories. All steel components shall be hot dipped galvanized.

1. 7/8" pulling irons.
2. Heavy duty adjustable notched channel cable racks, arms, and free moving porcelain saddle insulators. Provide racks at maximum 3'-0" intervals.
3. Provide a 10'-0" long copper clad steel drive ground rod in each manhole, extended 6" above manhole floor. All exposed non-current carrying metal accessories, and parts in manhole shall be connected to this ground rod via bare #6 AWG copper conductors.
4. Bond ground rod to the structural rebar with a #4/0 bare copper ground conductor.
5. Sump pits with 12” square cast iron grating.

J. All spare conduits shall be provided with a blank duct plug. The blank duct plug shall be as manufactured by Tyco Electronics.

K. Underground piping passing through manhole walls, shall have penetration closures of the modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill the annular space between the conduit and wall opening. Links shall be loosely assembled with bolts to form a continuous belt around the conduit and with a pressure plate under each bolt head and nut. After the seal assembly is positioned in the sleeve, tightening of the bolts shall cause the rubber sealing elements to expand and provide an absolutely

watertight seal between the conduit and wall, reducing chances of cathodic reaction between these members.

2.5 UNDERGROUND DUCT SYSTEM

A. Electrical Subcontractor shall furnish and install raceways and fittings for an underground duct system, as indicated on the drawings and specified herein.

B. Trade size of raceways shall be as per drawings for various systems.

C. Concrete, reinforcing rods, etc., shall be furnished and installed under this Section. The Electrical Subcontractor shall consult a structural engineer for proper placement and quantities of reinforcing rods.

D. Concrete shall be red dyed utilizing red dye mixed into the concrete.

E. Raceways shall transform from PVC to rigid steel conduit within 5'-0" of a manhole. Galvanized steel conduit shall be required within 10'-0" of either side of foundation wall. Electrical Subcontractor shall furnish and install proper coupling(s) to accommodate aforementioned transition.

F. Where offsets are required to clear obstructions and other underground services, a maximum of a 5° angle will be allowed at duct joints with prior approval of the Engineer.

G. Ducts shall be installed so as to drain to manholes.

H. All raceways as previously described shall utilize a mandrel of sufficient size to thoroughly clear raceways of all obstructions prior to installation of any wiring.

I. All concrete construction, excavation and backfill for the underground duct bank system shall be by the General Contractor.

J. Warning tape shall be provided on all duct systems to indicate route during installation.

PART 3 - EXECUTION

3.1 COOPERATION AND WORK PROGRESS

A. The Electrical work shall be carried on under the usual construction conditions, in conjunction with all other work at the site. The Electrical Subcontractor shall cooperate with the Architect, General Contractor, all other Subcontractors and equipment suppliers working at the site. The Electrical Subcontractor shall coordinate the work and proceed in a manner so as not to delay the progress of the project.

B. The Electrical Subcontractor shall coordinate his work with the progress of other Trades so that he will complete his work as soon as conditions permit. Any overtime hours worked or additional costs incurred due to lack of or improper coordination with other Trades or the Owner by the Electrical Subcontractor, shall be assumed by him without any additional cost to the Owner.

C. The Electrical Subcontractor shall furnish information on all equipment that is furnished under this Section but installed under another Section to the installing Subcontractor as specified herein.

D. The Electrical Subcontractor shall provide all materials, equipment and workmanship to provide for adequate protection of all electrical equipment during the course of construction of the project. This shall also include protection from moisture and all foreign matter. The Electrical

Subcontractor shall also be responsible for damage which he causes to the work of other Trades, and he shall remedy such injury at his own expense.

E. Waste materials shall be removed promptly from the premises. All material and equipment stored on the premises shall be kept in a neat and orderly fashion. Material or equipment shall not be stored where exposed to the weather. The Electrical Subcontractor shall be responsible for the security, safekeeping and damages, including acts of vandalism, of all material and equipment stored at the job site.

F. The Electrical Subcontractor shall be responsible for unloading all electrical equipment and materials delivered to the site. This shall also include all large and heavy items or equipment which require hoisting. Consult with the General Contractor for hoisting/crane requirements.

G. It shall be the responsibility of the Electrical Subcontractor to coordinate the delivery of the electrical equipment to the project prior to the time installation of equipment will be required; but he shall also make sure such equipment is not delivered too far in advance of such required installation, to ensure that possible damage and deterioration of such equipment will not occur. Such equipment stored for an excessively long period of time (as determined in the opinion of the Architect) on the project site prior to installation may be subject to rejection by the Architect.

3.2 INSTALLATION

A. General

1. Unless specifically noted or indicated otherwise, all equipment and material specified in Part 2 of this specification or indicated on the drawings shall be installed under this Contract whether or not specifically itemized herein. This Section covers particular installation methods and requirements peculiar to certain items and classes or material and equipment.
2. The Electrical Subcontractor shall obtain detailed information from manufacturers of equipment provided under Part 2 of this specification as to proper methods of installation.
3. The Electrical Subcontractor shall obtain final roughing dimensions and other information as needed for complete installation of items furnished under other Sections or furnished by the Owner.
4. The Electrical Subcontractor shall keep fully informed of size, shape and position of openings required for material and equipment provided under this and other Sections. Ensure that openings required for work of this Section are coordinated with work of other Sections. Provide cutting and patching as necessary.
5. All miscellaneous hardware and support accessories, including support rods, nuts, bolts, screws and other such items, shall be of a galvanized or cadmium plated finish or of another approved rust-inhibiting coating.
6. All conduit work shall be carefully cleaned and dried inside before temporarily sealing the conduits for future conductor installation use.
7. Where conduits are exposed to the weather, PVC-RMC shall be provided. PVC – RMC shall be installed by a factory trained Certified installer. PVC-RMC fittings, exposed threads and damaged coatings shall be field coated with Thomas & Betts – OCAL “Heat Cure Patch”
8. Size of rigid steel conduit, intermediate metal conduit, electrical metallic tubing and flexible metallic conduit shall be as shown on the drawings.

B. Medium Voltage Conductors

1. Provide the voltage rating, size, conductor material and number of cables indicated on the drawings.
2. Install cable identification tags on each cable at each point of access.
3. Install cables in continuous lengths whenever possible. Splices are permitted only at manholes and other points of access.

4. While pulling the cable, the maximum pulling tension as provided by the cable manufacturer shall not be exceeded. The pulling tension shall be monitored using dynamometer and recorded.
5. While pulling the cable, each individual conductor shall be attached to the pulling lead with the ball bearing swivel enabling each conductor to turn independently while being pulled.
6. While pulling the cable, cable lubricating compound(s) as recommended by manufacturer shall be used.
7. While pulling, each cable in the set shall be positively identified by a method selected by General Contractor.
8. Provide continuous insulation shielding through all splices and ground shielding at each splice and termination unless otherwise indicated on drawings.
9. In manholes or other accessible common enclosures, wrap each cable with fire retardant tape in accordance with manufacturer's instructions. To prevent unraveling, the fireproofing tape shall be random wrapped the entire length of the fireproofing with pressure sensitive glass cloth electrical tape.

C. Underground Conduits

1. Steel conduits in ground or in concrete duct banks shall be field coated with asphaltum or shall have additional outside factory coating of polyvinyl chloride or phenolic-resin-epoxy material or other equally flexible and chemical resistant material. Couplings and damaged areas of coated conduits shall be field-coated with same compound as conduits. Joints shall be threaded.
2. Joints in conduits and fittings shall be watertight and shall meet the requirements of manufacturer's installation recommendations. Threaded portions of steel conduits not encased in concrete, and adjoining ends of conduits, couplings and fittings shall be coated with asphaltum after installation. Connections between conduits of different types shall be made in an approved manner, using adapters and other materials and methods recommended by conduit manufacturers.
3. All metal conduit buried in the earth or fill shall be PVC coated galvanized steel , including couplings.
4. Excavation, shoring, bracing, backfilling and grading will be provided by the General Contractor. Trenches shall be evenly graded so that conduits slope uniformly a minimum 3" per 100'-0", without horizontal or vertical waves. Unless specified otherwise, conduit shall slope uniformly from (1) manhole to the next or from a high point between manholes to prevent pooling of water. Conduits run from building to manhole shall slope toward manhole to avoid water draining into the building. Avoid low points between manholes or upturned elbows.
5. Run conduits straight between manholes and upturned elbows. Unavoidable bends in nonmetallic conduits shall be made by assembling couplings at a slight angle if resulting radius is at least 100'-0". For radii less than 100'-0", use 5° angle couplings or 5° factory-made bend sections. Conduit shall terminate in end bells where raceway enters manholes. All conduit bends for telecommunication ductbanks shall be 12'-6" radius sweeps. Conduit bends for power cable conduits shall be minimum 36" radius.
6. Support multiple conduit runs and banks on preformed nonmetallic spacing block separators on minimum 5’-0” centers. Separator containing metal shall have metal non-continuous and shall not form a magnetic loop. Unless otherwise shown on the drawings, spacing between exterior surfaces of conduits shall be as follows:

    a. 3" between conduits containing cables operating at more than 600 volts
    b. Space conduit separators to prevent sagging of raceway and breaking of couplings and watertight seals, to maintain deformation of conduit at separators to 0.10" or less. Secure with cords where necessary. Do not use tie wires, reinforcing rods or other metallic materials.

7. Stagger conduit couplings so that couplings on adjacent conduits do not lie on the same transverse plane. Space end bells 9" center-to-center at manhole wall face for 4"

conduits and space proportionately for other sizes. Transition to end bell spacing shall start 10'-0" from face of manhole wall. Conduit slope shall equal that of main bank. Make new conduit entrances into manholes and building walls consistent with grading requirements and entrances. Waterproof all conduit entrances into manholes and buildings as required by the Architect.

8. Concrete for conduit envelopes shall be as required or as specified under Division 03. Concrete shall extend a minimum 3" beyond exterior surface of each conduit in bank. Coordinate work of this Section with that of Division 03.
9. Concrete envelopes between manholes shall be poured in a single operation. Where more than (1) pour is necessary, provide 3/4" reinforcing rod dowels extending 18" into concrete on each side of joint. Dowels shall be coated with bonded adhesive prior to the second pour. Concrete envelopes installed over extensive area of disturbed earth shall have a separate concrete base.
10. Concrete envelopes that cross other conduits or pipelines or are run under roads and driveways shall be reinforced. Provide reinforcement where envelopes connect to manhole and building walls. Concrete envelopes that terminate for future extension shall have dowels as specified for joints between pours. Reinforcement shall be as required; consult with Structural Engineer.
11. Trenches shall not be backfilled until concrete envelopes have had sufficient time to set. After concrete envelopes have set, nonmetallic conduits shall be cleared with mandrel of the same size as the conduit.
12. Where conduits cross under existing roadways, walks or other paved areas, steel conduits may be driven instead of conduits in trenches. After installation, paved grass areas and other areas disturbed shall be restored to original condition.
13. Cap ends of spare conduits 5'-0" beyond pavement and protect them from mechanical damage. Mark the location of conduit ends with concrete monuments, 6" in diameter by 18" long, set flush in the ground with "S/C" indented in the top.
14. Arrange multiple conduits as shown on the drawings. Make minor changes in location, or cross-sectional arrangement as necessary. Where conduit runs cannot be installed as shown because of conditions not discoverable prior to digging of trenches, request the Architect's instructions before further work is done. Coordinate this work with other outside service work.
15. Seal active and spare conduits with oakum or other plastic expandable compound until conductors are ready for installation.

3.3 MATERIALS AND WORKMANSHIP

A. All materials and equipment shall be new and unused and shall meet requirements of the latest Standards of NEMA, UL, IPCEA, ANSI and IEEE. Equipment shall have components required or recommended by OSHA, applicable NFPA documents and shall be UL listed and labeled.

B. Despite references in the specifications or on the drawings to materials or pieces of equipment by name, make or catalog number, such references shall be interpreted as establishing standards of quality for materials and performance.

C. Finish of materials, components and equipment shall not be less than Industry good practice. When material or equipment is visible or subject to corrosive or atmospheric conditions, the finish shall be as approved by the Architect.

D. Provide proper access to material or equipment that requires inspection, replacement, repair or service. If proper access cannot be provided, confer with the Architect as to the best method of approach to minimize effects of reduced access.

E. All work shall be installed in a neat and workmanlike manner and shall be done in accordance with all Local and State Codes.

F. The Owner will not be responsible for material, equipment or the installation of same before testing and acceptance.

END OF SECTION