

**PAYMENT**

This work shall be paid for at the contract unit price per L SUM for PUMP STATION, which payment shall include full compensation for furnishing labor, materials and equipment, complete, in place and accepted, and for all materials necessary to complete the work as shown on the plans and specified above, excluding the underpass lighting controller and transformer, which shall be paid for separately.

## Electrical Service and Distribution

### General

Electrical contractor shall provide distribution equipment and service equipment specified and shown on the drawings.

Install grounding protection for all equipment per Electric Code requirements. Provide additional ground wires in PVC conduit as required

Provide transient voltage surge suppression at the main service.

Coordinate new service installation with the Power Co. including the transformer pad and conduits.

Power connection of heating, ventilating, lift station system, controls, and miscellaneous items.

Provide power to control transformers. Coordinate with other trades.

Service grounds and supplementary driven ground.

Coordinate the circuit breaker sizes with the actual supplied equipment and/or consultation with each individual subcontractor/supplier prior to breaker installation.

### Related Work

Electrical Materials and Methods

Storm Water Pump Station

### Submittals

Shop Drawings

Product data for panelboards and safety switches.

Product data for new service entrance equipment.

Product data for specialty items.

### Acceptable Manufacturers

Fuses:

Bussman	Ferraz Shawmut	General Electric
RK-1	All purpose	A2K

Safety Switches:

Square D	ITE	Cutler Hammer
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Heavy Duty Vacu Break

Panelboards:

Cutler Hammer	ITE	Square D
Bolt-on	Bolt-on	NQOB

Circuit Breakers:

Motor rated same as panelboard manufacturer

Service Protection:

Cutler Hammer	Multilin/Lehman Co.	Square D
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Transformers:

Cutler Hammer	Square D	ITE	General Electric
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Copper winding  
Service Entrance  
Cutler Hammer        ITE        Square D  
100 per cent rated  
Fused Switches  
Boltswitch  
Current Transformers and Metering:  
Erickson  
Transient Voltage Surge Suppressors  
Cutler Hammer    Leviton    Square D

**Service Entrance and main distribution panels:**

Bus shall be copper with 1000 amp per square inch capacity.  
Service entrance shall be 100 per cent rated.  
Furnish pull sections as required.  
Furnish replacement parts manual and instruction booklet.  
Provide stored capacitor trip where required for ground fault or service control.  
Install screw on nameplate.  
Minimum A.I.C. shall be 65000 amperes.

**Circuit Breaker, Lighting, and Distribution Panelboards:**

Circuit breakers shall be quick-make, quick-break, thermalmagnetic, trip indicating, and have common trip on all multipole circuit breakers  
The minimum circuit breaker interrupting capacity shall be 22,000 amperes for 120 and 208/240 volt circuit breakers if current limiting fuse protected or as determined by a fault current study.  
The system shall be suitable for 65,000 ampere interrupting capacity.  
Circuit breakers shall be bolt-on type with lockable handles for equipment switched at the panel and to meet OSHA requirements.  
Bus bars shall be copper All current carrying parts of the bus assembly shall be plated. Provide proper temperature rating and terminations for wire type used.  
All circuit breaker terminals and neutral bus terminals shall be UL listed as suitable for the type of conductor specified.  
Panelboard bus assemblies shall be enclosed in galvanized or rust-resisting steel cabinets. Fronts shall include doors and cylinder tumbler type locks with catches and spring loaded door pulls. All doors shall be keyed alike. Door hinges shall be concealed when panel doors are closed. Fronts shall not be removable with doors locked. A circuit directory frame and card with clear plastic cover shall be locked on the inside of the front. Door and front shall be of code gauge steel with rust-inhibiting primer and baked enamel finish.  
Furnish with solid neutral. Provide insulated neutral bar and separate equipment grounding as required.  
Circuit breakers for motors shall be horsepower rated for the motor starting loads. Electric panel supplier shall provide rated circuit breakers at no additional cost to the project.  
Circuit breaker sizes shall be determined from equipment supplied at the site. Electrical contractor is responsible for changing circuit breakers per supplied equipment requirements as part of the base contract. Provide locking circuit breakers for any equipment switched at the panelboard.

### **Safety Switches**

All safety switches shall be horsepower rated. Safety switches rated 10 HP and above shall be heavy duty. Safety switches rated less than 10 HP may be general duty except for safety switches used as service equipment, which shall be heavy duty. Provide fused safety switches for 1 horsepower and above.

Enclosures shall be code gauge steel with rust inhibiting primer and gray baked enamel finish.

Install safety switches with NEMA 1 enclosures; 3R enclosures in wet locations.

Switches shall have quick-make, quick-break operating handle and mechanism that shall be an integral part of the enclosure. Switches shall be lockable in both positions and shall have an interlock to prevent opening switch door with handle in OFF position. This feature shall have a defeater mechanism. Conform to OSHA requirements.

Switches shall be dead front type with arc suppressors. Lugs shall be UL listed for copper or aluminum. All current carrying parts shall be plated.

Switches shall have a solid neutral unless otherwise noted.

Fusible switches shall have factory installed kits to prevent the use of other than UL class R fuses.

Fuses shall be RK1 current limiting.

### **Amp Interrupting Capacity**

The service entrance and distribution system shall be braced to withstand the power company fault current but in no case less than 65,000 amperes. Provide a fault current study prior to equipment submittal. This will determine A.I.C. for panels and switches. Branch panels shall have a minimum interrupting capacity of 22,000 amperes if current limited by fusing.

### **Transient Voltage Surge Protector**

250ka capacity

Visual indication of defective or blown protective devices.

NEMA 1 enclosure or panel mounted

Provide 2 sets of spare protective modules.

Cutler Hammer Clipper / Visor or equal

### **PVC / PE Underground Electrical Duct**

Materials

High density polyethylene meeting the requirements of ASTM D1248, Nema TC-2 and Nema TC-7.

Schedule 80 PVC

### **Grounding**

Install a system ground and equipment grounding for all equipment. Conform to local and utility company requirements for all grounding.

Equipment grounding provisions shall consist of:

Exposed, noncurrent-carrying metal parts of fixed equipment likely to become energized, including the following, shall be grounded:

Electrical distribution system and control equipment enclosures, frames, cabinets, and cutout boxes.

Metal raceways and boxes.  
Wiring devices  
Motor controller enclosures  
Ground to driven rod system.

#### **Panelboards**

Install panelboards and motor control centers with a minimum of 3'6" working clearance measured from front of enclosure.  
Support panels adequately.  
Wiring within the panelboards and controllers shall be done in a neat and workmanlike manner with branch circuit and power conductors run in wireways.

#### **Panel Indication and Directories**

Provide typewritten directories for all panels and insert in door.  
Provide engraved panel nameplate for each panel. (1" high)  
All 480 volt panels shall be so indicated with minimum 2 inch high letters indicating 480 volt.  
Provide metal panel at lift station indicating that power disconnects are located in the building.  
Affix to cover of lift station access door.

#### **Non Metallic Duct Installation**

Duct shall be trenched and backfilled. Trench excavation material may be reused if no backfilling is done with rocks larger than 1-1/2".  
Conduit shall be free of any kinks or crushing. Contractor shall replace any damaged conduit.  
Heavy wall steel conduit shall be used above grade.  
All joints shall be watertight.  
Primary electric ducts shall be encased in concrete per Power Company requirements.  
Install ground wire sized for the power cables installed in the conduit.

## Electrical Materials and Methods

### General

This section includes the requirements for the installation of the electric service and requirements for various control and power equipment. Refer to the Storm Water Pump Station section of these specifications for additional information.

### Contractor provide:

Raceway and wiring shown or specified including electrical power distribution system, lighting system, fire alarm system power, telephone, heating, and other systems including all recessed electrical boxes and conduits.

Feeders and branch circuits to all electrically powered or controlled equipment provided by other contractors including disconnects.

Fuses or circuit breakers for all fusible equipment including that equipment provided by other contractors including disconnects.

Installation of motor starters and wiring of motors and controls.

Grounding conductors, supplementary ground rods, and system to connect the electrical system components to the building ground location.

Alarm and dialer system

### Miscellaneous Requirements:

Contractor shall become familiar with all local codes and shall in their base bid include all items required to meet the code. Contractor shall contact the Building Department for any special Electrical requirements during the bidding process.

Contractor shall visit the site and determine all items that may affect his work. These costs shall be included in his price.

Examine all drawings including but not limited to architectural, electrical, structural, site, demolition, fire protection etc. to determine all equipment to be furnished and installed.

Each contractor is responsible for a complete operating system and shall provide all items including connections, fittings etc., required to place the system into operation whether or not they are indicated on the drawings or in the specifications.

Contact local utilities for underground utility locations prior to starting work. Contractor is responsible for any damage to underground utilities.

Prior to bidding verify quantities with authority having jurisdiction and include in bid.

Safety controls meeting state and local codes shall be provided for all applicable equipment.

Provide motor starters with proper coil voltage for equipment furnished under this contract.

Provide stamped metal nameplates for all exterior major pieces of equipment. Nameplate shall indicate all input, output, electrical characteristics etc. for the item. Typewritten or printed nameplates on adhesive foil are not acceptable for exterior use.

Obtain required contractor and subcontractor licenses and bonds prior to starting work. No work is authorized until all approved permits have been obtained and all requirements of the Code Authority reviewed by all subcontractors.

Each contractor is responsible for installing their controls and interlocks including exposed conduit. The electrical contractor is responsible for all concealed conduit in walls, floors, to the wet well and valve vault, and miscellaneous exterior conduits.

Each contractor shall be responsible for construction means, methods, techniques, sequences, procedures, and for safety precautions and programs in connection with the work.

The Electrical Contractor shall coordinate final equipment power requirements based on what is provided on site by the other trades and/ or equipment suppliers and install proper size protection as part of the base contract.

Electrical contractor shall coordinate the location and routing of electrical equipment with the other trades prior to any installation.

### **Maintenance**

Electrical contractor shall perform normal maintenance on all equipment during the warranty period. Each contractor is responsible for the replacement of any defective equipment during the warranty period.

### **Related Work Specified Elsewhere:**

Electrical Service and Distribution

Storm Water Pump Station

### **Related Drawings**

Examine all drawings including Structural, Site, Electrical Details for Lighting Controller, etc. to determine all equipment to be furnished and installed and to include in bid. Drawings are diagrammatic and are not to be scaled.

Provide all new materials, without blemish or defect, in accord with standards specified and U.L. listed or labeled.

### **Quality Assurance**

Regulatory Requirements

Comply with ANSI C1, National Electric Code, latest edition as a minimum and/or local electric code with amendments. Local code shall govern. Contractor shall be familiar with the Code and shall include any special requirements in the base contract.

State of Illinois Requirements

East Hazel Crest, Illinois Building Requirements

Reference Publications:

American National Standards Institute, ANSI.

C80.1 – Specification for rigid steel conduit, zinc coated

C80.3 – Specification for Electrical Metallic tubing, zinc coated

C80.4 – Specification for fittings and rigid metal conduit and EMT.

National Electrical Manufacturers Association, NEMA for specialties

Manufacturer's Catalog

Catalogs of specified manufacturers current at date of contract documents are incorporated by reference to same force and effect as if repeated herein.

Conflicts:

If there is any conflict in the contract documents, it shall be brought to the attention of the Engineer for a decision during the bidding process. No additional compensation to resolve the conflict will be allowed during construction.

**Submittals**

Provide submittals for all equipment including but not limited to service entrance, power, lighting, specialties, etc.

Provide shop drawings for all electric rooms. Shop drawings shall reflect any special requirements of the authorities having jurisdiction.

Review of submittals and shop drawing will be made based on information received. Contractor is responsible for providing all items as required by the contract documents whether reviewed or not. It is the contractor's responsibility to confirm all dimensions and orientations for installation in the field prior to purchasing equipment or specialties.

Where a catalog or model number is specified the item submitted shall contain all standard equipment and additional items as specified. Manufacturers indicated without model number if used by the contractor shall contain all of the items as those specified with the catalog number. The contractor shall furnish items not provided by the equipment manufacturer. Any deviation whatever from what is shown and/or specified shall be indicated by the contractor on the submittal sheets.

**Demolition - Relocation:**

Electrical contractor is responsible for the demolition and/or relocation of all electrical in or passing through the construction area. Contractors shall visit the site and shall check the drawings and include all electrical demolition or relocation work in the base bid.

Piping, equipment, etc. that is abandoned shall be removed and disposed of legally. Cap and/or reroute items as required to maintain offsite equipment in operating condition.

**Substitutions**

Proposed substitutions will be considered that will offer substantial advantage to the owner after deducting offsetting disadvantages including delays, additional compensation to the Engineer for redesign, evaluation and other necessary services. Substitution evaluation will be made at Engineer standard consulting rate.

All substitutions shall include any cost increase incurred by the other trades and shall be paid for by the contractors requesting the substitutions. All items indicated for the specified equipment shall be included in the substitution.

Submittals shall indicate cost increase or decrease when substitutions are requested.

Substitutions shall be compared with the items specified and shall indicate in writing all differences from the items specified. Specified item submittal sheets with all options shall be compared to the items requesting substitution.

**Conduit:**

Steel Rigid Metal. ANSI C80.1 & UL-6

Intermediate Metal. ANSI C80.1 & UL-6

Steel Flexible Metal, UL-1

Steel Liquidtight Flexible. UL-1

Rigid Nonmetallic. NEMA TC-2, PVC, Schedule 40 or 80  
Tubing

HDPE Conduit ASTM D2447, UL 651B Schedule 40 or 80

Steel Electrical Metallic. Comply with ANSI C80.3 & UL 797.

### **Fittings**

Rigid and IMC, HDPE & PVC

ANSI C80.4

ASTM D3350

Locknuts; steel or malleable iron

Bushing; insulating or insulated throat type

Couplings; threaded or gland compression malleable iron type

Connectors; malleable iron, threadless, squeeze clamp type for nonjacketed conduit.

Connectors; steel or malleable iron compression type with insulated throat and "O" ring assembly for liquidtight conduit.

Acceptable Manufacturers

Appleton

Crouse-Hinds

RACO

Thomas & Betts

Steel City

### **Sealing**

All conduits to the wet well and valve vault shall be sealed with a conduit seal to prevent any gas or moisture migration into the building electrical or control systems. The wet well is considered a hazardous area. All conduits leaving the wet well must be sealed.

### **Wire And Cable**

Building Wire: Copper, 98% conductivity, 600 volt insulation, THW, THWN, XHHW or THHN complying with UL-83, ICEA S-61-402 or S-66-524. Wire through #10 solid; #8 and larger, stranded. Exterior wiring shall be classified for wet location.

Branch Circuit Wiring: Conductors sized per Code 75 degrees C. Ampacity tables but not less than No. 12 AWG. Increase size when furthest outlet is greater than 75 feet from panelboard.

Wiring for systems other than power: Comply with system manufacturer's standards. No. 14 AWG minimum size unless otherwise specified.

Aluminum wire is not allowed.

Exterior wiring shall be suitable for wet locations.

Color code conductors to designate neutral and phase. Standard insulation colors.

Where conductors of different systems are installed in same raceway, box, or other type enclosure, comply with NEC 210-5, or local code. Use different colors for other systems.

Color coding of phase conductors may be accomplished with colored tape approved by Engineer for sizes larger than No. 8 AWG. Identify control wire at each end and in all junction boxes with designated wire number corresponding to control schematics.

Acceptable Manufacturers:

Anaconda Wire & Cable Co.

General Wire and Cable

Okonite

Pirelli

## American Wire and Cable

### Electrical Boxes

#### Pull Boxes and Junction Boxes

NEC – 370 and U.L. 50

Flush mounted pull boxes: Overlapping cover with flush head security type retaining screws, primecoated. Provide two screw removal/insertion tools to Owner. Overlap two inches on all sides.

Surface mounted boxes: Screw-on or hinged cover. Provided silicon bronze standard retaining screws where accessible only to authorized personnel; security type in all other locations.

Boxes of 14 gauge steel minimum, galvanized or prime coated in finished areas.

#### Outlet Boxes

Hot dipped galvanized, 1.25 oz. per sq. ft. sherardized or cadmium plated. U.L. 514.

Interior boxes: Sheet steel with conduit knockouts, attached lugs for locating.

Exterior boxes or exposed interior in wet/damp locations: cast aluminum, deep type, corrosion proof fasteners, watertight, gasketed, threaded hubs.

For suspended or surface mounted fixtures:

4 – inch octagonal or square according to devices used, minimum of 1-1/2 inch deep boxes for poured concrete ceilings. Furnished with fixture studs. Installed with 3/4 inch minimum depth plaster rings on suspended ceilings.

4 – inch octagonal or square for all exposed conduit work with fixture extension pan or deep fixture canopy to enclose the box. Use #14 stranded, type AF, 300 volt wire in pipe pendants.

For Recessed Fixtures

4 – inch octagonal or square. A minimum of 1-1/2 inch deep. Complete with blank cover.

Wire in Greenfield to be #12 type THHN, 600 volt.

#### Switch and Receptacle Boxes

Wall – 4 – inch square for up to two devices. Solid gang boxes for over two devices.

Complete with 3 / 4 inch minimum depth ( or as required)tile ring where used in exposed concrete, or block walls. Install with 1/2 inch raised galvanized device covers where used for exposed conduit work.

Provide corrosion resistant steel knockout closures for unused openings.

Exterior handholes or pull boxes shall be equal to Strogwell Quazite or Neenah R6600 series.

#### Conduit Bodies

Galvanized cast metal of type, shape and size to fit location.

Constructed with threaded conduit ends, removable cover, corrosion resistant screws.

#### Acceptable Manufacturers

Appleton Electric Co.

Crouse-Hinds Co.

Killark Electric Mfg. Co.

O.Z. / Gedney Co.

RACO

Square D

Steel City

Thomas & Betts Co.

## WIRING DEVICES

### Wall Switches

120/277 volt, quiet, slow make, slow break design, toggle handle, totally enclosed case, rated 20 amperes, spec. grade. Equivalent 2 pole, 3-way and 4-way switches.

Switch and pilot light: toggle type with integral long-life pilot, rated 15 amperes, 120 volt.

Color: Brown, Ivory

Acceptable Manufacturers

Bryant Electric Co#4901-1

Harvey Hubbell Inc #1221-1

Leviton Inc. #1221-1

P& S CS 20 AC1 or CSB 20 AC1

General Electric #5951-2G

### Receptacles

Standard duplex: Full gauge size, polarized, parallel blade, U-grounded slot, spec. grade, rated 20 amp, 125 volt, NEMA line 5, designed for split feed service.

Color: Brown – Ivory – Red for units on emergency circuits.

Acceptable Manufacturers

Harvey Hubbell Inc #5362-1

Leviton Inc. #5262-1

Pass & Seymour 5362 TR62-W

General Electric #6200-1

Ground Fault Circuit Interrupter:

General duty feed thru type capable of protecting downstream receptacles on single circuit, grounding type, UL Class A, Group 1, 20 ampere rating, 125 volts.

Wallplate compatible with receptacle configuration.

### Covers

Nylon, smooth, high abuse, color to match device

Stainless steel: type 302 or 304, No. 4 finish, 0.040 inch thick, accurately die cut, protected with release paper.

Cast metal; die cast profile, ribbed for strength, flash removed.

Gaskets; resilient rubber or closed cell foam urethane

Steel; hot dip galvanized, 1.25 oz. per square foot minimum

### Plates

Flush mounting: beveled type with smooth rolled outer edge.

Surface: beveled, steel, pressure formed for smooth edge to fit box.

Weatherproof: cast metal, gasketed, wet label for constant cord use with locking hasp. Lexan to be approved by owner.

Acceptable Manufacturers

Bell Electric Co.

Bryant Electric

Harvey Hubbell

Leviton

Pass & Seymour

### **Circuit and Motor Disconnects**

#### **Safety Switches**

Heavy-duty enclosed safety switch, surface mounted, fusible or non-fused as specified, rated at 600 volts, UL listed.

Quick-make, quick-break mechanisms, position of blades visible with cover open.

Operating handle integral part of enclosure base with position easily identified, handle lockable in 'off' position with padlocks. Conform to OSHA requirements.

Meet NEMA Enclosed Safety Switch Standard KS-1 for H.D. type. Silver-tungsten type contact surfaces.

Current carrying parts of high conductivity copper with silver-tungsten type contact surfaces. Positive pressure reinforced fuse clips for fused type. Clips shall be suitable for time delay fuses.

#### **Enclosures**

Outdoor NEMA 3R

Indoor NEMA 1

#### **Acceptable Manufacturers**

Cutler Hammer

ITE

Square D

Westinghouse

### **MOTOR AND MOTOR STARTERS**

Each contractor providing a piece of equipment requiring a motor starter shall provide factory fabricated starters complying with NEMA Standards Publication ICS 2 with NEMA type enclosures as required by location. Loose starters shall be turned over to the Electrical Contractor.

Provide starters with thermal overload protection on each phase utilizing interchangeable melting alloy as required or, Class 20 (trip in 20 seconds or less when carrying a current equal to 600 percent of its current rating) overload heaters, sized in field for full load current rating indicated on each motor nameplate or as required by the motor supplier.

### **FUSES**

Fuses shall be based on Ferraz Shawmut Amptrap 2000 Level of protection. Other manufacturers shall match Shawmut Manufacturing Company.

#### **Acceptable Products**

Fuses rated up to 600 amperes shall be U.L. listed class RK-1 time delay current limiting type. Ferraz Shawmut Amptrap 2000 level of Protection applies to these fuses.

#### **Acceptable Products**

Shawmut A6D up to 600 amps

Bussman lps-rk

Littlefuse

Fuses up to 600 amperes at 250 volts shall be U.L. listed.

#### **Acceptable Products**

Shawmut A2D up to 200 amps A6D 600 amps and above

Bussman LPN-RK

Littlefuse

Furnish three each of each size and type fuse installed to Owner at time of Substantial Completion. House spare fuses in a steel 24"x35"x12" or as required by the fuses steel cabinet.

Shawmut GSFC

Bussman SFC

## IDENTIFICATION

### Nameplates

Each contractor to provide nameplates for all starters, controllers and other equipment it furnishes.

Nameplates shall be white bakelite engraving stock, black core. Lettering 3/16-inch high minimum identifying equipment function or equipment served.

Attach nameplate to equipment with sheet metal screws after painting is completed.

Exterior equipment shall be equipped with stamped metal nameplates indicating equipment characteristics.

### Installation

Cooperate with other contractors engaged in project. Execute work in a manner not to interfere with other contractors or Owner's operation.

Coordinate work with other contractors regarding location and size of pipes, raceways, outlets, so there is no interference between installation or of progress of any contractor.

Location of any item may be moved up to ten feet prior to installation at no additional cost to the contract if requested by Owner or Engineer.

Install all equipment with ample space allowed for removal, repair, or changes to equipment.

Provide ready accessibility to removable parts of equipment and to all wiring without moving equipment installed or already in place

Provide sleeves for all electrical conduits passing through walls, partitions, ceilings and floors. Provide sleeves of sufficient length to extend through full thickness of wall construction with ends flush. Extend floor sleeves one inch above finished floor.

Where cutting is required to facilitate construction, patch and repair cut items to original state. Structural work shall not be cut without prior written approval of Engineer.

Holes through concrete and masonry in new and existing structures shall be cut with a diamond core drill or concrete saw. Layout holes in advance. Notify Engineer prior to drilling through structural sections for determination of proper layout.

Make floor, exterior wall and roof penetrations watertight. Sleeve walls and floors.

At project completion, clean all equipment to the original finish. Remove all shipping labels.

Painting of conduit and other electrical equipment where specified shall be done in accord with Architectural requirements. Provide touch-up painting of all equipment marred in any way during shipment or installation.

Wiring connections to equipment shall be made finger safe.

All boxes shall be flush mounted in public areas. Surface mounting shall be approved by the Engineer.

Install safety striping as required by local Codes and install resilient protection on any equipment extending into the pathways or accessways in all areas. Coordinate with Engineer.

### **Conduit Installation**

PVC or HDPE conduit with proper ground wire may be used outside of the building foundation for underground applications (none exposed to weather) subject to local codes and unless otherwise specified.

Use rigid steel or IMC for:

All conduit larger than two inches trade size in or below floor slabs or in masonry or concrete walls.

All conduit smaller than two inches installed below concrete slabs on grade or in wet areas.

All conduit exposed inside and outside of structures.

#### **Conduit Runs**

Size all conduit as indicated on Drawings; where not shown, in accordance with the Electrical code. Ground in accordance with the Electrical code.

Run all exposed conduit parallel to building walls using right angle bends. Locate conduit installed in concrete slabs to not adversely affect structural strength of slab. Coordinate with Engineer. Encase PVC primary service entrance and secondary service entrance conduits in three-inch minimum concrete envelope or as required by ComEd.

Seal each underground joint and make watertight. Prevent water entrance into exterior conduits.

Provide pull boxes in runs over 150 feet and as required to install the wiring

Perform all work in hazardous locations as defined by NEC in strict accord with NEC for particular 'Class', 'Division' and 'Group' of hazardous locations involved or indicated on drawings. Provide conduit and cable seals in accordance with NEC. The wet well and valve vault are considered hazardous areas.

### **Wire and Cable Installation**

Do not make splices except in outlet or junction boxes. Make all feeder cables continuous from origin to panel or equipment terminations without running splices in intermediate pull or boxes, unless specifically indicated on the Drawings or approved in writing by Engineer. Do not exceed conduit fill and current carrying capacity established by the Electrical Code for number of conductors installed in a raceway.

Use wire sizes no less than shown on the drawings or specified herein.

Control and Signal #14 AWG minimum.

Provide each service entrance cable or conductor in panels, pullboxes, or troughs with a permanent pressure-sensitive label with suitable numbers or letter for easy identifications. Identify control wires at each end and in junction boxes with designated wire numbers corresponding to control schematic drawings.

Provide wires and cables entering equipment or panels with adequate slack. Neatly arrange wiring, bundle and fan out to termination panels.

Support all conductors in vertical raceways in accord with Electrical Code.

Leave at least eight inch loops or ends at each outlet for installation of devices or fixtures.

Upon Completion of cable and wire installation, but before termination to equipment, test each wire for grounds and short circuits. Replace or correct defective wiring.

All exterior wiring shall be suitable for wet location.

### **Disconnect and Motor Starter Installation**

Supply motor or load from individual branch circuit in separate branch conduit except where otherwise shown.

Verify proper direction of rotation of all motors.

Provide nameplates or legends indicating equipment served or the function of all disconnects, combination starters, and control devices furnished by contractor. Size nameplates or legends relative to the device. Make from engraved phenolic compound and properly secure to device.

Contractor furnishing motor starter/equipment shall be fully responsible for providing adequate and correct wiring diagrams and instructions.

Motor sizes shown in schedules and locations may differ from that provided, dependent upon manufacturer. Coordinate with various trades and provide connections of proper capacity at proper locations regardless of those differences.

Damper motors interlocked with fan motors shall be wired by the electrical contractor.

Safety controls shall not be bypassed in the hand or automatic positions.

Install proper fuses and overloads.

### **ELECTRICAL EQUIPMENT OPERATION AND MAINTENANCE MANUAL**

General: The contractor shall prepare a manual for the operation and servicing of all electrical equipment installed as a part of the construction contract, including but not limited to the following items:

- Service Entrance
- Circuit Breakers
- Fused Switches
- Panelboards
- Disconnect Switches
- Specialties
- Fire Alarm Panel
- Fire Specialties
- Temperature Controls
- Lighting Fixtures
- Emergency System
- Motion Sensor

Specific information: The information contained in the manual shall be for the exact equipment installed not the complete product line of the manufacturer. It shall include the following data for each item of equipment.

Parts lists used for ordering replacements and repairs.

Recommend spare parts to be stocked.

Instructions and specifications for assembly installation, alignment, checking, and placing in operation.

Maintenance information and maintenance schedule.

Format: The information contained in the manual shall be grouped in an orderly arrangement under basic equipment categories, i.e. power, lighting, fire protection, and temperature control, as a minimum.

Submittal: The contractor shall be required to submit the operation and maintenance manuals to the Engineer for distribution to the Owner.

Instruction of Personnel: Prior to final acceptance the contractor shall review the maintenance manual and equipment with the Owner designated personnel and shall instruct them in the proper operation, maintenance, and safety of all systems.