COMMONWEALTH ENGINEERS, INC.
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ADVERTISEMENT FOR BIDS:
ELKHART COUNTY REGIONAL SEWER DISTRICT
HEATON LAKE NORTH LIFT STATION REHABILITATION PROJECT

ECRSD – PROPOSAL FOR HEATON LAKE NORTH SIDE LIFT STATION REHABILITATION PROJECT

A. GENERAL INFORMATION

Description

The Elkhart County Regional Sewer District (ECRSD) has a lift station located in Elkhart, Indiana. The North Lift Station is a one lift duplex pump station with a design pumping capacity of 120 GPM located on the north side of Heaton Lake near the intersection of Acorn Lane and Decker Drove. The lift station was built in 2006, and the pumps and electrical equipment have not been replaced since original installation.

ECRSD is advertising for bids from qualified Contractors to perform maintenance work to the lift station in accordance with the requirements outlined in this document.

The scope of the work is to include the installation of two (2) new submersible grinder pumps, elbow pieces, and guide rails, replacement of electrical and control units, and bypass pumping.

Bids for the North Side Lift Station Rehabilitation Project are due by **February 5th, 2024 at 6:30 PM Eastern Time**. Bids will be opened publicly at the ECRSD's regular board meeting on February 5, 2024 at 6:30 PM Eastern Time at 4230 Elkhart Road, Goshen, IN 46526.

Proposals shall be delivered to:

Elkhart County Regional Sewer District

4230 Elkhart Road

Goshen, Indiana 46527

The proposal shall include:

1. Price, inclusive of labor and materials for performing the lift station rehabilitation work in accordance with the requirements outlined in this document.
2. All types of equipment that will be used.
3. Number of employees that will be working at the site.
4. Work hours on the project site.
5. Approximate start date and number of days to complete the project.
6. Project Superintendent name and contact information.
7. Proof of General Liability Insurance.
8. Performance and Warranty Documentation from the material supplier(s).
9. Financial Statement

Project Schedule

The Contractor must procure materials within 120 days of the Notice to Proceed, complete the work onsite in a satisfactory manner within 30 calendar days from the date the Lift Station is taken offline. Perform final completion within the same timeframe as the substantial completion. The Owner intends to issue the Notice to Proceed in March and can be flexible with the Contractor on the date the lift station taken offline.

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19 N. Court Street Crown Point, IN 46307
Ph: (219) 900-9177

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Obtaining the Bidding Documents

Prospective bidders may examine the Bidding Documents at the Elkhart County Public Services Building at 4230 Elkhart Road, Goshen, IN 46527, on Mondays through Fridays between the hours of 8:00 a.m. and 4:00 p.m. Prospective bidders may also examine the documents via the Web-based service of Commonwealth Engineers, Inc. at www.commonwealthengineers.com.

Contractor Warranty

The Contractor shall warrant its work against defect or failures caused by poor workmanship or poor material for a period of one (1) year from the date of acceptance of the project.

Bid Selection

ECRSD will make final selection in compliance with applicable State and Local Statutes.

Owner Project Team

The selected Proposer will hold a Purchase Order with ECRSD, contingent on approval from ECRSD. All potential Proposers shall communicate directly with the ECRSD's Consultant (Commonwealth) during the procurement process. For reference, the Project Team will consist of the Owner, Consultant, and Installation Contractor.

Additional Information

A field visit is necessary as well to verify existing conditions at the plant. Field visits will be available on request and can be coordinated with Matt Rippey at (574) 238-3735

Project Plans

See attached lift station details and electrical drawings.

Product Specifications

See attached specifications.

Submission of Questions and Requests for Clarification

Questions about any aspect of this advertisement, or the project, shall be submitted to: Ryan LaReau, Commonwealth Engineers, e-mail: rlareau@contactcei.com. The deadlines for submission of questions relating to the project shall be January 29, seven (7) days prior to the bid due date. ECRSD reserves the right to request clarification or additional information from any Bidder. Specific questions may be addressed to any Bidder by ECRSD. ECRSD may also consider further elaboration by the Bidder of any information previously submitted during the bid evaluation process.

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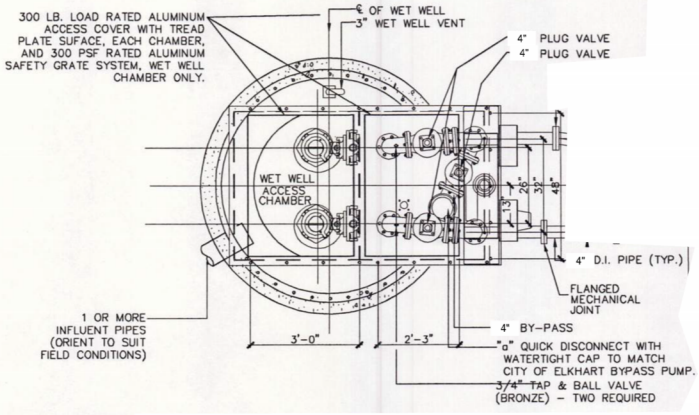

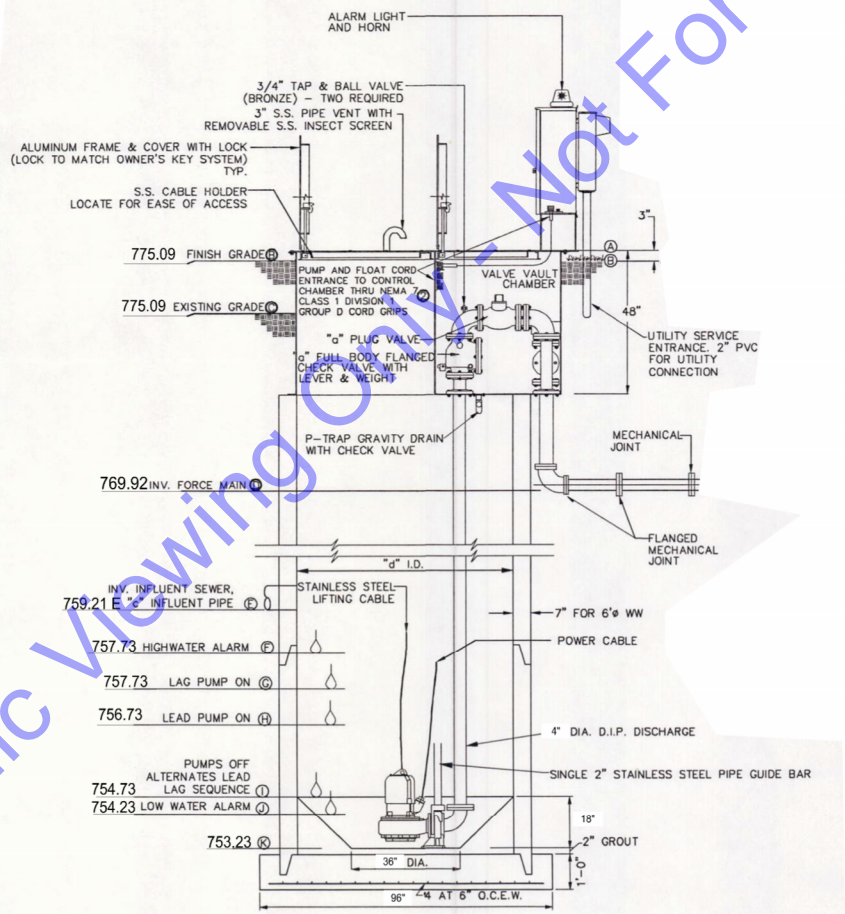

PUMP STATION SECTION

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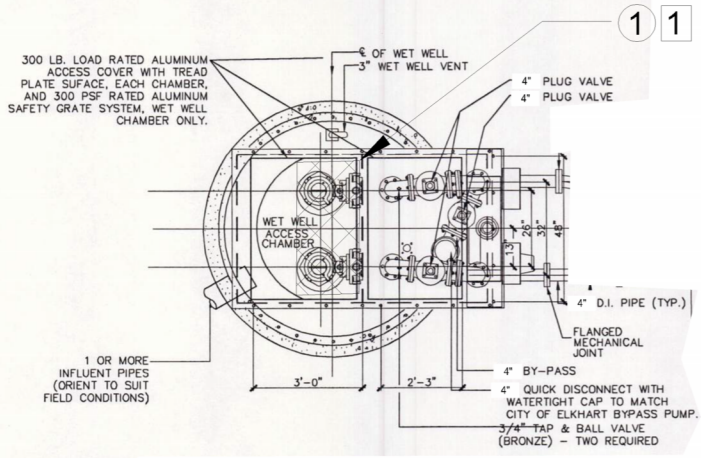
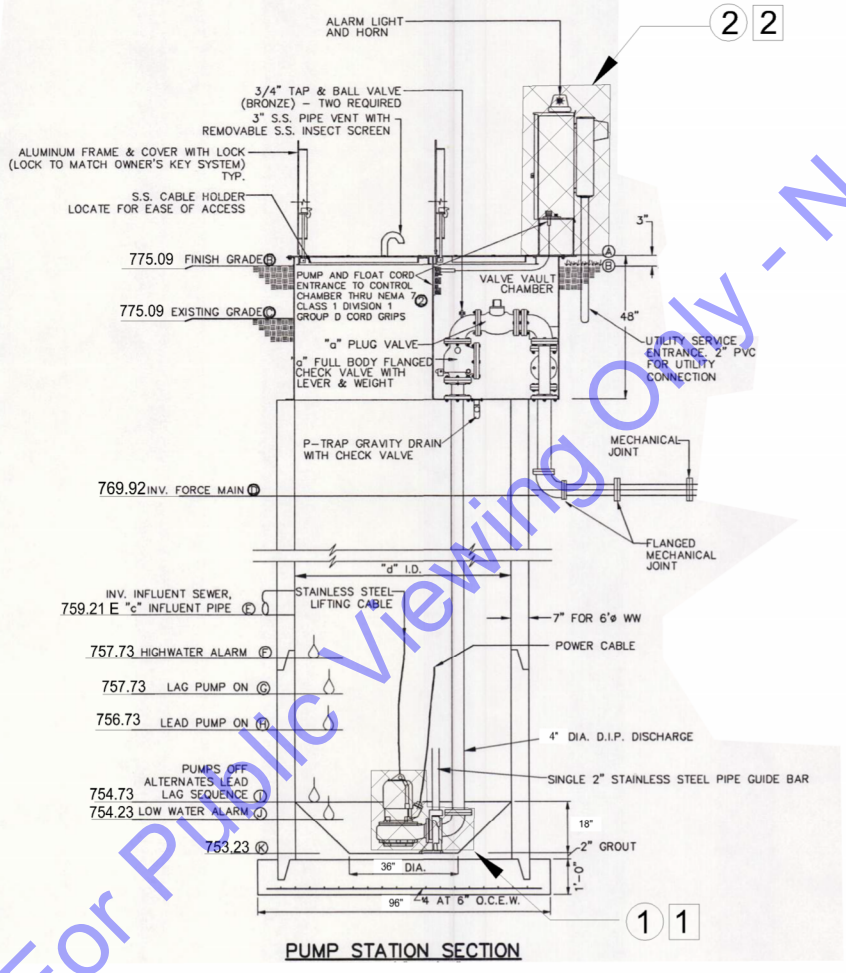
CITY OF ELKHART
ELKHART COUNTY, INDIANA

HEATON LAKE NORTHSIDE LIFT STATION

EXISTING CONDITIONS

Z:\Shared\IN_Clients_A-I\Elkhart County_RSD\S19117 - On-Call Assistance\Heaton Lake North Lift Station Drawdown Test\RFQ Package\Plans\LS_Plans.dwg, PRINTED: 8/14/2024 11:11 AM, BY: Sarah Deutsch





PUMP STATION SECTION

INSTALL:

1 INSTALL NEW PUMPS, PUMP ELBOWS, AND PUMP BASES. INSTALL NEW ANCHORS TO ATTACH BASES TO EXISTING STRUCTURE FLOOR AND PROVIDE GROUT AS NEEDED. INSURE NEW PUMPS ARE CENTER IN EXISTING HATCH OPENING AND CAN BE REMOVED,, SPACING SHOULD MEET MANUFACTURER RECOMMENDATIONS.

2 INSTALL NEW CONTROL PANEL. THE LOCATION ON THE NEW CONTROL PANEL SHOULD BE COORDINATED WITH OWNER AND ENGINEER (SEE EXISTING LIFT STATION SITE PICTURE BELOW). NEW TRANSDUCER AND BACKUP FLOATS SHOULD BE INSTALLED AND MODIFY EXISTING SUPPORT BRACKETS AS REQUIRED. SEE ELECTRICAL SPEC AND PRINTS FOR ADDITIONAL INFORMATION.

DEMO:

1 REMOVE EXISTING PUMPS, PUMP ELBOWS, PUMP BASES, ANCHORS FLOATS AND ANY OTHER ANCILLART INTEMS IN THEIR ENTIRETY.

2 REMOVE EXISTING CONTROL PANEL, JUNCTION BOX, PUMP LEADS, FLOAT CABLES AND ANY OTHER ANCILLART ELECTRICAL ITEMS.

Drawing Sourced from Wightman Petrie Inc. (2006)

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CITY OF ELKHART
ELKHART COUNTY, INDIANA
HEATON LAKE NORTHSIDE LIFT STATION
IMPROVEMENTS SHEET

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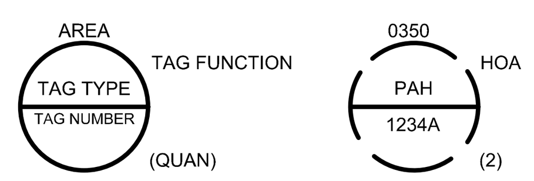
PROCESS AND INSTRUMENTATION DIAGRAM LEGEND

INSTRUMENT TAG IDENTIFICATION



COMPONENT DESIGNATOR

AREA 035D: BUILDING OR PROCESS AREA NUMBER

TAG TYPE P: FIRST LETTER, SEE ISA TABLE BELOW
AH: SUCCEEDING LETTERS, SEE ISA TABLE BELOW

TAG NUMBER 12: P&ID NUMBER
3: LOOP NUMBER
4: EQUIPMENT NUMBER
A: DEVICE LETTER IF MULTIPLE DEVICES

TAG FUNCTION HOA: TAG FUNCTION ABBREVIATION, SEE LISTING AT RIGHT

(QUANTITY) (2): TOTAL NUMBER OF DEVICES WHERE MORE THAN ONE DEVICE IS REQUIRED. DEVICE NUMBERS ARE SEQUENTIAL BEGINNING WITH THE TAG NUMBER SHOWN. IF QUANTITY IS NOT SHOWN, THEN ONE DEVICE ONLY IS REQUIRED.

COMPONENT DESIGNATOR SEE LISTING AT RIGHT

PLC POINT TYPE

ANALOG INPUT	▲
ANALOG OUTPUT	▼
DISCRETE INPUT	△
DISCRETE OUTPUT	▽
NETWORK CONNECTION	⧗

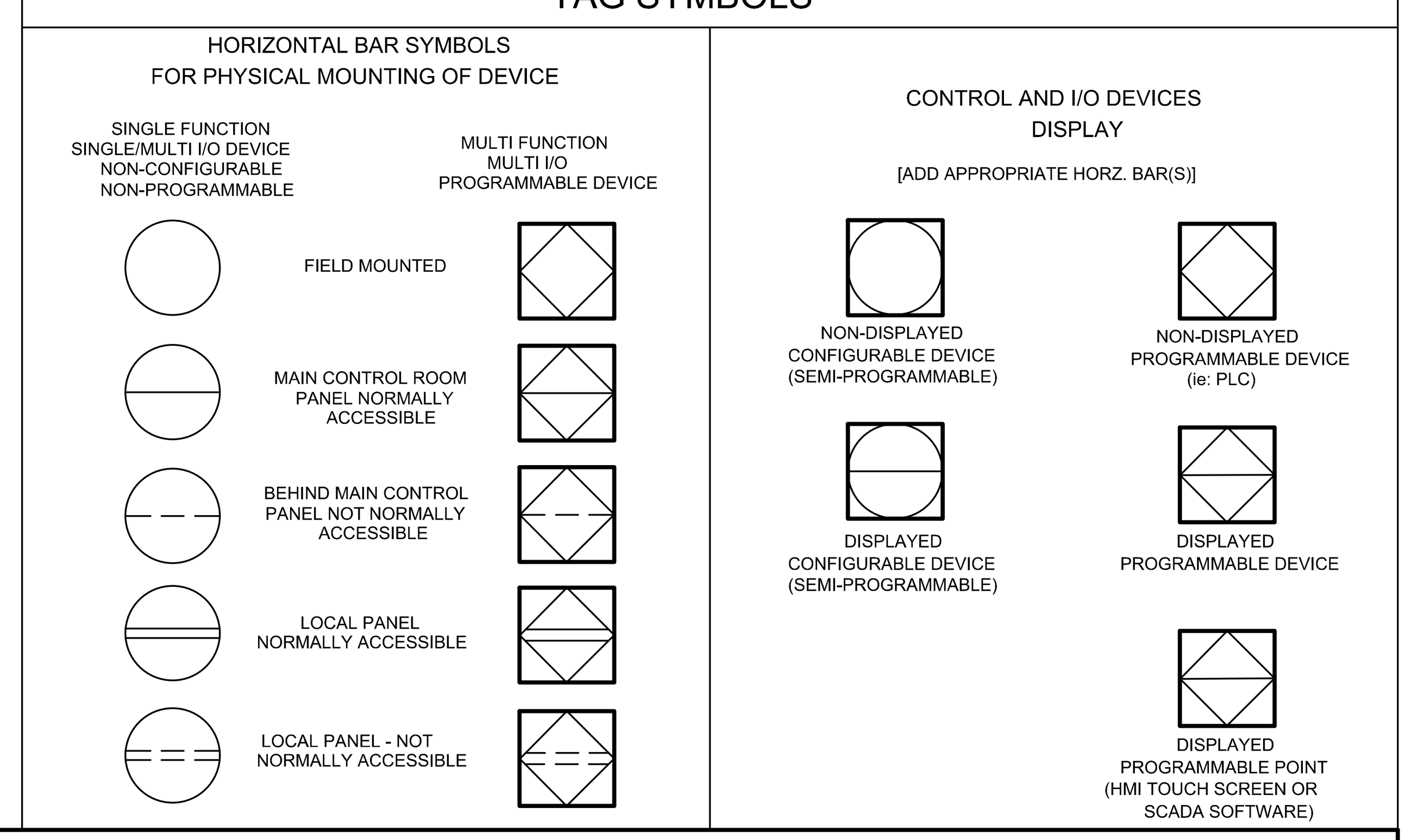
TAG FUNCTION ABBREVIATIONS

ALT ALTERNATE
C CLOSED(C)
CM COMPUTER-MANUAL
DIFF DIFFERENCE OR DIFFERENTIAL
DO DISSOLVED OXYGEN
F FAIL
F(X) CHARACTERIZED
FOR FOWARD-STOP(OFF)-REVERSE(MAINTAINED CONTACT)
FSR FOWARD-STOP-REVERSE(MOMENTARY CONTACT)
HOA HAND-OFF-AUTOMATIC(MAINTAINED CONTACT)
HOR HAND-OFF-REMOTE(MAINTAINED CONTACT)
II CURRENT TO CURRENT
IP CURRENT TO PNEUMATIC
LL LEAD-LAG(MAINTAINED CONTACT)
LOE LOSS OF ECHO(ULTRASONIC SENSOR FAILURE)
LOR LOCAL-OFF-REMOTE(MAINTAINED CONTACT)
LOS LOCKOUT STOP(LOCKABLE IN "STOP" POSITION MOMENTARY CONTACT)
L/R LOCAL/REMOTE(MAINTAINED CONTACT)
MA MANUAL-AUTOMATIC(MAINTAINED CONTACT)
MOA MANUAL-OFF-AUTOMATIC(MAINTAINED CONTACT)

O OPEN
OA OFF-AUTOMATIC
OCA OPEN-CLOSE-AUTOMATIC(MAINTAINED CONTACT)
OC OPEN-CLOSE(D)(MAINTAINED CONTACT)
OSC OPEN-STOP-CLOSE(MOMENTARY CONTACT SPRING RETURN TO CENTER POSITION)
00 ON-OFF(MAINTAINED CONTACT)
OOA ON-OFF-AUTOMATIC(MAINTAINED CONTACT)
OOR ON-OFF-REMOTE(MAINTAINED CONTACT)
R RUN
SBL SLUDGE BLANKET INTERFACE LEVEL
SP SPEED POT
SQRT SQUARE ROOT
SS START-STOP
SSA START-STOP-AUTOMATIC
SSL START-STOP-LOCK (LOCKABLE IN "STOP" POSITION. MOMENTARY CONTACT)
SUM SUMMMATION
VIB VIBRATION
X MULTIPLY

FWD FOWARD
REV REVERSE
F/R FOWARD/REVERSE(MOTOR STARTER COILS)
ESTP ESTOP(EMERGENCY STOP)
SPD (SPEED POT)
SUSP SUSPEND
ALRT ALERT
RSET RESET
STRT START

TAG SYMBOLS



INSTRUMENT SOCIETY OF AMERICA TABLE

LETTER	FIRST LETTER(S)		SUCCEEDING LETTER(S)		
	PROCESS OR INITIATING VARIABLE	MODIFIER	READOUT OR PASSIVE FUNCTION	OUTPUT FUNCTION	MODIFIER
A	ANALYSIS		ALARM(W. LOGGING)	ANNUNCIATE	
B	BURNER COMBUSTION		USERS CHOICE(*)	USERS CHOICE(*)	USERS CHOICE(*)
C	USERS CHOICE(*)			CONTROL	CLOSE
D	USERS CHOICE(*)	DIFFERENTIAL			
E	VOLTAGE		PRIMARY ELEMENT		
F	FLOW RATE	RATIO			FEEDBACK
G	USERS CHOICE(*)		GLASS		
H	HAND (MANUAL)				HIGH
I	CURRENT		INDICATE		
J	POWER	SCAN			
K	TIME OR SCHEDULE	TIME RATE OF CHANGE	KEYPAD(DATA ENTRY)	CONTROL STATION	
L	LEVEL		LIGHT(PILOT)		LOW
M	MOTOR	MOMENTARY			MONITORING
N	USERS CHOICE(*)		USERS CHOICE(*)	USERS CHOICE(*)	USERS CHOICE(*)
O	USERS CHOICE(*)		ORIFICE		
P	PRESSURE OR VACUUM		POINT TEST CONNECTION		
Q	QUANTITY	INTEGRATE			
R	RADIATION		RECORD, TREND, LOG		
S	SPEED OR FREQUENCY	SAFETY		SWITCH	
T	TEMPERATURE			TRANSIT	
U	UNIVERSAL/MULTIVARIABLE(*)		MULTIFUNCTION(*)	MULTIFUNCTION(*)	MULTIFUNCTION(*)
V	VIBRATION		VALUE	VALVE	
W	WEIGHT, FORCE, TORQUE		WELL	W	
X	UNCLASSIFIED(*)	X AXIS	UNCLASSIFIED(*)	UNCLASSIFIED(*)	UNCLASSIFIED(*)
Y	EVENT, STATE	Y AXIS		RELAY OR COMPUTE(*)	
Z	POSITION, DIMENSION	Z AXIS		DRIVE, ACTUATE OR UNCLASSIFIED FINAL CONTROL ELEMENT	

(*) WHEN USED, EXPLANATION IS SHOWN ADJACENT TO INSTRUMENT SYMBOL

SPECIAL CASES:
ETM - ELAPSED TIME METER
JBX - JUNCTION BOX
NDX - INDEX #
MS - MOTOR STARTER
MOR - MOTOR OVERLOAD RELAY
MPR - MOTOR PROTECTION RELAY

CONDUIT NOTES

PVC SCHEDULE 40 BELOW GRADE. PVC SCHEDULE 40 IN VALVE VAULT.

RIGID ALUMINUM OR PVC COATED RGS CONDUIT ABOVE GRADE OUTDOORS. PVC SCHEDULE 40 MAY BE USED IF APPROVED BY CEG.

RIGID ALUMINUM OR PVC COATED RGS CONDUIT IN CLASSIFIED AND CORROSIVE SPACES.

NO CONDUIT SHALL BE RAN ON TOP OF A DECK, ON A WALKWAY, OR IN AN AREA THAT MAY POSE A TRIP HAZARD. NO CONDUIT SHALL BE RAN ABOVE A DECK, ABOVE A WALKWAY, OR IN AN AREA THAT IS COMMONLY TRAVELED. ALL CONDUIT IN SUCH AREAS SHALL BE COORDINATED WITH THE OWNER/ENGINEER AND SHALL BE RAN BELOW GRADE OR IN THE CONCRETE DECKING OR PAD. CONDUIT RAN IN CONCRETE DECKING OR PAD SHALL BE AVOIDED WHEN POSSIBLE. IF CONDUIT IS TO BE ROUTED IN A STRUCTURAL CONCRETE DECK, PAD, WALL, ETC. IT SHALL BE COORDINATED AND APPROVED BY THE ENGINEER PRIOR TO INSTALLATION. CONDUIT RAN IN CONCRETE CAN IMPACT THE STRUCTURAL INTEGRITY OF CONCRETE. IT IS THE CONTRACTORS RESPONSIBILITY TO CONFORM TO ANY REQUIREMENTS REQUIRED OF THE STRUCTURAL ENGINEER TO ACCOMMODATE THE INTEGRITY OF THE INSTALLATION AT NO COST TO THE OWNER. FOR A CONDUIT EMBEDDED IN CONCRETE TO BE CONSIDERED IT MUST BE THE ONLY REASONABLE SOLUTION AS DETERMINED BY THE ENGINEER. ALL PROPOSED INSTALLATIONS MUST COMPLY WITH ACI 318 AND BE ENGINEER APPROVED.

ALL UNDERGROUND CONDUITS SHALL BE SEALED AT BOTH ENDS.

NO CONDUIT PENETRATIONS ON THE TOP OF ANY OUTDOOR PANELS/ENCLOSURES.

CONTROL WIRING REQUIREMENTS

EACH ANALOG INPUT REQUIRES AN 18/2 TWISTED SHIELDED PAIR IN 3/4" CONDUIT UNLESS NOTED OTHERWISE.

EACH ANALOG OUTPUT REQUIRES AN 18/2 TWISTED SHIELDED PAIR IN 3/4" CONDUIT UNLESS NOTED OTHERWISE.

EACH DISCRETE INPUT REQUIRES 2 #14's IN 3/4" CONDUIT UNLESS NOTED OTHERWISE.

EACH DISCRETE OUTPUT REQUIRES 2 #14's IN 3/4" CONDUIT UNLESS NOTED OTHERWISE.

CONTROL WIRING OF THE SAME TYPE MAY BE COMBINED INTO THE SAME CONDUIT. EXAMPLES: TWO 4-20MA ANALOG SIGNALS MAY BE COMBINED, TWO 24VDC DISCRETE SIGNALS MAY BE COMBINED, AND TWO 120VAC DISCRETE SIGNALS MAY BE COMBINED.

NOTE: INSTRUMENTS AND CABLE SHALL BE AS REQUIRED BY THE INSTRUMENT MANUFACTURER.

INSTRUMENT POWER

INSTRUMENTS REQUIRING 120 VAC:

1. MAGNETIC FLOW METERS
2. TURBIDITY TRANSMITTERS
3. pH TRANSMITTERS
4. ORP TRANSMITTERS
5. DO TRANSMITTERS
6. ULTRASONIC LEVEL TRANSMITTERS
7. ULTRASONIC FLOW TRANSMITTERS
8. INFLUENT AND EFFLUENT SAMPLERS

NOTE: THIS LIST IS PROVIDED AS A REFERENCE AND IS NOT ALL INCLUSIVE. COORDINATE WITH THE GENERAL CONTRACTOR AND THE EQUIPMENT SUPPLIERS FOR DETAILED WIRING REQUIREMENTS OF INSTRUMENTS, SENSORS, AND EQUIPMENT.

ELECTRICAL GENERAL NOTES

(GENERAL NOTES APPLICABLE TO ALL ELECTRICAL SHEETS)

G0. CONTRACTOR SHALL EXAMINE NOT ONLY PLANS AND SPECIFICATIONS FOR ELECTRICAL AND INSTRUMENTATION, BUT PLANS AND SPECIFICATIONS FOR OTHER RELATED SECTIONS. VISIT THE SITE TO BECOME ACQUAINTED WITH ALL PROJECT CONDITIONS INCLUDING EXISTING CONDITIONS. EXECUTION OF CONTRACT IS EVIDENCE THAT THE CONTRACTOR HAS EXAMINED ALL DRAWINGS AND SPECIFICATIONS AND THAT ALL CONDITIONS OF INSTALLING THE WORK IN THIS SECTION ARE VERIFIED. LATE CLAIMS FOR LABOR AND MATERIALS REQUIRED DUE TO DIFFICULTIES ENCOUNTERED, WHICH COULD HAVE BEEN FORESEEN HAD EXAMINATIONS BEEN MADE WILL NOT BE RECOGNIZED.

G1. THE DRAWINGS ARE DIAGRAMMATIC AND ARE NOT INTENDED TO INCLUDE EVERY DETAIL OF REQUIRED CONSTRUCTION, EQUIPMENT, AND MATERIALS. PROVIDE ALL MATERIALS AND WORK NOT SPECIFICALLY MENTIONED, SHOWN, OR CAN BE REASONABLY INFERRED ON THE DRAWINGS BUT WHICH ARE NECESSARY TO FULLY COMPLETE THE WORK.

G2. WHEN SUBSTITUTING OTHER EQUIPMENT, MATERIALS, AND PRODUCTS THAN SPECIFIED IN THE CONTRACT DOCUMENTS, INCLUDE IN PRICING ALL COSTS FOR OTHER DESIGN CHANGES TO THE PROJECT (ALL DIVISIONS) WHICH WILL RESULT FROM USE OF THE SUBSTITUTED ITEM(S).

G3. REVIEW THE CONTRACT DOCUMENTS OF OTHER DIVISIONS, AND COORDINATE ELECTRICAL AND CONTROL WORK WITH THE WORK OF OTHER DISCIPLINES TO AVOID CONFLICTS AND INTERFERENCE.

G4. UPON COMPLETION OF THE WORK REQUIRED UNDER THIS CONTRACT, PROVIDE TYPED UPDATED DIRECTORY WITHIN DOOR OF EACH AFFECTED PANELBOARD. LEAVE "SPARE" BREAKERS IN "OFF" POSITION.

G5. ALL MOUNTING HEIGHTS INDICATED ON DRAWINGS ARE TO CENTERLINE, UON.

G6. PROVIDE LIGHTING FIXTURES COMPATIBLE WITH CEILING CONSTRUCTION. COORDINATE WITH ARCHITECTURAL ROOM FINISH SCHEDULES.

G7. IN AREAS HAVING FINISHED CEILINGS, LOCATE CEILING-MOUNTED ELECTRICAL DEVICES AND FIXTURES ACCORDING TO ARCHITECTURAL REFLECTED CEILING PLAN. DO NOT INSTALL CEILING-MOUNTED SMOKE DETECTORS WITHIN 4 FEET OF HVAC SUPPLY DIFFUSERS.

G8. IN ELECTRICAL AND MECHANICAL EQUIPMENT SPACES, COORDINATE EXACT LOCATIONS OF LIGHTING FIXTURES WITH CONDUIT BANKS, DUCTWORK, PIPING, STRUCTURE, SUPPORTS, AND OTHER OBSTRUCTIONS. LOCATE FIXTURES SUCH THAT DIALS, GAUGES, METERS, ETC. ARE PROPERLY ILLUMINATED.

G9. DO NOT USE ANY LIGHTING FIXTURE AS A RACEWAY FOR CONDUCTORS NOT SERVING THAT PARTICULAR FIXTURE.

G10. CONNECT BATTERY-OPERATED EMERGENCY LIGHTING UNITS AND EXIT SIGNS HAVING BATTERY BACK-UP TO UNSWITCHED LEG OF LOCAL LIGHTING CIRCUIT IN ACCORDANCE WITH MANUFACTURER'S RECOMMENDATIONS AND NEC SUCH THAT FAILURE OF CIRCUIT TRANSFERS UNIT FROM NORMAL TO EMERGENCY MODE, CAUSING LAMPS TO RE-ENERGIZE.

G11. DO NOT INSTALL OUTLET BOXES BACK-TO-BACK IN NON-RATED PARTITIONS. OFFSET AND SEAL, SIMILAR TO REQUIREMENTS FOR RATED PARTITIONS, TO MINIMIZE SOUND TRANSMISSION.

G12. COORDINATE ROUTING OF ALL LARGE CONDUITS (2" DIA AND LARGER) AND PULL BOX LOCATIONS WITH GENERAL CONTRACTOR PRIOR TO INSTALLATION TO AVOID CONFLICTS AND TO GUARANTEE REQUIRED CLEARANCE AND ACCESSIBILITY OF ELECTRICAL AND OTHER SYSTEMS.

G13. COORDINATE WITH OWNER OR OWNER'S SELECTED VENDOR PRIOR TO ROUGH-IN FOR EXACT LOCATIONS OF SPECIAL PURPOSE OUTLETS DEDICATED TO SPECIFIC EQUIPMENT. VERIFY REQUIRED NEMA CONFIGURATION OF ALL SUCH OUTLETS.

G14. PROVIDE APPROPRIATE PULL WIRE IN EACH EMPTY SYSTEMS CONDUIT INCLUDED IN THIS PROJECT.

G15. INCLUDE GREEN-INSULATED GROUNDING CONDUCTOR SIZED PER 2002 NEC TABLE 250-122 WITH ALL BRANCH CIRCUIT CONDUCTORS SERVING LIGHTING FIXTURES, RECEPTACLES, MECHANICAL OR OTHER DEVICES INSTALLED AT OR BELOW 8'-0".

G16. MATCH A.I.C. RATINGS AND OTHER CHARACTERISTICS OF EXISTING DEVICES IN PANELBOARD WHEN ADDING BREAKERS TO EXISTING PANELBOARDS.

G17. ALL WORK SHALL BE IN CONFORMANCE WITH THE NATIONAL ELECTRICAL CODE - LASTEST EDITION ADOPTED BY INDIANA, THE INDIANA CODE AMENDMENT, LOCAL/MUNICIPAL CODE, AND THE AUTHORITIES HAVING JURISDICTION.

G18. ALL CONNECTIONS TO EQUIPMENT SUBJECT TO MOVEMENT OR VIBRATION SHALL BE LIQUID TIGHT FLEXIBLE METAL CONDUIT, NOT LESS THAN 12" IN LENGTH, NOR GREATER THAN 36" IN LENGTH.

G19. ALL CONDUIT PENETRATIONS SHALL BE SEALED WITH APPROPRIATE CONDUIT SEALING MATERIAL.

G20. ALL CABLE SIZES SHALL UTILIZE COPPER CONDUCTORS.

G21. FIELD VERIFY LOCATIONS OF BUILDING EXPANSION JOINTS WHEN ROUTING CONDUIT. ALL CONDUITS CROSSING EXPANSION JOINTS SHALL BE INSTALLED WITH THE EXPANSION FITTINGS. EXPANSION FITTINGS SHALL BE INSTALLED IN ACCORDANCE WITH THE NEC AND MANUFACTURERS WRITTEN RECOMMENDATIONS.

G22. FEEDERS FROM PANELBOARDS BACK TO MAIN SWITCHBOARD, BETWEEN AUTO TRANSFER SWITCHES AND THEIR SOURCES/LOADS, BETWEEN DRY TRANSFORMERS AND THEIR SOURCES/LOADS ARE NOT INDICATED. FEEDERS ARE PART OF THE WORK, AND SHALL BE SIZED AS INDICATED ON THE LINE DIAGRAM.

G23. HOMERUNS SHALL NOT BE COMBINED IN A RACEWAY UNLESS SHOWN ON THE CONTRACT DRAWINGS. SINGLE PHASE BRANCH CIRCUIT HOMERUNS MAY BE COMBINED AT THE CONTRACTORS DISCRETION NOT GREATER THAN (3) PHASE CONDUCTORS, NEUTRAL CONDUCTORS, AND A GROUNDING CONDUCTOR.

G24. EACH SINGLE PHASE BRANCH CONDUCTOR SHALL HAVE A DEDICATED NEUTRAL BACK TO THE PANEL.

G25. ALL PENETRATIONS BELOW GRADE SHALL USE LINK SEALS.

G26. WHERE LOW VOLTAGE (CONTROL) CABLING IS ALLOWED TO BE INSTALLED WITHOUT A RACEWAY, IT SHALL BE SUPPORTED NOT EXCEEDING INTERVALS OF 48", AND NOT MORE THAN 6" FROM THE CABINETS, BOXES, FITTINGS, OUTLETS, RACKS, FRAMES AND TERMINALS.

G27. ALL MOUNTING HARDWARE INCLUDING NUTS, BOLTS, SCREWS, WASHERS, ETC. SHALL BE STAINLESS STEEL.

G28. MOUNT JUNCTION BOXES AND DISCONNECT SWITCHES ON STAINLESS STEEL UNISTRUT.

G29. ALL UNISTRUT, MOUNTING BRACKETS AND SUPPORTING STRUCTURES SHALL BE STAINLESS STEEL.

G30. DO NOT MIX CONTROL AND POWER CONDUCTORS IN THE SAME CONDUIT. DO NOT MIX DISCRETE AND ANALOG CONTROL CONDUCTORS IN THE SAME CONDUIT.

G31. ADJUSTABLE SPEED DRIVES (ASD) LINE AND LOAD WIRE SHALL BE RUN IN SEPARATE RACEWAYS.

G32. CONTRACTOR SHALL COORDINATE WITH HEAT TRACE MANUFACTURER DURING BIDDING AND CONSTRUCTION AND SHALL PROVIDE ALL CONDUIT, WIRING, AND CIRCUITS AS REQUIRED. HEAT TRACE SHALL BE PROVIDED/INSTALLED COMPLETE. ALL HEAT TRACE IS REQUIRED TO BE GFI PROTECTED.

PUMP AND METER LEGEND

SYMBOL	DESCRIPTION
M	MAGNETIC FLOW METER
	SONIC FLOW METER
	CENTRIFUGAL PUMP
	LOBE PUMP
	PERISTALTIC PUMP
	SUBMERSIBLE PUMP
	GRINDER PUMP

LIGHTING LEGEND

SYMBOL	DESCRIPTION
	FIXTURE WITH STANDARD BALLAST.
	FIXTURE WITH STANDARD BALLAST AND EMERGENCY BALLAST.

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LEGEND

SYMBOL	DESCRIPTION	MTG HGT AFF TO CL, UON
	OPEN LIGHTING FIXTURE SYMBOLOGY DENOTING FIXTURES CONNECTED TO NORMAL POWER: FIXTURE TYPE DETERMINES MOUNTING.	-----
	SINGLE DIAGONAL LIGHTING FIXTURE SYMBOLOGY DENOTING FIXTURES CONNECTED TO CRITICAL OR EQUIPMENT BRANCH (OR EMERGENCY POWER), UON: FIXTURE TYPE DETERMINES MOUNTING.	-----
	DOUBLE DIAGONAL LIGHTING FIXTURE SYMBOLOGY DENOTING FIXTURES CONNECTED TO LIFE SAFETY BRANCH (OR EMERGENCY POWER), UON: FIXTURE TYPE DETERMINES MOUNTING.	-----
	BATTERY POWERED EMERGENCY LIGHTING UNIT	7'-6"
	EXIT SIGN: ARROWS DENOTE DIRECTIONAL INDICATING CHEVRON RQMTS, SHADING DENOTES FACE(S) ORIENTATION.	-----
	WALLWASH OR OTHER DIRECTIONALLY ADJUSTABLE/AIMABLE FIXTURE: OPEN SIDE DENOTES ORIENTATION. TYPE DETERMINES MOUNTING.	-----
	TRACK LIGHTING FIXTURE: TYPE DETERMINES MOUNTING.	-----
	POLE-MOUNTED SITE LIGHTING FIXTURE: TYPE DETERMINES MTG.	-----
	FLOOD LIGHTING FIXTURE: TYPE DETERMINES MOUNTING.	-----
PC	PHOTO-CELL	-----
XX	ALL FIXTURES IN THIS SPACE SHALL BE SAME TYPE INDICATED, U.O.N.	
S	SINGLE-POLE TOGGLE SWITCH	3'-10"
$	SINGLE-POLE TOGGLE SWITCH: SLASH DENOTES ESSENTIAL POWER SYSTEM CONNECTION - TYPICAL FOR ALL SWITCHES.	3'-10"
OS_W	DUAL TECHNOLOGY, WALL MNTD OCCUPANCY SENSOR WITH MANUAL OVERRIDE SWITCH	3'-10"
OS_C	DUAL TECHNOLOGY, CEILING MNTD OCCUPANCY SENSOR WITH REMOTE MANUAL OVERRIDE SWITCH	
S_{OR}	SINGLE-POLE REMOTE OVERRIDE SWITCH FOR CEILING MNTD OCCUPANCY SENSOR	3'-10"
S_D	DIMMER SWITCH	3'-10"
S_D3	THREE-WAY DIMMER SWITCH	3'-10"
S_P	SINGLE-POLE TOGGLE SWITCH WITH PILOT LIGHT	3'-10"
S_M	SINGLE-POLE MOTOR-RATED TOGGLE SWITCH DISCONNECT	3'-10"
S_T	SINGLE-POLE OR DOUBLE-POLE MANUAL MOTOR STARTER WITH MELTING ALLOY ELEMENTS FOR THERMAL OVERLOAD PROTECTION	3'-10"
S_{IR}	OCCUPANCY SENSOR SWITCH	3'-10"
S_{IT}	INTERVAL TIMER RESET AND CONTROL SWITCH	3'-10"
S_J	JOG SWITCH	3'-10"
	MUSHROOM HEAD TYPE PUSHBUTTON STATION	5'-0"
P	AUTO DOOR CONTROL PUSHPLATE	-----
S_V	VARIABLE INTENSITY CONTROLLER INCLUDED WITH OWNER-FURNISHED-CONTRACTOR-INSTALLED SURGICAL LIGHTING FIXTURE	5'-0"
S_{LV}	LOW VOLTAGE CONTROL SWITCH	3'-10"
WS	FACTORY SUPPLIED WALL CONTROLLER FOR CEILING MOUNTED LIGHT-INSTALLED BY ELECTRICAL CONTRACTOR	3'-10"
	120V DUPLEX RECEPTACLE, STANDARD MOUNTING HEIGHT	1'-6"
	120V DUPLEX RECEPTACLE, SPECIAL MOUNTING HEIGHT INSTALL AT SAME HEIGHT AS SWITCHES IF NO HEIGHT IS INDICATED	ABOVE COUNTER
	120V QUADRUPLEX RECEPTACLE, STANDARD MOUNTING HEIGHT	1'-6"
	120V QUADRUPLEX RECEPTACLE, SPECIAL MOUNTING HEIGHT INSTALL AT SAME HEIGHT AS SWITCHES IF NO HEIGHT IS INDICATED	ABOVE COUNTER
	120V SINGLE RECEPTACLE, AMP RATING (IF OTHER THAN 20A) SHOWN: STANDARD MOUNTING HEIGHT, OR OTHER HEIGHT AS NOTED	1'-6", UON
GFCI	120V GFCI DUPLEX RECEPTACLE, STANDARD MOUNTING HEIGHT	1'-6"
	120V GFCI QUADRUPLEX RECEPTACLE, SPECIAL MOUNTING HEIGHT INSTALL AT SAME HEIGHT AS SWITCHES IF NO HEIGHT IS INDICATED	ABOVE COUNTER
	120V GFCI DUPLEX RECEPTACLE, SPECIAL MOUNTING HEIGHT INSTALL AT SAME HEIGHT AS SWITCHES IF NO HEIGHT IS INDICATED	ABOVE COUNTER
	SINGLE RECEPTACLE (OTHER THAN 120V), VOLTAGE, AMP RATING, NEMA CONFIGURATION, AND MOUNTING HEIGHT AS NOTED	-----
	RECPTACLE OR J-BOX CONNECTION FOR X-RAY VIEWER: VERIFY CONNECTION RQMTS WITH UNIT FURNISHED PRIOR TO ROUGH-IN	-----
	120V DUPLEX RECEPTACLE IN FLUSH FLOOR-MOUNTED BOX	-----
TP	TELE-POWER POLE	-----
H	HALON DUMP STATION	-----
F	FIRE ALARM MANUAL PULL STATION	3'-10"
FK	FIRE ALARM MANUAL PULL STATION, KEY-OPERATED	3'-10"
D	FIRE ALARM CEILING-MOUNTED SMOKE DETECTOR	-----
H	FIRE ALARM CEILING-MOUNTED HEAT DETECTOR	-----
D_S	FIRE ALARM SUPPLY AIR DUCT-MOUNTED SMOKE DETECTOR	-----
D_R	FIRE ALARM RETURN AIR DUCT-MOUNTED SMOKE DETECTOR	-----
DR	FIRE ALARM PROJECTED BEAM SMOKE DETECTOR - RECEIVER	AS NOTED
DT	FIRE ALARM PROJECTED BEAM SMOKE DETECTOR - TRANSMITTER	AS NOTED
Y	FIRE ALARM CONNECTION TO SPRINKLER SYSTEM VALVE STATUS SWITCH (TAMPER SWITCH)	-----
FS	FIRE ALARM CONNECTION TO SPRINKLER SYSTEM WATER FLOW SWITCH	-----
F	FIRE ALARM AUDIO/VISUAL NOTIFICATION DEVICE-CHIME & STROBE	6'-8"
F	FIRE ALARM AUDIO/VISIUAL NOTIFICATION DEVICE-HORN & STROBE	6'-8"
F	FIRE ALARM VISUAL ONLY NOTIFICATION DEVICE - STROBE LIGHT	6'-8"
FS	FIRE ALARM SPEAKER: CEILING-MOUNTED, WALL-MOUNTED	6'-8"
FH	FIRE ALARM HORN, WALL-MOUNTED	AS NOTED
RI	DUCT SMOKE DETECTOR ALARM REMOTE INDICATOR LIGHT: CEILING-MOUNTED, WALL-MOUNTED	6'-8"
SAI	DUCT SMOKE DETECTOR ALARM REMOTE INDICATOR LIGHT AND TEST SWITCH: CEILING-MOUNTED, WALL-MOUNTED	6'-8"
Z	FIRE ALARM ZONE ADDRESSABLE MODULE	-----
I	FIRE ALARM INDIVIDUAL ADDRESSABLE MODULE	-----
	FIRE ALARM ELECTRO-MAGNETIC DOOR HOLDER	6'-4"
FR	FIRE RELAY	-----
ID	DESK MOUNTED INTERCOM	-----
IW	WALL MOUNTED INTERCOM	-----
$\$_X$	EXPLOSION PROOF SWITCH	3'-10"
$\$_3$	3 WAY SWITCH	3'-10"
$\$_4$	4 WAY SWITCH	3'-10"
$\$_{WP}$	NEMA 4X SWITCH	3'-10"

LEGEND

ABBREVIATIONS

ABV	ABOVE	IG	ISOLATED GROUND
AFF	ABOVE FINISHED FLOOR	MON	MONITOR
ACLG	ABOVE FINISHED CEILING	MTG	MOUNTING
BFC	BELOW FINISHED CEILING	MV	MULTI-VIEWER
C	CRITICAL BRANCH OR EMERG PWR-RED DEVICE & PLATE, UON.	MW	MICROWAVE OVEN
CL	CENTER-LINE	NEC	NATIONAL ELECTRICAL CODE
CLG	CEILING-MOUNTED	OCPD	OVERCURRENT PROTECTIVE DEVICE
COF	COFFEE MAKER	OFCI	OWNER-FURNISHED-CONTRACTOR-INSTALLED
COP	COPIER	OFE	OWNER-FURNISHED EQUIPMENT
CTR	COUNTER	PRT	PRINTER
ECB	ENCLOSED CIRCUIT BREAKER	PTS	PNEUMATIC TUBE STATION
EMER	EMERGENCY	Q	EQUIP BRANCH OR EMERG PWR-RED DEVICE & PLATE, UON.
EWC	ELECTRIC WATER COOLER	REF	REFRIGERATOR
EWH	ELECTRIC WATER HEATER	RQMTS	REQUIREMENTS
FAX	FACSIMILE MACHINE	WP	WEATHERPROOF
FBO	FURNISHED BY OTHERS	T	TAMPERPROOF DEVICE
GFCI	GROUND FAULT CIRCUIT INTERRUPT-ING - PERSONNEL PROTECTION	UON	UNLESS OTHERWISE NOTED
GFI	GROUND FAULT INTERRUPTING - EQUIPMENT PROTECTION	UCR	UNDER-COUNTER REFRIGERATOR
HGT	HEIGHT		
FPMR	FUSED PER MANUFACTURE'S RECOMMENDATIONS		

SYMBOL	DESCRIPTION	MTG HGT AFF TO CL, UON
	EXPOSED RACEWAY	-----
	RACEWAY CONCEALED IN OR ABOVE CEILINGS AND WITHIN WALLS	-----
	BRANCH CIRCUIT RACEWAY CONCEALED IN OR BELOW FLOOR SLAB OR BELOW GRADE	-----
	FEEDER RACEWAY CONCEALED BELOW FLOOR SLAB OR BELOW GRADE	-----
	LIGHTNING PROTECTION CABLING	-----
	HOMERUN RACEWAY: NUMBER OF ARROWHEADS DENOTES NUMBER OF CIRCUITS.	-----
	RACEWAY TURNING UP AS VIEWED FROM THE LOAD	-----
	RACEWAY TURNING DOWN AS VIEWED FROM THE LOAD	-----
	RACEWAY VERTICAL RISER WITH HORIZONTAL CONTINUATION AT TWO LEVELS SHOWN	-----
	CAPPED RACEWAY	-----
	GENERAL LIGHTING OR OUTLET CIRCUIT - MAY BE DAISY CHAINED	
J	JUNCTION BOX	AS NOTED
	ENCLOSED BREAKER	
	FUSIBLE SAFETY SWITCH (AMP RATING, POLES, FUSE SIZE, AND NEMA ENCLOSURE TYPE IF OTHER THAN 1 NOTED)	-----
	NON-FUSIBLE SAFETY SWITCH (AMP RATING, POLES, AND NEMA ENCLOSURE TYPE IF OTHER THAN 1 NOTED)	-----
	COMBINATION MAGNETIC ACROSS-THE-LINE STARTER WITH MOTOR CIRCUIT PROTECTOR (NEMA STARTER SIZE NOTED)	-----
	CONTROL PANEL FURNISHED INTEGRAL TO EQUIPMENT (SINGLE-POINT ELECTRICAL CONNECTION REQUIRED)	-----
	MOTOR	-----
	FLEXIBLE CONDUIT CONNECTION	-----
	SURFACE- OR FLUSH-MOUNTED LIGHTING/RECEPTACLE PANELBOARD	-----
	POWER DISTRIBUTION PANELBOARD	-----
T T	DRY TYPE TRANSFORMER	-----
XXX	MISCELLANEOUS SYSTEMS PANEL OR CABINET: REFER TO ABBREVIATIONS.	-----

NOTE !! ALL ABBREVIATIONS, NOTES, AND SYMBOLS SHOWN ON THIS DRAWING DO NOT NECESSARILY APPEAR IN THIS SET OF CONTRACT DOCUMENTS. REFER ONLY TO THOSE THAT APPLY.

ABBREVIATIONS

ABBREVIATION	MEANING
GFI	GROUND FAULT INTERRUPTER
WP	WEATHER PROOF
AFF	ABOVE FINISHED FLOOR
UNO	UNLESS NOTED OTHERWISE
FPMR	FUSE PER MANUFACTURERS RECOMMENDATIONS
IG	ISOLATED GROUND-ORANGE RECEPTACLE
M	MONITOR RECEPTACLE- CRITICAL POWER- RED RECEPTACLE- 60"A.F.F. (UNO) (UNLESS VENDOR DRAWINGS REQUIRE DIFFERENT HEIGHT)
TSP	TWISTED SHIELDED PAIR

MOTOR CONTROLLER LEGEND

SYMBOL	DESCRIPTION
MS	ACROSS THE LINE MOTOR STARTER
SS	SOFT STARTER
VFD	VARIABLE FREQUENCY DRIVE
MS	ACROSS THE LINE MOTOR STARTER WITH INTEGRAL DISCONNECT
SS	SOFT STARTER WITH INTEGRAL DISCONNECT
VFD	VARIABLE FREQUENCY DRIVE WITH INTEGRAL DISCONNECT

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TOBY LEE CHURCH
REGISTERED
No. 11300603
STATE OF INDIANA
PROFESSIONAL ENGINEER

Signature 08/30/2024 Date

ELKHART COUNTY REGIONAL SEWER DISTRICT
ELKHART COUNTY, INDIANA
HEATON LAKE LIFT STATION UPGRADES

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Issue Date: 08/2024	Project No: S19117	Scale: AS SHOWN

LEGENDS AND SCHEDULES

Drawing No:
E0-0
Sheet: 1 OF 3

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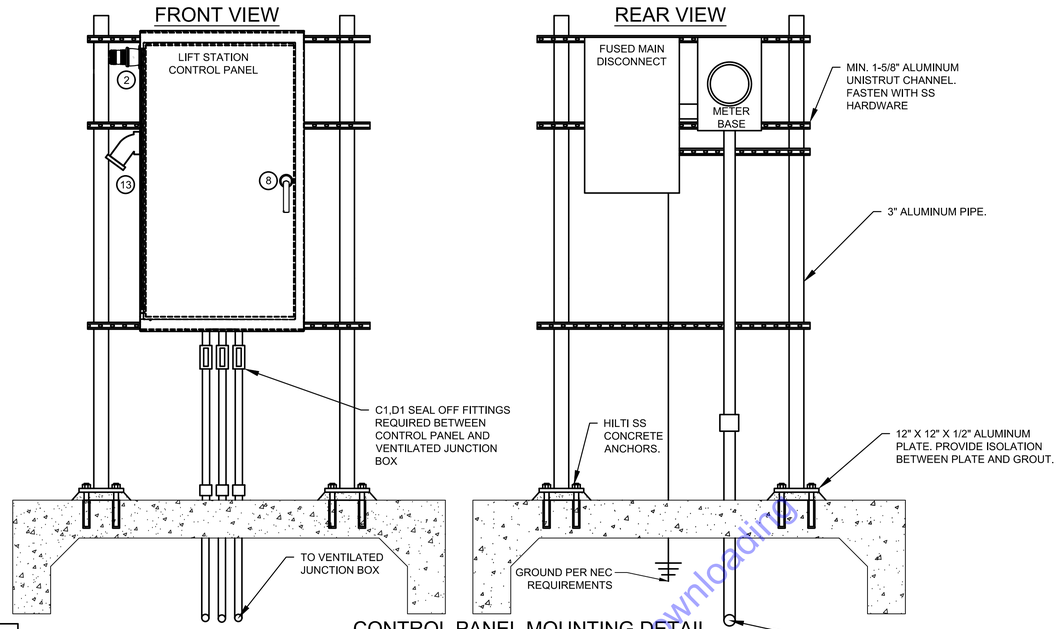
NEMA 4X CONTROL PANEL DEVICE LEGEND (#)

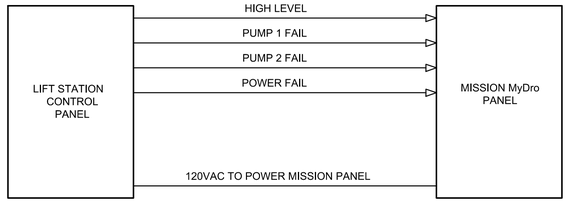
ITEM#	DESCRIPTION
1	PILOT DEVICES (TYPICAL FOR EACH PUMP): VFD RUNNING LIGHT, BYPASS RUNNING LIGHT, OVERLOAD LIGHT, SEAL FAIL LIGHT, HIGH MOTOR TEMP LIGHT, VFD FAULT LIGHT, VFD FAULT RESET PUSHBUTTON, HOA SWITCH, DRIVE BYPASS SWITCH, AND ELAPSED TIME METER. PILOT DEVICES TO BE MOUNTED ON PANEL DEAD FRONT.
2	NEMA 4 ALARM LIGHT WITH INTEGRAL BUZZER AND ALARM ACKNOWLEDGE PUSHBUTTON LOCATED ON SIDE OF PANEL.
3	ALTERNATING RELAYS AND CONTROL RELAYS AS REQUIRED.
4	VFD WITH . VFD TO BE SIZED FOR PHASE CONVERSION.
5	ISOLATION CIRCUIT BREAKERS WITH LOCKOUT/TAGOUT CAPABILITY. BREAKER ACCESSIBLE THROUGH DEAD FRONT.
6	MISCELLANEOUS COMPONENTS INCLUDING BUT NOT LIMITED TO PILOT RELAYS, PUMP SEAL, TEMPERATURE AND OIL SAFETY RELAYS,TERMINAL BLOCKS, CIRCUIT BREAKERS, CONTROL TRANSFORMER, POWER SUPPLIES, ETHERNET SWITCH, ETC. TO PROVIDE FOR A COMPLETE AND FUNCTIONING CONTROL PANEL.
7	HEATER WITH INTEGRAL THERMOSTAT.
8	3 POINT LATCHING SYSTEM ON PANEL DOOR (CLAMPS NOT ACCEPTABLE).
9	COOLTRON CIRCULATION FAN. PROVIDE HEAT LOAD CALCULATIONS FOR PANEL.
10	ELAPSED TIME METER.
11	MISSION ALARM DIALER.
12	FLANGED MOUNTED WITH DUAL INTERLOCKED BREAKERS LABELED MAIN POWER/ MAIN POWER OFF.GENERATOR POWER.
13	GENERATOR PLUG, 240 V, 100-A, 4W, 4PIN.
14	CONTROL TRANSFORMER.



CONTROL PANEL MOUNTING DETAIL

SCALE: NTS

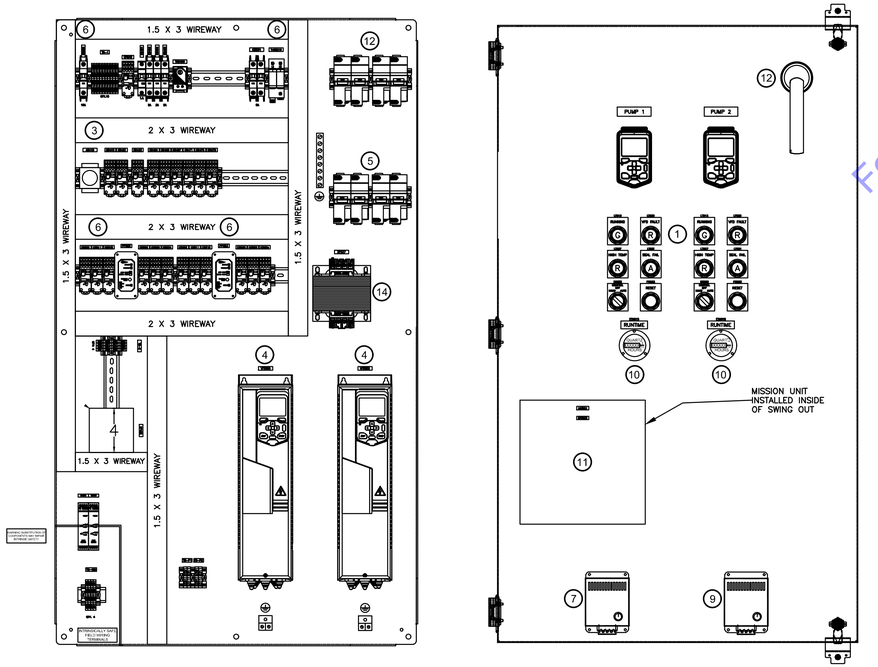
Load Wiring Schedule		
	Copper Wire	
Type #:	Quantity and Wire Size	Conduit
20	3 #12's & #12 Ground	3/4"
30	3 #10's & #10 Ground	3/4"
50	3 #8's & #10 Ground	3/4"
60	3 #6's & #8 Ground	3/4"
80	3 #4's & #8 Ground	1"
100	3 #2's & #6 Ground	1.5"
125	3#1's & #6 Ground	1.5"
150	3 - 2/0 & #6 Ground	2"
200	3 - 4/0 & #4 Ground	2.5"
250	3 - 300's & #4 Ground	3"



LIFT STATION MISSION DETAIL

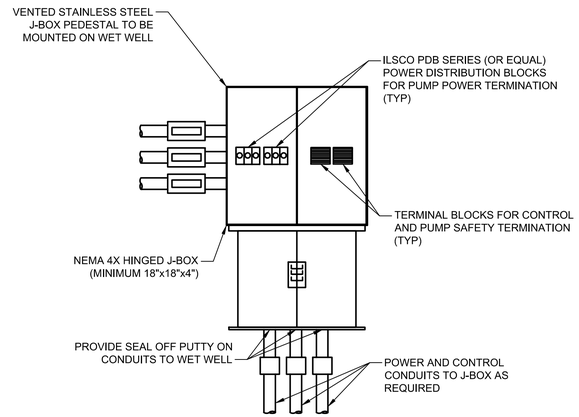
NOTES:

1. SIZE NEMA 4X CONTROL PANEL AS REQUIRED.
2. CONTROL PANEL SHALL BE CONSTRUCTED TO UL STANDARDS IN A UL PANEL SHOP. CONTROL PANEL SHALL BE UL LISTED.
3. CONTRACTOR IS RESPONSIBLE FOR COORDINATING WITH THE ELECTRIC UTILITY (AEP) TO PROVIDE ANY POWER REQUIREMENT UPGRADES TO THE NEW LIFT STATION IF REQUIRED. PROVIDE CONDUIT, WIRE, METER BASE, ETC. TO PROVIDE POWER COMPLETE TO THE LIFT STATION. .
4. ALL COSTS ASSOCIATED WITH ANY MODIFICATIONS REQUIRED FOR PROVIDING POWER TO THE LIFT STATION SHALL BE INCLUDED IN THE CONTRACTOR'S BID PRICE; INCLUDING ANY CHARGES BY THE UTILITY COMPANY (AEP) FOR THEIR WORK.
5. PILOT DEVICES, ELAPSED TIME METERS, AND TOUCH SCREEN SHALL BE MOUNTED ON THE PANEL DEAD FRONT.
6. PROVIDE FLOATS FOR LEAD/LAG/HIGH/LOW LEVEL OPERATION OF PUMPS AND ALARMS.
7. FLOATS TO BE HARDWIRED TO START VFD'S.

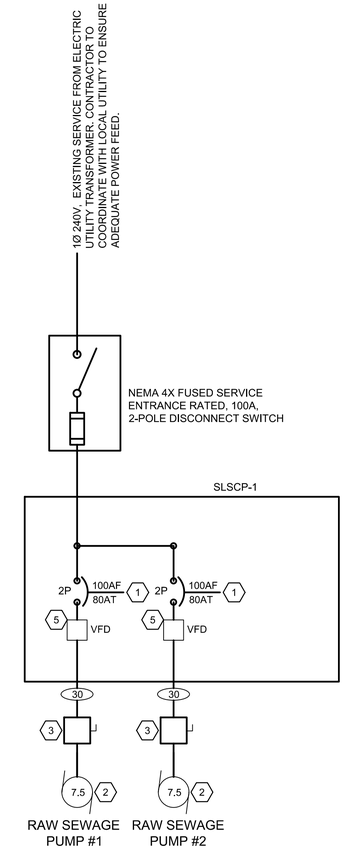


CONTROL PANEL DETAIL

SCALE: NTS



J-BOX INTERIOR DETAIL



ONE LINE DIAGRAM

SCALE: NTS

PLAN NOTES:

1. COORDINATE WITH THE CONTRACTOR AND EQUIPMENT SUPPLIERS WHEN SELECTING THE CIRCUIT BREAKER SIZES TO ENSURE NEW CIRCUIT BREAKERS ARE PROPERLY SIZED.
2. WIRE PUMP SAFETIES AND LEVEL CONTROLS AS REQUIRED. REFERENCE DS SPECIFICATIONS AND COORDINATE WITH CONTRACTOR DURING BIDDING AND CONSTRUCTION. INTEGRATE PUMP SAFETY RELAYS INTO CONTROL PANEL AS REQUIRED BY PUMP MANUFACTURER.
3. 3-POLE NEMA 4X STAINLESS STEEL DISCONNECT WITH AUXILIARY CONTACTS TO STOP VFD WHEN SWITCH IS OPEN, SIZED AS REQUIRED FOR THE LOAD PER NEC.
4. THE CONTRACTOR SHALL REINSTALL THE EXISTING MISSION CELLULAR RTU IN THE NEW LIFT STATION CONTROL PANEL AND RECONNECT ALL ALARMS. NEW CONTROL PANEL IS REQUIRED TO PROVIDE SPACE AND POWER TO MISSION RTU.
5. THREE PHASE CONVERSION FOR PUMPS ACCOMPLISHED THROUGH VARIABLE FREQUENCY DRIVES, CONTRACTOR TO COORDINATE WIITH PUMP AND VFD SUPPLIER TO ENSURE SELECTED VARIABLE FREQUENCY DRIVES ARE PROPERLY SIZED TO OPERATE NEW THREE PHASE PUMPS.

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TOBY LEE CHURCH REGISTERED No. 11300603 STATE OF INDIANA PROFESSIONAL ENGINEER
Signature 08/30/2024 Date

ELKHART COUNTY REGIONAL SEWER DISTRICT
ELKHART COUNTY, INDIANA
HEATON LAKE LIFT STATION UPGRADES

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NORTH LIFT STATION ELECTRICAL AND CONTROL DETAILS

Drawing No: **E1-0**

Sheet: 2 OF 3

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EXISTING METER BASE AND 240 VAC, 60-AMP/1-PHASE SERVICE DISCONNECT

EXISTING LIFT STATION CONTROL PANEL

GENERAL NOTES:

1. THE EXISTING PUMPS, CONTROL PANEL, SERVICE DISCONNECT AND ELECTRIC METER/BASE WILL BE REPLACED AND RELOCATED AS PART OF THIS PROJECT. THE CONTRACTOR SHALL FURNISH AND INSTALL ALL ELECTRICAL CONDUIT, WIRE AND MATERIAL REQUIRED.

2. THE PUMP STATION WET WELL IS CLASSIFIED AS CLASS 1, DIVISION 1, GROUP D AREA PER NFPA 820. THE AREA WHICH EXTENDS TO 18" ABOVE THE PUMP STATION TOP OF SLAB AND EXTENDS 3' BEYOND ALL SIDES OF THE HATCH IS A CLASS 1, DIVISION 2 HAZARDOUS LOCATION. ANY EQUIPMENT LOCATED WITHIN THE CLASSIFIED AREA SHALL BE UL LISTED FOR THAT AREA. ALL WIRING METHODS SHALL CONFORM TO THE REQUIREMENTS OF NEC ARTICLE 500 AND 501.

3. THE PUMP STATION VALVE VAULT IS CLASSIFIED AS CLASS 1, DIVISION 2, GROUP C AND D AREAS PER NFPA 820. ANY EQUIPMENT LOCATED WITHIN THE CLASSIFIED AREA SHALL BE UL LISTED FOR THAT AREA. ALL WIRING METHODS SHALL CONFORM TO THE REQUIREMENTS OF NEC ARTICLE 500 AND 501.

4. A MINIMUM 3' 6" WORKING CLEARANCE IS REQUIRED IN FRONT OF THE CONTROL PANEL PER NEC TABLE110.26(A)(1).

5. THE CONTRACTOR SHALL COORDINATE WITH UTILITY (AEP) TO RELOCATE THE EXISTING ELECTRICAL SERVICE AND ANY UPGRADES REQUIRED TO INCREASE THE EXISTING SERVICE TO 100-AMP. 100-AMP ELECTRICAL SERVICE IS REQUIRED BY THE INCREASE IN LIFT STATION PUMP HORSEPOWER. ELECTRICAL EQUIPMENT SHALL BE RELOCATED TO MEET THE CLEARANCE REQUIREMENT IN NOTE 3.

6. THE CONTRACTOR SHALL FURNISH AND INSTALL NEW CONTROL PANEL, METER BASE, IF REQUIRED BY UTILITY (AEP), NEMA 4X, 240 VAC, 100-AMP/1-PHASE DISCONNECT ON NEW MOUNTING FRAME, ANCHORED TO NEW CONCRETE EQUIPMENT PAD, INSTALLED BY THE CONTRACTOR, MOUNTING AS SHOWN IN DETAIL ON E1-0. PAD DETAIL SHOWN BELOW.

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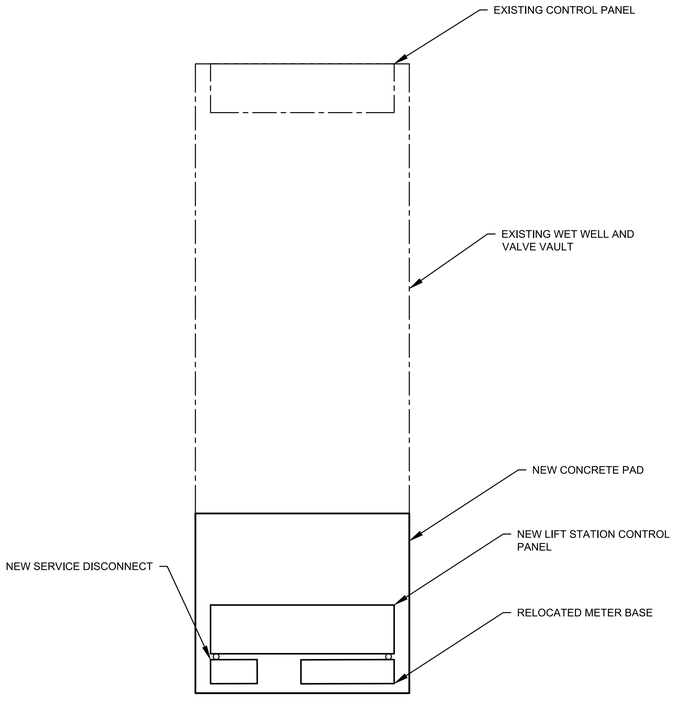

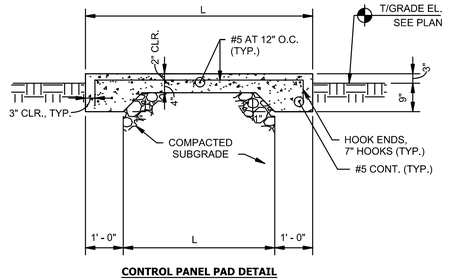

CONTROL PANEL PAD DETAIL

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PROFESSIONAL ENGINEER

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HEATON LAKE LIFT STATION UPGRADES

NORTH LIFT STATION CONTROL PANEL RELOCATION

Drawing No:
E1-2
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DETAILED SPECIFICATIONS

ELKHART COUNTY REGIONAL SEWER DISTRICT

HEATON LAKE NORTH LIFT STATION REHABILITATION

TABLE OF CONTENTS

Note: Detailed specifications herein are certified by the plan sheet noted electrical, mechanical, instrumentation and control, structural and process engineers for which work is applicable.

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SECTION 01

SALVAGE, DEMOLITION, RENOVATION, AND REMOVAL

1. GENERAL

A. This specification addresses the quality, quantity, and procedures of all demolitions, removal, salvage, and renovations to all items described herein, as shown on the plans, and as augmented by other sections of these specifications. All items to be salvaged, renovated, demolished, and removed as indicated on the plans or as necessary to attain quality workmanship and material shall be considered as part of the work and shall not be excluded by the Contractor in the completion of this contract.

B. All Items as indicated on the Construction Plans to be demolished shall be demolished and removed complete and disposed of lawfully as indicated on the Plans and described herein, except items noted herein as being salvaged for the Owner.

C. Under this section, the Contractor shall be responsible for furnishing all materials, labor, tools, and equipment necessary to complete the basic tasks of demolition, removal, salvage, and renovation on the equipment, items, and/or structures specified herein.

2. EXECUTION

A. Demolition

1. Abandoned items shall be demolished where shown on the plans and to the limits expressed within these specifications. Demolition on any item shall be complete unless otherwise agreed to by the Engineer.

2. The Contractor shall be responsible so that demolitions take place in the safest possible environment. No demolition shall occur which would present a potential hazard to adjacent equipment, tankage, etc., and/or personnel safety. The Contractor shall be fully liable to the Owner complete restoration to the Owner for any damages that occur due to Contractor negligence of potential problems. Demolition procedures on any such item or associated item that is to be reused under this project shall be agreed upon by the Owner/Engineer prior to the start of unit demolition.

3. All work shall be done in a manner to assure safety of all possibly affected persons.

4. The Contractor shall be responsible for keeping an accurate record of all demolition performed, noting which items were removed from the site as fill material and which salvage items were stored at the designated site; the quantity, size, and quality of the salvaged items and the Engineer's indication that said items have been inspected.

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5. The Contractor shall perform demolition work as described herein and as indicated on the drawings. The items noted on the plans to be included in the demolition work shall be limited to the extent as shown on the plans, described elsewhere in these specifications, and as necessary to complete the intended construction, modifications, and installations.

6. Any adjacent walls, floors, ceiling, etc., damaged during demolition shall be restored to original condition or better at no additional cost to owner.

7. All concrete to remain that has been marred, damaged or defaced as a result of demolition shall be repaired. Saw cut and remove concrete to a depth of not less than 1-inch. Remove exposed reinforcing to preclude it from exiting new surface. Apply appropriate bonding agent to the surface. Patch with non-shrink, non-metallic grout to match the existing surface unless otherwise noted.

8. All embedded anchors of removed items shall be cut flush with the existing surface and sealed. If the area of the existing anchors must be reused for new anchors, remove anchors and concrete and replace as required by equipment manufacturer.

B. Salvage

1. It is the responsibility of the Contractor to store on a site selected by the Owner the salvageable equipment and items as identified by owner and listed herein prior to demolition activity. Prior to removal of any salvageable items, the Contractor and the Engineer shall inspect the item as to its condition and photograph each item. It is the Contractor's responsibility to protect the item and deliver it to the Owner in its original condition.

2. The Contractor shall be advised by the Engineer to store on the designated site any other item(s) that might be deemed reusable.

3. After inspection and acceptance, the Owner shall be responsible for all materials stored at the salvage site.

4. The Contractor shall consider all items as salvageable and shall realize that all items belong to the Owner. Any items deemed not salvageable by the Owner shall be removed from the site and disposed of at the Contractor's expense.

5. Salvage Items: Coordinate with Owner on the salvage of the existing pumps and electrical equipment to be replaced.

C. Removal

1. The Contractor shall be responsible for coordinating with the Engineer which items shall be removed from location or from the site. The Contractor shall be responsible for transportation of removed items.

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2. Except for salvageable items, all items removed, including demolition rubble, and/or associated refuse that has no reuse value, shall be removed from the plant site and be disposed of in a proper manner.

3. The Contractor shall remove unsalvageable debris, equipment, conduit, wiring, and other unusable materials as described herein and as indicated on the drawings. The items noted on the plans to be included in the removal work shall be limited to the extent as shown on the plans, described elsewhere in these specifications, and as necessary to complete the intended construction, modifications, and installations.

D. Renovation

1. Work described under this subsection shall include the following materials and procedures as necessitated by the condition(s) of existing structures where work is being performed:

a. Sandblasting (wet or dry) – to be performed on existing concrete, etc. where new work is to be performed as required

1) The material to be used for cleaning shall be suitably graded, absolutely clean particles of sand, granite, quartz, grit or other material.
2) If water is used or desirable for certain job conditions, it shall be clean, potable water under normal pressure. Special mixing nozzles shall be used to project material and water onto the surfaces.
3) Provide all necessary shields, barriers, protection or other precautions to properly execute this work to the designated structures.
4) All equipment shall be furnished by the Contractor unless otherwise specified. It shall be erected, used and removed in a manner that will assure the safety of traffic at the work site.
5) The sandblasting process is to clean surfaces by means of forcing particles of cleaning material under pressure against the surface to be cleaned. All dirt, paint or other undesired coatings are to be removed. The type of cleaning material used and the pressure under which it is applied re variable and will be governed by the type of surface to be cleaned and the substance to be removed.

b. Hi-Pressure Water Cleaning Per SSPC-SP12 WJ-4 – *to be performed on existing concrete, etc. where new work is to be performed as required*

1) Provide all necessary shields, barriers, protection or other precautions to properly execute this work to the designated structures.
2) All surfaces as described shall be cleaned by the hi-pressure water cleaning method. The purpose of this

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cleaning method is to thoroughly remove all dirt, grime and loose particles from the surface in such a manner as to cause no disruption and harm to the surface. The action of this cleaning method is to be one of scouring and scrubbing only.

3) The pump used to develop this pressure is to be gasoline or diesel driven, capable of maintaining pressures of 1200 psi at minimum elevations of 300 feet above the pump.

4) A special nozzle design will be used to project the water at 1,000 to 1,200 lbs pressure. This nozzle is to contain a device allowing the water stream to be aerated thereby breaking up the force of the water stream as the result of aeration.

5) If necessary, where dirty surfaces require, the surface shall be soaked prior to cleaning with the hi-pressure water nozzle by previous wetting with hoses of perforated piping. Where extremely dirty areas occur it may also be necessary to draw through the top of the aerating nozzle a fine aggregate or sand approximately 50 to 60 mesh to remove these stubborn areas of dirt.

c. Non-Shrink Grouting

1) The restoration of designated areas shall be by a non-shrink metallic aggregate. This shrinkage-compensating aggregate is not to be a ready-to-use project. It must be mixed with sand, cement and water as follows.

2) The intended use for the grout is to set machinery, anchor bolts, dowels, structural columns, fillets, bearing plates, underpinning, ad a bonding coat.

3) The minimum mixing proportions shall be 1:1:1 by weight; the basic quantities shall be:

100 lbs. - Non-Shrink Metallic Aggregate
94 lbs. - Type 1 Cement
100 lbs. - Dry Sand (Coarse)

4) Other concrete openings shall be closed using a non-shrink, non-metallic grout. All new openings shall be prepared by being neatly cut or drilled to prevent face chipping or spalling.

d. Caulking and Sealing – *to be performed as required. All construction/contraction joints shall be caulked/sealed.*

1) Caulking and sealing shall include exterior perimeters; expansion or construction joints; joints in all horizontal surfaces; metal to masonry, metal to metal, and other specific job requirements of existing concrete structures to be re-used. Sealing for all new structures shall be included under DS & W&M Coatings Specifications.

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2) Sealant to be polysulfide base sealant based on liquid polymer.
3) Primer, where required, shall be as recommended by manufacturer of sealant.
4) Back-up materials, preformed joint fillers or bond breaking tapes, are to be non-staining, compatible with sealant and primer, and of resilient nature.
5) Materials impregnated with oil, bitumen or similar materials shall not be used. Purpose of back-up material is to prevent bonding of sealant to back of joint. Sealant should bond only to opposing sides of joint.
6) Prepare joints for sealant by removing foreign matter, such as dust, oil, grease, water, surface dirt or frost.
7) Porous surfaces to be cleaned by grinding, abrading by hand or mechanical grinder or acid wash. Non-porous surfaces such as metal or glass to be cleaned mechanically or chemically, and all protective coats removed by solvent, leaving residue. Do not allow solvent to air dry without wiping.
8) Install back-up or joint filler material where required or as detailed. Size and shape of back-up or filler should when compressed (25 to 50%), fit joints to be sealed. When using back-up of hose or rod stock, roll into joint, do not twist or braid.
9) Apply masking tape in alignment with joint edge where required, removing immediately after joints are sealed and tooled.
10) Prime joint sides as required by manufacturer.
11) Apply sealant under pressure with power actuated gun. Gun to have correct nozzle size and pressure to fill joints as detailed.
12) Tool and finish white and light colored sealants using dry tool or tooling solution recommended by sealant manufacturer.
13) Clean sealant or soil from adjacent surfaces as work progresses, using proper solvents or cleaning agents. All finished work to be left in a neat, clean condition, free of fins or overlaps.
14) Caulk/Seal all construction / contraction joints.

E. Construction Phasing

1. Because the existing facilities must remain in operation during construction until such time as construction and start-up of new or temporary facilities is completed, the Contractor must fully coordinate and cooperate with the Owner and Engineer in developing a Plan of Operation for the phasing of construction. This Plan, as included in these specifications and/or as prepared or amended by the Engineer in discussions with the Owner and the Contractor, shall designate a logical order of task completion for the purpose of maintaining a quality of wastewater treatment equal to normal plant effluent concentrations of pollutants prior to initiation of construction.

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The Contractor shall include in his plans for phasing of construction the coordination of all disposal requirements.

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SECTION 02

BYPASS PUMPING

1. GENERAL

A. General

1. Under this item the Contractor is required to furnish all materials, labor, equipment, power, maintenance, etc. to implement a temporary pumping system for the purpose of diverting existing flow around the work area as needed during the project. Bypass pumping is required to divert sanitary sewage flows during work on the lift station. The Contractor shall be responsible to assure that the collection system has a means to convey wastewater flows at all times during the project without surcharging the collection system. If it becomes necessary to temporarily disconnect or plug an existing sewer, the Contractor shall provide bypass pumping as specified below or similar means approved by the Engineer.

2. The design, installation and operation of the temporary pumping system shall be the Contractor's responsibility. The Contractor shall employ the services of a vendor who can demonstrate to the Engineer specialization in the design and operation of temporary bypass pumping systems. The vendor shall provide at least 5 references of projects of a similar size and complexity as this project, performed by the firm within the past five years. The bypass system shall meet the requirements of all regulations and codes of the regulatory agencies having jurisdiction.

3. The Contractor shall provide all manpower, fuel, power and means to operate the bypass pumps. The Contractor will not be allowed to use power from the site.

4. The Bypass Pumping Plan shall include, but not be limited to, details of the following:

   a. Staging areas for pumps;
   b. Sewer plugging method and types of plugs;
   c. Description of Pump installation;
   d. Number, size, material, location and method of installation of suction and discharge piping;
   e. Bypass pump sizes, capacity, number of each size to be on site and power requirements;
   f. Calculations of static lift, friction losses, and flow velocity (pump curves showing pump operating range shall be submitted);
   g. Standby power generator size, location;
   h. Downstream discharge plan including method of protecting discharge manholes or structures from erosion and/or damage;
   i. Thrust and restraint block sizes and locations;
   j. Sections showing suction and discharge pipe depth, embedment, select fill and special backfill;
   k. Method of noise control for each pump and/or generator;

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l. Any temporary pipe supports and anchoring required;
m. Access limitation and security measures to bypass pumping locations;
n. Calculations for selection of bypass pumping pipe size;
o. Schedule for installation of and maintenance of bypass pumping lines;
p. Plan indicating bypass pumping line locations.
q. A description of fuel volume, location and type of fuel containers, spill prevention, spill cleanup, and the length of time the bypass pumping system can operate with the given volume of fuel.
r. Contractor's plan of operation for bypass pumping during non-work hours if required as a result of the Contractor's work activities or schedule. Plan to summarize alarm operations and emergency contact information including arrival time to the project site.

5. The Contractor shall prevent spillages of wastewater to the environment during the connection and disconnection of hoses and pumps.

B. Submittals

1. Shop drawings and Manufacturer's Operation and Maintenance Manuals shall be submitted to the Engineer for approval in accordance with these specifications.

2. The Contractor shall submit to the Engineer detailed plans and descriptions outlining all provisions and precautions to be taken by the Contractor regarding the handling of existing flows. This plan must be specific and complete, including such items as schedules, locations, elevations, capacities of equipment, materials and all other incidental items necessary and/or required to insure proper protection of the facilities, including protection of the access and bypass pumping locations from damage due to the discharge flows, and compliance with the requirements and permit conditions specified in these Contract Documents. No construction shall begin until all provisions and requirements have been reviewed and approved by the Engineer.

3. Submit design and performance data on the following items to obtain approval of the equipment to be used. The equipment selected shall be such as to provide reliable service.

a. Pumps
b. Piping
c. Hosing
d. Controls
e. Hydraulic power packs
f. Generator
g. Electrical gear
h. Pipe connection details

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2. PRODUCTS

A. Equipment

1. All pumps used shall be fully automatic self-priming units not requiring the use of foot-valves or vacuum pumps in the priming system. The pumps shall be powered by diesel or diesel generators. All pumps used must be constructed to allow dry running for long periods of time to accommodate the cyclical nature of effluent flows. Pumps shall be heavy duty and reliable.

2. The Contractor shall provide the necessary stop/start controls for each pump.

3. The Contractor shall include one stand-by pump of each size to be maintained on site. Back-up pumps shall be on-line, isolated from the primary system by a valve.

4. Discharge Piping - In order to prevent the accidental spillage of flows, all discharge systems shall be temporarily constructed of pipe with positive, restrained joints. Under no circumstances will aluminum “irrigation” type piping or glued PVC pipe be allowed. Butt fused HDPE pipe will be allowed with proper support. Discharge hose will only be allowed in short sections and by specific permission from the Engineer

B. System Description

1. Design Requirements:

a. Bypass pumping systems shall have a primary and standby bypass pumps of sufficient capacity to pump the wet weather peak sewage flow. The Contractor shall provide all pipeline plugs, pumps of adequate size to handle peak flow, and temporary discharge piping to ensure that the total flow of the main can be safely diverted around the section to be repaired. Bypass pumping system will be required to be operated 24 hours per day.

b. The Contractor shall have adequate standby equipment available and ready for immediate operation and use in the event of an emergency or breakdown. One standby pump for each size pump utilized shall be installed at the mainline flow bypassing locations, ready for use in the event of primary pump failure.

c. Bypass pumping system shall be capable of bypassing the flow around the work area and of releasing any amount of flow up to full available flow into the work area as necessary for satisfactory performances of work.

d. The Contractor shall make all arrangements for bypass pumping during the time when the main is shut down for any reason. System must overcome any existing force main pressure on discharge.

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2. Performance Requirements

a. The existing lift station operates at 120 gpm and 35 TDH. Contractor shall provide bypass pumping equipment to meet or exceed the lift station capacity.

b. Pumps shall be capable of operating satisfactorily left and right of specified duty point to accommodate various conditions of existing force main.

c. The Contractor shall provide, maintain and operate all temporary facilities such as dams, plugs, pumping equipment (both primary and back-up units as required), conduits, all necessary power, and all other labor and equipment necessary to intercept flow before it reaches the point where it would interfere with the work, carry it past the work and return it to the existing gravity influent sewer downstream of the work.

d. The design, installation and operation of the temporary pumping system shall be the Contractor's responsibility. The bypass system shall meet the requirements of all codes and regulatory agencies having jurisdiction.

e. The Contractor shall provide all necessary means to safely convey the sewage past the work area. The Contractor will not be permitted to stop or impede the flows under any circumstances.

f. The Contractor shall maintain sewer flow around the work area in a manner that will not cause surcharging of sewers, damage to sewers and that will protect public and private property from damage and flooding.

g. The Contractor shall disconnect hoses and pumps in such a manner as to prevent spillage of wastewater to the environment. Any significant spillage of wastewater, if it occurs, shall be pumped back into the existing manhole.

3. EXECUTION

A. Field Quality Control and Maintenance

1. Test

a. The Contractor shall perform leakage and pressure tests of the bypass pumping discharge piping using clean water prior to actual operation. The Owner and Engineer will be given 48 hours notice prior to testing. **Testing will be required at each bypass pumping location.** Testing shall be successfully completed before the bypass pumping system will be accepted for use.

2. Inspection

a. Contractor shall inspect bypass pumping system, when in operation, at least every hour to ensure the system is working correctly.

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3. Maintenance Service

a. The Contractor shall insure the temporary pumping system is properly maintained and a responsible operator shall be on hand at all times when the bypass pump(s) is/are operating.

4. Extra Materials

a. Spare parts for pumps and piping shall be kept onsite as required.
b. Adequate hoisting equipment for each pump and accessories shall be maintained at the site.

B. Preparation

1. Precautions

a. Contractor is responsible for locating any existing utilities in the area the Contractor selects to locate the bypass pipelines. The Contractor shall locate his bypass pipelines to minimize any disturbance to existing utilities and shall obtain approval of the pipeline locations from the Owner and the Engineer. All costs associated with relocating utilities and obtaining all approvals shall be paid by the Contractor.
b. During all bypass pumping operation, the Contractor shall protect the pump station, streets, residences and all local sewer lines from damage inflicted by any equipment. The Contractor shall be responsible for all physical damage to the treatment plant, streets, residences and all local sewer lines caused by human or mechanical failure.

C. Installation and Removal

1. When working inside structures, manholes or gravity sewer, the Contractor shall exercise caution and comply with OSHA requirements when working in the presence of sewer gases, combustible oxygen-deficient atmospheres, and confined spaces.

2. The Contractor shall remove manhole sections or make connections to the existing sewer and construct temporary bypass pumping structures as may be required to provide adequate suction conduit.

3. Plugging or blocking of sewage flows shall incorporate a primary and secondary plugging device. When plugging or clocking is no longer needed for performance and acceptance of work, it is to be removed in a manner that permits the sewage flow to slowly return to normal without surge, to prevent surcharging or causing other major disturbances downstream.

4. The installation of the bypass pipelines is prohibited in all wetland areas. The pipeline must be located off roadways and sidewalks and on shoulders of the road. When the bypass pipeline crosses local streets and private driveways, the Contractor shall place the bypass pipeline in a trench and

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cover with temporary pavement. Upon completion of the bypass pumping operations, and after the receipt of written permission from the Engineer, The Contractor shall remove all the piping, restore all property to pre-construction condition and restore all pavement.

5. Once written permission is issued, the Contractor shall remove all components of the temporary pumping system. The Contractor shall perform all restoration work to the satisfaction of the Engineer.

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SECTION 03

SUBMERSIBLE WASTEWATER PUMPS FOR DUPLEX WET WELL INSTALLATION

1. GENERAL

A. Scope of Work

1. The work in this section shall include furnishing and placing into operation two (2) submersible pumps, with discharge connections, lifting chains and guide bars as specified herein and as indicated on the drawings.

B. References

1. American Society for testing and material (ASTM) International

   a. A 48: Standard Specification for Gray Iron Castings.
   b. A743: Standard Specification Iron-Chromium Nickel, Corrosion Resistant,

2. American National Standards Institute (ANSI):

   a. 1.B16.1: Standard for Cast Iron Pipe Flanges and Flanged Fittings, 125 lb.

3. Hydraulic Institute: Current Standards.

   a. HI 14.6: Hydrodynamic Pumps for Hydraulic Performance Acceptance Tests.
   b. HI 11.6: Submersible Pump Tests

C. Submittals

1. Submittal data shall be provided to show compliance with these specifications, plans or other specifications that will influence the proper operation of the pump(s).

2. Standard submittal data for approval must consist of:

   a. Pump Performance Curves.
   b. Pump Outline Drawing.
   c. Station Drawing for Accessories.
   d. Electrical Motor Data.
   e. Typical Installation Guides.
   f. Technical Manuals and Parts List.
   g. Printed Warranty.
   h. Management system certificate ISO 9001.
   i. Manufacturer's Equipment Storage Recommendations.
   j. Manufacturer's Standard Recommended Start-Up Report Form.

3. Lack of the above requested submittal data is cause for rejection.

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D. Qualification Requirements

1. The manufacturer shall provide data on alternate equipment manufacturer's experience. Only Manufacturers with 20 or more years of experience who have furnished at least 5 similar lift stations shall be considered.

2. After installation, a pump station start-up shall be performed by the installing contractor under the supervision of the manufacture's authorized representative. 8 hours of field service shall be provided by an authorized, factory trained representative of the pump manufacturer. Services shall include, but not be limited to, inspection of the completed pump station installation to ensure that it has been performed in accordance with the manufacturer's instructions and recommendations, supervision of all field-testing and activation of the Pump Manufacturer's Warranty. The test shall demonstrate to the satisfaction of the Owner that the equipment meets all specified performance criteria, is properly installed and anchored, and operates smoothly without exceeding the full load amperage rating of the motor. The Contractor shall be responsible for coordinating the required field services with the Pump Manufacturer.

E. Operational, Requirements and Warranty

1. The contractor shall supply and install 2 submersible sewage pumps with discharge connections, discharge pipes, guide bars, cable holder lifting chains.

2. The submersible pumps shall have a semi open multi vane self-cleaning impeller designed to transport wastewater with fibrous materials like wet wipes.

3. The impeller shall be wear resistant and made of high chromium cast iron with at least 24% chrome against sand and grit which is expected to enter the pump station with the sewage or the storm water. Impellers that have surface hardening (by thermal, coating, etc.) will not be allowed.

4. Each pump shall be capable to lift **128 US gpm** at a total dynamic head of **34.9 feet**.

5. The pumps shall be provided with prorated 60 months (5 years) warranty against defects in materials and or workmanship. Unless otherwise specified, all other equipment shall be warrantied for 12 months (1 year). The warranty shall be in printed form and previously published as the manufacturer's standard warranty for all similar units manufactured, latest revision. Upon warranty occurrence, the manufacturer's authorized service center shall remove the pump, repair, reinstall and provide start up on the repaired pump. A detailed failure analysis shall be submitted to the Owner for their records summarizing corrective action taken.

6. The manufacturer shall guarantee clog-free operation for a period of 12 months from the date of start-up of the pumps by the local authorized

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factory representative. A certificate shall be provided to the Owner on the day of start up with the local contact information and effective date. If the impeller clogs with typical solids or modern trash debris normally found in domestic wastewater during this period, an authorized representative shall travel to the jobsite, remove the pump, clear the obstruction and reinstall the pump at no cost for the Owner. A written report shall be provided to the Owner detailing the service call with pictures for verification purposes.

2. PRODUCTS

A. Submersible Sewage Pumps

1. Pumps shall be manufactured by Xylem-Flygt, model Flygt NP 3127, and provided locally by representative B.L. Anderson LLC. (765-463-1518)

2. Each station shall be equipped with two (2) submersible, close-coupled wastewater pumps.

3. Each pump shall be equipped with a 7.5 HP submersible electric motor, capable to operate on a 230 volt, 3 phases, 60 hertz voltage supply.

4. The hydraulic of the pump shall be capable of handling raw domestic wastewater and storm water with fibrous materials like wet wipes.

5. The impeller blades shall be self-cleaning upon each rotation as they pass across a sharp relief groove in the Insert ring and shall keep the impeller blades clear of debris. The insert ring shall have a guide pin which moves fibers from the center of the impeller to the leading edges of the impeller. The impeller shall move axially upwards to allow larger debris to pass through and immediately return to normal operating position. The clearance between the insert ring and the impeller leading edges shall be adjustable.

6. The impeller shall be wear resistant and made of high chromium cast iron with at least 24% chrome against sand and grit which is expected to enter the pump station with the sewage or the storm water. Impellers that have surface hardening (by thermal, coating, etc.) will not be allowed

7. The impeller shall be mounted on the motor shaft. Couplings shall not be accepted.

8. The pump motor shall be induction type with a squirrel cage rotor, shell type design, housed in an air filled, watertight chamber. It shall be permanently submersible according standard IEC 60034 and protection class IP 68.

9. The stator windings shall be insulated with moisture resistant Class H insulation rated for 356°F.

10. The motor shall be capable of no less than 30 evenly spaced starts per hour and be able to operate throughout the entire pump performance curve from shut-off through run-out even when the motor is not submerged

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11. Sealing of the pumping unit to the discharge connection shall be accomplished by a machined metal to metal watertight contact. Sealing of the discharge interface with a diaphragm, O-ring or profile gasket will not be acceptable.

12. It shall be possible to lift and lower the pumps on parallel guide bars and connect them to wet well mounted discharge connection. There shall be no need for personal to enter the wet well when removing or reinstalling the pumps.

13. The pump housing shall be prepared for the assembling of a sump mixing valve. The discharge flange of the pump housing shall be 3”.

14. The junction chamber containing the terminal board shall be hermetically sealed from the motor by an elastomeric compression seal. Connection between the cable conductors and stator leads shall be made with threaded compression type binding posts permanently affixed to a terminal board. The motor and the pump shall be produced by the same manufacturer.

15. The motor shall be protected by 3 thermal switches embedded in the stator set to open at 260°F and one leakage sensor floating type located in the stator chamber. The sensor and the switches shall be connected to the control panel which shall stop the motor and send an alarm when the sensors are activated.

16. The pump shall be Explosion approved according to FM CLASS 1. DIV 1 "C" & "D"

17. The cable entry shall consist of dual cylindrical elastomer sleeves, flanked by washers, all having a close tolerance fit against the cable and the cable entry. Epoxies, silicones, or other secondary sealing systems shall not be considered acceptable.

18. The pump shaft shall rotate on two bearings. Motor bearings shall be permanently grease lubricated and have a nominal L10 lifetime of 50.000 hours. The upper bearing shall be a single deep groove ball bearing. The lower bearing shall be a two row angular contact bearing to compensate for axial thrust and radial forces. Single row lower bearings are not acceptable.

19. The shaft shall be sealed by a tandem mechanical shaft seal system consisting of two seals, each having an independent spring system. The seals shall require neither maintenance nor adjustment and shall be capable of operating in either clockwise or counter clockwise direction of rotation without damage or loss of seal function.

20. Each pump shall be provided with a lubricant chamber for the shaft sealing system. The lubricant chamber shall be designed to prevent overfilling and to provide lubricant expansion capacity. The drain and inspection plug, with positive anti-leak seal shall be easily accessible from the outside. The seal

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system shall not rely upon the pumped media for lubrication. Seal lubricant shall be non-hazardous.

21. Where a seal cavity is present in the seal chamber, the area about the exterior of the lower mechanical seal in the cast iron housing shall have cast in an integral concentric spiral groove. This groove shall protect the seals by causing abrasive particulate entering the seal cavity to be forced out away from the seal due to centrifugal action

22. The Materials of construction shall be as follows:

    Pump housing: ASTM A-48, Class 35B
    Impeller and insert ring: A 532 ALLOY III A (25% Chrome)
    Stator housing: ASTM A-48, Class 35B
    Shaft: ASTM A479 S43100-T.
    Shaft seal: Pump side: - Corrosion resistant Tungsten carbide WCCR
    Shaft seal Motor side: - Carbon-Aluminum oxide (AL2O3)

23. All castings must be blasted before coating. All wet surfaces are to be coated with two-pack oxyrane ester Duasolid 50. The total layer thickness should be at least 120 microns. Zink dust primer shall not be used.

24. The motor shall be equipped with 30 feet of screened cable suitable for submersible pump applications. The power cable shall be sized according to NEC and ICEA. The outer jacket of the cable shall be oil resistant chlorinated polyethylene rubber. The cable shall be capable of continuous submergence underwater without loss of watertight integrity to a depth of 65 feet.

25. Each completed and assembled pump/motor unit shall undergo the following factory tests at the manufacturer's plant prior to shipment. The Manufacturer shall provide on demand a copy of his quality control plan for these tests and an ISO 9001 factory certificate:

    a. Minimum 3-point hydraulic performance test
    b. No-Leak seal integrity test
    c. Electrical integrity test

B. Equipment for Wet Well Installation

1. For each pump the contractor shall supply and install a discharge connection made of cast iron ASTM A-48, Class 35B.

2. The outlet flange of the discharge connection shall be 3" drilled according ANSI B16.1-89; tab.5.

3. The pump(s) shall be automatically and firmly connected to the discharge connection, guided by no less than two parallel guide bars extending from the top of the station to the wet well mounted discharge connection. The material of the guide bars shall Stainless steel AISI 316.

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4. The length of the guide bars shall be per plans and they shall be fasten at the top of the station with a guide bar holder made of Stainless steel AISI 316.

5. For each pump the contractor shall supply and install a cable holder made with 4 hooks of Stainless steel AISI 316.

6. There shall be no need for personnel to enter the wet-well.

7. The sealing of the pumping unit to the discharge connection shall be accomplished by a machined metal to metal contact. Sealing of the discharge interface with a diaphragm, O-ring or profile gasket will not be accepted. The entire weight of the pump/motor unit shall be borne by the pump discharge elbow. No portion of the pump/motor unit shall bear on the sump floor directly or on a sump floor mounted stand.

C. Lifting Equipment for Pumps

1. Each pump shall be fitted with necessary length of stainless steel lifting chain or lifting cable. The working load of the lifting system shall be 50% greater than the pump unit weight.

3. EXECUTION

A. General

1. Perform installation in accordance with Contract Documents and manufacturers specifications.

B. Examination

1. A factory trained technician shall examine the work area prior to beginning work and check the following:

a. The environment is safe to begin working in
b. All surfaces are ready to receive work

C. Field Quality Control

1. The follow field tests shall be performed by a factory trained technician

a. Point to point wiring verification
b. Utility power verification
c. Site acceptance testing
d. System demonstration

2. Point to Point I/O Verification

a. After installation of the pumps and the control panel, a factory trained technician shall prepare the I/O checklist. The checklist shall include the following:

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1) All inputs and outputs connected to the control panel
2) All alarms that can be generated by the control panel

3. The technician shall follow a test procedure to test all alarms.

   a. All digital inputs shall be tested from point of origin unless it is unsafe.
   b. All digital outputs shall be tested by running a simulation test from the controller or by simulating the fault condition.
   c. All analog inputs shall be tested from the point of origin where possible and by use of a signal generator otherwise.
   d. All analog outputs shall be tested by running a simulation program or by forcing the output to a value.

D. Test Equipment

1. All test equipment shall be provided by the Contractor.

E. Training

1. Training shall be a minimum of four (4) hours and cover the complete Pumping System and related controls.
2. Instruction material shall be provided for four (4) trainees.

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SECTION 04

ELECTRICAL

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SECTION 260100 – BASIC ELECTRICAL REQUIREMENTS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Special Conditions apply to work of this section.

1.02 DESCRIPTION OF WORK

A. The following information is a general description of the Electrical Work included for upgrades of the Heaton North Lakes Lift Station for Elkhart County RSD. This description is not all inclusive nor is the work limited to the following. It is general in nature and intended to provide a broad overview of the scope:

1. The contractor shall coordinate with Local Utility (AEP) on location as the local control panel and meter base are required to be relocated. The AEP meter number is 996 524 793.

2. The contractor shall coordinate with Local Utility (AEP) on service conduit size and installation requirements by Utility for service cables.

3. The contractor shall disconnect and remove existing conduits and wiring to control panels, lift station pumps and all controls.
   a. The contractor shall Install the new lift station control panel, all power/control conduits, wiring for new pumps, controls. Power to lift stations is 230 VAC, 1-Phase. Variable Frequency Drives will be provided in new control panels to convert 1-phase incoming power to operate new 3-phase lift station pumps.
   b. Pump horsepower for the north lift station will increase. The Contractor shall coordinate with utility to for any required modifications to power feeds to the lift station required due to the increase in pump horsepower.
   c. The contractor shall move the existing Mission Cellular RTU from the existing control panel to the new lift station control panel. Mounting space for the Mission Cellular RTU has been provided for in the new lift station control panel by the panel manufacturer.

B. The Basic Electrical Requirements apply to all electrical materials, equipment, installations, and services supplied under any portion of the work. The Contractor shall coordinate the Basic Electrical Requirements as applicable to any equipment, installations, and services of an electrical nature.

C. It is the intention of this Division of the Specifications and the accompanying drawings to describe and provide for the furnishing, installing, testing and placing in satisfactory and successful operation all equipment, materials, devices and necessary appurtenances to provide a complete electrical system, together with other miscellaneous installations and equipment hereinafter specified and/or shown on the plans. The work shall include all materials, appliances and apparatus not specifically mentioned herein or noted on the

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plans, but which are necessary to make a complete working installation of all electrical systems shown on the plans or described herein. Equipment and devices furnished and installed under other Divisions of this specification (or by Owner) shall be connected under this Division. The drawings and specifications are complementary and what is called for in either is binding as if called for in both.

D. The contract drawings indicate the extent and the general location and arrangement of equipment, conduit, and wiring. The contractor shall study plans and details and shall cooperate with all other trades to prevent conflict and interference as to space requirements. Fixtures, equipment, and outlets shall be located to avoid interference with mechanical or structural features. Lighting fixtures shall be symmetrically located according to the room arrangement. Raceways, junction and outlet boxes, lighting fixtures, panels and cabinets, and all other electrical equipment shall be properly supported to comply with applicable codes and good work practice.

E. Electrical Contractor is responsible for installation of a complete and operating electrical system in accordance with the intent of the drawings and specifications.

F. The scale of drawings cannot show all necessary transitions, offsets, changes in direction, etc. It shall be the responsibility of the Electrical Contractor to provide all pull boxes, elbows, fittings, supports, etc. necessary to install his work to conform to structures, to preserve head room, provide access, and to keep openings and passageways clear.

G. Electrical diagrams are schematic and diagrammatic only, not necessarily to scale, and do not necessarily show physical arrangement of equipment. Electrical diagrams and plans are complementary and what is shown on either is same as if shown on both.

H. The horsepower of motors and equipment wattages indicated on the plans are based on information made available to Engineer and field notes of existing installation and are as accurate as practical. However, there may be discrepancies. All wiring, switches, circuit breakers, and magnetic motor starters shall be of sizes and capacities to suit the horsepower of the motors and equipment furnished and connected. However, in no case shall wiring, switches, circuit breakers and magnetic motor starters be of smaller capacities or sizes than those indicated on the drawings or specified unless approved by the Engineer.

I. Any minor changes in the location of all equipment, switchboards, panelboards, starters, fixtures, conduits, outlets, etc. from those shown on the plans shall be made without extra charge if so, directed by the Engineer or Owner before installation. Minor changes in location shall be defined as within 15 feet in any direction, horizontally or vertically, from the location indicated on the drawings.

J. Contractor shall examine not only plans and specification for electrical and instrumentation but plans and specifications for other related sections. Visit the site to become acquainted with all project conditions including existing.
Execution of contract is evidence that the contractor has examined all drawings

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and specifications and that all conditions of installing the work in this section are verified. Later claims for labor and materials required due to difficulties encountered which could have been foreseen had examination been made shall not be recognized.

K. Make detailed arrangements with the Owner for selected electrical service work and any/all shutdowns required.

1. Provide temporary services: The Contractor shall be responsible for and bear the cost of all temporary service or equipment feeders which may be required.

2. All shutdown and power transfer work must be closely scheduled with the Owner, approved in advance by the Owner, and at the convenience of the Owner; and shall be performed only with the Owner present and/or under direct/indirect supervision of the Owner.

3. Power shutdowns and transfers must be scheduled with the Owner and all such shutdowns and transfers shall be scheduled at the Owner's convenience. At the Owner's discretion, work may be required to be performed on holidays, weekends, evenings, early mornings, and during similar non-standard work periods, without additional cost to the Owner.

1.03 PERMITS AND FEES

A. This work shall include the procurement of and payment of all permits and fees for the performance of the electrical work.

1.04 COORDINATION OF ELECTRICAL WORK

A. Contract documents are diagrammatic in showing certain physical relationships which must be established; such establishment and the final physical relationship is the exclusive responsibility of the Contractor.

1. Arrange electrical work in a neat, well organized manner with conduit and similar services running parallel with primary lines of structures, maximize overhead clearance.

2. Locate operating and control equipment and arrange entire electrical work with adequate access for operation and maintenance.

3. Advise other trades of openings required in their work, and scheduling cooperation required, for the subsequent move-in of large units of electrical work (equipment, conduits, pull boxes, etc.).

1.05 COORDINATION OF OPTION, SUBSTITUTIONS, AND ARRANGEMENT

A. Where the contract documents permit the selection from several product options, and where it becomes necessary to authorize a substitution, do not proceed with purchasing until coordination of interface requirements has been checked and satisfactorily established.

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B. The Contractor will not be paid for cutting, patching, retrofitting, and finishing required for relocation of work installed due to interference and improperly located equipment.

1.06 QUALITY ASSURANCE

A. In case of difference between building codes, state laws and federal laws, local ordinances, industry standards and utility regulations and the Contract Documents, the most stringent shall govern. The Contractor shall promptly notify the Engineer in writing of any such difference.

1.07 NON-COMPLIANCE

A. Should the Contractor perform any work that does not comply with the requirements of the applicable building codes, state and federal laws, local ordinances, industry standards and utility regulations, he shall bear all costs in correcting all deficiencies.

B. Applicable codes and standards shall include all the state laws, local ordinances, utility company regulations and the applicable requirements of the following nationally accepted codes and standards. All the following codes shall apply to the equipment, and equipment installation, where applicable. All equipment shall bear U.L. labels where labeled equipment is available.

C. Industry Standards, Codes and Specifications

1.	NEC	National Electric Code (NFPA No. 70), with State and Local Amendments as applicable.
2.	NFPA820	Water and Wastewater Specific Code
3.	IBC	International Building Code, with State and Local Amendments as applicable.
4.	ANSIC2	National Electrical Safety Code.
5.	IEEE	Institute of Electrical and Electronics Engineers.
6.	ASTM	American Society of Testing Materials.
7.	IPCEA	Insulated Power Cable Engineers Association.
8.	NEMA	National Electrical Manufacturers Association.
9.	NFPA	National Fire Protection Association.
10.	UL	Underwriters Laboratories.
11.	NECA	National Electrical Contractors Association Standards of Installation
12.	NFPA	No. 101 Life Safety Code.
13.	FM	Factory Mutual
14.	ADA	Americans with Disabilities Act.

D. All electric materials shall be new, in original cartons, bundles, or shipping crates and shall have U.L. label whenever available.

E. Nothing in these drawings and specifications shall be construed to permit work not conforming with governing codes. Also, this shall not be construed as relieving the Contractor from complying with any requirements of the plans or

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specifications which may exceed requirements of the hereinbefore mentioned governing codes and rules and not contrary to same.

1.08 MANUFACTURERS

A. Firms regularly engaged in the manufacture of the equipment specified of the types and capacities required, whose products have been in satisfactory use in similar service for not less than 5 years, unless specified otherwise.

1.09 INSTALLERS

A. A firm with at least 5 years of successful installation experience on projects with electrical installation work similar to that required for the project, unless specified otherwise.

1.10 SUBMITTALS

A. General: Provide submittals of shop drawings and descriptive data for selected all electrical power, control, lighting, and similar items, and obtain Engineer's approval of same prior to proceeding with work.

B. Submittals shall comply with the following:

1. Include complete catalog information such as construction, ratings, and insulating systems, as applicable.

2. For any material specified to meet U.L. or trade standards, furnish manufacturer's or vendor's certification that material furnished for work does in fact equal or exceed Specifications.

3. Shop drawings shall be submitted in complete groups of material (i.e., all lighting fixtures or all switchgear, etc.), and each item of material submitted shall have Contractor's stamp and be initialed by Contractor as verification that submittal has been reviewed in detail and is in fact Contractor's choice of materials. Bind catalog cuts, descriptive bulletins, and drawings 11" x 17" or smaller in sets with covers showing titles.

4. Contractor shall verify dimensions of equipment and be satisfied as to code compliance for fit prior to submitting shop drawings for approval. Departure from the above procedure will result in rejection of the submittal and the requirement that the Contractor revise and resubmit the information. Any costs associated with delays arising out of such resubmittal process shall be the sole responsibility of the Contractor.

1.11 O&M MANUALS

A. Submit three sets of Operation and Maintenance Manuals. Refer to General Conditions.

1.12 WARRANTIES

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A. All new equipment shall have a warranty on one (1) year, including all parts and labor.

END OF SECTION

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SECTION 260519 – LOW-VOLTAGE ELECTRICAL; POWER CONDUCTORS AND CABLES

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Building wires and cables and associated splices, connectors, and terminations for wiring systems rated 600 v and less.

1.02 DEFINITIONS

A. Underfloor Conduits.
   1. Conduits run underground within perimeter of building walls under building floor. This may consist of 1 conduit, or several conduits grouped together.

B. Duct Bank Conduits
   1. Conduits run underground outside perimeter of building walls. This may consist of 1 conduit, or several conduits grouped together.

C. Underground Conduits
   1. Underground conduits are both underfloor conduits and duct bank conduits.

1.03 QUALITY ASSURANCE

A. Items provided under this Section shall be listed or labeled by UL or other Nationally Recognized Testing Laboratory (NRTL).
   1. Term "NRTL" shall be as defined in OSHA Regulation 1910.7.
   2. Terms "listed" and "labeled" shall be as defined in National Electrical Code, Article 100.

B. Regulatory Requirements:
   1. National Electrical Code (NEC): Components and installation shall comply with National Fire Protection Association (NFPA) 70.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Deliver wire and cable according to NEMA WC 26.

PART 2 PRODUCTS

2.01 BUILDING WIRES AND CABLES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Alcan Products Corporation; Alcan Cable Division.
   2. American Insulated Wire Corp.; a Leviton Company.
   3. Belden

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4. Encore Wire and Cable.
5. General Cable Corporation
6. Senator Wire & Cable Company.
7. Southwire Company.

B. UL-listed building wires and cables with conductor material, insulation type, cable construction, and rating as required to meet application and NEC requirements.

2.02 Wire and cable for 600 volts and below: Soft drawn, copper wire with 600-volt insulation.

A. Conductors:
1. Annealed, copper in accordance with ASTM B33.
2. Stranding: Class B in accordance with ASTM B8.

B. Insulations and Coverings:
1. Rubber: Conform to NEMA WC 3.
2. Thermoplastic: Conform to NEMA WC 5.
3. Cross-Linked Polyethylene: Conform to NEMA WC 7.
4. Ethylene Propylene Rubber: Conform to NEMA WC 8.

C. Feeders and service conductors: Single conductor Type XHHW-2.

D. Branch Circuits:
1. Single Conductor Type THWN: Above ground and underfloor conduits.
2. Single Conductor Type XHHW-2: Duct bank conduit.
3. No. 12 AWG minimum size (unless otherwise noted) for branch circuit wiring, including motor circuits.
4. Size 120 v branch circuits for length of run on following basis.
   a. 0 to 50 ft Run from Panelboard to first outlet: No. 12 AWG minimum.
   b. 51 to 100 ft Run: Increase one wire size, i.e., No. 12 AWG becomes No. 10 AWG.
   c. 101 to 150 ft Run: Increase two wire sizes, i.e., No. 12 AWG becomes No. 8 AWG.
   d. 151 ft and above: Wiring sized for 3% maximum voltage drop.
5. For other branch circuits, voltage drop for branch circuits and feeder circuit combined shall not exceed requirements of the NEC 215.

E. Control Circuits:
1. Single conductor Type THWN: Above ground and underfloor conduits.
2. No. 12 AWG minimum size (unless otherwise noted).
3. Multi-wire cable assembly: Duct bank conduits.

F. Non-shielded Instrumentation, Graphic Indication, and Other Control Wiring Operating at Less Than 120 v: No. 14 AWG except as otherwise indicated with same insulation as control circuits.
1. Single conductor Type THHW/THWN, above ground and underfloor conduits.
2. Multi-wire cable assembly: Duct bank conduits.

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G. Shielded instrumentation wiring, above ground and underfloor conduits:
   1. PVC insulation, tinned copper (19 by 27) stranded, No. 16 AWG, twisted pair or triplet cabled with aluminum mylar shielding, stranded, tinned, No. 18 AWG copper drain wire, and overall black FR-PVC, 90ºC, 600-volt jacket.
   2. Multi-wire cable assembly: duct bank conduits.

H. Telephone Wire, above ground conduits:
   1. Vinyl insulation, tinned copper, solid twisted pair, cabled conductors, and silver-gray vinyl jacket.
      a. Up to 4 conductors per cable: 22 AWG solid wire.
      b. Over 4 conductors per cable: 24 AWG solid wire.
      c. Duct Bank: High density polyethylene jacketed multi-wire cable assemblies.

I. Fire Pump Feeder: Type MI, 3-conductor copper.

J. Multi-Wire Control and Instrumentation Cable Assemblies:
   1. Multi-conductor, color-coded cable with number and size of conductors indicated.
   2. Where spare conductors are not indicated provide 10% spare conductors. One pair minimum.
   3. Control and non-shielded instrumentation.
      a. Bare soft stranded No. 14 or 12 AWG copper in accordance with ASTM B3.
      b. Class B stranded in accordance with ASTM B8.
      c. Type THWN insulation also meeting requirements of NEMA WC-5 with armor-nylon in accordance with UL 83-THWN.
      d. Color coded in accordance with NEMA WC-5 Method I Table K-2.
      e. Cabled with suitable fillers.
      f. Overall black FR-PVC, 90°C, 600-volt sunlight resistant jacket.
      g. UL listed for installation in cable trays in accordance with NEC Art. 318, Class I, Division 2 hazardous areas and in accordance with NEC 340 and for direct burial.
   4. Shielded Instrumentation:
      a. Bare soft stranded No. 16 AWG copper in accordance with ASTM B3.
      b. Class B stranded tinned copper in accordance with ASTM B8.
      c. PVC with nylon armor insulation.
      d. Twisted pairs color coded in accordance with NEMA WC-5 Method I Table K-2 and numbered.
      e. Individual and overall aluminum mylar shields and seven strand tinned copper drain wires.
      f. Overall black FR-PVC 90°C 600-volt sunlight resistant jacket.
      g. UL listed for installation in cable trays in accordance with NEC 318, Class I, Division 2 hazardous areas in accordance with NEC 340 and for direct burial.

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2.03 CONNECTORS AND SPLICES

A. Underwriters Laboratories (UL) -listed factory-fabricated wiring connectors of size, ampacity rating, material, and type and class for application and for service indicated.

B. Select to comply with Project's installation requirements and as required to meet application.

C. Conductors No. 10 AWG and Smaller: 3M Electric Products, Skotchlok, or equal pre-insulated spring connector. Comply with manufacturer's packaging requirements for number, size, and combination of conductors.

D. Conductors No. 8 AWG and Larger: Bronze 2-bolt type connectors with spacer.

2.04 TERMINATIONS

A. Power Conductors: Compression crimp type lugs.

B. Control and Instrumentation Conductors: Compression crimp type fork tongue, insulated support type lugs on terminal strips. Do not splice.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install wires and cables as indicated, according to manufacturer's written instructions and NECA "Standard of Installation".

B. Remove existing wire from raceway before pulling in new wire and cable.

C. Run wire and cable in conduit unless otherwise indicated on Drawings. Pull conductors into raceway simultaneously where more than 1 is being installed in same raceway.

1. Use pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation.
2. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips that will not damage cables or raceway.
3. Do not draw conductor into conduits until building is enclosed, watertight, and work causing cable damage has been completed.

D. Install cable supports for vertical feeders in accordance with NEC. Provide split wedge type which firmly clamps each individual cable and tightens due to cable weight.

E. For panelboards, cabinets, wireways, switches, and equipment assemblies, neatly form, train, and tie cables in individual circuits.

F. Seal cable and wire entering building from underground between wire and conduit, where cable exits conduit, with non-hardening approved compound.

G. Install wire and cables in separate raceway systems as follows:

1. Exit lights.
2. ac Control.

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3. dc control.
4. Shielded instrumentation.
5. Telephone cables.
6. Network Cables.
7. Fiber Optic Cables.
8. Emergency system.
9. Fire alarm system.
10. As required by NEC.

H. Where control or instrumentation cables are run in underground conduit and ducts provide multi-wire cable assemblies.

I. Where power cables and instrument/signal cables enter and pass through same manhole, handhole, or distribution box, steel barrier or separate raceways shall continue through box manhole, handhole to avoid magnetic interaction between power cables and instrumentation conductors. In manholes and handholes, provide Type C raceway outlet body with 3/16 in. holes drilled in bottom for drainage.

J. Do not run instrumentation cables into control cabinets or MCC unless cables are terminated in cabinet or MCC.

K. Wiring at Outlets: Install with at least 12 in. (300 mm) of slack conductor at each outlet.

L. Connect outlets and components to wiring and to ground as indicated and instructed by manufacturer. Tighten connectors and terminals, including screws and bolts, according to equipment manufacturer's published torque-tightening values for equipment connectors. Where manufacturer's torqueing requirements are not indicated, tighten connectors and terminals according to tightening torques specified in UL 486A.

M. Drawings do not designate number of conductors in conduit nor does location of branch circuits and switch legs indicated on Drawings designate location or routing. Route branch circuits and switch legs as dictated by construction and these Specifications.

3.02 TERMINATIONS AND SPLICES

A. Terminate control, instrumentation, and communication cables on terminal strips in separate terminal cabinets located near conduit entrances of buildings or as shown on Drawings.

B. Power Cable Splices (no splices in cables unless approved by Engineer):
1. Provide continuous lengths of cable without splices in motor circuits and feeders unless otherwise noted. Splices may be installed in motor circuits and feeders with prior approval by ENGINEER.
2. Install splices and taps that possess equivalent or better mechanical strength and insulation ratings than conductors being spliced.
3. Use splice and tap connectors that are compatible with conductor material.
4. Where pre-insulated spring connectors are used for equipment connections, tape connector to wire to prevent loosening under vibration.

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5. Each tap, joint or splice in conductors No. 8 AWG and larger shall be taped with two half-lap layers of vinyl plastic electrical tape and finish wrap of color coding tape where required by code.
6. Cable splices shall be made only in manholes, handholes, wireways, distribution boxes, and junction boxes.

C. Power Cable Terminations:
1. Termination of wires with full compression type lugs installed with appropriate hand or hydraulic tool. Use proper dies to achieve the desired compression.
2. For screw type terminal blocks, terminations for stranded conductors shall be made with T & B lock-on fork connector with insulated sleeves.
3. Motor lead conductor terminations shall be made with a T & B or approved equal, full compression lug, full ring type, bolted, and taped as required. For connecting motor lead to service wiring fasten full ring lugs together with cadmium plated steel cap screws, and cover with a minimum of 2 layers 1/2 lap, 3M Scotch No. 33 tape; option: T & B "Motor Stub Splice Insulator".

3.03 CONTROL CIRCUITS

A. Control circuit home runs from same area for the same system returning to same panel, (e.g., LCP, DPC, etc.,) may be combined provided signal and voltage types are not mixed.

B. Following types of home runs shall not be combined with other types:
1. 4-20 ma dc analog; Type 2 shielded cable.
2. 24 vdc discrete (e.g., field or LCP powered dry contacts).

3.04 BRANCH CIRCUITS

A. Motor branch circuits and branch circuits for 3 phase circuits shall not be combined.

B. Branch circuits for single phase equipment devices from same LP or PP may be combined provided that such combining does not result in having to derate ampacity of conductors.

3.05 FEEDERS:

A. Extend feeders at full capacity from origin to termination.

B. Each conduit raceway shall contain only those conductors constituting single feeder circuit.

C. Where multiple raceways are used for single feeder, each raceway shall contain conductor of each phase and neutral if used.

D. Where feeder conductors run in parallel, conductors shall be of same length, material, circular-mil area, insulation type, and terminated in same manner.

E. Where parallel feeder conductors run in separate raceways, raceways shall have same physical characteristics.

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F. Confine feeders to insulated portions of building unless otherwise shown.

G. On network systems, neutral shall be run with phase wires. Unbalanced neutral current shall not exceed normal or derated conductor capacity.

3.06 MOTORS AND EQUIPMENT WIRING

A. Provide motor circuits in accordance with diagrams and schedules on Drawings and code requirements, from source of supply to associated motor starter and starter to motor terminal box, including necessary and required intermediate connections.

B. Do not include associated control conductors in same conduit with power conductors.

C. Provide branch circuits to conform with NEC requirements and nameplate ratings. CONTRACTOR responsible for verification of ratings of motors and installing proper branch circuits.

3.07 COLOR CODING

A. Conductors for Lighting and Power Wiring:

Phase	208/120 v	480/277 v
A	Black	Brown
B	Red	Orange
C	Blue	Yellow
Travelers	Pink	Purple
Neutral	White	White with non-green stripe
Ground	Green	Green

B. Colored pressure-sensitive plastic tape.

1. Apply in half overlapping turns for minimum of three inches at terminal points, and in junction boxes, pull boxes, troughs, manholes, and handholes.
2. 3/4 in. wide with colors as specified.
3. Apply last two laps of tape with no tension to prevent possible unwinding.
4. Where cable markings are covered by tape, apply tags to cable stating size and insulation type.

C. For modifications and additions to existing wiring systems, color coding shall conform to existing wiring system.

D. Color code for insulated power system wiring shall be in accordance with NEC.

E. Color code for intrinsically safe systems shall be light blue.

3.08 CONTROL, COMMUNICATION AND SIGNAL SYSTEM IDENTIFICATION

A. Install permanent wire marker at termination.

B. Identifying numbers and letters on wire markers shall correspond to those on terminal blocks or wiring diagrams used for installing systems.

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C. Plastic sleeve or self-adhesive vinyl cloth.

D. In each manhole and handhole, install embossed brass tags to identify system served and function.

E. Comply with Section 260553.

3.09 FEEDER IDENTIFICATION

A. Manholes, handholes, pull-boxes, and junction boxes, install metal tags on circuit cables and wires to clearly designate circuit identification and voltage.

B. Provide tags of embossed brass type, in manholes and handholes showing cable type and voltage rating. Attach tags to cables with slip-free plastic cable lacing units.

C. Comply with Section 260553.

3.10 INSTALLATION IN MANHOLES AND HANDHOLES

A. Install and support cable in manholes, and handholes on steel racks with porcelain or equal insulators. Train cables around walls, but do not bend to radius less than 6 times overall cable diameter.

B. Electrical Fireproofing:

1. Where low voltage cables are installed in same manholes or handholes with high voltage cables, cover low voltage cable with arc-proof fireproof tape.
2. Use same type as for high voltage cables, applied in single layer, one-half lapped or as recommended by manufacturer. Extend not less than 1 in. into each duct.
3. Secure tape in place with random wrap of glass cloth tape.

3.11 FIELD QUALITY CONTROL

A. Visual and Mechanical Inspection:

1. Inspect cables for physical damage and proper connection in accordance with single-line diagram.
2. Test cable mechanical connections to manufacturer's recommended values using calibrated torque wrench.
3. Check cable color coding with specifications and NEC standards.

B. Test in accordance with Section 260126.

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SECTION 260523 – CONTROL-VOLTAGE ELECTRICAL POWER CABLES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract apply to this Section.

B. Specification Section “Identification for Electrical Systems”.

1.02 SUMMARY

A. Section Includes:
   1. UTP cabling.
   2. Low-voltage control cabling.
   3. Control-circuit conductors.

1.03 DEFINITIONS

A. EMI: Electromagnetic interference.

B. IDC: Insulation displacement connector.

C. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control and signaling power-limited circuits.

D. Open Cabling: Passing telecommunications cabling through open space (e.g., between the studs of a wall cavity).

E. UTP: Unshielded twisted pair.

1.04 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Qualification Data: For qualified layout technician, installation supervisor, and field inspector.

C. Source quality-control reports.

D. Field quality-control reports.

E. Maintenance Data: For wire and cable to include in maintenance manuals.

1.05 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

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1.06 DELIVERY, STORAGE, AND HANDLING

A. Test cables upon receipt at Project site.
   1. Test each pair of UTP cable for open and short circuits.

1.07 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install UTP and connecting materials until wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

PART 2 PRODUCTS

2.01 PATHWAYS

A. Conduit and Boxes: Comply with requirements in Specification Section "Raceway and Boxes for Electrical Systems."
   1. Outlet boxes shall be no smaller than 2 inches wide, 3 inches high, and 2-1/2 inches deep.

2.02 BACKBOARDS

A. Refer to electrical sheets for requirements.

2.03 UTP CABLE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Belden CDT Inc.; Electronics Division.
   2. Berk-Tek; a Nexans company.
   3. CommScope, Inc.

B. Description: 100-ohm, four-pair UTP
   1. Comply with ICEA S-90-661 for mechanical properties.
   2. Comply with TIA/EIA-568-B.1 for performance specifications.
   3. Comply with TIA/EIA-568-B.2, Category 5e.
   4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444 and NFPA 70 for the following types:
      a. Multipurpose: Type CM or Type CMG or Type CMR or Type CMP for in-conduit installation.

2.04 UTP CABLE HARDWARE

A. Manufacturers: Subject to compliance with requirements, Provide products by one of the following:
   1. CommScope Uniprise
   2. Hubbell Premise Wiring.
   3. Leviton Voice & Data Division.

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4. Ortronics
5. Panduit Corp.

B. UTP Cable Connecting Hardware: IDC type, using modules designed for punch-down caps or tools. Cables shall be terminated with connecting hardware of the same category or higher.

C. Connecting Blocks: 110 style for appropriate Category. Provide blocks for the number of cables terminated on the block, plus [25] percent spare; integral with connector bodies, including plugs and jacks where indicated.

2.05 LOW-VOLTAGE CONTROL CABLE

A. Paired Cable: NFPA 70, Type CMG.
1. One pair, twisted, No. 16 AWG, stranded (19x29) tinned-copper conductors.
2. PVC insulation.
3. Shielded with Tinned Copper Drain Wire
4. PVC jacket.
5. Flame Resistance: Comply with UL 1581.

B. Paired Cable: NFPA 70, Type CMG.
1. One pair, twisted, No. 18 AWG, stranded (19x30) tinned-copper conductors.
2. PVC insulation.
3. Shielded with Tinned Copper Drain Wire
4. PVC jacket.
5. Flame Resistance: Comply with UL 1581.

2.06 CONTROL-CIRCUIT CONDUCTORS

A. Class 1 Control Circuits: Stranded copper, Type THHN-THWN, in raceway, complying with UL 44.

B. Class 2 Control Circuits: Stranded copper, Type THHN-THWN, in raceway, complying with UL 44.

C. Class 3 Control Circuits: Stranded copper, Type THHN-THWN, in raceway, complying with UL 44.

2.07 SOURCE QUALITY CONTROL

A. Factory test UTP on reels according to TIA/EIA-568-B.1.

B. Factory test UTP cables according to TIA/EIA-568-B.2.

C. Cable will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

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PART 3 EXECUTION

3.01 INSTALLATION OF PATHWAYS

A. Comply with requirements Specification Section 26 Section "Raceway and Boxes for Electrical Systems" for installation of conduits and wireways.

3.02 INSTALLATION OF CONDUCTORS AND CABLES

A. Comply with NECA 1.

B. General Requirements for Cabling:
   1. Comply with TIA/EIA-568-B.1.
   2. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, and cross-connect and patch panels.
   3. Cables may not be spliced. Secure and support cables at intervals not exceeding 48 inches and not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
   4. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" Chapter. Install lacing bars and distribution spools.
   5. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
   6. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
   7. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.

C. UTP Cable Installation:
   1. Comply with TIA/EIA-568-B.2.
   2. Install 110-style IDC termination hardware unless otherwise indicated.
   3. Do not untwist UTP cables more than 1/2 inch from the point of termination to maintain cable geometry.

D. Installation of Control-Circuit Conductors:
   1. Install wiring in raceways. Comply with requirements specified in Specification Section "Raceway and Boxes for Electrical Systems."

E. Separation from EMI Sources:
   1. Comply with BICSI TDMM and TIA/EIA-569-A recommendations for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.
   2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:

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a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches.
b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches.
c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches.

3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:
   a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches.
   b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches.
   c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches.
4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
   a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
   b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches.
   c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches.
5. Separation between Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches.
6. Separation between Cables and Fluorescent Fixtures: A minimum of 5 inches.

3.03 CONTROL-CIRCUIT CONDUCTORS

A. Minimum Conductor Sizes:
1. Class 1 remote-control and signal circuits, [No 14] AWG.
2. Class 2 low-energy, remote-control, and signal circuits, [No. 16] AWG.
3. Class 3 low-energy, remote-control, alarm, and signal circuits, [No 12] AWG.

3.04 GROUNDING

A. For data communication wiring, comply with ANSI-J-STD-607-A and with BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.

B. For low-voltage wiring and cabling, comply with requirements in Specification Section "Grounding and Bonding for Electrical Systems."

3.05 IDENTIFICATION

A. Identify system components, wiring, and cabling according to TIA/EIA-606-A. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

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3.06 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Visually inspect UTP and optical fiber cable jacket materials for UL or third-party certification markings. Inspect cabling terminations to confirm color-coding for pin assignments and inspect cabling connections to confirm compliance with TIA/EIA-568-B.1.
2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.

C. Document data for each measurement. Print data for submittals in a summary report that is formatted using Table 10.1 in BICSI TDMM as a guide or transfer the data from the instrument to the computer, save as text files, print, and submit.

D. End-to-end cabling will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

END OF SECTION

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SECTION 260529 – HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract apply to this Section.

1.02 SUMMARY

A. This Section includes the following:
   1. Hangers and supports for electrical equipment and systems.
   2. Construction requirements for concrete bases.

1.03 PERFORMANCE REQUIREMENTS

A. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.

B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

C. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of five times the applied force.

1.04 SUBMITTALS

A. Product Data: For the following:
   1. Stainless Steel slotted support systems.
   2. Nonmetallic slotted support systems for areas identified as “Corrosive” on the contract drawings.

1.05 QUALITY ASSURANCE

A. Comply with NFPA 70.

1.06 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in concrete specification.

B. Coordinate installation of roof curbs, equipment supports, and roof penetrations.

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PART 2 PRODUCTS

2.01 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Stainless Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Allied Tube & Conduit.
   b. Cooper B-Line, Inc.; a division of Cooper Industries.
   c. ERICO International Corporation.
   d. GS Metals Corp.
   e. Thomas & Betts Corporation.
   f. Unistrut; Tyco International, Ltd.
2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4. Use allowed only in Electrical and Storage Rooms.
3. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
4. Channel Dimensions: Selected for applicable load criteria.

B. Nonmetallic Slotted Support Systems: Structural-grade, factory-formed, glass-fiber-resin channels and angles with 9/16-inch-diameter holes at a maximum of 8 inches on center in at least 1 surface.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Allied Tube & Conduit.
   b. Cooper B-Line, Inc.; a division of Cooper Industries.
   c. Fabco Plastics Wholesale Limited.
   d. Seasafe, Inc.
2. Fittings and Accessories: Products of channel and angle manufacturer and designed for use with those items.
3. Fitting and Accessory Materials: Same as channels and angles [except metal items shall be stainless steel].
4. Rated Strength: Selected to suit applicable load criteria.

C. Raceway and Cable Supports: As described in NECA 1 and NECA 101.

D. Conduit and Cable Support Devices: [Stainless Steel] hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

E. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.

F. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, stainless steel plates, shapes, and bars; black and galvanized.

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G. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      1) Hilti Inc.
      2) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
      3) Or Equal
2. Mechanical-Expansion Anchors: Insert-wedge-type, [zinc-coated] steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      1) Cooper B-Line, Inc.; a division of Cooper Industries.
      2) Hilti Inc.
      3) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
      4) Or Equal
3. Concrete Inserts: Stainless Steel slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element, stainless steel.
5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325. Stainless steel.
6. Toggle Bolts: All-stainless-steel springhead type.
7. Hanger Rods: Threaded stainless steel.

2.02 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

PART 3 EXECUTION

3.01 APPLICATION

A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.

B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for raceway as scheduled in NECA 1, where its Table 1 lists maximum spacings less than stated in NFPA 70. Minimum rod size shall be 1/4 inch in diameter.

C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted or other support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.

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1. Secure raceways and cables to these supports with single-bolt conduit clamps using spring friction action for retention in support channel.

D. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1 inch and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

3.02 SUPPORT INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.

B. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.

C. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:

1. To Wood: Fasten with stainless steel lag screws or stainless steel through bolts.
2. To New Concrete: Bolt to stainless steel concrete inserts.
3. To Masonry: Approved stainless steel toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
4. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches thick.
5. To Steel: Welded threaded studs complying with AWS D1.1/D1.1M, with lock washers and nuts, Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69.
6. To Light Steel: Stainless steel sheet metal screws.
7. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on metallic stainless steel or non-metallic fiberglass slotted-channel racks attached to substrate by means that meet anchorage requirements].

D. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.03 INSTALLATION OF FABRICATED METAL SUPPORTS

A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

B. Field Welding: Comply with AWS D1.1/D1.1M.

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3.04 CONCRETE BASES

A. Construct concrete bases of dimensions indicated but not less than 4 inches larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.

B. Use 3000-psi, 28-day compressive-strength concrete.

C. Anchor equipment to concrete base.

1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
2. Install anchor bolts to elevations required for proper attachment to supported equipment.
3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

END OF SECTION

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SECTION 260533 – RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract apply to this Section.

1.02 SUMMARY

A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.

1.03 DEFINITIONS

A. EMT: Electrical metallic tubing.

B. LFNC: Liquidtight flexible nonmetallic conduit.

C. PVC-RGS: PVC coated Rigid Galvanized Steel conduit.

D. Rigid Aluminum

E. RNC: Rigid nonmetallic conduit.

F. XP: Explosion proof

1.04 SUBMITTALS

A. Product Data: For surface raceways, wireways, fittings, boxes, hinged-cover enclosures, and cabinets.

B. Source quality-control test reports.

1.05 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70.

PART 2 PRODUCTS

2.01 METAL CONDUIT AND TUBING

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. AFC Cable Systems, Inc.
2. Alflex Inc.

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3. Allied Tube & Conduit; a Tyco International Ltd. Co.
4. Anamet Electrical, Inc.; Anaconda Metal Hose.
5. Electri-Flex Co.
6. Manhattan/CDT/Cole-Flex.
7. Maverick Tube Corporation.
8. O-Z Gedney; a unit of General Signal.
9. Wheatland Tube Company.
10. Or Equal

B. Manufacturers for PVC-RGS:
1. Perma-Cote; Robroy Industries
2. Approved Equal

C. Rigid Steel Conduit: ANSI C80.1.

D. PVC-coated rigid steel conduit.
1. Comply with NEMA RN 1.
2. Coating Thickness: 0.040 inch minimum.

E. EMT: ANSI C80.3.

F. LFNC: Flexible nonmetallic conduit with PVC jacket.

G. Fittings for Conduit (Including all Types and Flexible and Liquidtight), EMT, and Cable: NEMA FB 1; listed for type and size raceway with which used, and for application and environment in which installed.
1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886.
2. Fittings for EMT: compression type.
3. Coating for Fittings for PVC-Coated Conduit: Minimum thickness, 0.040 inch, with overlapping sleeves protecting threaded joints.

H. PVC-RGS Steel Conduit and Fittings
1. The PVC-RGS conduit shall be UL Listed.
2. The PVC coating shall be investigated by UL as providing the primary corrosion protection for the rigid metal conduit. Ferrous fittings for general service locations shall be UL Listed with PVC as the primary corrosion protection. Hazardous location fittings, prior to plastic coating shall be UL listed. All conduit and fittings shall be new, unused material. Applicable UL standards may include: UL 6 Standard for Safety, Rigid Metal Conduit, UL514B Standard for Safety, Fittings for Conduit and Outlet Boxes.
3. The PVC-RGS conduit shall be ETL Verified to the Intertek ETL SEMKO High Temperature H2O PVC Coating Adhesion Test Procedure for 200 hours. The PVC-RGS conduit shall bear the ETL Verified PVC-001 label to indicate compliance with the adhesion performance standard
4. The PVC-RGS conduit shall be hot dip galvanized inside and out with hot galvanized threads

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5. A PVC sleeve extending one pipe diameter or two inches, whichever is less, shall be formed at every female fitting opening except unions. The inside sleeve diameter shall be matched to the outside diameter of the conduit.
6. The PVC coating on the outside of conduit couplings shall have a series of longitudinal ribs not less than 40 mils in thickness to protect the coating from tool damage during installation.
7. Form 8 Condulets, 1/2" through 2" diameters, shall have a tongue-in-groove gasket to effectively seal against the elements. The design shall be equipped with a positive placement feature to ease and assure proper installation. Certified results confirming seal performance at 15 psig (positive) and 25 in. of mercury (vacuum) for 72 hours shall be available.
8. Form 8 Condulets shall be supplied with plastic encapsulated stainless steel cover screws
9. A urethane coating shall be uniformly and consistently applied to the interior of all conduit and fittings. This internal coating shall be not less than 2 mil thickness.
10. The PVC exterior and urethane interior coatings applied to the conduit shall afford sufficient flexibility to permit field bending without cracking or flaking at temperatures above 30°F (-1°C)
11. All male threads on conduit, elbows and nipples shall be protected by application of a urethane coating. All female threads on fittings or conduit couplings shall be protected by application of a urethane coating
12. Independent certified test results shall be available to confirm coating adhesion under the following conditions.
    a. Conduit and condulet exposure to 150°F (65°C) and 95% relative humidity with a minimum mean time to failure of 30 days. (ASTM D1151)
    b. The interior coating bond shall be confirmed using the Standard Method of Adhesion by Tape Test (ASTM D3359).
    c. No trace of the internal coating shall be visible on a white cloth following six wipes over the coating, which has been wetted with acetone (ASTM D1308).
    d. The exterior coating bond shall be confirmed using the methods described in Section 3.8, NEMA RN1. After these tests the physical properties of the exterior coating shall exceed the minimum requirements specified in Table 3.1, NEMA RN1.
13. Right angle beam clamps and U bolts shall be specially formed and sized to snugly fit the outside diameter of the coated conduit. All U bolts will be supplied with plastic encapsulated nuts that cover the exposed portions of the threads.

I. Joint Compound for Rigid Steel and Rigid Aluminum Conduit: Listed for use in cable connector assemblies, and compounded for use to lubricate and protect threaded raceway joints from corrosion and enhance their conductivity.

2.02 NONMETALLIC CONDUIT AND TUBING

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. AFC Cable Systems, Inc.

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2. Anamet Electrical, Inc.; Anaconda Metal Hose.
3. Arnco Corporation.
4. CANTEX Inc.
5. CertainTeed Corp.; Pipe & Plastics Group.
6. Condux International, Inc.
7. ElecSYS, Inc.
8. Electri-Flex Co.
9. Lamson & Sessions; Carlon Electrical Products.
10. Manhattan/CDT/Cole-Flex.
11. RACO; a Hubbell Company.
12. Thomas & Betts Corporation.
13. Or Equal

B. ENT: NEMA TC 13.

C. RNC: NEMA TC 2, [Type EPC-40-PVC] unless otherwise indicated.

D. LFNC: UL 1660.

E. Fittings for ENT and RNC: NEMA TC 3; match to conduit or tubing type and material.

F. Fittings for LFNC: UL 514B.

2.03 METAL WIREWAYS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Cooper B-Line, Inc.
2. Hoffman.
3. Square D; Schneider Electric.
4. Or Equal

B. Description: Sheet metal sized and shaped as indicated, NEMA 250, Type 4X, stainless steel unless otherwise indicated.

C. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

D. Wireway Covers: Hinged type.

E. Finish: Manufacturer's standard enamel finish.

2.04 SURFACE RACEWAYS

A. Surface Metal Raceways: Galvanized steel with snap-on covers. Manufacturer's standard enamel finish in standard color.

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1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Thomas & Betts Corporation.
   b. Mono Systems, Inc.
   c. Walker Systems, Inc.; Wiremold Company (The).
   d. Wiremold Company (The); Electrical Sales Division.
   e. Or Equal

B. Surface Nonmetallic Raceways: Two-piece construction, manufactured of rigid PVC with texture and color selected by Architect from [manufacturer's standard] colors.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Butler Manufacturing Company; Walker Division.
   b. Enduro Systems, Inc.; Composite Products Division.
   c. Hubbell Incorporated; Wiring Device-Kellems Division.
   d. Lamson & Sessions; Carlon Electrical Products.
   e. Panduit Corp.
   f. Walker Systems, Inc.; Wiremold Company (The).
   g. Wiremold Company (The); Electrical Sales Division.
   h. Or Equal

2.05 BOXES, ENCLOSURES, AND CABINETS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Cooper Crouse-Hinds; Div. of Cooper Industries, Inc.
2. EGS/Appleton Electric.
3. Erickson Electrical Equipment Company.
4. Hoffman.
5. Hubbell Incorporated; Killark Electric Manufacturing Co. Division.
6. O-Z/Gedney; a unit of General Signal.
7. RACO; a Hubbell Company.
8. Robroy Industries, Inc.; Enclosure Division.
9. Scott Fetzer Co.; Adalet Division.
10. Spring City Electrical Manufacturing Company.
11. Thomas & Betts Corporation.
12. Walker Systems, Inc.; Wiremold Company (The).
13. Woodhead, Daniel Company; Woodhead Industries, Inc. Subsidiary.
14. Or Equal

B. General
1. Interior Outlet Boxes
   a. Boxes shall be 4” square, minimum 2 1/8” deep, for up to two devices.
   b. Provide single gang tile ring as required for single device applications.

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2. Exterior Outlet Boxes
   a. Provide corrosion-resistant, cast iron, weatherproof outlet box of types, shapes, sizes, depths as required for respective location.
   b. For recessed in exterior wall application, provide galvanized sheet steel boxes with suitable depth.

C. Sheet Metal Outlet and Device Boxes: NEMA OS 1.

D. Cast-Metal Outlet and Device Boxes: NEMA FB 1, Type FD, with gasketed cover.

E. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

F. Cast-Metal Access, Pull, and Junction Boxes: NEMA FB 1, cast aluminum with gasketed cover.

G. Hinged-Cover Enclosures: NEMA 250, Type 1, with continuous-hinge cover with flush latch, unless otherwise indicated.
   1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.

H. Cabinets:
   1. NEMA 250, Type 1, galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
   2. Hinged door in front cover with flush latch and concealed hinge.
   3. Key latch to match panelboards.
   4. Metal barriers to separate wiring of different systems and voltage.
   5. Accessory feet where required for freestanding equipment.

2.06 SLEEVES FOR RACEWAYS

A. Per Specification Section “Common Work Results for Electrical”.

2.07 SLEEVE SEALS

A. Per Specification Section “Common Work Results for Electrical.”

2.08 BOXES AND FITTINGS FOR EXPLOSION PROOF AREAS

A. Manufacturers: Subjects compliance with requirements, provide product by one of the following:
   1. Appleton Electric
   2. Akron Electric Inc.
   3. Crouse-Hinds
   4. Or Equal

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PART 3 EXECUTION

3.01 RACEWAY APPLICATION

A. Outdoors: Apply raceway products as specified below, unless otherwise indicated:
   1. Exposed Conduit: PVC Coated Rigid galvanized steel conduit.
   2. Concealed Conduit, Aboveground in Finished Spaces (i.e. office, restroom): EMT or RGS.
   3. Underground Conduit for Power: RNC, Type EPC-40-PVC, direct buried and/or concrete encased.
   4. Underground Conduit for Signal/Instrumentation/Controls: RNC, Type EPC-40-RGS direct buried and/or concrete encased.
   5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFNC.
   6. Boxes and Enclosures, Aboveground: NEMA 250, Type 4X.

B. Comply with the following indoor applications, unless otherwise indicated:
   1. Exposed and Subject to Physical Damage: PVC Coated RGS:
   2. EMT is acceptable in the electrical room and control room that does not exit either room.
   3. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFNC
   4. Damp, Wet, Corrosive or Classified Locations: PVC-coated rigid galvanized steel conduit.
   5. Non-classified dry, non-corrosive areas not subject to physical damage: Aluminum Rigid.
   6. Boxes and Enclosures: Type 4X, stainless steel or fiberglass in damp or wet or corrosive locations.

C. Minimum Raceway Size: 3/4-inch trade size.

D. Raceway Fittings: Compatible with raceways and suitable for use and location.
   1. Rigid galvanized steel and Rigid Galvanized Aluminum Conduit: Use threaded rigid steel conduit fittings and threaded rigid aluminum conduit fittings respectively, unless otherwise indicated.
   2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with that material. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer.

3.02 INSTALLATION

A. Comply with NECA 1 for installation requirements applicable to products specified in Part 2 except where requirements on Drawings or in this Article are stricter.

B. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

C. Complete raceway installation before starting conductor installation.

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D. Support raceways as specified in "Hangers and Supports for Electrical Systems."

E. Arrange stub-ups so curved portions of bends are not visible above the finished slab.

F. Conceal conduit and EMT within finished walls, ceilings, and floors, unless otherwise indicated.

G. Raceways Embedded in Slabs:
   1. No raceways shall be embedded in slabs. Under slab raceways to be not less than 6” below bottom of slab.
   2. Change from RNC, Type EPC-40-PVC to PVC-coated rigid steel conduit, before rising above the floor.

H. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.

I. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors, including conductors smaller than No. 4 AWG.

J. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire.

K. Install raceway sealing fittings at suitable, approved, and accessible locations and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points:
   1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
   2. Where otherwise required by NFPA 70.

L. Expansion-Joint Fittings: Install in each run of aboveground conduit that is located where environmental temperature change may exceed 30 deg F, and that has straight-run length that exceeds 25 feet.
   1. Install expansion-joint fittings for each of the following locations, and provide type and quantity of fittings that accommodate temperature change listed for location:
      a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F temperature change.
      b. Catwalk transition from concrete to steel grating.
      c. Attics and roofs: 135 deg F temperature change.
   2. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F of temperature change.

M. Flexible Non-metallic Conduit Connections: Use maximum of 72 inches of LFNC for recessed lighting fixtures, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.

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N. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall.

3.03 INSTALLATION OF UNDERGROUND CONDUIT

A. Direct-Buried Conduit:

1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom for pipe less than 6 inches in nominal diameter.
2. Install backfill.
3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction.
4. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through the floor, unless otherwise indicated. Encase elbows for stub-up ducts throughout the length of the elbow.
5. Install manufactured PVC-Coated rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through the floor.
   a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches of concrete.
   b. For stub-ups at equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60 inches from edge of equipment pad or foundation. Install insulated grounding bushings on terminations at equipment.
6. Warning Planks: Bury magnetic warning tape approximately 12 inches above direct-buried conduits or concrete encased conduits. Align tape along the width and along the centerline of conduit run.

3.04 PROTECTION

A. Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION

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SECTION 260543 – UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes the following:
   1. Conduit, ducts, and duct accessories for direct-buried and concrete-encased duct banks, and in single duct runs.
   2. Handholes and boxes.
   3. Manholes.

1.03 DEFINITION

A. RNC: Rigid nonmetallic conduit.

1.04 ACTION SUBMITTALS

A. Product Data: For the following:
   1. Duct-bank materials, including separators and miscellaneous components.
   2. Ducts and conduits and their accessories, including elbows, end bells, bends, fittings, and solvent cement.
   3. Accessories for manholes, handholes, boxes, and other utility structures.
   4. Warning tape.
   5. Warning planks.

B. Shop Drawings for Precast or Factory-Fabricated Underground Utility Structures: Include plans, elevations, sections, details, attachments to other work, and accessories, including the following:
   1. Duct entry provisions, including locations and duct sizes.
   2. Reinforcement details.
   3. Frame and cover design and manhole frame support rings.
   4. Ladder and/or Step details.
   5. Grounding details.
   6. Dimensioned locations of cable rack inserts, pulling-in and lifting irons, and sumps.
   7. Joint details.

C. Shop Drawings for Factory-Fabricated Handholes and Boxes Other Than Precast Concrete: Include dimensioned plans, sections, and elevations, and fabrication and installation details, including the following:
   1. Duct entry provisions, including locations and duct sizes.

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2. Cover design.
3. Grounding details.
4. Dimensioned locations of cable rack inserts, and pulling-in and lifting irons.

1.05 INFORMATIONAL SUBMITTALS

A. Duct-Bank Coordination Drawings: Show duct profiles and coordination with other utilities and underground structures.
   1. Include plans and sections, drawn to scale, and show bends and locations of expansion fittings.
   2. Drawings shall be signed and sealed by a qualified professional engineer.

B. Product Certificates: For concrete and steel used in precast concrete manholes and handholes, as required by ASTM C 858.

C. Qualification Data: For professional engineer and testing agency.

D. Source quality-control test reports.

E. Field quality-control test reports.

1.06 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.

B. Comply with ANSI C2.

C. Comply with NFPA 70.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver ducts to Project site with ends capped. Store nonmetallic ducts with supports to prevent bending, warping, and deforming.

B. Store precast concrete and other factory-fabricated underground utility structures at Project site as recommended by manufacturer to prevent physical damage. Arrange so identification markings are visible.

C. Lift and support precast concrete units only at designated lifting or supporting points.

1.08 PROJECT CONDITIONS

A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:
   1. Notify Owner and Engineer no fewer than two days in advance of proposed interruption of electrical service.
   2. Do not proceed with interruption of electrical service without Owner's written permission.

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1.09 COORDINATION

A. Coordinate layout and installation of ducts, manholes, handholes, and boxes with final arrangement of other utilities, site grading, and surface features as determined in the field.

B. Coordinate elevations of ducts and duct-bank entrances into manholes, handholes, and boxes with final locations and profiles of ducts and duct banks as determined by coordination with other utilities, underground obstructions, and surface features. Revise locations and elevations from those indicated as required to suit field conditions and to ensure that duct runs drain to manholes and handholes, and as approved by Architect.

1.10 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

B. Furnish cable-support stanchions, arms, insulators, and associated fasteners in quantities equal to 5 percent of quantity of each item installed.

PART 2 PRODUCTS

2.01 CONDUIT

A. Rigid Steel Conduit: Galvanized. Comply with ANSI C80.1.

B. RNC: NEMA TC 2, Type EPC-80-PVC, UL 651, with matching fittings by same manufacturer as the conduit, complying with NEMA TC 3 and UL 514B.

2.02 NONMETALLIC DUCTS AND DUCT ACCESSORIES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

C. Basis-of-Design Product: Subject to compliance with requirements, provide a product by one of the following:

1. ARNCO Corp.
2. Beck Manufacturing.
3. Cantex, Inc.
4. CertainTeed Corp.; Pipe & Plastics Group.
5. Condux International, Inc.
6. ElecSys, Inc.
7. Electri-Flex Company.
8. IPEX Inc.

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9. Lamson & Sessions; Carlon Electrical Products.
10. Manhattan/CDT; a division of Cable Design Technologies.
11. Spiraduct/AFC Cable Systems, Inc.
12. Or Equal

D. Underground Plastic Utilities Duct: NEMA TC 6 & 8, Type DB-80-PVC, ASTM F 512, with matching fittings by the same manufacturer as the duct, complying with NEMA TC 9.

E. Duct Accessories:
1. Duct Separators: Factory-fabricated rigid PVC interlocking spacers, sized for type and sizes of ducts with which used, and selected to provide minimum duct spacings indicated while supporting ducts during concreting or backfilling.
2. Warning Tape: Underground-line warning tape specified in Division 26 Section "Identification for Electrical Systems."
3. Concrete Warning Planks: Nominal 12 by 24 by 3 inches (300 by 600 by 76 mm) in size, manufactured from 6000-psi (41-MPa) concrete.
   a. Color: Red dye added to concrete during batching.
   b. Mark each plank with "ELECTRIC" in 2-inch- (50-mm-) high, 3/8-inch- (10-mm-) deep letters.

2.03 PRECAST CONCRETE HANDHOLES AND BOXES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Carder Concrete Products.
2. Christy Concrete Products.
3. Elmhurst-Chicago Stone Co.
4. Oldcastle Precast Group.
5. Riverton Concrete Products; a division of Cretex Companies, Inc.
6. Utility Concrete Products, LLC.
7. Utility Vault Co.
8. Wausau Tile, Inc.
9. Or Equal

C. Comply with ASTM C 858 for design and manufacturing processes.

D. Description: Factory-fabricated, reinforced-concrete, monolithically poured walls and bottom unless open-bottom enclosures are indicated. Frame and cover shall form top of enclosure and shall have load rating consistent with that of handhole or box.
1. Frame and Cover: Weatherproof cast-iron frame, with cast-iron cover with recessed cover hook eyes and tamper-resistant, captive, cover-securing bolts.
2. Frame and Cover: Weatherproof steel frame, with steel cover with recessed cover hook eyes and tamper-resistant, captive, cover-securing bolts.

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3. Frame and Cover: Weatherproof steel frame, with hinged steel access door assembly with tamper-resistant, captive, cover-securing bolts.
   a. Cover Hinges: Concealed, with hold-open ratchet assembly.
   b. Cover Handle: Recessed.
4. Frame and Cover: Weatherproof aluminum frame with hinged aluminum access door assembly with tamper-resistant, captive, cover-securing bolts.
   a. Cover Hinges: Concealed, with hold-open ratchet assembly.
   b. Cover Handle: Recessed.
5. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
6. Cover Legend: Molded lettering, "ELECTRIC" "TELEPHONE", etc. as required.
7. Configuration: Units shall be designed for flush burial and have open bottom on gravel bed, unless otherwise indicated.
8. Extensions and Slabs: Designed to mate with bottom of enclosure. Same material as enclosure.
   a. Extension shall provide increased depth of 12 inches (300 mm).
   b. Slab: Same dimensions as bottom of enclosure, and arranged to provide closure.
9. Windows: Precast openings in walls, arranged to match dimensions and elevations of approaching ducts and duct banks plus an additional 12 inches (300 mm) vertically and horizontally to accommodate alignment variations.
   a. Windows shall be located no less than 6 inches (150 mm) from interior surfaces of walls, floors, or frames and covers of handholes, but close enough to corners to facilitate racking of cables on walls.
   b. Window opening shall have cast-in-place, welded wire fabric reinforcement for field cutting and bending to tie in to concrete envelopes of duct banks.
   c. Window openings shall be framed with at least two additional No. 4 steel reinforcing bars in concrete around each opening.
10. Duct Entrances in Handhole Walls: Cast end-bell or duct-terminating fitting in wall for each entering duct.
    a. Type and size shall match fittings to duct or conduit to be terminated.
    b. Fittings shall align with elevations of approaching ducts and be located near interior corners of handholes to facilitate racking of cable.
11. Handholes 12 inches wide by 24 inches long (300 mm wide by 600 mm long) and larger shall have inserts for cable racks and pulling-in irons installed before concrete is poured.

2.04 HANDHOLES AND BOXES OTHER THAN PRECAST CONCRETE

A. Description: Comply with SCTE 77.
   1. Color: Gray or Green.
   2. Configuration: Units shall be designed for flush burial and have open bottom with gravel bed, unless otherwise indicated.
   3. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure.

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4. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
5. Cover Legend: Molded lettering, "ELECTRIC" "TELEPHONE", or as required for each service.
6. Direct-Buried Wiring Entrance Provisions: Knockouts equipped with insulated bushings or end-bell fittings, selected to suit box material, sized for wiring indicated, and arranged for secure, fixed installation in enclosure wall.
7. Duct Entrance Provisions: Duct-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
8. Handholes 12 inches wide by 24 inches long (300 mm wide by 600 mm long) and larger shall have factory-installed inserts for cable racks and pulling-in irons.

B. Polymer Concrete Handholes and Boxes with Polymer Concrete Cover: Molded of sand and aggregate, bound together with a polymer resin, and reinforced with steel or fiberglass or a combination of the two.
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
3. Basis-of-Design Product: Subject to compliance with requirements, provide product by one of the following:
    a. Armorcast Products Company.
    b. Carson Industries LLC.
    c. CDR Systems Corporation.
    d. NewBasis.
    e. Or Equal

C. Fiberglass Handholes and Boxes with Polymer Concrete Frame and Cover: Sheet-molded, fiberglass-reinforced, polyester resin enclosure joined to polymer concrete top ring or frame.
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
3. Basis-of-Design Product: Subject to compliance with requirements, provide product by one of the following:
    a. Armorcast Products Company.
    b. Carson Industries LLC.
    c. Christy Concrete Products.
    d. Synertech Moulded Products, Inc.; a division of Oldcastle Precast.
    e. Or Equal

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D. Fiberglass Handholes and Boxes: Molded of fiberglass-reinforced polyester resin, with covers of polymer concrete or reinforced concrete.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
3. Basis-of-Design Product: Subject to compliance with requirements, provide product by one of the following:
   a. Carson Industries LLC.
   b. Christy Concrete Products.
   c. Nordic Fiberglass, Inc.
   d. Or Equal

E. High-Density Plastic Boxes: Injection molded of high-density polyethylene or copolymer-polypropylene. Cover shall be polymer concrete.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
3. Basis-of-Design Product: Subject to compliance with requirements, provide a comparable product by one of the following:
   a. Carson Industries LLC.
   b. Nordic Fiberglass, Inc.
   c. PenCell Plastics.
   d. Or Equal

2.05 PRECAST MANHOLES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Carder Concrete Products.
2. Christy Concrete Products.
3. Elmhurst-Chicago Stone Co.
4. Oldcastle Precast Group.
5. Riverton Concrete Products; a division of Cretex Companies, Inc.
6. Utility Concrete Products, LLC.
7. Utility Vault Co.
8. Wausau Tile, Inc.
9. Or Equal

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C. Comply with ASTM C 858, and with interlocking mating sections, complete with accessories, hardware, and features.

1. Windows: Precast openings in walls, arranged to match dimensions and elevations of approaching ducts and duct banks plus an additional 12 inches (300 mm) vertically and horizontally to accommodate alignment variations.
   a. Windows shall be located no less than 6 inches (150 mm) from interior surfaces of walls, floors, or roofs of manholes, but close enough to corners to facilitate racking of cables on walls.
   b. Window opening shall have cast-in-place, welded wire fabric reinforcement for field cutting and bending to tie in to concrete envelopes of duct banks.
   c. Window openings shall be framed with at least two additional No. 4 steel reinforcing bars in concrete around each opening.
2. Duct Entrances in Manhole Walls: Cast end-bell or duct-terminating fitting in wall for each entering duct.
   a. Type and size shall match fittings to duct or conduit to be terminated.
   b. Fittings shall align with elevations of approaching ducts and be located near interior corners of manholes to facilitate racking of cable.

D. Concrete Knockout Panels: 1-1/2 to 2 inches (38 to 50 mm) thick, for future conduit entrance and sleeve for ground rod.

E. Joint Sealant: Asphaltic-butyl material with adhesion, cohesion, flexibility, and durability properties necessary to withstand maximum hydrostatic pressures at the installation location with the ground-water level at grade.

2.06 CAST-IN-PLACE MANHOLES

A. Description: Underground utility structures, constructed in place, complete with accessories, hardware, and features. Include concrete knockout panels for conduit entrance and sleeve for ground rod.

B. Materials: Comply with ASTM C 858 and with Division 03 Section "Cast-in-Place Concrete."

C. Structural Design Loading: As specified in Part 3 "Underground Enclosure Application" Article.

2.07 UTILITY STRUCTURE ACCESSORIES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Bilco Company (The).
2. Campbell Foundry Company.
3. Carder Concrete Products.
4. Christy Concrete Products.

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5. East Jordan Iron Works, Inc.
6. Elmhurst-Chicago Stone Co.
7. McKinley Iron Works, Inc.
8. Neenah Foundry Company.
9. NewBasis.
10. Oldcastle Precast Group.
11. Osburn Associates, Inc.
12. Pennsylvania Insert Corporation.
13. Riverton Concrete Products; a division of Cretex Companies, Inc.
14. Strongwell Corporation; Lenoir City Division.
15. Underground Devices, Inc.
16. Utility Concrete Products, LLC.
17. Utility Vault Co.
18. Wausau Tile, Inc.
19. Or Equal

C. Manhole Frames, Covers, and Chimney Components: Comply with structural design loading specified for manhole.

1. Frame and Cover: Weatherproof, gray cast iron complying with ASTM A 48/A 48M, Class 30B with milled cover-to-frame bearing surfaces; diameter, 29 inches (737 mm).
   a. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
   b. Special Covers: Recess in face of cover designed to accept finish material in paved areas.
2. Cover Legend: Cast in. Selected to suit system.
   a. Legend: "ELECTRIC-LV" for duct systems with power wires and cables for systems operating at 600 V and less.
   b. Legend: "ELECTRIC-HV" for duct systems with medium-voltage cables.
   c. Legend: "SIGNAL" for communications, data, and telephone duct systems.
3. Manhole Chimney Components: Precast concrete rings with dimensions matched to those of roof opening.
   a. Mortar for Chimney Ring and Frame and Cover Joints: Comply with ASTM C 270, Type M, except for quantities less than 2.0 cu. ft. (60 L) where packaged mix complying with ASTM C 387, Type M, may be used.

D. Manhole Sump Frame and Grate: ASTM A 48/A 48M, Class 30B, gray cast iron.

E. Pulling Eyes in Concrete Walls: Eyebolt with reinforcing-bar fastening insert, 2-inch-(50-mm-) diameter eye, and 1-by-4-inch (25-by-100-mm) bolt.

1. Working Load Embedded in 6-Inch (150-mm), 4000-psi (27.6-MPa) Concrete: 13,000-lbf (58-kN) minimum tension.

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F. Pulling Eyes in Nonconcrete Walls: Eyebolt with reinforced fastening, 1-1/4-inch- (32-mm-) diameter eye, rated 2500-lbf (11-kN) minimum tension.

G. Pulling-In and Lifting Irons in Concrete Floors: 7/8-inch- (22-mm-) diameter, hot-dip galvanized, bent steel rod; stress relieved after forming; and fastened to reinforcing rod. Exposed triangular opening.

1. Ultimate Yield Strength: 40,000-lbf (180-kN) shear and 60,000-lbf (270-kN) tension.

H. Bolting Inserts for Concrete Utility Structure Cable Racks and Other Attachments: Flared, threaded inserts of noncorrosive, chemical-resistant, nonconductive thermoplastic material; 1/2-inch (13-mm) ID by 2-3/4 inches (69 mm) deep, flared to 1-1/4 inches (32 mm) minimum at base.

1. Tested Ultimate Pullout Strength: 12,000 lbf (53 kN) minimum.

I. Expansion Anchors for Installation after Concrete Is Cast: Zinc-plated, carbon-steel-wedge type with stainless-steel expander clip with 1/2-inch (13-mm) bolt, 5300-lbf (24-kN) rated pullout strength, and minimum 6800-lbf (30-kN) rated shear strength.

J. Cable Rack Assembly: Steel, hot-rolled or hot-dip galvanized, except insulators.

1. Stanchions: T-section or channel; 2-1/4-inch (57-mm) nominal size; punched with 14 holes on 1-1/2-inch (38-mm) centers for cable-arm attachment.
2. Arms: 1-1/2 inches (38 mm) wide, lengths ranging from 3 inches (75 mm) with 450-lb (204-kg) minimum capacity to 18 inches (460 mm) with 250-lb (114-kg) minimum capacity. Arms shall have slots along full length for cable ties and be arranged for secure mounting in horizontal position at any vertical location on stanchions.
3. Insulators: High-glaze, wet-process porcelain arranged for mounting on cable arms.

K. Cable Rack Assembly: Nonmetallic. Components fabricated from nonconductive, fiberglass-reinforced polymer.

1. Stanchions: Nominal 36 inches (900 mm) high by 4 inches (100 mm) wide, with minimum of 9 holes for arm attachment.
2. Arms: Arranged for secure, drop-in attachment in horizontal position at any location on cable stanchions, and capable of being locked in position. Arms shall be available in lengths ranging from 3 inches (75 mm) with 450-lb (204-kg) minimum capacity to 20 inches (508 mm) with 250-lb (114-kg) minimum capacity. Top of arm shall be nominally 4 inches (100 mm) wide, and arm shall have slots along full length for cable ties.

L. Duct-Sealing Compound: Nonhardening, safe for contact with human skin, not deleterious to cable insulation, and workable at temperatures as low as 35 deg F (2 deg C). Capable of withstanding temperature of 300 deg F (150 deg C) without slump and adhering to clean surfaces of plastic ducts, metallic conduits, conduit coatings, concrete, masonry, lead, cable sheaths, cable jackets, insulation materials, and common metals.

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M. Fixed Manhole Ladders: Arranged for attachment to roof or wall and floor of manhole. Ladder and mounting brackets and braces shall be fabricated from hot-dip galvanized steel.

N. Portable Manhole Ladders: UL-listed, heavy-duty fiberglass specifically designed for portable use for access to electrical manholes. Minimum length equal to distance from deepest manhole floor to grade plus 36 inches. One required.

O. Cover Hooks: Heavy duty, designed for lifts 60 lbf and greater.

2.08 SOURCE QUALITY CONTROL

A. Test and inspect precast concrete utility structures according to ASTM C 1037.

B. Nonconcrete Handhole and Pull-Box Prototype Test: Test prototypes of manholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.

1. Tests of materials shall be performed by an independent testing agency.
2. Strength tests of complete boxes and covers shall be by either an independent testing agency or the manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.
3. Testing machine pressure gages shall have current calibration certification complying with ISO 9000 and ISO 10012, and traceable to NIST standards.

PART 3 EXECUTION

3.01 UNDERGROUND DUCT APPLICATION

A. Ducts for Electrical Cables Over 600 V: RNC, NEMA Type EPC-80-PVC, in concrete-encased duct bank, unless otherwise indicated.

B. Ducts for Electrical Feeders 600 V and Less: RNC, NEMA Type EPC-80-PVC, in concrete-encased duct bank, unless otherwise indicated.

C. Ducts for Electrical Feeders 600 V and Less: RNC, NEMA Type EPC-80-PVC, in direct-buried duct bank, unless otherwise indicated.

D. Ducts for Electrical Branch Circuits: RNC, NEMA Type EPC-80-PVC, in direct-buried duct bank, unless otherwise indicated.

E. Underground Ducts for Telephone, Communications, or Data Utility Service Cables: RNC, NEMA Type EPC-40-PVC, in concrete-encased duct bank, unless otherwise indicated.

F. Underground Ducts Crossing Paved Paths, Walks and Driveways, Roadways and Railroads: RNC, NEMA Type EPC-40-PVC, encased in reinforced concrete.

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3.02 UNDERGROUND ENCLOSURE APPLICATION

A. Handholes and Boxes for 600 V and Less:
   1. Units in Roadways and Other Deliberate Traffic Paths: Precast concrete. AASHTO HB 17, H-20 structural load rating.
   2. Units in Driveway, Parking Lot, Sidewalks, and Off-Roadway Locations, Subject to Occasional, Nondeliberate Loading by Vehicles: Precast concrete, AASHTO HB 17, H-20 structural load rating.
   3. Units Subject to Light-Duty Pedestrian Traffic Only: Fiberglass-reinforced polyester resin, structurally tested according to SCTE 77 with 3000-lbf (13 345-N) vertical loading.

B. Manholes: Precast or cast-in-place concrete.
   1. Units Located in Roadways and Other Deliberate Traffic Paths by Heavy or Medium Vehicles: H-20 structural load rating according to AASHTO HB 17.
   2. Units Not Located in Deliberate Traffic Paths by Heavy or Medium Vehicles: H-10 load rating according to AASHTO HB 17.

3.03 EARTHWORK

A. Excavation and Backfill: Comply with Division 31 Section "Earth Moving," but do not use heavy-duty, hydraulic-operated, compaction equipment.

B. Restore surface features at areas disturbed by excavation and reestablish original grades, unless otherwise indicated. Replace removed sod immediately after backfilling is completed.

C. Restore areas disturbed by trenching, storing of dirt, cable laying, and other work. Restore vegetation and include necessary topsoiling, fertilizing, liming, seeding, sodding, sprigging, and mulching. Comply with Division 32 Sections "Turf and Grasses" and "Plants."

D. Cut and patch existing pavement in the path of underground ducts and utility structures according to Division 01 Section "Cutting and Patching."

3.04 DUCT INSTALLATION

A. Slope: Pitch ducts a minimum slope of 1:300 down toward manholes and handholes and away from buildings and equipment. Slope ducts from a high point in runs between two manholes to drain in both directions.

B. Curves and Bends: Use 5-degree angle couplings for small changes in direction. Use manufactured long sweep bends with a minimum radius of 48 inches, both horizontally and vertically, at other locations, unless otherwise indicated.

C. Joints: Use solvent-cemented joints in ducts and fittings and make watertight according to manufacturer's written instructions. Stagger couplings so those of adjacent ducts do not lie in same plane.

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D. Duct Entrances to Manholes and Concrete and Polymer Concrete Handholes: Use end bells, spaced approximately 10 inches (250 mm) o.c. for 5-inch (125-mm) ducts, and vary proportionately for other duct sizes.

1. Begin change from regular spacing to end-bell spacing 10 feet (3 m) from the end bell without reducing duct line slope and without forming a trap in the line.
2. Direct-Buried Duct Banks: Install an expansion and deflection fitting in each conduit in the area of disturbed earth adjacent to manhole or handhole.
3. Grout end bells into structure walls from both sides to provide watertight entrances.

E. Building Wall Penetrations: Make a transition from underground duct to rigid steel conduit at least 10 feet (3 m) outside the building wall without reducing duct line slope away from the building, and without forming a trap in the line. Use fittings manufactured for duct-to-conduit transition. Install conduit penetrations of building walls as specified in Division 26 Section "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

F. Sealing: Provide temporary closure at terminations of ducts that have cables pulled. Seal spare ducts at terminations. Use sealing compound and plugs to withstand at least 15-psig (1.03-MPa) hydrostatic pressure.

G. Pulling Cord: Install 100-lbf- (445-N-) test nylon cord in ducts, including spares.

H. Concrete-Encased Ducts: Support ducts on duct separators.

1. Separator Installation: Space separators close enough to prevent sagging and deforming of ducts, with not less than 5 spacers per 20 feet (6 m) of duct. Secure separators to earth and to ducts to prevent floating during concreting. Stagger separators approximately 6 inches (150 mm) between tiers. Tie entire assembly together using fabric straps; do not use tie wires or reinforcing steel that may form conductive or magnetic loops around ducts or duct groups.
2. Concreting Sequence: Pour each run of envelope between manholes or other terminations in one continuous operation.
   a. Start at one end and finish at the other, allowing for expansion and contraction of ducts as their temperature changes during and after the pour. Use expansion fittings installed according to manufacturer's written recommendations, or use other specific measures to prevent expansion-contraction damage.
   b. If more than one pour is necessary, terminate each pour in a vertical plane and install 3/4-inch (19-mm) reinforcing rod dowels extending 18 inches (450 mm) into concrete on both sides of joint near corners of envelope.
3. Pouring Concrete: Spade concrete carefully during pours to prevent voids under and between conduits and at exterior surface of envelope. Do not allow a heavy mass of concrete to fall directly onto ducts. Use a plank to direct concrete down sides of bank assembly to trench bottom. Allow concrete to flow to center of bank and rise up in middle, uniformly filling all open spaces. Do not use power-driven agitating equipment unless specifically designed for duct-bank application.

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4. Reinforcement: Reinforce concrete-encased duct banks where they cross disturbed earth and where indicated. Arrange reinforcing rods and ties without forming conductive or magnetic loops around ducts or duct groups.
5. Forms: Use walls of trench to form side walls of duct bank where soil is self-supporting and concrete envelope can be poured without soil inclusions; otherwise, use forms.
6. Minimum Space between Ducts: 3 inches (75 mm) between ducts and exterior envelope wall, 2 inches (50 mm) between ducts for like services, and 4 inches (100 mm) between power and signal ducts.
7. Depth: Install top of duct bank at least 24 inches (600 mm) below finished grade in areas not subject to deliberate traffic, and at least 30 inches (750 mm) below finished grade in deliberate traffic paths for vehicles, unless otherwise indicated.
8. Stub-Ups: Use manufactured duct elbows for stub-ups at poles and equipment and at building entrances through the floor, unless otherwise indicated. Extend concrete encasement throughout the length of the elbow.
9. Stub-Ups: Use manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through the floor.
    a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches (75 mm) of concrete.
    b. Stub-Ups to Equipment: For equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60 inches (1500 mm) from edge of base. Install insulated grounding bushings on terminations at equipment.
10. Warning Tape: Bury warning tape approximately 12 inches (300 mm) above all concrete-encased ducts and duct banks. Align tape parallel to and within 3 inches (75 mm) of the centerline of duct bank. Provide an additional warning tape for each 12-inch (300-mm) increment of duct-bank width over a nominal 18 inches (450 mm). Space additional tapes 12 inches (300 mm) apart, horizontally.

I. Direct-Buried Duct Banks:
1. Support ducts on duct separators coordinated with duct size, duct spacing, and outdoor temperature.
2. Space separators close enough to prevent sagging and deforming of ducts, with not less than 5 spacers per 20 feet (6 m) of duct. Secure separators to earth and to ducts to prevent displacement during backfill and yet permit linear duct movement due to expansion and contraction as temperature changes. Stagger spacers approximately 6 inches (150 mm) between tiers.
3. Excavate trench bottom to provide firm and uniform support for duct bank. Prepare trench bottoms as specified in Division 31 Section "Earth Moving" for pipes less than 6 inches (150 mm) in nominal diameter.
4. Install backfill as specified in Division 31 Section "Earth Moving."
5. After installing first tier of ducts, backfill and compact. Start at tie-in point and work toward end of duct run, leaving ducts at end of run free to move with expansion and contraction as temperature changes during this process. Repeat procedure after placing each tier. After placing last tier, hand-place backfill to 4 inches (100 mm) over ducts and hand tamp. Firmly tamp backfill around ducts to provide maximum supporting strength. Use hand tamper only.

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After placing controlled backfill over final tier, make final duct connections at end of run and complete backfilling with normal compaction as specified in Division 31 Section "Earth Moving."

6. Install ducts with a minimum of 3 inches (75 mm) between ducts for like services and 6 inches (150 mm) between power and signal ducts.
7. Depth: Install top of duct bank at least 36 inches (900 mm) below finished grade, unless otherwise indicated.
8. Set elevation of bottom of duct bank below the frost line.
9. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through the floor, unless otherwise indicated. Encase elbows for stub-up ducts throughout the length of the elbow.
10. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through the floor.
    a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches (75 mm) of concrete.
    b. For equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60 inches (1500 mm) from edge of equipment pad or foundation. Install insulated grounding bushings on terminations at equipment.
11. Warning Planks: Bury warning planks approximately 12 inches (300 mm) above direct-buried ducts and duct banks, placing them 24 inches (600 mm) o.c. Align planks along the width and along the centerline of duct bank. Provide an additional plank for each 12-inch (300-mm) increment of duct-bank width over a nominal 18 inches (450 mm). Space additional planks 12 inches (300 mm) apart, horizontally.

3.05 INSTALLATION OF CONCRETE MANHOLES, HANDHOLES, AND BOXES

A. Cast-in-Place Manhole Installation:
1. Finish interior surfaces with a smooth-troweled finish.
2. Windows for Future Duct Connections: Form and pour concrete knockout panels 1-1/2 to 2 inches (38 to 50 mm) thick, arranged as indicated.
3. Cast-in-place concrete, formwork, and reinforcement are specified in Division 03 Section "Cast-in-Place Concrete."

B. Precast Concrete Handhole and Manhole Installation:
1. Comply with ASTM C 891, unless otherwise indicated.
2. Install units level and plumb and with orientation and depth coordinated with connecting ducts to minimize bends and deflections required for proper entrances.
3. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1-inch (25-mm) sieve to No. 4 (4.75-mm) sieve and compacted to same density as adjacent undisturbed earth.

C. Elevations:
1. Manhole Roof: Install with rooftop at least 15 inches (380 mm) below finished grade.
2. Manhole Frame: In paved areas and trafficways, set frames flush with finished grade. Set other manhole frames 1 inch (25 mm) above finished grade.

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3. Install handholes with bottom below the frost line below grade.
4. Handhole Covers: In paved areas and trafficways, set surface flush with finished grade. Set covers of other handholes 1 inch (25 mm) above finished grade.
5. Where indicated, cast handhole cover frame integrally with handhole structure.

D. Drainage: Install drains in bottom of manholes where indicated. Coordinate with drainage provisions indicated.

E. Manhole Access: Circular opening in manhole roof; sized to match cover size.
1. Manholes with Fixed Ladders: Offset access opening from manhole centerlines to align with ladder.
2. Install chimney, constructed of precast concrete collars and rings to support frame and cover and to connect cover with manhole roof opening. Provide moisture-tight masonry joints and waterproof grouting for cast-iron frame to chimney.

F. Waterproofing: Apply waterproofing to exterior surfaces of manholes and handholes after concrete has cured at least three days. Waterproofing materials and installation are specified in the Detailed Specifications. After ducts have been connected and grouted, and before backfilling, waterproof joints and connections and touch up abrasions and scars. Waterproof exterior of manhole chimneys after mortar has cured at least three days.

G. Dampproofing: Apply dampproofing to exterior surfaces of manholes and handholes after concrete has cured at least three days. Dampproofing materials and installation are specified in Division 07 Section "Bituminous Dampproofing." After ducts have been connected and grouted, and before backfilling, dampproof joints and connections and touch up abrasions and scars. Dampproof exterior of manhole chimneys after mortar has cured at least three days.

H. Hardware: Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated.

I. Fixed Manhole Ladders: Arrange to provide for safe entry with maximum clearance from cables and other items in manholes.

J. Field-Installed Bolting Anchors in Manholes and Concrete Handholes: Do not drill deeper than 3-7/8 inches (98 mm) for manholes and 2 inches (50 mm) for handholes, for anchor bolts installed in the field. Use a minimum of two anchors for each cable stanchion.

K. Warning Sign: Install "Confined Space Hazard" warning sign on the inside surface of each manhole cover.

3.06 INSTALLATION OF HANDHOLES AND BOXES OTHER THAN PRECAST CONCRETE

A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting ducts to minimize bends and deflections required for

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proper entrances. Use box extension if required to match depths of ducts, and seal joint between box and extension as recommended by the manufacturer.

B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch (12.7-mm) sieve to No. 4 (4.75-mm) sieve and compacted to same density as adjacent undisturbed earth.

C. Elevation: In paved areas and trafficways, set so cover surface will be flush with finished grade. Set covers of other handholes 1 inch (25 mm) above finished grade.

D. Install handholes and boxes with bottom below the frost line, <Insert depth of frost line below grade at Project site> below grade.

E. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables, but short enough to preserve adequate working clearances in the enclosure.

F. Field-cut openings for ducts and conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

G. For enclosures installed in asphalt paving and subject to occasional, nondeliberate, heavy-vehicle loading, form and pour a concrete ring encircling, and in contact with, enclosure and with top surface screeded to top of box cover frame. Bottom of ring shall rest on compacted earth.

1. Concrete: 3000 psi (20 kPa), 28-day strength, complying with Division 03 Section "Cast-in-Place Concrete," with a troweled finish.
2. Dimensions: 10 inches wide by 12 inches deep (250 mm wide by 300 mm deep).

3.07 GROUNDING

A. Ground underground ducts and utility structures according to Division 26 Section "Grounding and Bonding for Electrical Systems."

3.08 FIELD QUALITY CONTROL

A. Perform the following tests and inspections and prepare test reports:

1. Demonstrate capability and compliance with requirements on completion of installation of underground ducts and utility structures.
2. Pull aluminum or wood test mandrel through duct to prove joint integrity and test for out-of-round duct. Provide mandrel equal to 80 percent fill of duct. If obstructions are indicated, remove obstructions and retest.
3. Test manhole and handhole grounding to ensure electrical continuity of grounding and bonding connections. Measure and report ground resistance as specified in Division 26 Section "Grounding and Bonding for Electrical Systems."

B. Correct deficiencies and retest as specified above to demonstrate compliance.

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3.09 CLEANING

A. Pull leather-washer-type duct cleaner, with graduated washer sizes, through full length of ducts. Follow with rubber duct swab for final cleaning and to assist in spreading lubricant throughout ducts.

B. Clean internal surfaces of manholes, including sump. Remove foreign material.

END OF SECTION

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SECTION 260544 - SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:
   1. Sleeves for raceway and cable penetration of non-fire-rated construction walls and floors.
   2. Sleeve-seal systems.
   3. Sleeve-seal fittings.
   4. Grout.
   5. Silicone sealants.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. LEED Submittals:
   1. Product Data for Credit EQ 4.1: For sealants, documentation including printed statement of VOC content.
   2. Laboratory Test Reports for Credit EQ 4: For sealants, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

PART 2 PRODUCTS

2.01 SLEEVES

A. Wall Sleeves:
   1. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, plain ends.
   2. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

B. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies: Galvanized-steel sheet; 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint, with tabs for screw-fastening the sleeve to the board.

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C. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.

D. Molded-PVC Sleeves: With nailing flange for attaching to wooden forms.

E. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.

F. Sleeves for Rectangular Openings:
   1. Material: Galvanized sheet steel.
   2. Minimum Metal Thickness:
      a. For sleeve cross-section rectangle perimeter less than 50 inches and with no side larger than 16 inches, thickness shall be 0.052 inch.
      b. For sleeve cross-section rectangle perimeter 50 inches or more and one or more sides larger than 16 inches, thickness shall be 0.138 inch.

2.02 SLEEVE-SEAL SYSTEMS

A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Advance Products & Systems, Inc.
      b. CALPICO, Inc.
      c. Metraflex Company (The).
      d. Pipeline Seal and Insulator, Inc.
      e. Proco Products, Inc.
      f. Or Equal
   2. Sealing Elements: EPDM rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
   3. Pressure Plates: Stainless steel.
   4. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

2.03 SLEEVE-SEAL FITTINGS

A. Description: Manufactured plastic, sleeve-type, waterstop assembly made for embedding in concrete slab or wall. Unit shall have plastic or rubber waterstop collar with center opening to match piping OD.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Presealed Systems.
      b. Or equal.

2.04 GROUT

A. Description: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.

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B. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

C. Design Mix: 5000-psi, 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

2.05 SILICONE SEALANTS

A. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below.

1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces that are not fire rated.
2. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

B. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, non-shrinking foam.

PART 3 EXECUTION

3.01 SLEEVE INSTALLATION FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

A. Comply with NECA 1.

B. Comply with NEMA VE 2 for cable tray and cable penetrations.

C. Sleeves for Conduits Penetrating Above-Grade Non-Fire-Rated Concrete and Masonry-Unit Floors and Walls:

1. Interior Penetrations of Non-Fire-Rated Walls and Floors:
   a. Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants."
   b. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect material while curing.
2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
3. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway or cable unless sleeve seal is to be installed.
4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.
5. Install sleeves for floor penetrations. Extend sleeves installed in floors 2-inches above finished floor level. Install sleeves during erection of floors.

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D. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies:

1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
2. Seal space outside of sleeves with approved joint compound for gypsum board assemblies.

E. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.

F. Aboveground, Exterior-Wall Penetrations: Seal penetrations using stainless steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

G. Underground, Exterior-Wall and Floor Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch annular clear space between raceway or cable and sleeve for installing sleeve-seal system.

3.02 SLEEVE-SEAL-SYSTEM INSTALLATION

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at raceway entries into building.

B. Install type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.03 SLEEVE-SEAL-FITTING INSTALLATION

A. Install sleeve-seal fittings in new walls and slabs as they are constructed.

B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.

C. Secure nailing flanges to concrete forms.

D. Using grout, seal the space around outside of sleeve-seal fittings.

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SECTION 260553 – IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes the following:
   1. Identification for raceway non-metallic-clad cable.
   2. Identification for conductors and communication and control cable.
   3. Underground-line warning tape.
   4. Warning labels and signs.
   5. Instruction signs.
   6. Equipment identification labels.
   7. Miscellaneous identification products.

1.03 SUBMITTALS

A. Product Data: For each electrical identification product indicated.

1.04 QUALITY ASSURANCE

A. Comply with ANSI A13.1 and ANSI C2.

B. Comply with NFPA 70.

C. Comply with 29 CFR 1910.145.

1.05 COORDINATION

A. Coordinate identification names, abbreviations, colors, and other features with requirements in the Contract Documents, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual, and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.

B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

C. Coordinate installation of identifying devices with location of access panels and doors.

D. Install identifying devices before installing acoustical ceilings and similar concealment.

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PART 2 PRODUCTS

2.01 RACEWAY AND METAL-CLAD CABLE IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.

B. Color for Printed Legend:
   1. Power Circuits: Black letters on an orange field.
   2. Legend: Indicate system or service and voltage, if applicable.

C. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

2.02 CONDUCTOR AND COMMUNICATION- AND CONTROL-CABLE IDENTIFICATION MATERIALS

A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.

B. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

C. Aluminum Wraparound Marker Labels: Cut from 0.014-inch-thick aluminum sheet, with stamped, embossed, or scribed legend, and fitted with tabs and matching slots for permanently securing around wire or cable jacket or around groups of conductors.

D. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch, with stamped legend, punched for use with self-locking nylon tie fastener.
   1. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.

2.03 RUBBER MATS

A. Provide insulated rubber mat in front the following electrical equipment:
   1. MCC
   2. Transformer
   3. Panelboard
   4. Control Panel
   5. Motor Starter
   6. Disconnect Switch
   7. Automatic Transfer Switch
   8. Generator Breaker

2.04 UNDERGROUND-LINE WARNING TAPE

A. Description: Permanent, bright-colored, continuous-printed, polyethylene tape.
   1. Not less than 6 inches wide by 4 mils thick.

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2. Compounded for permanent direct-burial service.
3. Embedded continuous metallic strip or core.
4. Printed legend shall indicate type of underground line.

B. Identify Paths of Underground Electrical Lines: During trench backfilling, for exterior underground power, control, signal, and communications lines, install continuous underground plastic line marker located directly above line at 6 to 8 in. (150 to 200 mm) below finished grade. Where multiple lines installed in common trench or concrete envelope provide multiple underground line warning tapes, one for each 16 inches of width of lines. If lines do not exceed an overall width of 16 in. (400 mm), use single line marker.
1. Install line marker for underground wiring, both direct buried and in raceway.

2.05 WARNING LABELS AND SIGNS

A. Comply with NFPA 70 and 29 CFR 1910.145.

B. Self-Adhesive Warning Labels: Factory printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment, unless otherwise indicated.

C. Baked-Enamel Warning Signs: Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application. 1/4-inch grommets in corners for mounting. Nominal size, 7 by 10 inches.

D. Metal-Backed, Butyrate Warning Signs: Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with 0.0396-inch galvanized-steel backing; and with colors, legend, and size required for application. 1/4-inch grommets in corners for mounting. Nominal size, 10 by 14 inches.

E. Warning label and sign shall include, but are not limited to, the following legends:
1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 42 INCHES."

2.06 INSTRUCTION SIGNS

A. Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch thick for signs up to 20 sq. in. and 1/8 inch thick for larger sizes.
1. Engraved legend with black letters on white face.
2. Punched or drilled for mechanical fasteners.
3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

2.07 EQUIPMENT IDENTIFICATION LABELS

A. Adhesive Film Label: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch.

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2.08 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Cable Ties: Fungus-inert, self-extinguishing, 1-piece, self-locking, Type 6/6 nylon cable ties.
   1. Minimum Width: 3/16 inch.
   2. Tensile Strength: 50 lb, minimum.
   3. Temperature Range: Minus 40 to plus 185 deg F.
   4. Color: Black, except where used for color-coding.

B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 EXECUTION

3.01 APPLICATION

A. Power-Circuit Conductor Identification: For conductors No. 1/0 AWG and larger in pull and junction boxes, use color-coding conductor tape AND metal tags. Identify source and circuit number of each set of conductors. For single conductor cables, identify phase in addition to the above.

B. Branch-Circuit Conductor Identification: Where there are conductors for more than three branch circuits in same junction or pull box, use marker tape. Identify each ungrounded conductor according to source and circuit number.

C. Conductors to Be Extended in the Future: Attach marker tape to conductors and list source and circuit number.

D. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, signal, instrumentation, voice, and data connections.
   1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
   2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
   3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and Operation and Maintenance Manual.

E. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable. Install underground-line warning tape for both direct-buried cables and cables in raceway.

F. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Comply with 29 CFR 1910.145 and apply self-adhesive warning labels. Identify system voltage with black letters on an orange background. Apply to exterior of door, cover, or other access.
   1. Equipment with Multiple Power or Control Sources: Apply to door or cover of equipment including, but not limited to, the following:
      a. Power transfer switches.
      b. Controls with external control power connections.

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2. Equipment Requiring Workspace Clearance According to NFPA 70: Unless otherwise indicated, apply to door or cover of equipment but not on flush panelboards and similar equipment in finished spaces.

G. Instruction Signs:

1. Operating Instructions: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.
2. Emergency Operating Instructions: Install instruction signs with white legend on a red background with minimum 3/8-inch- high letters for emergency instructions at equipment used for power transfer.

H. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.

1. Labeling Instructions:
   a. Indoor Equipment: Engraved, laminated acrylic or melamine label. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on 1-1/2-inch- high label; where 2 lines of text are required, use labels 2 inches high.
   b. Outdoor Equipment: Engraved, laminated acrylic or melamine label.
2. Equipment to Be Labeled:
   a. Panelboards, electrical cabinets, and enclosures.
   b. Access doors and panels for concealed electrical items.
   c. Electrical switchgear and switchboards.
   d. Electrical substations.
   e. Motor control centers.
   f. Motor starters.
   g. Push button stations.
   h. Power transfer equipment.
   i. Contactor
   j. Remote controlled switches.
   k. Dimmers.
   l. Control devices.
   m. Transformers.
   n. Inverters.
   o. Rectifiers.
   p. Frequency converters.
   q. Battery racks.
   r. Power generating units.
   s. Telephone switching equipment.
   t. Clock/program master equipment.

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u. Call system master station.
v. TV/audio monitoring master station.
w. Fire alarm master station or control panel.
x. Security monitoring master station or control panel.
y. Outlets.
z. Light Switches.

3. Apply designation labels of engraved plastic laminate for disconnect switches, breakers, push buttons, pilot lights, motor control centers, and similar items for power distribution and control components above, except panelboards and alarm/signal components where labeling is specified elsewhere. For panelboards, provide framed, typed circuit schedules with explicit description and identification of items controlled by each individual breaker.

3.02 INSTALLATION

A. Verify identity of each item before installing identification products.

B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.

C. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.

D. Attach non-adhesive signs and plastic labels with screws and auxiliary hardware appropriate to the location and substrate.

E. Color-Coding for Phase and Voltage Level Identification, 600 V and Less: Use the colors listed below for ungrounded service, feeder, and branch-circuit conductors.

1. Color shall be field-applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.
2. Colors for 208/120-V Circuits:
   a. Phase A: Black.
   b. Phase B: Red.
   c. Phase C: Blue.
   d. Neutral: White.
3. Colors for 480/277-V Circuits:
   a. Phase A: Brown.
   b. Phase B: Orange.
   c. Phase C: Yellow.
   d. Neutral: Gray

F. Aluminum Wraparound Marker Labels and Metal Tags: Secure tight to surface of conductor or cable at a location with high visibility and accessibility.

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G. Underground-Line Warning Tape: During backfilling of trenches install continuous magnetic underground-line warning tape directly above line at 12 inches above buried raceway. Use multiple tapes where width of multiple lines installed in a common trench exceeds 16 inches overall.

H. Painted Identification: Prepare surface and apply paint.

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SECTION 260583 - WIRING CONNECTIONS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes electrical connections to equipment.

B. Related Sections:
   1. Section 260519 - Low-Voltage Electrical Power Conductors and Cables.
   2. Section 260533 - Raceway and Boxes for Electrical Systems.

1.02 REFERENCES

A. National Electrical Manufacturers Association:
   1. NEMA WD 1 - General Requirements for Wiring Devices.
   2. NEMA WD 6 - Wiring Devices-Dimensional Requirements.

1.03 SUBMITTALS

A. Section 013300 - Submittal Procedures: Submittal procedures.

B. Product Data: Submit wiring device manufacturer's catalog information showing dimensions, configurations, and construction.

C. Manufacturer's installation instructions.

1.04 CLOSEOUT SUBMITTALS

A. Section 017000 - Execution and Closeout Requirements: Submittal procedures.

B. Project Record Documents: Record actual locations, sizes, and configurations of equipment connections.

1.05 COORDINATION

A. Section 013000 - Administrative Requirements: Coordination and project conditions.

B. Obtain and review shop drawings, product data, manufacturer's wiring diagrams, and manufacturer's instructions for equipment furnished under other sections.

C. Determine connection locations and requirements.

D. Sequence rough-in of electrical connections to coordinate with installation of equipment.

E. Sequence electrical connections to coordinate with start-up of equipment.

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PART 2 PRODUCTS

2.01 CORD AND PLUGS

A. Manufacturers:
   1. Leviton Manufacturing Co., Inc.
   2. Pass & Seymour/Legrand
   3. Square D: By Schneider Electric
   4. Hubbel Inc.

B. Attachment Plug Construction: Conform to NEMA WD 1.

C. Configuration: NEMA WD 6; match receptacle configuration at outlet furnished for equipment.

D. Cord Construction: Type SO multiconductor flexible cord with identified equipment grounding conductor, suitable for use in damp locations.

E. Size: Suitable for connected load of equipment, length of cord, and rating of branch circuit overcurrent protection.

PART 3 EXECUTION

3.01 EXAMINATION

A. Section 013000 - Administrative Requirements: Coordination and project conditions.

B. Verify equipment is ready for electrical connection, for wiring, and to be energized.

3.02 INSTALLATION

A. Make electrical connections.

B. Make conduit connections to equipment using flexible conduit. Use liquid-tight flexible conduit with watertight connectors in damp or wet locations.

C. Connect heat producing equipment using wire and cable with insulation suitable for temperatures encountered.

D. Install receptacle outlet to accommodate connection with attachment plug.

E. Install cord and cap for field-supplied attachment plug.

F. Install suitable strain-relief clamps and fittings for cord connections at outlet boxes and equipment connection boxes.

G. Install disconnect switches, controllers, control stations, and control devices to complete equipment wiring requirements.

H. Install terminal block jumpers to complete equipment wiring requirements.

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I. Install interconnecting conduit and wiring between devices and equipment to complete equipment wiring requirements.

J. Coolers and Freezers: Cut and seal conduit openings in freezer and cooler walls, floor, and ceilings.

3.03 ADJUSTING

A. Section 17700 - Closeout Procedures:

B. Cooperate with utilization equipment installers and field service personnel during checkout and starting of equipment to allow testing and balancing and other startup operations. Provide personnel to operate electrical system and checkout wiring connection components and configurations.

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SECTION 262726 – WIRING DEVICES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, apply to this Section.

1.02 SUMMARY

A. This Section includes the following:

1. Receptacles, receptacles with integral GFCI, and associated device plates.

2. Snap switches and wall-box dimmers.

3. Communications outlets.

4. Multi-outlet assemblies.

1.03 DEFINITIONS

A. EMI: Electromagnetic interference.

B. GFCI: Ground-fault circuit interrupter.

C. Pigtail: Short lead used to connect a device to a branch-circuit conductor.

D. RFI: Radio-frequency interference.

E. UTP: Unshielded twisted pair.

1.04 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.

C. Field quality-control test reports.

D. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing label warnings and instruction manuals that include labeling conditions.

1.05 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of wiring device and associated wall plate through one source from a single manufacturer. Insofar as they are available,

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obtain all wiring devices and associated wall plates from a single manufacturer and one source.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NFPA 70.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers' Names: Shortened versions (shown in parentheses) of the following manufacturers' names are used in other Part 2 articles:

1. Cooper Wiring Devices; a division of Cooper Industries, Inc. (Cooper).
2. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).
3. Leviton Mfg. Company Inc. (Leviton).
4. Pass & Seymour/Legrand; Wiring Devices & Accessories (Pass & Seymour).
5. Or Equal

2.02 STRAIGHT BLADE RECEPTACLES

A. Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Cooper; 5362.
b. Hubbell; HBL5362.
c. Leviton; 5362.
d. Pass & Seymour; PS5362.
e. Or Equal

2.03 GFCI RECEPTACLES

A. General Description: Straight blade, feed-through type. Comply with NEMA WD 1, NEMA WD 6, UL 498, and UL 943, Class A, and include indicator light that is lighted when device is tripped.

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B. Duplex GFCI Convenience Receptacles, 125 V, 20 A:

1. Products: Subject to compliance with requirements, provide one of the following:

a. Cooper; GF20.
b. Hubbell
c. Or Equal

C. NEC code 406.9(B) requires 15 and 20-ampere, 125 and 250-Volt receptacles installed outdoors in a wet location shall have an enclosure that is weatherproof whether the attachment plug cap is inserted. Cover shall be NEMA 3R Rated, UL listed and CSA Certified and meet all the requirements of NEC code 406.9(B).

2.04 SNAP SWITCHES

A. Comply with NEMA WD 1 and UL 20.

B. Switches, 120/277 V, 20 A:

1. Products: Subject to compliance with requirements, provide one of the following:

a. Cooper; 2221 (single pole), 2222 (two pole), 2223 (three way), 2224 (four way).
b. Hubbell; HBL1221 (single pole), HBL1222 (two pole), HBL1223 (three way), HBL1224 (four way).
c. Leviton; 1221-2 (single pole), 1222-2 (two pole), 1223-2 (three way), 1224-2 (four way).
d. Pass & Seymour; 20AC1 (single pole), 20AC2 (two pole), 20AC3 (three way), 20AC4 (four way).

2.05 WALL PLATES

A. Single and combination types to match corresponding wiring devices.

1. Plate-Securing Screws: Metal with head color to match plate finish.

2. Material for Finished Spaces: Smooth, high-impact thermoplastic.

3. Material for Unfinished Spaces: Smooth, high-impact thermoplastic.

4. Material for Damp Locations: Cast aluminum with spring-loaded lift cover and listed and labeled for use in "wet locations."

B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with type 3R weather-resistant, die-cast aluminum with lockable cover.

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2.06 MULTIOUTLET ASSEMBLIES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Hubbell Incorporated; Wiring Device-Kellems.

2. Wiremold Company (The).

3. Or Equal

C. Components of Assemblies: Products from a single manufacturer designed for use as a complete, matching assembly of raceways and receptacles.

D. Raceway Material: Metal, with manufacturer's standard finish.

E. Wire: No. 12 AWG.

2.07 FINISHES

A. Color: Wiring device catalog numbers in Section Text do not designate device color.

1. Wiring Devices Connected to Normal Power System: Gray, unless otherwise indicated or required by NFPA 70 or device listing.

PART 3 EXECUTION

3.01 INSTALLATION

A. Comply with NECA 1, including the mounting heights listed in that standard, unless otherwise noted.

B. Coordination with Other Trades:

1. Take steps to ensure that devices and their boxes are protected. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of the boxes.

2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.

3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.

4. Install wiring devices after all wall preparation, including painting, is complete.

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C. Conductors:

1. Do not strip insulation from conductors until just before they are spliced or terminated on devices.

2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.

3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.

4. Existing Conductors:

   a. Cut back and pigtail or replace all damaged conductors.
   b. Straighten conductors that remain and remove corrosion and foreign matter.
   c. Pigtailing existing conductors is permitted provided the outlet box is large enough.

D. Device Installation:

1. Replace all devices that have been in temporary use during construction or that show signs that they were installed before building finishing operations were complete.

2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.

3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.

4. Connect devices to branch circuits using pigtails that are not less than 6 inches in length.

5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, 2/3 to 3/4 of the way around terminal screw.

6. Use a torque screwdriver when a torque is recommended or required by the manufacturer.

7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.

8. Tighten unused terminal screws on the device.

9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device mounting screws in yokes, allowing metal-to-metal contact.

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E. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles up, and on horizontally mounted receptacles to the left.

F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

G. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

3.02 IDENTIFICATION

A. Comply with Division 26 Section "Identification for Electrical Systems."

1. Receptacles: Identify panelboard and circuit number from which served. Use hot, stamped or engraved machine printing with black-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

3.03 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

1. Test Instruments: Use instruments that comply with UL 1436.

2. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated LED indicators of measurement.

B. Tests for Convenience Receptacles:

1. Line Voltage: Acceptable range is 105 to 132 V.

2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is not acceptable.

3. Ground Impedance: Values of up to 2 ohms are acceptable.

4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.

5. Using the test plug, verify that the device and its outlet box are securely mounted.

6. The tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions remove malfunctioning units and replace with new ones, and retest as specified above.

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SECTION 262923 – ADJUSTABLE FREQUENCY DRIVES

PART 1 GENERAL

1.01 Coordinate Full Load Amperage requirements with General Contractor for equipment being provided.

1.02 SUMMARY

A. This section provides specification requirements for solid-state, pulse-width modulated (PWM) Adjustable Frequency Drives, herein referred to as AC Drives, for use with Inverter Duty NEMA® (MG-1 Part31) design AC motors.

B. The AC Drive supplier shall furnish, field test, adjust and certify all installed AC Drives for satisfactory operation.

C. Any exceptions/deviations to this specification shall be indicated in writing and submitted no less than one week prior to bid date.

1.03 REFERENCES

A. ANSI®/NFPA® 70 - National Electrical Code® (NEC®).
B. UL 508 - UL Standard for Safety Industrial Control Equipment.
C. UL 508C - UL Standard for Safety Power Conversion Equipment.
D. NEMA ICS 7.1

1.04 SUBMITTALS

A. A submittal package, including drawings shall be furnished for the Engineers' approval prior to factory assembly of the AC Variable Speed Drives. These packages shall consist of elementary power and control wiring diagrams on one drawing and enclosure outline drawings. The enclosure drawings shall include front and side views of the enclosures with overall dimensions and weights shown, and conduit entrance locations. Standard catalog specification sheets showing voltage, horsepower and maximum current ratings shall be furnished as part of the submittal package.

1.05 WARRANTY

A. An 18-month warranty shall be provided on materials and workmanship from the date of shipment.

B. With certified start up, a 24 month warranty shall be provided on materials and workmanship from the date of shipment. The startup must be performed by a Factory Authorized Service Center Representative.

1.06 QUALITY ASSURANCE

A. The manufacturer of the AC Variable Speed Drive shall be a certified ISO 9001 facility.

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B. The AC Variable Speed Drive and all associated optional equipment shall be UL Listed according to UL 508 - Power Conversion Equipment. As verification, a UL label shall be attached on the inside of the combination enclosure.

C. The AC Variable Speed Drive shall be designed, constructed and tested in accordance with UL, CSA, NEMA, and NEC standards.

D. Every power converter shall be tested with an AC induction motor while loaded and temperature cycled within an environment chamber at 40 ˚C (104 ˚F).

PART 2 PRODUCT

2.01 MANUFACTURERS

A. The AC Variable Speed Drive shall be manufactured by:

1. Yaskawa P-1000 with NEMA 4X heat sink kit.
2. Owner approved equal with NEMA 4X heat sink kit. (Heat Calculations and compensation required to be submitted prior to approval)

2.02 GENERAL DESCRIPTION

A. The AC Variable Speed Drive shall convert the input AC mains power to an adjustable frequency and voltage.

B. The input power section shall utilize a full wave bridge design incorporating diode rectifiers. The diode rectifiers shall convert fixed voltage and frequency, AC line power to fixed DC voltage.

C. The output power section shall change fixed DC voltage to adjustable frequency AC voltage.

D. The adjustable frequency drive package shall consist of a circuit breaker disconnect, line reactor, EMI/RFI filter, 120V control transformer, control circuit terminal board for digital and analog field wiring. AC line fuses do not meet specification.

E. The drive door shall have mounted and wired, Hand-Off-Auto switch, and Manual Speed Potentiometer. The keypad alone, without wired operators, does not meet the specification.

F. Provide constant torque Variable Frequency Drives for applications requiring constant torque drives by the equipment manufacturer such as PD blowers.

2.03 CONSTRUCTION

A. All enclosure and heat sink fans shall be accessible from the front and shall not require the removal of the AC drive power converter for fan replacement.

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2.04 APPLICATION DATA

A. The AC Variable Speed Drive shall be sized to operate a variable torque load.

B. The speed range shall be from a minimum speed of 1.0 Hz to a maximum speed of 60 Hz.

2.05 ENVIRONMENTAL RATINGS

A. The AC Variable Speed Drive shall meet IEC 60664-1 Annex A and NEMA ICS 1, UL, and CSA standards.

B. The AC Variable Speed Drive shall be designed to operate in an ambient temperature from -10 to 40 ˚C (14 to 104 ˚F).

C. The storage temperature range shall be -25 to 65 ˚C (-13 to 149 ˚F).

D. The maximum relative humidity shall be 95%, non-condensing.

E. The AC Variable Speed Drive shall be rated to operate at altitudes less than or equal to 3300 ft (1000 m). For altitudes above 3300 ft (1000 m), the AC Drive should be de-rated per drive specifications.

F. The AC Variable Speed Drive shall meet the IEC 60721-3-3-3M3 operational vibration specification.

G. The AC Variable Speed Drive shall be Seismic Qualified to 2000 IBC Level 3 “Extreme” rating with an Importance Factor 1p=1.5

2.06 RATINGS

A. The AC Variable Speed Drive shall be designed to operate at the input line voltage indicated on the equipment schedule.

B. The AC Variable Speed Drive shall operate from an input frequency range of 60 Hz (±) 5%.

C. The displacement power factor shall not be less than .98 lagging under any speed or load condition.

D. The efficiency of the AC Variable Speed Drive at 100% speed and load shall not be less than 97%.

E. The variable torque rated AC Variable Speed Drive over current capacity shall be not less than 110% for 1 minute.

F. The output carrier frequency of the AC Variable Speed Drive shall be programmable at 0.5, 1, 2, 4 or 8 kHz. In addition, the output carrier frequency shall be randomly modulated about the selected frequency.

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2.07 PROTECTION

A. Upon power-up, the AC Variable Speed Drive shall automatically test for valid operation of memory, loss of analog reference input, loss of communication, DC-to-DC power supply, control power and pre-charge circuit.

B. The enclosure shall provide a fully coordinated 100,000 AIC current rating marked on the enclosure nameplate. Short circuit coordination to UL 508 Power Conversion Equipment and NEMA ICS 7.1.

C. The AC Variable Speed Drive shall be protected against short circuits, between output phases and to ground.

D. The AC Variable Speed Drive shall have a minimum AC undervoltage power loss ride-through of 200 milliseconds (12 cycles).

E. The AC drive shall have a programmable ride-through function, which will allow the logic to maintain control for a minimum of one-second (60 cycles) without faulting.

F. For a fault condition other than a ground fault, short circuit or internal fault, an auto restart function will provide up to 6 programmable restart attempts. The time delay before restart attempts will be 30 seconds.

G. Upon loss of the analog process follower reference signal, the AC Drive shall be programmable to display a fault.

H. The AC Variable Speed Drive shall have a solid-state UL listed overload protective device and meet IEC 60947.

I. The output frequency shall be software enabled to fold back when the motor is overloaded.

J. There shall be three skip frequency ranges that can be programmed to a bandwidth of ± 2.5 Hz.

2.08 ADJUSTMENTS & CONFIGURATIONS

A. The AC Variable Speed Drive will be factory programmed to operate all specified optional devices.

B. The acceleration and deceleration ramp times shall be adjustable from 0.05 to 999.9 seconds.

C. The memory shall retain and record run status and fault type of the past eight faults.

D. The software shall have an energy economy function that, when selected, will reduce the voltage to the motor when selected for variable torque loads. A constant volts/Hz ratio will be maintained during acceleration. The output voltage will then automatically adjust to meet the torque requirement of the load.

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Selectable volts/Hz ratio patterns does not meet specification, the function must be automatically optimized.

2.09 KEYPAD DISPLAY INTERFACE

A. A keypad display interface shall offer the modification of AC Variable Speed Drive adjustments through a touch keypad. All electrical values, configuration parameters, I/O assignments, application and activity function access, faults, local control, and adjustment storage, and diagnostics shall be accessible.

B. The AC Variable Speed Drive model number, torque type, software revision number, horsepower, output current, motor frequency and motor voltage shall be listed on the drive identification portion of the LCD display.

C. The keypad display shall have a hardware selector switch that allows the keypad to be locked out from unauthorized personnel.

2.10 OPERATOR CONTROLS

A. The control power for the digital inputs and outputs shall be 24 Vdc.

B. The internal power supply shall incorporate automatic current fold-back that protects the internal power supply if incorrectly connected or shorted. The transistor logic outputs will be current limited and will not be damaged if shorted.

C. Pull-apart terminal strips shall be used on all logic and analog signal connections in the power converter

D. Two voltage-free relay output contacts will be provided. One of the contacts will indicate AC Variable Speed Drive fault status. The other contact shall indicate a drive run status.

E. The enclosure shall have the following dedicated operator controls:

1. Hand-Off-Auto switch
2. Manual Speed Potentiometer
3. See P&I Drawings (if applicable) for additional pilot device requirements
4. The use of Keypad to perform these functions is acceptable.

F. The combination enclosure shall include terminal point connection for fire /freeze state interlock, to prevent drive operation. The interlock must shut down the motor in the drive.

2.11 SERIAL COMMUNICATION

A. The AC Variable Speed Drive shall Ethernet communications as indicated on the drawings.

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2.12 ELECTRICAL NOISE MITIGATION

A. Line Side: Each drive shall include a 3% AC line reactor mounted inside the drive enclosure to reduce power system harmonics and provide power quality protection for the drive. DC bus chokes do not meet specification and shall not be substituted.

B. Load Side: Each drive shall be provided with a dV/dT Filter

1. dV/dT Filter shall consist of a gapped, three phase, iron core inductor; AC-rated, polypropylene capacitors; and wire-wound resistors. The filter shall be rated for application at a maximum fundamental system frequency of 60Hz at nominal system voltages up to 600V. The filter shall operate at a maximum carrier frequency of 8kHz at 40% of fundamental voltage. The ambient temperature of operation shall be 40°C. The maximum distance from the drive to the input terminals of the V1k filter shall be 20 ft. V1k filter application shall be effective for lead distances between the drive and the motor that range from 50 ft. to 3,000 ft., depending on the application details (consult factory). Leads should not be electrically oversized more than four cable sizes or the mechanical limitations of the cable connectors.

2. Approved Manufacturers:

   a. TCI (www.transcoil.com) Contact: Andy McDonald, 317-430-5676
   b. Or equal

3. Components

   a. Inductors

      1) The three phase inductors shall be designed for harmonic filtering service and for slowing the rate of rapid current changes. The inductors shall be UL component-recognized and shall be built to comply with UL 508A standard. Construction shall be of copper wire wound on magnetic grade steel. Inductors shall be sized appropriately for the total connected load. The design maximum temperature rise for reactors shall be 115° C or 155º C depending on frame size at rated current.
      2) The core shall be made of laminated, electrical steel (grade M50 or better).
      3) Brackets shall be ASTM structural steel or structural aluminum. Coils shall be wedged in place and the core shall be locked in place using vertical ties or rods.
      4) Windings shall consist of copper wire or of copper foil. Terminations shall be copper alloy ring lugs, UL-recognized terminal blocks, or solid copper bus. Sheet insulation shall be Tufquin or Cequin IF or Dupont Nomex 410 of the thickness as required for UL insulation systems.

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5) Inductors shall be air-gapped to control saturation. Inductance shall be measured under full load and shall be within 10% of design value.

6) Completed inductors shall be impregnated with 100% solid epoxy resin. All insulation varnish systems shall be rated class R (220° C) or H (180°C), 600V.

7) Inductance shall remain above 50% of nominal for any overload up to 200% of rated current. Inductors shall not sustain any thermal damage for levels up to 150% of rated current for a minimum period of five minutes. Inductors shall be Hi-Pot tested (2,640V, 60 Hz, 1 second) line-to-line and line-to-ground.

b. Capacitors

1) Capacitors shall be constructed of metallized polypropylene film material.

2) Capacitors shall be Y(Wye)-connected and ungrounded neutral. Each capacitor element shall be rated at minimum of 700V AC.

c. Resistors

1) Resistors shall consist of wire-wound cement construction and incorporate thermal insulating terminations.

2) Resistors shall be derated to operate at twice the calculated worst case requirements for watts loss.

C. Protection

1. When VFD's are provided in a control panel or MCC the line reactors and dV/dT filter shall be provided in the same enclosure or shall be provided in a similarly rated enclosure. Example: VFD's provided in an air conditioned Nema 4X enclosure equates to the line reactors and the dV/dT filter being required to be included in the same panel or in an adjacent Nema 4X air conditioned panel. Contractor is responsible for all installation costs and ensuring adequate space is available.

2. When VFD's are mounted individually (wall or structure mounted) provide line reactors and dV/dT filter in a separate enclosure rated the same as the required VFD rating.

D. Warranty

1. Line reactor and dV/dTGuard output filter shall be warranted free from defects in both materials and in workmanship for a period of one year from the date of installation or for a maximum of two years from the date of purchase, whichever comes first.

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PART 3 INSTALLATION

3.01 INSPECTION

A. Verify that the location is ready to receive work and the dimensions are as indicated.

3.02 PROTECTION

A. Before and during the installation, the AC Variable Speed Drive equipment shall be protected from water and site contaminants.

3.03 INSTALLATION

A. Installation shall be in compliance with manufacturer's instructions, drawings and recommendations.

B. Drive Supplier shall provide a certified start up. The startup must be performed by a Factory Authorized Service Center Representative.

3.04 TRAINING

A. On-site training shall be provided as part of the start-up service.

3.05 DOCUMENTATION

A. The AC Variable Speed Drive supplier shall supply a comprehensive 8-1/2 x 11-inch bound instruction and installation manual that includes wiring diagrams, layout diagrams, and outline dimensions. This manual must be 3-hole punched for insertion in a shop manual supplied by the installing contractor.

END OF SECTION

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SECTION 271900 – DIRECTIONAL BORING

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Provide all services, labor, materials, tools, and equipment required for the complete and proper installation of exterior electrical pathways as called for in these specifications and related drawings.

B. This section includes minimum requirements and installation methods for the following:

1. Underground Conduit Systems

2. Horizontal Directional Drilling (Directional Boring)

1.02 QUALITY ASSURANCE

A. All installation work for the new exterior telecommunications pathways shall be performed in a neat and workmanlike manner.

B. Equipment and materials shall be of the quality and manufacturer indicated. The equipment specified is based on the acceptable manufacturers listed. Where “approved equal” is stated, equipment shall be equivalent in every way to that of the equipment specified and subject to approval based on submittals provided.

C. Materials and work specified herein shall comply with the applicable requirements of:

1. ANSI/NFPA 70 – National Electrical Code

2. IEEE/NESC – National Electrical Safety Code

3. NEMA Standards including, but not limited to:

a. NEMA, RN1, PVC Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit
b. NEMA, TC3, PVC Fittings for use with Rigid PVC Conduit and Tubing
c. NEMA, TC6, PVC and ABS Plastic Utilities Duct for Underground Installation
d. NEMA, TC8, Extra Strength PVC Plastic Utilities Duct for Underground Installation
e. NEMA, TC9, Fitting for ABS and OVC Plastic Utilities Duct and Fittings for Underground Installation
f. NEMA, TC10, PVC and ABS Plastic Communications Duct and Fittings for Underground Installation

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4. UL Standards including, but not limited to:

   a. UL 6, Rigid Metal Electrical Conduit
   b. UL 651 Schedule 40 and 80 PVC Conduit

5. ANSI-C80.2, Specification for Rigid Steel Conduit, Enameled

D. For horizontal directional drilling, the Contractor shall follow all procedural precautions necessary to ensure that the essential aspects of proper directional bore installation are adequately controlled.

E. Personnel for horizontal directional drilling shall be fully trained in their respective duties as part of the directional drilling crew and in safety.

1.03 SUBMITTALS

A. Product Data: For each type of product indicated.

B. As-built drawings: per Division 1 requirements.

PART 2 PRODUCTS

2.01 HORIZONTAL DIRECTIONAL DRILLING EQUIPMENT

A. The horizontal directional drilling equipment shall consist of a directional drilling rig of sufficient capacity to perform the bore, a guidance system to accurately guide boring operations, and trained and competent personnel to operate the system.

B. All equipment shall be in good, safe operating condition with sufficient supplies, materials and spare parts on hand to maintain the system in good working order for the duration of this project.

C. The directional drilling machine shall consist of a hydraulically powered system to drill into the ground at a variable angle.

1. The machine shall be anchored to the ground to withstand the pulling, pushing and rotating pressure required to complete the boring.

2. The hydraulic power system shall be self-contained with sufficient pressure and volume to power drilling operations.

3. The hydraulic system shall be free of leaks.

4. The drill head shall be steerable by changing its rotation and shall provide the necessary cutting surfaces and drilling fluid jets.

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D. The Guidance System shall be of a proven type and shall be set up and operated by personnel trained and experienced with this system.

1. The Operator shall be aware of any magnetic anomalies and shall consider such influences in the operation of the guidance system if using a magnetic system.

PART 3 EXECUTION

3.01 INSPECTION

A. Examine areas and conditions under which the new exterior pathways are to be installed. Provide notification, in writing, of conditions detrimental to proper completion of the work.

B. Verify field measurements and pathway routing conditions are as shown on drawings.

1. Provide notification, in writing, of conditions deviating from drawings.

C. Beginning of telecommunications pathway installation indicates Contractor acceptance of existing conditions.

3.02 CONDUIT SYSTEM PLACEMENT (GENERAL)

A. Twelve (12) inch clearance from all existing utilities shall be maintained if at all possible. Conduit ducts shall be installed below gas piping wherever possible.

B. During construction the ends of the conduits shall be plugged to prevent water washing mud into the conduits, manholes, or buildings. Particular care shall be taken to keep the conduits clean of concrete, dirt, or any other substance during the course of construction.

C. The new conduit shall extend through the wall into the building, tunnel, or crawl space a minimum of 4 inches.

D. Handholes shall be placed with the long dimension in line with the conduit run. The conduit shall enter opposite ends of the handhole on the short sides so that the handhole shall not be used as a 90 degree bend in cable installations.

E. All conduits entering bottom of handhole shall be flush with the inside wall. Dirt shall be removed 6” below the bottom of conduits entering the handhole and pea-gravel shall be placed on the bottom to help water dissipate.

F. After conduit duct installation has been completed pull test mandrel through all new conduit ducts to verify duct integrity and insure smooth interior surfaces free from burrs or obstructions that might damage cable sheaths. Following mandrel testing, draw cylindrical wire brush with stiff bristles through each conduit to clean the conduit and remove any concrete, dirt or other obstructions.

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G. Stub out conduits into cabinets only enough to attach connector and bushings with grounding lugs except conduits shall rise a minimum of two (2) inches above the finished floor.

H. Install new pull rope in all new conduit and extending three feet into each building space.

I. Plug ends of the new conduit with watertight rubber conduit plugs, conduit caulking compound, or conduit caps to ensure foreign matter does not enter the buildings.

3.03 CONDUIT SYSTEM for HORIZONTAL DIRECTIONAL DRILLING

A. The Engineer shall be notified 48 hours in advance of starting horizontal directional drilling work. The directional drilling shall not begin until the Engineer has inspected the proposed run and agrees that proper preparations for the operation have been made.

B. Site Preparation:

1. Prior to any alterations to work site, the entry and exit points shall be marked for each bore.

2. No alterations to the work site beyond what is required for operations shall be made.

3. All activities shall be confined to designated work areas. Locate all bore and receiving pits within existing road right-of-way.

C. Drill Path Survey:

1. The entire drill path shall be accurately surveyed with entry and exit stakes placed in the appropriate locations within the areas indicated on drawings.

2. If a magnetic guidance system is being used, the drill path will be surveyed for any surface geomagnetic variations or anomalies.

D. All applicable environmental regulations shall be adhered to.

E. Following drilling operations, the equipment will be de-mobilized and the worksite restored to its original condition. All excavations will be backfilled and compacted to 95% of original density. Placement of topsoil and seeding shall be per T-901 and T-903.

3.04 SAFETY

A. All applicable state, federal and local safety regulations, including OSHA regulations regarding confined space entry, shall be adhered to and all operations shall be conducted in a safe manner.

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B. When covers of manholes, handholes, or vaults are removed, the opening shall be promptly protected with a barrier, temporary cover, or other suitable guard. Structures in the AOA shall not remain open over-night.

C. All landside construction areas shall be fenced off during when construction is not active.

END OF SECTION

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SECTION 05

Pump Control Panel

254000 – Process Control System (PCS)
254001 – Lift Station Control Panel
254022 – Float Switches
254031 – Control Panel Construction
254041 – Miscellaneous Control Panel Devices

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SECTION 254000.1 DUPLEX LIFT STATION CONTROL PANELS

PART 1 GENERAL

1.01 SUMMARY

A. The general scope of control work shall include but is not limited to:

1. Lift Station Control Panels Description:
   a. Duplex Submersible Lift Station Control Panel
   b. Duplex Pumps Alternating
   c. Single phase to three phase conversion through Variable Frequency Drives where shown on electrical drawings.
   d. Variable Frequency Drives where three-phase power is available at site, as shown on electrical drawings.
   e. Soft Start Motor Starters where single-phase pumps are installed as shown on electrical drawings

2. Lift Station Control Panel Construction:
   a. Nema 4X stainless steel control panel.
   b. Enclosures shall be Hoffman, Rittal or Engineer approved equal.
   c. All programming and startup as required.
   d. Enclosures shall be provided with neoprene gaskets, which shall be attached to the enclosure with oil-resistant adhesive and held in place with stainless steel retaining strips.
   e. Door clamps shall be provided on three sides of the enclosure door. Clamps shall be quarter-turn or similar tool-less means.
   f. A hasp and staple shall be provided for padlocking.
   g. Panels shall be constructed using factory-fabricated enclosures. Install instruments and devices, plumb, and wire panels at panel shop or other facility prior to shipment to jobsite.
   h. VFD's for phase conversion

3. Instruments per specifications and outlined on the drawings
   a. Float Control. (Stop, Lead, Lag, High Level).

5. Control Panel Construction shall be constructed in a UL 508A/498 listed facility. All control panels shall be UL 508A/498 listed.

   Pump Control panels to be manufactured by:
   a. Toric Engineering Incorporated, Danville Indiana
   b. Frakes Engineering, Indianapolis Indiana
   c. Maxim Automation, Fishers Indiana
   d. Ferguson Water Works, South Bend Indiana
   e. (Or Engineer Approved Manufacturer)

6. Control Panel requirements

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a. Type 4x stainless steel enclosure
b. Control relays as required
c. Convenience receptacle
d. Disconnect, flange mounted with dual interlocked breakers labeled (Main Power/Power Off/Generator Power).
e. Elapsed time meter, quantity of two (2)
f. Phase monitor
g. Pilot light, 30-mm push to test, quantity of eight (8)
h. Power distribution block
i. Selector switch, 30-mm, 3-position, quantity of two (2)
j. Terminal Blocks as needed
k. Transformer, 240vac/120, 1kva
l. TVSS, 240 vac
m. UPS batter back-up
n. UL 698 listed intrinsically safe barriers
o. Cooltron Circulation Fan.
1) Provide panel heat load calculations.
p. Control panel heater and thermostat
q. Pump safeties as required.
r. All programming and startup as required.
s. Intrinsically safe barriers.
t. Alternator relay with selector switch.
u. Provide area in panel with power for existing Mission 150 RTU.
v. Generator Plug (Appleton 240 V, 100-A, 4W, 4P or Equal).

7. General:
a. Provide 15% spare panel space in all control panels.
b. Provide seal leak relays, high temperature relays, pump oil monitor relays, blower thermistor relays, etc. as required to integrate the equipment safeties into the control system.
c. Alarm horn and alarm light will be provided with a silence pushbutton.
d. Provide complete detail design, required submittals, startup, testing of system, owners training and operation and maintenance manuals.

B. COORDINATION

1. Field coordination with other contractors and supervision of the installation shall be provided by the system integrators.

C. SUBMITTALS:

1. Detailed control panel drawings shall be submitted to the engineer for approval before panel manufacturing can proceed. They shall include all internal panel wiring with wire numbers and all field interconnect wiring.

2. Product data sheets shall show detailed specifications of the product. The model number shall be clearly indicated, electrical or mechanical requirements, and physical size.

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3. The control panel drawings shall show the front and sub panel layouts with all devices marked.

4. Operation and maintenance (O&M) manuals shall contain as-built drawings for the system and full manuals on all equipment supplied. A copy of all programs from the controller shall be supplied on CD to the owner.

D. GENERAL REQUIREMENTS:

1. The equipment supplied under this contract shall be a standard off the shelf product. When two or more products of the same type are used, they are to be by the same manufacturer.

2. Equipment and materials are subject to review.

3. For proper operations, verify that installations, interface wiring, and adjustments are to manufactures guidelines.

4. All software programs supplied as part of this system shall be registered to the Owner.

E. SEQUENCE OF CONTROL:

1. “Power Failure” Alarm
Once activated, the alarm remains active until power is restored.

2. “High Temperature” Alarm
Once activated, the alarm remains active until manually turned off.
Once turned off, the alarm resets.

3. “Seal Failure” Alarm
Once activated remains active until manually turned off.
Once turned off, the alarm resets.

4. “High Level” Alarm/Strobe
Once activated strobe remains on until level falls.
Horn can be silenced through silence push button, resets when level falls below high level float point elevation.

5. Level Control.
On an increase in level, the lead float shall start lead pump through the alternator relay. The lead pump shall operate until the level falls to the elevation of stop float and the lead pump shall stop. If the level continues to rise the lag float shall start the lag pump, lead and lag pumps shall operate until the level falls to the elevation of the stop float and both pumps shall stop. Pumps shall alternate lead and lag positions through the alternator relay. The high level float shall activate the high level alarm horn and strobe light on a rise in level above the lag float elevation. A momentary push button mounted below the horn shall silence the horn

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when pressed. The strobe light shall continue operation until the level falls below the elevation of the high level float.

F. INDICATORS AND CONTROLS

1. Inner Door Devices
The following devices shall be operable or viewed through the outer door or inner door (dead front) to prevent operator exposure to live electrical current:

a. Pushbuttons
b. Selector switches.
c. Status lights.
d. Ground fault protected, 115V convenience receptacles.
e. Elapsed time meters.
f. Pump circuit breakers and Control breakers.
g. Flange mounted interlocked dual main breakers.
h. VFD touch screens.

G. GENERAL

1. Built in elapsed timer for all pumps. ETM's shall be nonvolatile and easily examined from the front panel.

H. General Control Notes:

1. All pumps shall be controlled by the system with the following capabilities:

a. Start/stop.
b. Status
c. Pump alternation

2. All analog values such as levels and flows, and analytical instruments shall be:

a. Trended
b. Real time values displayed on graphic screens.
c. Alarmed with adjustable setpoints.

1.02 I/O LIST

A. Refer to the Process and Instrumentation Drawings for I/O requirements.

1.02 QUALITY ASSURANCE

A. Acceptable Pump Suppliers:

a. Xylem-Flygt, provided locally by representative B.L. Anderson LLC. (765-463-1518.

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B. All control panels shall be designed and constructed to UL 508A standards. All control panels shall be UL 508A listed. Control panels shall be made available to the owner and engineer during factory testing. Intrinsically safe section shall be UL 698 listed.

C. PCS hardware and software shall be provided and integrated by a single Systems Integrator.

D. Provide process control system hardware required to meet function of specifications. Configure Ethernet Network to maximize process control system availability. Provide fully operational process control system.

E. Label hardware revision levels on equipment and spares installed.

PART 2 PRODUCTS

See related specifications and drawings for additional details on materials.

PART 3 EXECUTION

3.01 QUALITY CONTROL

A. Field installation and wiring of panel components shall be in accordance with approved submittals, manufacturer's recommendations, and any applicable federal, state, and local codes.

B. Perform field test of Process Control System upon completion of installation, wiring and field inspection.

3.02 ADDITIONAL SYSTEM SUPPLIER'S SERVICES

A. During the course of the Work and Warranty period, furnish all software and firmware with the latest revisions published.

B. Maintenance

1. Properly maintain operational equipment at factory or on-site throughout course of Work.
2. Keep maintenance records with equipment and make them available for inspection at any time during course of Work.

END OF SECTION

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SECTION 254001 – Lift Station Control Panel

PART 1 GENERAL

1.01 SUMMARY

A. Provide a new Lift Station Control Panel

B. Coordination

1. Field coordination with other contractors and supervision of the installation shall be provided by the system integrators.

C. Submittals

1. Detailed control panel drawings shall be submitted to the engineer for approval before panel manufacturing can proceed. They shall include all internal panel wiring with wire numbers and all field interconnect wiring.

2. Product data sheets shall show detailed specifications of the product. The model number shall be clearly indicated, electrical or mechanical requirements, and physical size.

3. The control panel drawings shall show the front and sub panel layouts with all devices marked.

4. Operation and maintenance (O&M) manuals shall contain as-built drawings for the system and full manuals on all equipment supplied. A copy of all programs from the PLC's, Touch Screens, and HMI graphics software shall be supplied on CD to the owner if part of control panel.

D. General Requirements

1. The equipment supplied under this contract shall be a standard off the shelf product. When two or more products of the same type are used, they are to be by the same manufacture.

2. Equipment and materials are subject to review.

3. For proper operations, verify that installations, interface wiring, and adjustments are to manufactures guidelines.

4. All software programs supplied as part of this system shall be registered to the Owner.

E. Control Panel Construction

1. All control panels shall be designed and constructed to UL 508A standards. All control panels shall be UL 508A listed.

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Control panel shall be made available to the owner and engineer during factory testing.

1.02 QUALITY ASSURANCE

A. PCS hardware and software if provided shall be provided and integrated by single Systems Integrator.

B. Provide process control system hardware required to meet function of specifications. Configure Ethernet Network to maximize process control system availability. Provide fully operational process control system.

C. Label hardware revision levels on equipment and spares installed.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION

3.01 QUALITY CONTROL

A. Field installation and wiring of panel components shall be in accordance with approved submittals, manufacturer's recommendations, and any applicable federal, state, and local codes.

B. Perform field test of Process Control System upon completion of installation, wiring and field inspection.

3.02 ADDITIONAL SYSTEM SUPPLIER'S SERVICES

A. During course of Work and Warranty period, furnish all software and firmware with latest revisions published.

3.03 MAINTENANCE

A. Properly maintain operational equipment at factory or on-site throughout course of Work.

B. Keep maintenance records with equipment and make them available for inspection at any time during course of Work.

END OF SECTION

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SECTION 254022 – FLOAT SWITCHES

PART 1 GENERAL

1.01 SUMMARY

A. Section includes field mounted Level Sensing Conductive Rod and Float Switches for Process Instrumentation and Control.

B. See the electrical and control drawings for quantities of level sensing instruments. Provide level sensors and transmitters complete including necessary instrument cables and mounting brackets.

PART 2 PRODUCTS

2.01 FLOAT SWITCHES

A. Float switches shall have an internal weight and be housed in a chemical-resistant polypropylene casing. Floats shall come in boot with a locked compression fitting providing a secure yet flexible means of attaching the cable to the float. Float shall be provided with three-wire single pole double throw (SPDT) capable of being wired normally open (NO) or normally closed (NC).

B. Float shall be mercury-free level switch for controlling liquid levels in a variety of applications.

C. A snap action switch activated by a ball rolling back and forth within a switching tube. Entire assembly enclosed in a plastic float housing.

D. In classified spaces provide float switches rated for the space as required. Provide Intrinsically Safe barriers as required.

E. Provide cable length as required. Provide stainless steel mounting bracket as required (SJE-RHOMBUS or equal).

F. Manufacturers:

1. Anchor Scientific
2. Or Engineer Approved Equal

PART 3 EXECUTION

3.01 INSTALLATION

A. Install and wire in accordance with System Integrator's and/or Equipment manufacturer's written instructions and approved submittals, applicable requirements of the NEC, NECA "Standard of Installation", and recognized industry practices.

B. Reference project drawings for installation details.

END OF SECTION

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SECTION 254031 – CONTROL PANEL CONSTRUCTION

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Panel and enclosure requirements for Process Control System.

B. Related Sections:

1. Section 254041 – Miscellaneous Panel Devices

1.02 MAINTENANCE

A. Extra Materials:

1. Provide minimum of 5 or 10%, whichever greater, of each type fuse used on project.

2. Provide minimum of 5 or 10%, whichever greater, of each type LED style pilot light or bulb for pilot lights used on project.

3. Provide minimum of 5 or 10%, whichever greater, of each color lens cap used on project.

4. Provide minimum of 30% mounted spare terminals, to be shown as such on panel drawings.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Acceptable Manufacturers include:

1. Hoffman.
2. Saginaw
3. Rittal

2.02 GENERAL

A. All panel construction shall comply with the requirements specified herein, unless specifically specified differently or shown differently on Plans.

B. Panels shall be constructed using factory-fabricated enclosures.

C. Install instruments and devices, plumb, and wire panels at panel shop or other facility prior to shipment to job-site.

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D. Wiring:

1. In addition to NEC and NEMA requirements, wiring shall conform to following:

   a. Power: 12 AWG stranded minimum, type MTW, 600 V.

   b. Control: 16 AWG stranded minimum, type MTW, 600 V.

   c. Analog Signal: Twisted pair, 18 AWG, Belden 1120 or equal.

2. Wire color code:

   a. Powered from within panel

      1) 480 Volts AC phase conductors conductor: Black (with phases A, B, and C color taped at each end Brown, Orange, and Yellow respectively)

      2) 480 Volts AC neutral conductor: White with colored (not green) stripe

      3) Grounding conductor: Green

   b. Powered from within panel:

      1) 120 Volts AC control conductor: Red

      2) 120 Volts AC neutral conductor: White

      3) Grounding conductor: Green

   c. Powered from remote source:

      1) 120 Volts AC control conductor: Yellow

      2) 120 Volts AC neutral conductor: Grey

      3) Grounding conductor: Green or Green with Yellow stripe

   d. DC (+) power conductor: Blue

   e. DC (-) power conductor: Blue

   f. DC control conductor: Blue

   g. Twisted pair cable (-) signal conductor: White

   h. Twisted pair cable (+) signal conductor: Black

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3. Design control panels to keep 480 Volts AC power or 120 Volts AC power separated from discrete signals, and analog and other low voltage signals.

   a. Do not run 480 Volts AC power or 120 Volts AC power in the same conduit or wire-duct as discrete signals, or analog or other low voltage signals.

   b. Where 480 Volts AC power or 120 Volts AC power must cross discrete signals, or analog or other low voltage signals, they shall do so at right angles.

4. Wiring Within Wire Duct:

   a. Wherever feasible plastic wire duct with cover shall be used for routing of wire within control panel.

   b. Size wire duct to be no more than 50% full.

   c. Maintain 2 inch clearance between wire duct and terminals.

5. Wiring outside of wire duct.

   a. Wiring outside of ducts shall be restrained by use of plastic wire-ties.

   b. Restrain wiring a minimum of every six inches.

   c. Provide abrasion protection for wires passing through holes or across abrasive metal edges.

   d. Adhesive type wire fasteners shall not be used. Hard screw type shall be employed.

6. Wiring of Controller I/O modules shall be through pre-wired cable assemblies as specified in Section 13450. Cable assemblies shall have Controller I/O module-specific wiring arms on one end and cable ends tinned for terminus on terminal blocks on the other.

E. Terminations:

1. Wiring within control panel shall be continuous and terminated only at terminal blocks or equipment terminals. Splices or butt connectors shall not be used within panel.

2. No more than one wire shall be terminated at any one terminal block on the terminal strip. No more than two wires shall be terminated at any terminal on a component within the control enclosure.

3. Make external connections by way of numbered terminal blocks on numbered terminal strips.

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4. When signals are powered from remote locations, switched terminal blocks shall be used for the powered conductor(s).

5. When signals are powered from within panel, fused terminal blocks shall be used for the powered conductor(s).

6. Provide integral bussing system on terminal block array where more than two terminations require common source or drain connection. Jumpered terminations shall not be acceptable.

7. Include provisions for grounding of shields on shielded twisted pair cables entering or leaving panel. Cable shields shall be grounded at terminal block end only.

8. Provide Finger-Safe style terminal blocks.

9. Provide separate terminal strips for each of the following types of signals.

   a. 480 Volts AC power circuits.

   b. 120 Volts AC power circuits.

   c. 120 Volts AC discrete signals.

   d. 24 or 48 Volts DC discrete signals.

   e. Analog signals.

   f. Serial or parallel digital communication signals.

   g. Intrinsically safe circuits.

F. Power Distribution:

1. Panels having 480 Volts AC power supply:

   a. Provide internal main circuit breaker to isolate power to panel.

   b. Provide circuit breakers for all motor starters provided.

   c. If panel includes separate 120 Volts AC control power supply, provide auxiliary contact to isolate control power when main circuit breaker is opened.

   d. 480 / 120 control power transformer requirements:

      1) Both primary leads shall be fused.

      2) First secondary lead shall be fused.

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3) Second secondary lead shall be grounded.

2. Panels having 120 Volts AC power supply: Provide circuit breaker on each power supply entering panel.

3. Provide separately fused power supply to each major panel component.

4. Panels using modular or solid state I/O devices.

a. Provide separately fused power circuit for panel powered I/O signals entering panel from field devices. Provide separate circuit for each module.

b. Include digital transient surge suppressor/varistor installed in parallel with output contact at terminal strip for each output signal driving an inductive load including:

1) Relays.

2) Solenoids.

3) Motor starters.

4) Motors.

G. Labels and Nameplates:

1. Panel Designation:

a. Engraved with Owner's tag number and description shown on the Construction Sheets and in Specifications.

b. Laminated white plastic with ½-in. high black characters.

c. Fastened with stainless steel screws or self-tapping fasteners.

2. Front of panel mounted devices.

a. Provide nameplate for each front of panel device with descriptive phrase using nomenclature as listed on Construction Sheets and in Specifications.

b. Laminated white plastic with 3/16-in. high black characters.

c. Fastened with stainless steel screws or self-tapping fasteners.

3. Rear of panel mounted devices.

a. Provide nameplate for each rear of panel device with labels used on panel drawings.

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b. Laminated white plastic with 1/8-in. high black characters.

c. Fastened with stainless steel screws or self-tapping fasteners.

4. Wiring.

a. Each conductor or twisted pair cable shall be labeled near its termination point.

b. Color-coded multi-conductor cable or multi-pair cable shall be labeled on overall jacket near its point of fan-out. Each pair of a multi-pair cable, when not color-coded, shall be labeled at its termination point in addition to the overall jacket.

c. Labels shall be machine-printed wrap-around types with tag visible from front without removal of wire from termination.

H. Panel Finish

1. Remove mill scale, grease, and oil.

2. Primer thickness shall be 0.8 mil minimum.

3. Finish coat shall be two-part epoxy or baked dry powder, 3 mil minimum dry film thickness.

4. Color: Gray.

I. Conveniences

1. Freestanding and floor mounted control panels shall be provided with door-activated, internal fluorescent panel lighting units. One unit shall be provided for every 3 feet of panel width and shall be mounted on the inside, top of the panel.

2. Freestanding and floor mounted control panels shall be provided with 15-amp, 120-volt, service outlet circuits within the back-of-panel area. The circuits shall be provided with three-wire, 120-volt, 15-ampere, duplex receptacles, one for every 3 feet of panel width and spaced evenly along the back-of-panel area.

2.03 PANEL CONSTRUCTION – INDOOR AND OUTDOOR ENCLOSURES

A. Indoor and Outdoor Enclosures shall conform to NEMA requirements as follows:

1. NEMA 7 for Indoor or Outdoor Enclosures in Class I, Division 1 or 2 Hazardous (Classified) Locations.

2. NEMA 4X - 316 Stainless Steel for Outdoor Enclosures and Indoor Enclosures in corrosive environments.

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3. NEMA 12 for Indoor Enclosures not in Classified or corrosive environments.

B. In addition to NEMA standards, conform to the following requirements:

1. Minimum metal thickness: 14 Ga.

2. Indoor Enclosures: Equip with rubber-gasketed doors with continuous metal hinges. Equip doors with 3-point lockable latches.

3. Outdoor Enclosures: Equip with hinged dead-front inner doors and rubber-gasketed, continuous metal hinged outer weather doors. Equip weather doors with 3-point lockable latches and gasketed, transparent panel for viewing of inner door mounted devices.

4. Size to adequately dissipate heat generated by equipment mounted in or on panel. Heat dissipation shall be sufficient for internal panel temperature to not exceed temperature rating of internal panel components.

5. Equip Outdoor Enclosures with thermostatically controlled heaters capable of maintaining internal panel temperature of 50 º F with 20 mph wind at ambient temperature of -20 º F. Heater shall operate at 110 Volts AC 60 Hz power.

6. Equipment enclosure with ventilation fan and cleanable, filtered louvers. Submit heat loss calculation to demonstrate sizing of equipment submitted.

C. Prior to final fabrication of panels, verify layout of front-of-panel devices with respect to rear-of-panel devices. Maintain minimum of 3 inches clearance between door and sub-panel mounted devices.

2.04 SOURCE QUALITY CONTROL

A. Control panels shall be designed and constructed by a UL-508A Listed Panel Shop/Systems Integrator. Panels shall be designed, constructed, and tested to UL-508A standards and shall be UL-508A listed.

B. In-Factory Inspection

1. Verify following in accordance with approved submittals:

a. Panel dimensions.

b. Equipment layout.

c. Wiring.

d. Wire and terminal identification.

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2. Verify proper access to equipment for maintenance.

3. Verify proper access to field wire and fiber optic termination points.

4. Inspect for neatness of wiring and wire harness construction.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install panels in locations indicated on Drawings and in accordance with SYSTEMS INTEGRATOR and manufacturer's written instructions and approved submittals.

B. Touch-up panel finish if marred during installation.

END OF SECTION

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254041 – MISCELLANEOUS CONTROL PANEL DEVICES

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Control panel devices for Process Control Systems.

B. Related Sections

1. Section 254031 – Control Panel Construction

1.02 REFERENCES

A. Codes and Standards referred to in this Section include:

1. American National Standards Institute (ANSI).
2. Institute of Electrical and Electronics Engineers (IEEE).
3. Underwriters Laboratory (UL).

1.03 QUALITY ASSURANCE

A. Standardization

1. Devices shall be latest and most modern design at time of bidding.
2. As much as possible devices shall be products of one manufacturer to achieve standardization for maintenance, spare parts, operation, and service.

PART 2 PRODUCTS

2.01 PUSHBUTTONS, SELECTOR SWITCHES AND PILOT LIGHTS.

A. Manufacturers

1. Rockwell Automation (Allen-Bradley)
2. Square D
3. Cutler-Hammer
4. Or equal.

B. Construction

1. Heavy duty
2. Watertight
3. Oil-tight
4. Flush panel mounting

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5. Size to mount in 30.5-mm diameter
6. Match NEMA rating of related enclosure

C. Control Stations

1. Describes enclosures used to house field pilot devices.

2. Control stations mounted outside of buildings must include locking cover mechanism over all control pushbuttons or hand switches.

3. NEMA ratings

   a. NEMA 7 in Class 1, Division 1 or 2 Hazardous (Classified) Locations.

   b. NEMA 4X 316 Stainless Steel in indoor wet/corrosive locations or outdoors.

   c. NEMA 12 in other areas.

4. Nameplates

   a. Engraved laminated plastic.

   b. Letters 3/16 inch high.

   c. Black letters on white background.

   d. Identify per equipment controlled, using names found on Drawings.

5. Each control station shall be mounted at the elevation and within 10 feet of respective motor being controlled.

D. Pushbuttons

1. Flush head unless specified elsewhere.

2. Contact Blocks:

   a. Double break silver contacts
   b. AC Ratings: 7,200 VA make, 720 VA break
   c. Single pole, double throw or double pole, single throw
   d. Up to six tandem blocks

3. Momentary contact unless specified elsewhere

4. Non-illuminated

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5. Legend plates, as required, for type of operation or as specified elsewhere

E. Remote Emergency Stop

1. Jumbo red mushroom head with protective ring guard

2. Contact Blocks

a. Double break silver contacts
b. AC Ratings: 7,200 VA make, 720 VA break
c. Single pole, double throw or double pole, single throw
d. Up to six tandem blocks

3. Push/pull

4. Maintained contact

5. Non-illuminated

6. Legend plates

a. Extra large
b. Red
c. Emergency

F. Selector Switches

1. Maintained position unless specified elsewhere

2. Contact Blocks

a. Double break silver contacts
b. AC Ratings: 7,200 VA make, 720 VA break
c. Single pole, double throw or double pole, single throw
d. Up to six tandem blocks

3. Operators

a. Number of positions as specified elsewhere
b. Standard knob type unless specified elsewhere

4. Legend plates as required for type of operation or specified elsewhere.

G. Pilot Lights

1. LED Lamp
2. Transformer type
3. Bayonet, 6 Volts AC bulb
4. Colored lens as specified elsewhere

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5. Interchangeable lenses
6. Transformer rated for 120 VAC, 60 Hz
7. Push to test
8. Legend plates as specified elsewhere

H. Nameplates

1. Engraved laminated plastic
2. Letters 3/16 inches high
3. Black letters on white background
4. Identify per equipment controlled, using names found on the Drawings

2.02 CONTROL RELAYS

A. Manufacturers

1. Potter and Brumfield
2. Struthers Dunn
3. Or equal.

B. Operating Data

1. Pickup Time: 13 ms maximum
2. Dropout Time: 10 ms maximum
3. Operating Temperature: -45 º F to 150 º F

C. Physical Data

1. DIN rail mountable
2. Enclosed and protected by polycarbonate cover
3. Provide with check button and indicator
4. Provide relay-retaining clips

D. Electrical Data

1. AC Coil

a. 120 or 240 Volts AC, 50 to 60 Hz
b. Continuous rated
c. 3.5 VA inrush maximum
d. 1.2 VA sealed, maximum
e. Minimum Dropout Voltage: 10% of coil rated voltage.

2. DC Coil

a. 24 or 120 Volts DC
b. Continuous rated
c. Minimum Coil Resistance:

1) 24 Volts DC: 450 Ω
2) 120 Volts DC: 9,000 Ω

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3. Contacts

a. Gold flashed fine silver, gold diffused for 1 amp or less resistive load, or Silver Cadmium Oxide
b. Four (4) form C contacts
c. 120 Volts AC, 10 Amp make, 1.5 Amp break (inductive)
d. Rated at 10 million operations

2.03 TERMINAL BLOCKS

A. Manufacturers

1. Phoenix Contact

B. Physical Specifications

1. 300 Volt rating for 120 Volt circuits and below
2. 600 Volt rating for 480 Volt circuits
3. Clamping screw
4. Isolating end caps for each terminal
5. Identification on both terminals
6. Clip-mounted on DIN rail
7. Accept AWG 12 to 22
8. Finger-Safe

C. Feed-Through Terminals: 20 Amp rating

D. Switched Terminals

1. Knife disconnect with test sockets
2. 10 Amp rating

E. Fused Terminals

1. Hinged fuse removal/disconnect
2. 10 Amp rating
3. Include blown fuse indication

2.04 REGULATED POWER SUPPLY

A. Manufacturers

1. Phoenix Contact
2. SOLA
3. Or Approved Equal

B. Furnish DC power supplies as required for Controller discrete inputs and 2 wire analog loops. Provide redundant 24 Volt DC regulated power supplies (at least two).

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C. Power supplies shall be sized to include 100% spare capacity. Include individual fusing and other protection as required.

2.05 ELECTRONIC CURRENT ISOLATOR

A. Manufacturers

1. Phoenix Contact Model MCR Series
2. Or Approved Equal.

B. Solid state instrument to electrically isolate one instrument loop from another instrument loop. Converter to accept 4-20 mAdc input signal and provide equal but isolated and power boosted output.

C. Physical Specifications

1. Mounting: DIN Rail
2. Temperature compensated, calibration-free
3. Input: 4 20 mA DC into 50 Ω
4. Output: 4 20 mA DC into output load up to 500 Ω
5. Isolation: Common mode up to 700 VAC between input and output
6. Accuracy: 0.5% of span

D. Provide power supply specific to isolator.

2.06 TEMPERATURE SWITCHES – PANEL STATUS

A. Hoffman A-TEMNO

B. Adjustable temperature set point.

C. Fixed differential type with automatic reset.

D. SP snap action dry contacts suitable for connection to Controller input.

E. Surface mount.

2.07 SURGE PROTECTION

A. Provide surge protection for instrument power and control wiring that any portion of is outside of the building envelope:

1. For analog 4-20mA signals provide Leviton 3400/3800 series at the Controller panel and at the instrument

2. For 24VDC provide Leviton 3824-DIN at the Controller panel and 3824-OEM at the instrument.

3. For 120VDC provide Leviton 3800-DIN at the Controller panel and 3800-OEM at the instrument.

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2.08 PANEL AIR CONDITIONER

A. Provide a control panel air conditioner sized to cool the control panel with all variable frequency drives running at full load. Provide heat load calculations with the submittal from the air conditioner manufacture. Air conditioner shall be sized to maintain a maximum interior temperature not to exceed 95 degrees Fahrenheit. Provide a closed loop air conditioning unit as manufactured by ISC or Hoffman. The AC unit is to be Nema 12 and shall have short cycle protection with an integral thermostat.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install and wire in accordance with Systems Integrator's and/or Equipment manufacturer's written instructions and approved submittals, applicable requirements of the NEC, NECA "Standard of Installation", and recognized industry practices.

END OF SECTION

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