IRONWOOD
MICHIGAN | Find Your North

CITY OF IRONWOOD

Bonnie Road Lift Station Generator

City of Ironwood -Bid Advertisement
Bonnie Road Lift Station Generator

The City of Ironwood is soliciting bids for Bonnie Road Lift Station Generator located in the City of Ironwood, Michigan.

The Ironwood City Clerk in the Memorial Building, Ironwood, Michigan 49938 will receive sealed offers until 10:00 A.M., Friday, June 7, 2024, at which time the bids shall be read aloud.

Bid Documents may be obtained from the City Clerk, Memorial Building, 213 S. Marquette Street, Ironwood, Michigan 49938, (906) 932-5050 or by visiting www.ironwoodmi.gov/government/projects.

The City reserves the right to accept or reject any and all bids.

Jennifer L. Jacobson
City Clerk

City of Ironwood
Proposal for Bonnie Road
Lift Station Generator

With Bids Received Until 10:00 A.M. on Friday, June 7, 2024

PROPOSAL OF:

Company Name: _____

Address: _____

City/State: _____

Phone: _____

Email: _____

Project:	Bonnie Road Lift Station Generator
Location:	204 E. Bonnie Road
Type of Work:	Provide and install generator
Completion Date:	December 1, 2024
Notice to Bidders:	In submitting Bid, you must return this complete proposal.

Section A – Bid Solicitation

Issued By:	City of Ironwood
Type of Solicitation:	Sealed Bids
Project Name:	Bonnie Road Lift Station Generator
Project Location:	204 E. Bonnie Road
Site Inspection:	Bidders are encouraged to visit the site prior to submitting a bid. Interested bidders may contact; - Paul Anderson, City Manager at 906-932-5050 ext. 116 - Bob Tervonen, Utilities Supervisor at 906- 932-5050, ext. 111
Delivery of Proposal:	The proposals shall be submitted in a sealed envelope, plainly marked with the name of the Project and the name and address of the bidder on the outside of the envelope. All offers must be received by the City Clerk prior to the time and at the place specified in the advertisement. Email bids received in PDF format accepted. Must state project name with bid opening date in subject line. Faxed bids are not acceptable.
Award Project:	A contract will be awarded, to the lowest responsive and responsible bidder, based on the Total Bid Price of the project. The City of Ironwood reserves the right to reject any and all bids as in the best interest of the City.

Section B – Special Provisions

1. Underground Utilities

(a) For protection of underground utilities and in conformance with Public Act 53, 1974, the Contractor shall call 1-800-482-7171 a minimum of three full working days, excluding Saturdays, Sundays and Holidays prior to beginning each excavation in areas where public utilities have not been previously located. Members will thus be routinely notified. This does not relieve the Contractor of the responsibility of notifying utility owners who may not be part of the "Miss Dig" alert system.

3. Construction Coordination / Permits

(a) Construction will need to be coordinated with the City of Ironwood Engineering Department.

(b) The contractor will be responsible for obtaining the necessary permits from the State of Michigan and/or any other necessary agency. Contractor shall include all permit costs with their bid.

4. Requirements for Performance Security and Payment Security

(a) The successful bidder, at the execution of the contract, shall furnish security to guarantee faithful performance of the contract in the amount of 100% of the total contract price.

(b) The successful bidder shall also furnish security to guarantee payment to all persons supplying labor or materials in the performance of the contract in the amount of 100% of the total contract price.

(c) Security may be in the form of a performance bond and payment bonds, postal money order, certified check or cashier's check.

(d) Upon completion of the project the contractor shall provide lien wavers from all contractors and suppliers.

5. Commencement, Execution and Completion of Work

(a) The contractor shall be required to commence work under this Contract within 5 calendar days after the date the Contractor receives the Notice to Proceed.

(b) Execute the work diligently.

(c) Working hours are between 7:00 A.M. and 7:00 P.M.

(d) A construction Schedule shall be provided and approved by a City Representative.

(e) No work shall be done on Saturday's or Sunday's unless approved in advance by a City Representative.

6. Failure to Complete Work Within Contract Time

Construction shall be fully completed by December 1, 2024. If the Contractor fails to prosecute the work, or any separate part thereof with such diligence as will insure its completion within the time specified in this contract, fixed and agreed Liquidate Damages will be assessed for each calendar day of delay until the work is completed and accepted. Liquidate Damages equal $250 / Calendar Day.

7. Warranty / Defects

The Contractor shall be responsible for any and all defects that may develop in any part of the entire work or installation furnished by him/her. Upon written notice of the City of Ironwood, the contractor shall immediately replace and make good, without expense to the owner, any faulty part, material, or workmanship. A one-year warranty shall be provided by the contractor. The warranty shall start from the date the final payment is made.

8. Scope of Work

The attached plans and specifications are the contract documents for the project.

SECTION C - BIDDING REQUIREMENTS, CONDITIONS AND CONTRACT ADMINISTRATION

C-1. Competency of Bidders

(a) The City Manager reserves the right to select bidders and may refuse to issue a proposal to any individual, partnership, firm or corporation based upon but not limited to one or more of the following facts:

(1) For having defaulted on previous contracts.
(2) For having performed similar work in an unsatisfactory manner.
(3) When in the City Manager's judgment, the bidder does not have the required experience in the class of work bid on, fails to have the proper labor and equipment, or fails to have sufficient capital or quick asset to finance the work.
(4) A minimum of three municipal references are required to bid projects.

C-2. Interpretation of Estimates, Specifications, Special Provisions and Site of Work

The quantities on the proposal are approximate only and given as a basis to compare bids. The City does not assume any responsibility that these quantities will remain unchanged in actual construction. The bidder is required to examine carefully the site of work, plans, specifications, and contract form for the proposed work. It will be assumed that he has judged for and satisfied himself as to the conditions to be encountered, as in the work, materials furnished, and in the above documents. The bidder is assumed to have familiarized himself with the Federal, State, and Local laws, which may affect the work, workers, or materials furnished.

C-3. Delivery of Proposal

Each proposal must be submitted in a sealed envelope with the bidder's name and address on the outside of the envelope. All proposals must be received on or before the hour stated in the advertisement. More than one proposal for the same project from an individual, partnership, firm, or corporation will not be considered. Email bids received in PDF format accepted. Must state project name with bid opening date in subject line. Faxed bids shall not be accepted.

C-4. Public Opening of Proposals

Proposals will be opened publicly and read aloud at the hour, date, and place set in the advertisement.

C-5. Execution of Contract

(a) Bonnie Road Lift Station Generator shall be completed no later than December 1, 2024. If the generator lead time is out longer than this date, the City of Ironwood will work with the Contractor on an alternate schedule. The City would expect that the slab and other sitework would be installed prior to winter conditions, so that the generator can be set once available.

City of Ironwood

Bonnie Road Lift Station Generator

Bid Form

TOTAL BID $_____

Company Name: _____

Address: _____

Email: _____

Phone Number: _____

Signature: _____

Title: _____

SECTION D – INSURANCE

D-1 Insurance

(1) Workmen's Compensation Insurance – The Contractor, prior to the execution of the Contract, shall file a certification that the Contractor carries Worker's Compensation Insurance.

(2) Bodily Injury and Property Damage Insurance – The Contractor prior to execution of the Contract shall file with the City of Ironwood copies of completed certificates of insurance, as evidence that the Contractor carries adequate insurance to afford protection against all claims for damages to public or private property and injuries to person, arising out of and during the progress of work. The minimum limits of insurance shall be as follows:

(3) General Liability
Bodily Injury and Property Damage Liability:
Each Occurrence $1,000,000
Aggregate… $2,000,000

(2) Automobile Liability Insurance (Comprehensive Form)
Bodily Injury Liability:
Each Person…..…. $ 500,000
Each Occurrence.....$1,000,000

Property Damage Liability:
Each Occurrence.....$1,000,000

Combined Single Limit for Bodily Injury and Property Damage Liability:
Each Occurrence.....$2,000,000

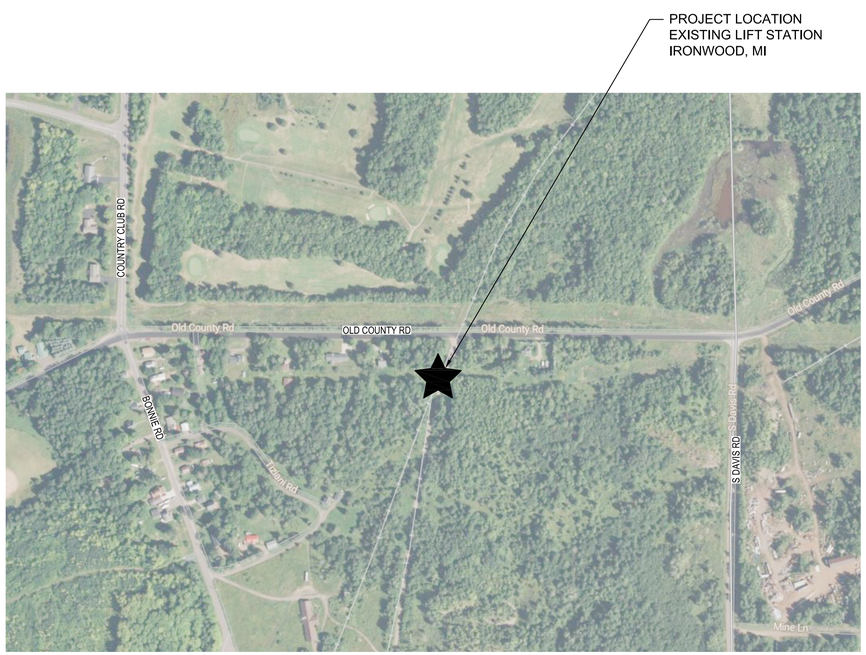
(4) The requirements for 1 and 2 above, may be met through an Umbrella policy.

(5) Owners Protective Liability. Bodily injury and property damage protection, including general supervision of work performed, shall be extended to the City of Ironwood employees and agents. The minimum limit shall be $1,000,000

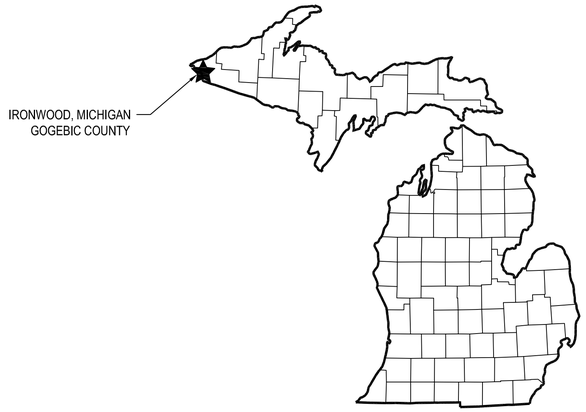
GENERATOR INSTALLATION

IRONWOOD, MICHIGAN

INDEX OF DRAWINGS	
G1	TITLE SHEET
E1	ELECTRICAL - SYMBOLS, ABBREVIATIONS AND NOTES
E2	ELECTRICAL - SITE PLAN
E3	ELECTRICAL - ONE-LINE DIAGRAM AND ELEVATIONS
E4	ELECTRICAL - DETAILS



PROJECT LOCATION MAP



MICHIGAN

SEH

STATE OF MICHIGAN
JOHN P. CARLSON
ENGINEER
No. 51210
DATE 02-15-2024
LICENSED PROFESSIONAL ENGINEER

Project Owner

CITY OF IRONWOOD
BONNIE RD. LIFT STATION GENERATOR INSTALLATION
IRONWOOD, MI

SEH Project	IRCTY 176376
Checked By	JPC
Drawn By	JRB
Project Status	**Issue Date**
PRELIMINARY DESIGN	00/00/0000

REVISION SCHEDULE

REV. #	DESCRIPTION	DATE

TITLE SHEET

G1

Save: 2/13/2024 10:53 AM jbrummel Plot: 2/13/2024 10:53 AM X:\F,I\IRCTY\176376\5-Final\dsgn\51-draw\mgs\35-Elec\G1.dwg

POWER & LIGHTING SYMBOLS

LP-1
1,3
3/4"C.,
2#12,
#12G
BRANCH CIRCUIT HOME RUN TO PANELBOARD, PANEL NAME SHOWN ABOVE CIRCUIT NUMBER(S) AND TAGGED TO INDICATE CONDUIT AND CONDUCTOR SIZES. CIRCUITING SIZES NOT SHOWN SHALL BE MINIMUM 3/4"C. WITH #12 AWG. CONDUCTORS AND SIZED PER NEC REQUIREMENTS.

CONDUIT EXPOSED
CONDUIT CONCEALED
CONDUIT CONTINUED
CONDUIT TURNING UP
CONDUIT CAPPED
OH — OVERHEAD ELECTRICAL LINE
E — UNDERGROUND CONCRETE ENCASED ELECTRICAL DUCT BANK
UNDERGROUND CONCRETE ENCASED ELECTRICAL BANK ROUTED BENEATH SLAB-ON-GRADE

EE — DIRECT BURIED CONDUIT
GROUND CONDUCTOR
INDICATES THAT ALL OR PART OF CIRCUIT MAY BE ROUTED IN DUCT BANK OR UNDERGROUND. CONDUIT SIZE SHOWN ON ONE-LINE IS ABOVE GROUND AND/OR INSIDE OF STRUCTURE. SEE DUCT BANK SCHEDULE AND SECTIONS FOR CONDUIT SIZE OF UNDERGROUND PORTION OF CIRCUIT.

2X4 LIGHT FIXTURE
UPPER CASE INDICATES FIXTURE TYPE NUMBER INDICATES CIRCUIT LOWER CASE INDICATES SWITCH DESIGNATION

1X4 LIGHT FIXTURE
4' INDUSTRIAL LIGHT FIXTURE
2X2 LIGHT FIXTURE
WALL MOUNTED LIGHT FIXTURE
SURFACE MOUNTED LIGHT FIXTURE
RECESSED LIGHT FIXTURE
EXIT LIGHT (WITH FACES & DIRECTION ARROWS INDICATED)
WALL MOUNTED EXIT LIGHT (WITH FACES & DIRECTION ARROWS INDICATED)
WALL MOUNTED BATTERY PACK EMERGENCY LIGHT
SHADED FIXTURE = EMERGENCY LIGHT
POLE MOUNTED LUMINAIRE
HANDRAIL MOUNTED LUMINAIRE

SWITCH SYMBOL:
SINGLE POLE (IF BLANK)
2 = DOUBLE POLE
3 = THREE-WAY
4 = FOUR-WAY
D = DIMMER
K = KEY OPERATED
LV = LOW VOLTAGE

MS = MANUAL MOTOR STARTER
OS = OCCUPANCY SENSOR
P = WITH PILOT LIGHT
WP = WEATHERPROOF
x = SMALL LETTER INDICATES LUMINARIES CONTROLLED
XP = EXPLOSION PROOF

POWER OR DISTRIBUTION CABINET
POWER OR LIGHTING PANELBOARD
MOTOR AND MOTOR SWITCH
METER
DISCONNECT
MOTOR STARTER
COMBINATION STARTER/DISCONNECT
TRANSFORMER
RELAY
SINGLE WALL RECEPTACLE
DUPLEX WALL RECEPTACLE
DUPLEX CEILING RECEPTACLE
EMERGENCY RECEPTACLE
SPECIAL PURPOSE RECEPTACLE
DOUBLE DUPLEX RECEPTACLE
FLOOR BOX, POKE-THROUGH OR GROUND ROD AS NOTED
JUNCTION BOX
WALL MOUNTED JUNCTION BOX
THERMOSTAT
PHOTOCELL
TELEPHONE OUTLET
COMBINATION VOICE/DATA OUTLET
DATA OUTLET
CCTV (CLOSED CIRCUIT TV CAMERA)
BUZZER
PUSHBUTTON STATION
FACP - FIRE ALARM CONTROL PANEL
FAAP - FIRE ALARM ANNUNCIATOR PANEL
FIRE ALARM MANUAL PULL STATION
FIRE ALARM HORN/STROBE
FIRE ALARM STROBE
FIRE ALARM SMOKE DETECTOR:
D = DUCT, I = IONIZATION, PH = PHOTOELECTRIC
FIRE ALARM HEAT DETECTOR
FIRE ALARM FLOW SWITCH
FIRE ALARM TAMPER SWITCH
FIRE SMOKE DAMPER
SMOKE DAMPER

SCHEMATIC SYMBOLS

OCCUPANCY SENSOR, CEIL MOUNT
OCCUPANCY SENSOR, WALL MOUNT
ANTENNA
AT MOTOR (SCHEMATIC DEVICE LOCATION)
AT PLC (SCHEMATIC DEVICE LOCATION)
AT MFR CP (SCHEMATIC DEVICE LOCATION)
CONNECTION POINT
EXTERNAL CONNECTION POINT
GROUND
CIRCUIT BREAKER
DRAWOUT CIRCUIT BREAKER
SWITCH
FUSE
NORMALLY OPEN PUSH-BUTTON
NORMALLY CLOSED PUSH-BUTTON
SELECTOR SWITCH
POTENTIOMETER
NORMALLY CLOSED CONTACTS
NORMALLY OPEN CONTACTS
FIXED CAPACITOR
MUSHROOM HEAD PUSH-BUTTON
NORMALLY CLOSED LIMIT SWITCH
NORMALLY OPEN LIMIT SWITCH
SOLENOID
FLOAT SWITCH (OPENING ON RISING LEVEL)
FLOAT SWITCH (CLOSING ON RISING LEVEL)
SWITCH (OPENING ON INCREASE) P=PRESSURE, V=VACCUM, DP=DIFFERENTIAL PRESSURE
SWITCH (CLOSING ON INCREASE) P=PRESSURE, V=VACCUM, DP=DIFFERENTIAL PRESSURE
TEMPERATURE SWITCH (OPENING ON RISING LEVEL)
TEMPERATURE SWITCH (CLOSING ON RISING LEVEL)
ON TIME DELAY SWITCH (TIME DELAY AFTER COIL IS ENERGIZED)
OFF TIME DELAY SWITCH (TIME DELAY BEFORE COIL IS ENERGIZED)
FLOW SWITCH (OPENING ON INCREASE IN FLOW)
FLOW SWITCH (CLOSING ON INCREASE IN FLOW)
TORQUE SWITCH (NORMALLY CLOSED)
TORQUE SWITCH (NORMALLY OPEN)
ENGINE DRIVEN GENERATOR
MOTOR- NUMBER DENOTES HORSEPOWER
CURRENT TRANSFORMER
POTENTIAL TRANSFORMER
METERING DEVICE
FUSED DISCONNECT
MAGNETIC STARTER
THERMAL OVERLOAD RELAY
SURGE SUPPRESSION
TRANSFORMER
ALARM HORN
KEY INTERLOCK
PILOT LIGHT
STARTER, CONTACTOR OR RELAY COIL

XX XXX (XX) — MISC. SYSTEM COMPONENT, SEE ABBREVIATIONS FOR LETTER DESIGNATIONS NOT LISTED BELOW.

LE = LEVEL ELEMENT
LIT = LEVEL INDICATING TRANSMITTER
FE = FLOW ELEMENT
FIT = FLOW INDICATING TRANSMITTER
FS = FLOW SWITCH
HS = HAND SWITCH
PB = PULLBOX
PT= PRESSURE TRANSDUCER
SS = SOFT STARTER
TS = TAMPER SWITCH
ATS = AUTOMATIC TRANSFER SWITCH
HOA = HAND OFF AUTO SELECTOR SWITCH
TIT = TEMPERATURE INDICATING TRANSMITTER
TSH = TEMPERATURE SWITCH HIGH
TVSS = TRANSIENT VOLTAGE SURGE SUPPRESSER
VFD = VARIABLE FREQUENCY DRIVE
SV = SOLENOID VALVE
XS = MOISTURE SWITCH
XSH = MOISTURE SWITCH HIGH
ZS = POSITION SWITCH

ELECTRICAL ABBREVIATIONS

A	AMBER, AMPERE, ALARM
AC	ALTERNATING CURRENT
AFF	ABOVE FINISHED FLOOR
AFG	ABOVE FINISHED GRADE
AM	AMMETER
ANN	ANNUNCIATOR
AR	ALARM RELAY
AS	AMMETER SWITCH
ATS	AUTOMATIC TRANSFER SWITCH
AWG	AMERICAN WIRE GAUGE
BC	BATTERY CHARGER
BLDG	BUILDING
C	CLOSE, COUNTER OR CONTACTOR
CAP	CAPACITOR
CB	CIRCUIT BREAKER
CD	CONTROL DAMPER
CGD	COMBUSTIBLE GAS DETECTOR
CKT	CIRCUIT
CL2	CHLORINE
CP	CONTROL PANEL
CPT	CONTROL POWER TRANSFORMER
CR	CURRENT OR CONTROL RELAY
CS	CONTROL STATION
CT	CYCLE TIMER OR CURRENT TRANSFORMER
CV	CONTROL VALVE
2/C	2 CONDUCTOR
4"C	4" CONDUIT
DC	DIRECT CURRENT
DI	DOOR INTERLOCK
DM	DAMPER MOTOR OR DEMAND METER
DPDT	DOUBLE POLE DOUBLE THROW
DPST	DOUBLE POLE SINGLE THROW
DP	DIFFERENTIAL PRESSURE
DPS	DIFFERENTIAL PRESSURE SWITCH
DS,DISC	DISCONNECT SWITCH
DWG	DRAWING
E	EMERGENCY OR DAMPER OPERATOR
EC	EMPTY CONDUIT
ECP	EQUIPMENT CONTROL PANEL
EG	ENGINE GENERATOR
EL	ELEVATION OR EMERGENCY LIGHT
EMH	ELECTRICAL MANHOLE
ES	END SWITCH
ETM	ELAPSED TIME METER
EUH	ELECTRICAL UNIT HEATER
EVS	EMERGENCY VENTILATION SHUTOFF
EXIST	EXISTING
F	FORWARD
FA	FIRE ALARM
FACP	FIRE ALARM CONTROL PANEL
FDR	FEEDER
FE	FLOW ELEMENT
FIT	FLOW INDICATING TRANSMITTER
FO	FIBER OPTIC
FS	FLOW SWITCH
FPSP	FIRE PROTECTION SIGNALING PANEL
FVNR	FULL VOLTAGE NON-REVERSING
G	GREEN OR GROUND OR GENERATOR
GD	GROUND DETECTOR OR GAS DETECTOR
GEN	GENERATOR
GFI	GROUND FAULT INTERRUPTER
GFCI	GROUND FAULT CKT INTERRUPTER
GND	GROUND
GUH	GAS UNIT HEATER
H	HIGH OR HUMIDISTAT
HH	HANDHOLE
HOA	HAND-OFF-AUTO
HP	HORSEPOWER
HTR	HEATER
HVMH	HIGH VOLTAGE ELECTRIC MANHOLE
HZ	HERTZ (CYLES PER SECOND)
I/O	INPUT/OUTPUT
INST	INSTANTANEOUS
IS	INTRINSICALLY SAFE
ISO	ISOLATION
J	JUNCTION BOX
K	KEY INTERLOCK
KAIC	KILOAMPERE
KCMIL	THOUSAND CIRCULAR MILS
KV	KILIVOLT
KVA	KILIVOLT AMPERE
KVAR	KILOVAR
KW	KILOWATT
KWH	KILOWATT HOUR
L	LOW, LEVEL
LA	LIGHTNING ARRESTER
LAN	LOCAL AREA NETWORK
LC	LIGHTING CONTACTOR
LE	LEVEL ELEMENT
LIT	LEVEL INDICATING TRANSMITTER
LP	LIGHTING PANEL
LS	LIMIT OR LEVEL SWITCH
LTG	LIGHTING
LWCO	LOW WATER CUTOFF
M	MAGNETIC MOTOR STARTER
MA	MILLIAMPERE
MCB	MAIN CIRCUIT BREAKER
MCC	MOTOR CONTROL CENTER
MD	MOISTURE DETECTOR
MFR	MANUFACTURER
MH	MANHOLE OR MOUNTING HEIGHT
MOV	MOTOR OPERATED VALVE
MS	MANUAL MOTOR STARTER
MSH	MOTOR SPACE HEATER
MTR	MOTOR
MTS	MANUAL TRANSFER SWITCH
MV	MILLIVOLT, MEDIUM VOLTAGE
MVA	MEGA VOLT AMPERE
N	NEUTRAL
NC	NORMALLY CLOSED
NMC	NON-METALLIC CONDUIT
NO	NORMALLY OPEN
O	OPEN
OL	OVERLOAD
OOA	ON-OFF-AUTO
OOR	ON-OFF-REMOTE
OH	OVERHEAD
P	PRIMARY
PB	PUSHBUTTON OR PULL BOX
PLC	PROGRAMMABLE LOGIC CONTROLLER
PF	POWER FACTOR
PFCC	POWER FACTOR CORRECTION CAPACITOR
PH	PHASE, CHEMICAL TERM
PRS	PROXIMITY SWITCH
PRV	POWER ROOF VENTILATOR
PS	PRESSURE SWITCH OR PUMP STATION
PT	POTENTIAL TRANSFORMER OR PROGRAM TIMER
PVC	POLYVINYL CONDUIT
2P	2 POLE
R	RED, RAISE RELAY OR REVERSE
RECP	RECEPTACLE
RGS	RIGID GALVANIZED STEEL
RMC	RIGID METALLIC CONDUIT
RTD	RESISTANCE TYPE TEMP DETECTOR
RTU	REMOTE TERMINAL UNIT
SA	SURGE SUPPRESSOR
SCC	SHORT CIRCUIT CURRENT
SCADA	SUPERVISORY CONTROL AND DATA ACQUISITION
S2	SIZE 2 STARTER
SP	SINGLE POLE
SPD	SURGE PROTECTOR
SPDT	SINGLE POLE DOUBLE THROW
SPST	SINGLE POLE SINGLE THROW
SS	SELECTOR SWITCH OR SOFT STARTER
S.S., SST	STAINLESS STEEL
SSRV	SOLID STATE REDUCED VOLTAGE STARTER
STR	STARTER
SV	SOLENOID VALVE
SWBD	SWITCHBOARD
SWGR	SWITCHGEAR
T	THERMOSTAT, TIMER OR TOTALIZER
TB	TERMINAL BLOCK
TCP	TEMPERATURE CONTROL PANEL
TD	TIME DELAY RELAY
TEMP	TEMPERATURE
TQ	TORQUE
TTB	TELEPHONE TERMINAL BOX
TVSS	TRANSIENT VOLTAGE SURGE SUPPRESSOR
UG	UNDERGROUND
UPS	UNINTERRUPTIBLE POWER SUPPLY
UV	UNDER VOLTAGE OR ULTRAVIOLET
V	VOLTS
VA	VOLT AMPERE
VAR	VOLTAMPERE REACTIVE
VFD	VARIABLE FREQUENCY DRIVE
VM	VOLTMETER
VS	VOLTMETER SWITCH
W	WHITE OR WATTS
WE	WEIGHT ELEMENT
WIT	WEIGHT INDICATING TRANSMITTER
WP	WEATHERPROOF
WPI	WEATHERPROOF IN-USE RECEPTACLE COVER
XFMR	TRANSFORMER
XP	EXPLOSION-PROOF

NOTES

GENERAL WIRING METHODS:

1. USE NO. 10 AWG CONDUCTOR FOR 20 AMPERE, 120-VOLT BRANCH CIRCUIT HOME RUNS LONGER THAN 75 FEET; AND FOR 20 AMPERE, 277-VOLT BRANCH CIRCUIT HOME RUNS LONGER THAN 150 FEET.

CONTACT INFORMATION:

JAMES BRUMMEL
PHONE: 651.765.2915
E-MAIL: jbrummel@sehinc.com

JOHN P. CARLSON, PE
PHONE: 651.490.2166
E-MAIL: jcarlson@sehinc.com

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SEH

STATE OF MICHIGAN
JOHN P. CARLSON
ENGINEER
No. 51210
DATE 02-13-2024
REGISTERED PROFESSIONAL ENGINEER

Project Owner

CITY OF IRONWOOD
BONNIE RD. LIFT STATION GENERATOR INSTALLATION

IRONWOOD, MI

SEH Project	IRCTY 176376
Checked By	JPC
Drawn By	JRB

Project Status	**Issue Date**
PRELIMINARY DESIGN	00/00/0000

REVISION SCHEDULE

REV. #	DESCRIPTION	DATE

ELECTRICAL - SYMBOL LEGEND, ABBREVIATIONS AND NOTES

E1

N

1
E2

ELECTRICAL SITE PLAN

SCALE: 1"=20'

20 0 20 40

scale 10 feet

GENERAL NOTES:

1. SEE ONE-LINE DIAGRAM ON SHEET E3 FOR CONDUIT AND CONDUCTOR SIZES.
2. FIELD COORDINATE THE EXACT LOCATION OF ATS, GENERATOR, LP TANK, U.G. CONDUIT ROUTING AND U.G. GAS PIPE ROUTING ON SITE DURING CONSTRUCTION.
3. COORDINATE LP SERVICE REQUIREMENTS WITH LOCAL LP PROVIDER.

KEYNOTES:

1. EQUIPMENT RACK ELEVATIONS SHOWN ON SHEET E3.
2. ATS ONE-LINE DIAGRAM AND INSTALLATION SHOWN ON SHEET E3.
3. APPROXIMATE LOCATION OF BURIED CIRCUITRY.
4. COORDINATE LOCATION OF LP TANK, GAS LINES, SIZES AND CONNECTIONS. PROVIDE GAS LINE FROM TANK TO GENERATOR. VERIFY ACTUAL LP GAS REQMNT'S WITH GENERATOR. PROVIDE 36"X42" GRAVEL PAD AT EACH CORNER FOR PRECAST MOUNTING BLOCKS PROVIDED BY THE GAS COMPANY.
5. PROVIDE SUFFICIENT BASE MATERIAL FOR TOP OF GENERATOR EQUIPMENT SLAB HEIGHT TO BE EQUAL OR GREATER THAN TOP OF LIFT STATION COVER.

SEH

STATE OF MICHIGAN
JOHN P. CARLSON
ENGINEER
No. 51210
DATE 02-15-2024
LICENSED PROFESSIONAL ENGINEER

Project Owner

CITY OF IRONWOOD
BONNIE RD. LIFT STATION GENERATOR INSTALLATION

IRONWOOD, MI

SEH Project	IRCTY 176376
Checked By	JPC
Drawn By	JRB

Project Status	**Issue Date**
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REVISION SCHEDULE

REV. #	DESCRIPTION	DATE

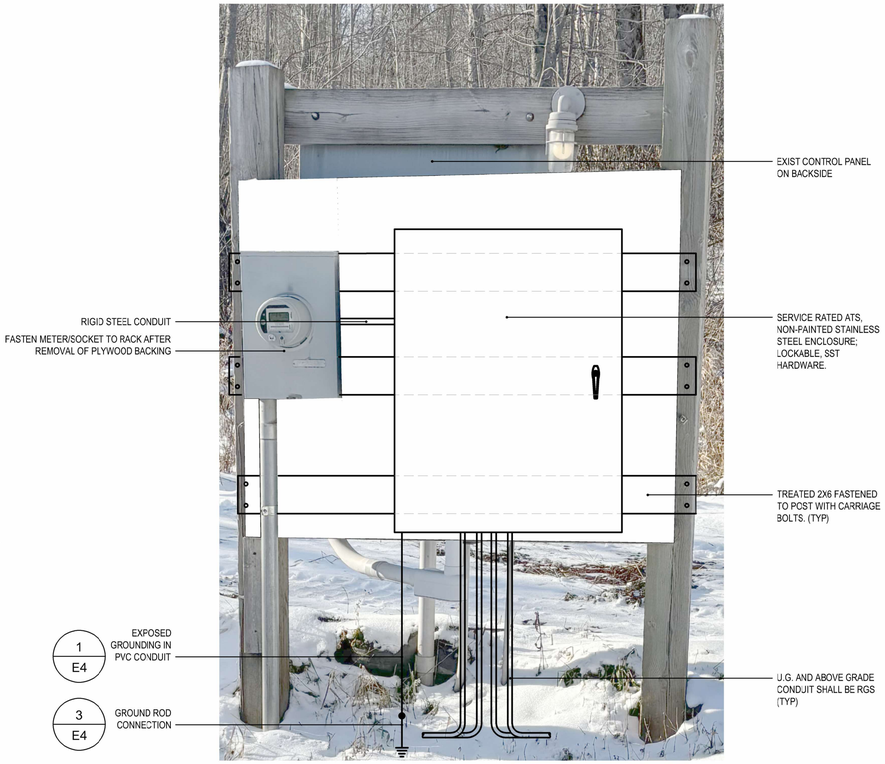
ELECTRICAL - SITE PLAN

E2

Save: 2/13/2024 10:47 AM jbrummel Plot: 2/13/2024 10:57 AM X:\FJ\IN\IRCTY\176376\5-final\dsgn\51-drawings\35-Elec\E2.dwg

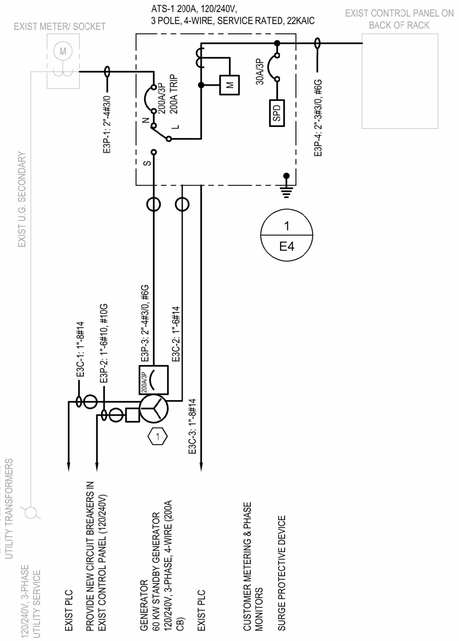
1 E3 EXIST EQUIPMENT RACK - FRONT VIEW (REMOVAL)

SCALE: NONE



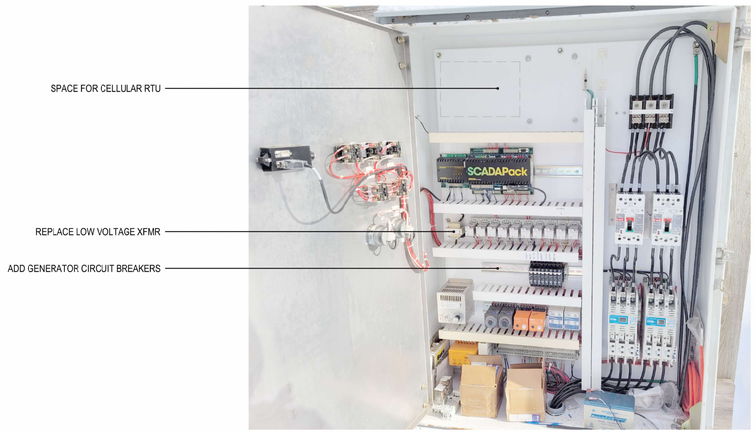
2 E3 EXIST EQUIPMENT RACK - FRONT VIEW

SCALE: NONE



3 E3 ATS ONE-LINE DIAGRAM

SCALE: NONE



BACK PANEL VIEW

FRONT VIEW

4 E3 EXIST CONTROL PANEL

SCALE: NONE

GENERAL NOTES:

1. REFER TO SITE PLAN SHEET E2 FOR LOCATIONS AND ORIENTATION.

KEYNOTES:

1. BOND TO GENERATOR FRAME GROUNDING POINT AND TO CONDUIT BANK GROUNDING CONDUCTOR(S). SEE DETAIL 2/E4.

SEH

STATE OF MICHIGAN
JOHN P. CARLSON
ENGINEER
No. 51210
DATE 02-13-2024
LICENSED PROFESSIONAL ENGINEER

Project Owner

CITY OF IRONWOOD
BONNIE RD. LIFT STATION GENERATOR INSTALLATION
IRONWOOD, MI

SEH Project	IRCTY 176376
Checked By	JPC
Drawn By	JRB

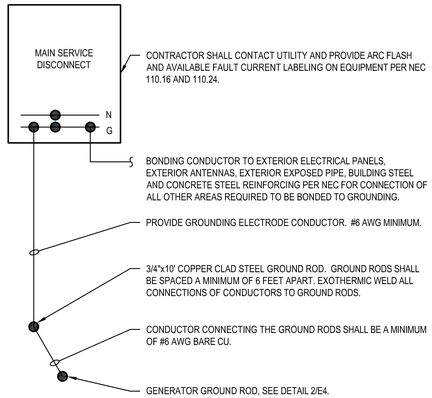
Project Status	**Issue Date**
PRELIMINARY DESIGN	00/00/0000

REVISION SCHEDULE

REV. #	DESCRIPTION	DATE

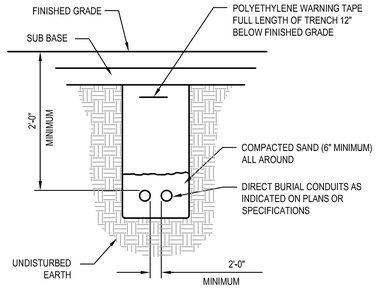
ELECTRICAL - ONE-LINE DIAGRAM AND ELEVATIONS

E3



1 / E4 **BONDING & GROUNDING SERVICE DISCONNECT**

SCALE: NONE

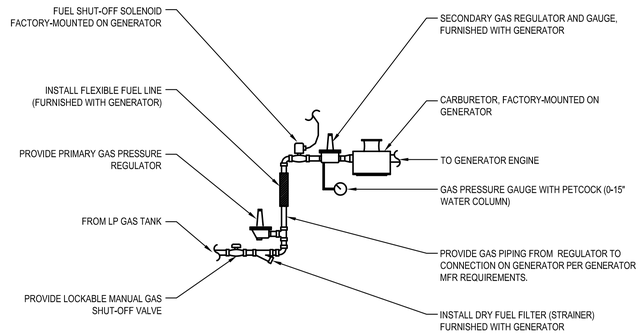


NOTES:

1. BACKFILL OF SELECT COMMON FILL COMPACTED IN LIFTS OF 6" (DEPTH VARIES)

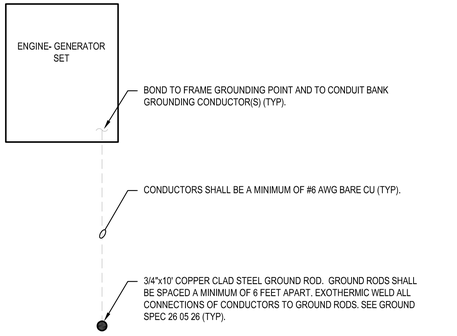
4 / E4 **DIRECT BURIED CONDUIT**

SCALE: NONE



6 / E4 **GENERATOR GAS PIPING DETAIL**

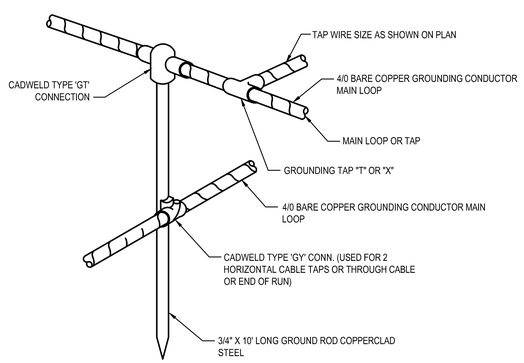
SCALE: NONE



NOTE: GROUNDING SYSTEM TO GO IN BEFORE COMMON SLAB

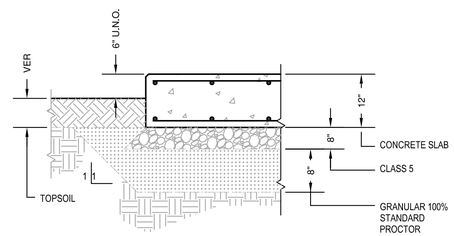
2 / E4 **BONDING & GROUNDING GEN SET**

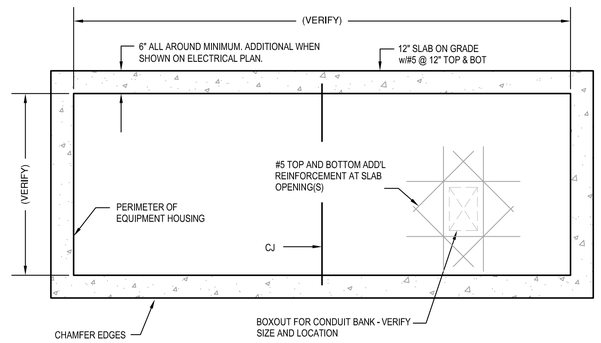
SCALE: NONE



3 / E4 **GROUND ROD CONNECTION**

SCALE: NONE





NOTES

- CJ = PROVIDE SLAB CONTROL JOINT: TOOLED JOINT, 1/2" DEEP, 1/8"W (MAX), MAKE SAW CUT AS SOON AS CUTTING CAN BE DONE WITHOUT RAVELING THE CONCRETE. FILL JOINTS WITH JOINT SEALER (UNO).
- COORDINATE SLAB LOCATION AND ORIENTATION WITH CIVIL.
- REFER TO ELECTRICAL PLANS AND SPECIFICATIONS FOR ADD'L NOTES & DETAILS.
- CONTRACTOR SHALL VERIFY DIMENSIONS AND ALL OTHER REQUIREMENTS.

5 / E4 **GENERATOR EQUIPMENT SLAB DETAIL**

SCALE: NONE

SEH

STATE OF MICHIGAN
JOHN P. CARLSON
ENGINEER
No. 51210
DATE 02-13-2024
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CITY OF IRONWOOD
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PRELIMINARY DESIGN	00/00/0000

REVISION SCHEDULE

REV. #	DESCRIPTION	DATE

ELECTRICAL - DETAILS

E4

SECTION 26 00 00

GENERAL PROVISIONS 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. Scope of Work:
   1. The work included under Division 26 and Division 40 is for the lift station portion of the project and shall consist of furnishing labor and materials necessary for the complete installation of the electrical systems shown on the Contract Drawings and described in the Specifications. This shall include minor items which are necessary to complete the installation and usually included in similar work even though not specifically mentioned in the Contract Documents.
   2. Contractor is responsible for the coordination of the installation of electrical equipment with other trades. Where conflicts between disciplines arise, contact the Engineer prior to equipment installation.

B. Related Requirements:
   1. The Contractor is responsible for information contained in the Division 26 Specifications in addition to electrical requirements and information contained in other divisions.

1.03 PERMITS, LICENSES, AND FEES

A. Provide temporary and permanent permits and licenses required for the completion of the work included under this contract. Fees and expenses required to obtain such permits shall be paid for by the Contractor.

B. Fees and costs charged by utility companies for utility services, or modifications to, shall be paid for by the Owner.
   1. Contractor to coordinate with Owner and Utility for direct billing of utility services to Owner.
      a. Contractor is responsible for re-routing of the existing Xcel service secondary through the Automatic Transfer Switch.
      b. Contractor is responsible for coordination of utility outages with Xcel Energy and the Owner.
         1) Notify Owner minimum of 1 week prior to any utility outage.
         2) Lift station shall not be without power for more than 4 hours at any time.
   2. Electric Utility is Xcel Energy.
      a. Contact Stacey Westeen at Xcel Energy (715) 492-4775
   3. Contractor to coordinate application and delivery of propane tank with gas provider and the Owner.
      a. Contractor to meet with gas supplier representative and Owner on-site to coordinate propane tank location.
      b. Contact Ritchie Oil
      c. Contractor to provide piping from tank to generator.

C. Provide inspections as required by regulating agencies or where required by code. Include and pay charges for inspection agencies and provide Owner with a certificate of final inspection and approval by the authority having jurisdiction.

D. Refer to General Conditions for state and local sales tax requirements.

1.04 REFERENCES

A. Material and workmanship to comply with applicable codes. As a minimum include State and Federal laws, local ordinances, Utility Company regulations and requirements and interpretations of the following by the local authority having jurisdiction:
   1. State and Local Building Codes.
   2. State and Local Fire Codes.
   3. National Electrical Code.
   4. State and Local Electrical Codes.
   5. OSHA Regulations.

B. If drawings and specifications are in conflict with these codes, notify the Engineer prior to rough-in.

C. The following is list of organizations and their abbreviations where referred to in the specifications as standards of construction:
   1. ANSI – American National Standard Institute.
   2. ASHRAE – American Society of Heating, Refrigeration and Air Conditioning Engineers.
   3. ADA – Americans with Disabilities Act.
   4. ASTM – American Society for Testing and Materials.
   5. FM – Factory Mutual.
   6. IRI – Industrial Risk Institute.
   7. IEEE – Institute of Electrical and Electronic Engineers.
   8. NBFU – National Board of Fire underwriters.
   9. NBS – National Bureau of Standards.
   10. NEC – National Electrical Code.
   11. NEMA – National Electrical Manufacturers Association.
   12. NFPA – National Fire Protection Agency.
   13. OSHA – Occupational Safety and Health Administration.
   14. UL – Underwriters' Laboratories, Inc.

1.05 DEFINITIONS

A. The terms listed below are defined as followed:
   1. Furnish: Obtain, coordinate, deliver to the job site and guarantee.
   2. Install: Furnished by others, receive on site, unload, store, set in place, connect, place in operation and guarantee workmanship of installation.
   3. Provide: Furnish and install.
   4. Connect: Bring service to the equipment and make final attachments, including necessary disconnect switches, control switches, outlets, etc.
   5. Conduit: Electrical conduit and associated fittings, hangers, pull boxes, supports, etc. as required for a complete and proper installation.
   6. Concealed: Hidden from sight in walls, ceilings or floors.
   7. Exposed: Surface mounted, not hidden from site.
   8. Building Structure: Columns and beams.
   9. Relocate: Existing equipment to be relocated to new location and existing conduit and branch circuiting (conductors) to be extended to new location and reconnected.
   10. Circuitry: Conduit, conductors and connections for a complete operational system.

1.06 SUBMITTALS

A. Substitutions shall be submitted through a bidding contractor and submitted to engineer (10) working days prior to bid opening. Include detailed information concerning substitution. Acceptable substitutions will be issued in an addendum to the Contract Documents prior to bid date. Extra costs incurred as a result of substitution, including those of other contractors are the responsibility of the submitting contractor, including engineering redesign cost.

B. Shop drawing submittals shall be done in accordance with the General Conditions and as listed under Division 1. Submit copies for each item as required per individual section of the specifications.

C. Submit Record Drawings in accordance with the General Conditions and as listed under Division 1. Record Drawings shall consist of one complete set marked up with changes completed during construction. Multiple set of markups is will not be accepted and must be transferred to one site prior to submittal.

D. Submit Operating, Maintenances and Warranty Data Manuals in accordance with the General Conditions and as listed in Division 1.

1.07 PROJECT/SITE CONDITIONS

A. Inspection of Site: Before submitting a proposal on the Work, the Contractor and Subcontractors shall examine the site of the proposed work and thoroughly familiarize themselves with existing conditions and limitations affecting the performance of their Work. No extra compensation will be allowed because of a misunderstanding as to the amount of Work involved or lack of knowledge of existing conditions which could have been discovered or reasonable anticipated prior to bidding.

1.08 STORAGE AND HANDLING

A. Protect electrical equipment and components stored or installed on-site with polyethylene or equivalent covering to protect from moisture, plaster, cement, paint, or work of other trades.

B. Additional protective coverings may be constructed of plywood sheeting for additional strength.

C. Replace or touch up and refinish surfaces of original finishes that becomes chipped or scratched during shipment or installation.

1.09 SEQUENCING AND SCHEDULING

A. Install work to accommodate Owner's occupancy requirements during construction period and coordinate electrical schedule and operations with owner.

B. Construct work in a sequence under provisions of division 01 – General requirements and other sections as applicable.

C. Electrical work shall be coordinated with other trades and contractors to expedite completion of project.

D. It will be the contractor's responsibility to examine the drawings and specifications, to take measurements where required to verify dimensions for correct placement of equipment and to progress the contract as expeditiously as possible, so that the progress of the work is orderly and does not cause unnecessary cutting and patching of structures. The contractor shall be responsible for cutting and patching of structures made necessary by the failure to install sleeves, grilles or other items required by the electrical work at the proper time for the normal installation of such items.

E. The determination of quantities of material and equipment required shall be made by the contractor based on the contract documents. Schedules on the drawings and in the specifications are completed as an aid to the contractor but where discrepancies arise, the actual number required shall govern.

1.10 WARRANTY

A. Provide a guarantee of workmanship and material and keep same in good operating condition for a period of one (1) year after final completion of the work as evidenced by issuance of final completion certificate by the Engineer.

B. Correct defects immediately and at contractor's expense those defects due to faulty workmanship or materials that arise during the above mentioned period and make corrections to the satisfaction of the Engineer. Such reconstruction and repairs shall include damages to the finish of the building resulting from the original defect.

C. The guarantee shall not apply where other guarantees for different lengths of time are specifically called for.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.01 ROUGH-IN

A. Verify location for rough-ins with field measurements and with the requirements of the actual equipment to be connected.

B. Consult the Contract Documents (Drawing and Specifications) of other Divisions and other trades for correlating information and layout work so that it will not interfere with other trades. Verify dimensions and conditions; i.e., finished ceiling heights, wall elevations, sections, footing and foundation elevations, beam depths, ductwork and piping etc. with architectural, mechanical, civil, and structural drawings. If conflicts occur such that resolution is not possible by the affected trades on the job, notify the Engineer so a resolution can be worked out. Where work must be replaced due to failure to verify conditions existing on the job, such replacement shall be accomplished at no extra cost to the owner. This shall apply to shop fabricated Work as well as work fabricated in place.

3.02 INSTALLATION

A. Arrange for chases, slots, and openings in other building components during the progress of construction to allow for electrical installation.

B. Install material and equipment in accordance with manufacturers' recommendations, instructions and current NECA, NFPA 70 and UL standards.

C. Install equipment and materials to provide required access for servicing and maintenance. Coordinate equipment location with required access panels and doors. Allow ample space for removal of parts that require replacement or servicing.

D. Coordinate the installation of required supporting devices and sleeves with structural systems.

E. Coordinate with other trades before installing equipment so that conflicts will be resolved before installation. In general large mechanical equipment shall be given priority. Maintain, wherever practical, a minimum separation of 3" from water and waste piping and 12" from hot water and steam piping.

F. Cutting and patching shall be performed in accordance with the provisions of the general conditions.

G. Install systems, materials and equipment level and plumb, parallel and perpendicular to other building systems and components, where installed exposed unless noted otherwise.

3.03 PROTECTION

A. Contractor shall be responsible for damage to electrical equipment or materials. Equipment installed by the Contractor shall be kept in a clean and functional condition until final acceptance by the Owner.

3.04 CLEANING

A. Keep the premises free from the accumulations of waste materials or rubbish caused by execution of the Work. At the completion of the Work, remove rubbish, tools, scaffolding and surplus material from

and about the premises. The premises shall be “broom-cleaned” or its equivalent, unless more thorough cleaning is specified elsewhere.

3.05 PAINTING

A. Refinish electrical equipment damaged during shipping or installation to its original condition. Remove rust, prime and paint per manufacturer’s recommendations for finished equal to original. Do not paint nameplates, labels, tags, stainless steel or items such as shafts, levels, handles, trim or terminal strips.

B. Conduit and raceway systems shall be unpainted unless specifically noted. If painting of conduit and raceway systems is required, coat with paint type and color to match background mounting surface.

C. Touch-up paint shall be applied to equipment with chips or scratch marks.

3.06 OPENINGS, CUTTING AND PATCHING

A. The contractor shall coordinate the placing of openings in structures as required for the installation of electrical work.

B. The contractor shall coordinate the accurate location and size for required openings and shall assure that the proper size openings are provided. Openings shall be patched and/or sealed.

C. Contractor shall provide cutting and patching as required for the installation of the work, and shall furnish lintels and supports as required for openings. Cutting of the structural members will not be permitted without prior approval of the Engineer. Extent of the cutting shall be minimized by use of core drills, power saws or other machines which will provide neat, minimum openings. Patching shall match adjacent materials and surfaces and shall be performed by craftsman skilled in the respective discipline.

3.07 TEST AND DEMONSTRATIONS

A. Systems shall be tested and placed in proper working order prior to demonstrating to Owner.

B. Prior to acceptance of the electrical installation, the contractor shall demonstrate to the Owner or Owner’s designated representative all essential features and functions of the systems installed and shall instruct the owner in the proper operation and maintenance of such systems.

C. Contractor shall furnish the necessary trained personnel to perform to demonstrations and training and shall arrange to have the manufacturers’ representatives for the system present to assist with the demonstration, the owner and contractor shall each sign a certification stating that the training has been performed and the owner accepts the same.

3.08 CONCRETE WORK

A. The contractor shall coordinate size and location of concrete bases and pads for electrical equipment with the required trades and with the utility.

B. The contractor shall furnish equipment anchor bolts and shall be responsible for their proper installation and accurate location.

3.09 EXCAVATING, TRENCHING AND BACKFILLING

A. The contractor shall do excavating necessary for underground electrical ducts, wiring manholes, conduit, etc. and shall backfill such trenches and excavations after equipment has been installed and tested. Care shall be taken in excavating, so that walls and footings and adjacent load bearing soils are not disturbed, except where lines must cross under a wall footing. Where a line must pass under a footing, the crossing shall be made by the smallest possible trench to accommodate the pipe.

B. Excavations shall be kept free from water by pumping if necessary. No greater length of trench shall be left open, in advance of pipe and utility laying, than necessary.

C. Immediately after testing and/or inspection, the trench shall be carefully backfilled. Place backfill into trench, so the impact on installed pipe is minimized. Backfill and compact to specifications described in division 02 for utility trenching.

END OF SECTION

SECTION 26 05 19

LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

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. Copper building wire rated 600 V or less.
   2. Control Cable
   3. Connectors, splices, and terminations rated 600 V and less.

PART 2 PRODUCTS

2.01 COPPER BUILDING WIRE

A. Description: Flexible, insulated and uninsulated, drawn copper current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.

B. Manufacturer: Subject to compliance with requirements, provide products by one of the following:
   1. Alpha Wire Company.
   2. American Insulated Wire Corporation.
   3. Belden Inc.
   4. Cerro Wire LLC.
   5. Encore Wire Corporation.
   6. General Cable Corporation.
   7. Southwire Company.
   8. WESCO
   9. Approved Substitution.

C. Standards:
   1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
   2. RoHS compliant.
   3. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

D. Conductors: Copper, complying with ASTM B3 for bare annealed copper and with ASTM B8 for stranded conductors.

E. Conductor Insulation:
   1. Type THWN-2: Comply with UL 83.
   2. Type XHHW-2: Comply with UL 44.

2.02 LOW VOLTAGE CONTROL CABLE (SHIELDED)

A. Standard Cable: NFPA 70, Type CM.
   1. Paired, one pairs, No. 16 AWG, stranded (9x29) tinned-copper conductors.
   2. Individual aluminum foil-polyester tape shielded pairs with 100 percent shield coverage.
   3. PVC jacket.
   4. Flame Resistance: Comply with UL 1685.

5. 600volt rated

2.03 CONTROL WIRING

A. Control wiring as specified for power and lighting wiring, except minimum size may be No. 14 AWG.

B. Wire: Large enough so that voltage drop under in-rush conditions will not adversely affect operation of the controls.

2.04 CONNECTORS AND SPLICES

A. Description: Factory-fabricated connectors, splices, and lugs of size, ampacity rating, material, type, and class for application and service indicated; listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.

B. Manufacture: Subject to compliance with requirements, provide products by one of the following:
1. 3M Electrical Products.
2. AFC Cable Systems.
3. Gardner Bender.
4. Hubbell Power Systems, Inc.
5. Ideal Industries, Inc.
6. ILSCO.
7. NSi Industries LLC.
8. O-Z/Gedney.
9. Service Wire Co.
10. Approved Substitution.

C. Jacketed Cable Connectors: For steel and aluminum jacketed cables, zinc die-cast with set screws, designed to connect conductors specified in this Section.

D. Lugs: One piece, seamless, designed to terminate conductors specified in this Section.
1. Material: Copper.
2. Type: One or two hole with standard barrels.
3. Termination: Compression.

PART 3 EXECUTION

3.01 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders: Copper; solid or stranded for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

B. Branch Circuits: Copper. Solid or stranded for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

3.02 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Service Entrance: Type THHN/THWN-2, single conductors in raceway or Type XHHW-2, single conductors in raceway.

B. Feeders: Type THHN/THWN-2, single conductors in raceway or Type XHHW-2, single conductors in raceway.

C. Branch Circuits: Type THHN/THWN-2, single conductors in raceway or Type XHHW-2, single conductors in raceway.

3.03 INSTALLATION OF CONDUCTORS AND CABLES

A. Complete raceway installation between conductor and cable termination points according to Section 260533 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.

B. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips that will not damage cables or raceway.

3.04 MINIMUM SIZES

A. Minimum control circuit conductor sizes:
   1. Class 1 remote-control and signal circuits; No 16 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 14 AWG.

B. Minimum building wire and power conductor size shall be No. 12 AWG for power and lighting circuits, and No. 14 AWG for control circuits. In order to minimize voltage drop for longer runs, the following minimum conductor sizes apply:
   1. 20A, 120V circuits longer than 75 feet: No. 10 AWG minimum.
   2. 20A, 120V circuits longer than 150 feet: No. 8 AWG minimum.
   3. 20A, 120V circuits longer than 300 feet: No. 6 AWG minimum
   4. 20A, 277V circuits longer than 150 feet: No. 10 WG minimum.
   5. 20A, 277V circuits longer than 300 feet: No. 8 AWG minimum.

3.05 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.

B. Make splices, terminations, and taps that are compatible with conductor material.

C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches (150 mm) of slack.

3.06 IDENTIFICATION

A. Identify and color-code conductors and cables according to Section 260553 "Identification for Electrical Systems."

B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

3.07 FIELD QUALITY CONTROL

A. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors and conductors feeding the following critical equipment and services for compliance with requirements:
   1. Service entrance equipment
   2. Motors larger than 25HP
   3. Equipment rated 100A or greater.
      a. Perform each of the following visual and electrical tests:
         1) Inspect exposed sections of conductor and cable for physical damage and correct connection according to the single-line diagram.
            a) Test bolted connections for high resistance using one of the following:
               (1) low-resistance ohmmeter.
               (2) Calibrated torque wrench.

(3) Thermographic survey.

2) Inspect compression-applied connectors for correct cable match and indentation.
3) Inspect for correct identification.
4) Inspect cable jacket and condition.
5) Insulation-resistance test on each conductor for ground and adjacent conductors. Apply a potential of 500-V dc for 300-V rated cable and 1000-V dc for 600-V rated cable for a one-minute duration.
6) Continuity test on each conductor and cable.
7) Uniform resistance of parallel conductors.

B. Perform each of the following visual and electrical tests on all other equipment:
   a. Inspect exposed sections of conductor and cable for physical damage and correct connection according to the single-line diagram.
   b. Test bolted connections for high resistance using one of the following:
      1) A low-resistance ohmmeter.
      2) Calibrated torque wrench.
      3) Thermographic survey.
   c. Inspect compression-applied connectors for correct cable match and indentation.
   d. Inspect for correct identification.
   e. Inspect cable jacket and condition.
   f. Test receptacles for polarity and continuity.

C. Cables will be considered defective if they do not pass tests and inspections.

END OF SECTION

SECTION 26 05 26

GROUNDING & BONDING 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. Section includes grounding and bonding systems and equipment, plus the following special applications:
   1. Service grounding.
   2. Equipment grounding.

1.03 SUBMITTALS

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

PART 2 PRODUCTS

2.01 SYSTEM DESCRIPTION

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.

B. Comply with UL 467 for grounding and bonding materials and equipment.

2.02 CONDUCTORS

A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.

B. Bare Copper Conductors:
   1. Solid Conductors: ASTM B 3.
   2. Stranded Conductors: ASTM B 8.
   3. Tinned Conductors: ASTM B 33.
   4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch (6 mm) in diameter.
   5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
   6. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.
   7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.

2.03 CONNECTORS

A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.

B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy.

C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

D. Bus-Bar Connectors: Mechanical type, cast silicon bronze, solderless compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.

2.04 GROUNDING ELECTRODES

A. Ground Rods: Copper-clad steel; 3/4 inch by 10 feet (19 mm by 3 m).

PART 3 EXECUTION

3.01 APPLICATIONS

A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger unless otherwise indicated.

B. Underground Grounding Conductors: Install bare copper conductor, No. 2/0 AWG minimum.
   1. Bury at least 24 inches (600 mm) below grade.

C. Conductor Terminations and Connections:
   1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
   2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
   3. Connections to Ground Rods at Test Wells: Bolted connectors.
   4. Connections to Structural Steel: Welded connectors.

3.02 GROUNDING AT THE SERVICE

A. Equipment grounding conductors and grounding electrode conductors shall be connected to the ground bus in the main service entrance equipment. Install a main bonding jumper between the neutral and ground buses.

B. Provide required NEC service grounds per NEC 225, 230, and 250.

3.03 GROUNDING SEPARATELY DERIVED SYSTEMS

A. Generator: Install grounding electrode(s) at the generator location. The electrode shall be connected to the equipment grounding conductor and to the frame of the generator. The ground connection shall be terminated at the ground bus in the electrical room.

3.04 EQUIPMENT GROUNDING

A. Install insulated equipment grounding conductors with all feeders and branch circuits.

B. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:
   1. Feeders and branch circuits.
   2. Lighting circuits.
   3. Receptacle circuits.
   4. Single-phase motor and appliance branch circuits.
   5. Three-phase motor and appliance branch circuits.
   6. Flexible raceway runs.

3.05 INSTALLATION

A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

B. Ground Rods: Drive rods until tops are 2 inches (50 mm) below finished floor or final grade unless otherwise indicated.
   1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.
   2. For grounding electrode system, install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.

C. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.
   1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
   2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
   3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.

3.06 FIELD QUALITY CONTROL

A. Perform tests and inspections.
   1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Tests and Inspections:
   1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
   2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
   3. Test completed grounding system at service disconnect enclosure grounding terminal, and at individual ground rods. Make tests at ground rods before any conductors are connected.
      a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
      b. Perform tests by fall-of-potential method according to IEEE 81.
   4. Prepare dimensioned Drawings locating each test well, ground rod and ground-rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.

C. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Engineer promptly and include recommendations to reduce ground resistance.

END OF SECTION

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SECTION 26 05 33

RACEWAYS AND BOXES 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. Section Includes:
   1. Metal conduits and fittings.
   2. Nonmetallic conduits and fittings.
   3. Boxes, enclosures, and cabinets.
   4. Handholes and boxes for exterior underground cabling.

1.03 DEFINITIONS

A. RMC: Rigid Metal Conduit.

B. GRC: Galvanized Rigid Steel Conduit.

C. LFMC: Liquid Tight Flexible Metal Conduit.

D. RNC: Rigid non-metallic conduit.

1.04 SUBMITTALS

A. Product Data: For raceways, hinged-cover enclosures, and cabinets.

PART 2 PRODUCTS

2.01 METAL CONDUITS AND FITTINGS

A. Metal Conduit:
   1. Manufacturer: Subject to compliance with requirements, provide products by one of the following:
      a. AFC Cable Systems.
      b. Allied Tube & Conduit.
      c. Anamet Electrical, Inc.
      d. Calconduit.
      e. Electri-Flex Company.
      f. FSR, Inc.
      g. Korkap.
      h. NEC, Inc.
      i. Opti-Com Manufacturing Network, Inc. (OMNI)
      j. O-Z/Gedney.
      k. Patriot Aluminum Products, LLC.
      l. Perma-Cote.
      m. Picoma Industries, Inc.
      n. Plasti-Bond.
      o. Approved Substitution.
   2. Listing and Labeling: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

3. GRC: Comply with ANSI C80.1 and UL 6.
    a. Metallic zinc applied by hot-dipped galvanizing or electro-galvanizing.
    b. Threads galvanized after cutting.
    c. Internal coating: Baked lacquer, varnish or enamel for a smooth surface.
4. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.
    a. Flexible steel conduit with PVC jacket and complying with UL 360.
    b. Core formed of continuous, spiral wound, got-dipped galvanized steel with successive convolutions securely interlocked.
    c. Extruded PVC outer jacket positively locked to the steel core.
    d. Liquid and vaportight.

B. Metal Fittings:
1. Comply with NEMA FB 1 and UL 514B.
2. Listing and Labeling: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
3. Fittings, General: Listed and labeled for type of conduit, location, and use.
4. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 1203 and NFPA 70.
5. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.

C. Joint Compound: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.02 NONMETALLIC CONDUITS AND FITTINGS

A. Nonmetallic Conduit:
1. Manufacturer: Subject to compliance with requirements, provide products by one of the following:
    a. AFC Cable Systems.
    b. Anamet Electrical, Inc.
    c. Arnco Corporation.
    d. CANTEX Inc.
    e. CertainTeed Corporation.
    f. Champion Fiberglass, Inc.
    g. Condux International, Inc.
    h. Electri-Flex Company
    i. FRE Composites.
    j. Kraloy.
    k. Lamson & Sessions.
    l. Niedax Inc.
    m. RACO; Hubbell.
    n. Thomas & Betts Corporation.
    o. Approved Substitution.
2. Listing and Labeling: Nonmetallic conduit shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
3. RNC: Type EPC-40-PVC, Type EPC-80-PVC.
    a. Complying with NEMA TC 2 and UL 651 unless otherwise indicated.
    b. Polyvinyl-chloride (PVC) plastic compound.
    c. Rated for direct sunlight exposure where installed exposed.
    d. Fire retardant and low smoke emission.
    e. Suitable for use with 90 Degree C wire.
4. LFNC: Comply with UL 1660.

B. Nonmetallic Fittings:
1. Fittings, General: Listed and labeled for type of conduit, location, and use.
2. Fittings for RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.
3. Fittings for LFNC: Comply with UL 514B.
4. Solvents and Adhesives: As recommended by conduit manufacturer.

2.03 CONDUIT SEALS

A. Conduit seals shall be provided wherever conduits penetrate exterior concrete walls below grade, or cross hazardous location boundaries:
   1. For conduits less than 60 inches below grade; OZ/Gedney Type FSK, or equal.
   2. For conduits more than 60 inches below grade; OZ/Gedney Type WSK, or equal.
   3. For Class 1 Division 1 or Division 2 hazardous location boundaries, conduits shall be sealed at the point where they leave the room. Fittings shall be "EYS", Appleton or Chico "X" Fiber and Chico "A" compound, or approved equal.

2.04 BOXES, ENCLOSURES, AND CABINETS

A. Manufacturer: Subject to compliance with requirements, provide products by one of the following:
   1. Adalet.
   2. Crouse-Hinds.
   3. EGS/Appleton Electric.
   4. Erickson Electrical Equipment Company.
   5. FSR, Inc.
   6. Hoffman.
   7. Hubbell.
   8. Kraloy.
   9. Milbank Manufacturing Company.
   10. MonoSystems, Inc.
   11. Oldcastle Enclosure Solutions.
   12. O-Z/Gedney.
   13. Plasti-Bond.
   14. Approved Substitution.

B. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.

C. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.

D. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.

E. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, cast aluminum with gasketed cover.

F. Box extensions used to accommodate new building finishes shall be of same material as recessed box.

G. Device Box Dimensions: 4 inches square by 2-1/8 inches deep (100 mm square by 60 mm deep).

H. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1, Type 4, Type 3R with continuous-hinge cover with flush latch unless otherwise indicated.
   1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
   2. Nonmetallic Enclosures: Fiberglass.
   3. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.
   4. Metal barriers to separate wiring of different systems and voltage.
   5. Accessory feet where required for freestanding equipment.

I. Cabinets:
   1. NEMA 250, Type 1, Type 4, Type 3R to match environment 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. Metal barriers to separate wiring of different systems and voltage.
   4. Accessory feet where required for freestanding equipment.

J. Boxes, enclosures, and cabinets installed in Class 1, Division I and Division II shall be rated for the area installed.

2.05 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

A. General Requirements for Handholes and Boxes:
   1. Boxes and handholes for use in underground systems shall be designed and identified as defined in NFPA 70, for intended location and application.
   2. Boxes installed in wet areas shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel, fiberglass, or a combination of the two.
   1. Manufacture: Subject to compliance by one of the following:
      a. Armorcast Projects Company.
      b. Carson Industries LLC.
      c. NewBasis
      d. Oldcastle precast, Inc.
      e. Quazite: Hubbell Power Systems, Inc.
      f. Synertech Moulded Products
   2. Standard: Comply with SCTE 77.
   3. Configuration: Designed for flush burial with open bottom unless otherwise indicated.
   4. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
   5. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
   6. Cover Legend: As called for in the drawings.
   7. Conduit Entrance Provisions: Conduit-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: Have inserts for cable racks and pulling-in irons installed before concrete is poured.

PART 3 EXECUTION

3.01 RACEWAY APPLICATION

A. Area classifications are defined on the drawings. See drawings for specific area classification requirements.

B. Outdoors: Apply raceway products as specified below unless otherwise indicated:
   1. Exposed Conduit: GRC.
   2. Concealed Conduit, Aboveground: GRC.
   3. Underground Conduit: RNC, Type EPC-40-PVC, direct buried. Schedule 80 PVC under roadways.
      a. Provide transition to GRC for elbow and riser out of ground. RNC is not permitted above ground.
   4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
   5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R, Type 4X, Type 7.

C. Indoors: Apply raceway products as specified below unless otherwise indicated:
   1. Exposed: GRC.
   2. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
   3. Damp, Humid or Wet Locations: GRC.
      a. GRC shall be painted with corrosive resistant paint.
   4. Hazardous, (Class I or Class II) areas: GRC.
   5. Boxes and Enclosures:

a. Indoors, dry locations: NEMA 250, Type 1 or Type 12.
b. Damp or wet locations: NEMA 250, Type 3R or Type 4 stainless steel.
c. Corrosive Areas: Type 4X stainless steel.
d. Hazardous, (Class I), areas: NEMA 250, Type 7.

D. Minimum Raceway Size: 3/4-inch, (21-mm), trade size.

E. Raceway Fittings: Compatible with raceways and suitable for use and location.
1. Rigid Steel Conduit: Use threaded rigid steel conduit fittinngs. Comply with NEMA FB 2.10.
2. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.

F. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.

3.02 INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.

B. Complete raceway installation before starting conductor installation.

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

D. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches, (300 mm), of changes in direction.

E. Make bends in raceway using large-radius preformed ells. Field bending shall be according to NFPA 70 minimum radii requirements. Use only equipment specifically designed for material and size involved.

F. Support conduit within 12 inches, (300 mm), of enclosures to which attached.

G. Raceways Embedded in Slabs:
1. Run conduit larger than 1-inch, (27-mm), trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure raceways to reinforcement at maximum 10-foot, (3-m), intervals.
2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
3. Arrange raceways to keep a minimum of 1 inch, (25 mm), of concrete cover in all directions.
4. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.

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. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch, (35mm), trade size and insulated throat metal bushings on 1-1/2-inch, (41-mm), trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.

K. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.

L. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.

M. Cut conduit perpendicular to the length. For conduits 2-inch, (53-mm), trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.

N. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb, (90-kg), tensile strength. Leave at least 12 inches, (300 mm), of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.

O. Install raceway sealing fittings at accessible locations according to NFPA 70 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 according to NFPA 70.

P. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:
   1. Where an underground service raceway enters an enclosure.
   2. Conduit extending from interior to exterior of enclosure.
   3. Where otherwise required by NFPA 70.

Q. Comply with manufacturer's written instructions for solvent welding RNC and fittings.

R. Expansion-Joint Fittings:
   1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F, (17 deg C), and that has straight-run length that exceeds 25 feet, (7.6 m). Install in each run of aboveground RMC conduit that is located where environmental temperature change may exceed 100 deg F, (55 deg C), and that has straight-run length that exceeds 100 feet, (30 m).
   2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:
      a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F, (70 deg C), temperature change.
      b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F, (86 deg C) temperature change.
      c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F, (70 deg C), temperature change.
      d. Attics: 135 deg F, (75 deg C), temperature change.
   3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F, (0.06 mm per meter of length of straight run per deg C), of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F, (0.0115 mm per meter of length of straight run per deg C), of temperature change for metal conduits.
   4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
   5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.

S. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 36 inches, (915 mm), of flexible conduit for equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
   1. Use LFMC in damp or wet locations subject to severe physical damage.
   2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.

T. Installations for Class 1, Division I & II shall be installed to meet NEC 70 requirements. GRC conduits and cast iron boxes shall be used.

3.03 INSTALLATION OF UNDERGROUND CONDUIT

A. Direct-Buried Conduit:

1. Excavate trench bottom to provide firm and uniform support for conduit.
2. Install backfill:
   a. Backfill shall be free of rocks and other unsuitable debris.
   b. Deposit material uniformly on both sides of pie throughout entire trench width.
   c. Place material in 6-inch lifts and mechanically compact.
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, (300 mm), of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction.
4. Install manufactured rigid steel conduit elbows below grade for stub-ups at poles and equipment and at building entrances through floor. Transition to rigid steel conduit at elbow for riser above ground. **Rigid steel shall be used for all exposed piping above ground, non-metallic conduit is not acceptable.**
   a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches, (75 mm), of concrete for a minimum of 12 inches, (300 mm), on each side of the coupling.
   b. For stub-ups at equipment mounted on outdoor concrete bases and where conduits penetrate building foundations, extend steel conduit horizontally a minimum of 60 inches, (1500 mm), from edge of foundation or equipment base. Install insulated grounding bushings on terminations at equipment.
5. Underground Warning Tape: Comply with requirements in Section 260553 "Identification for Electrical Systems."

3.04 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

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

B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch, (12.5-mm), sieve to No. 4, (4.75-mm), sieve and compacted to same density as adjacent undisturbed earth.

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

D. Install handholes with bottom below frost line.

3.05 PROTECTION

A. Protect coatings, finishes, and cabinets from damage and deterioration.
   1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
   2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION

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SECTION 26 05 53

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. Section Includes:
   1. Color and legend requirements for raceways, conductors, and warning labels and signs.
   2. Labels.
   3. Bands and tubes.
   4. Tapes and stencils.
   5. Tags.
   6. Signs.
   7. Cable ties.
   8. Paint for identification.
   9. Fasteners for labels and signs.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Comply with NFPA 70.

B. Comply with ANSI Z535.4 for safety signs and labels.

C. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

2.02 COLOR AND LEGEND REQUIREMENTS

A. Raceways and Cables Carrying Circuits at 600 V or Less:
   1. Black letters on an orange field.
   2. Legend: Indicate voltage and system or service type.

B. Color-Coding for Phase Identification, 600 V or Less: Use colors listed below for ungrounded conductors.
   1. Color shall be factory applied, or field applied for sizes larger than No. 6 AWG if authorities having jurisdiction permit.
   2. Colors for 208/120-V Circuits:
      a. Phase A: Black.
      b. Phase B: Red.
      c. Phase C: Blue.
   3. Colors for 240-V Circuits:
      a. Phase A: Black.
      b. Phase B: Red.
   4. Colors for 480/277-V Circuits:
      a. Phase A: Brown.
      b. Phase B: Orange.
      c. Phase C: Yellow.

5. Color for Neutral: White for 240V and below, Gray for greater than 240V.
6. Color for Equipment Grounds: Green.
7. Colors for Isolated Grounds: Green with two or more yellow stripes.

C. Warning Label Colors:
1. Identify system voltage with black letters on an orange background.

D. Warning labels and signs shall include, but are not limited to, the following legends:
1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."

E. Equipment Identification Labels:
1. Black letters on a white field.
2. For service equipment, include the following information:
a. Nominal system voltage.
b. Available fault current at the service overprotection devices based on the available fault current at the service equipment.
c. The clearing time of service overcurrent protective devices based on the fault current at the service equipment.
d. The date the label was applied.

2.03 LABELS

A. Manufacturer: Subject to compliance with requirements, provide products by one of the following:
1. Brady Corporation.
2. Champion America.
3. emedco.
4. Grafoplast Wire Markers.
5. Helermann Tyton.
6. LEM Products, Inc.
7. Marking Services, Inc.
8. Industrial Safety Solutions.
9. Approved Substitution.

B. Vinyl Wraparound Labels: Preprinted, flexible labels laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing label ends.

C. Snap-around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeves, with diameters sized to suit diameters and that stay in place by gripping action.

D. Self-Adhesive Wraparound Labels: Preprinted, 3-mil-, (0.08-mm-), thick, vinyl flexible label with acrylic pressure-sensitive adhesive.
1. Self-Lamination: Clear; UV-, weather- and chemical-resistant; self-laminating, protective shield over the legend. Labels sized such that the clear shield overlaps the entire printed legend.
2. Marker for Labels: Permanent, waterproof, black ink marker recommended by tag or printer manufacturer.

E. Self-Adhesive Labels: Vinyl, thermal, transfer-printed, 3-mil-, (0.08-mm-), thick, multicolor, weather- and UV-resistant, pressure-sensitive adhesive labels, configured for intended use and location.
1. Minimum Nominal Size:
a. 1-1/2 by 6 inches, (37 by 150 mm), for raceway and conductors.
b. 3-1/2 by 5 inches, (76 by 127 mm), for equipment.
c. As required by authorities having jurisdiction.

2.04 BANDS AND TUBES

A. Manufacturer: Subject to compliance with requirements, provide products by one of the following:
1. Brady Corporation.
2. Helermann Tyton.

3. Approved Substitution.

B. Snap-around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeves, 2 inches, (50 mm) long, with diameters sized to suit diameters and that stay in place by gripping action.

C. Heat-Shrink Preprinted Tubes: Flame-retardant polyolefin tubes with machine-printed identification labels, sized to suit diameter and shrunk to fit firmly. Full shrink recovery occurs at a maximum of 200 deg F, (93 deg C). Comply with UL 224.

2.05 TAPES AND STENCILS

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

B. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; not less than 3 mils, (0.08 mm), thick by 1 to 2 inches, (25 to 50 mm), wide; compounded for outdoor use.

C. Tape and Stencil: 4-inch-, (100-mm-), wide black stripes on 10-inch, (250-mm), centers placed diagonally over orange background and are 12 inches, (300 mm), wide. Stop stripes at legends.

D. Floor Marking Tape: 2-inch-, (50-mm-), wide, 5-mil, (0.125-mm), pressure-sensitive vinyl tape, with yellow and black stripes and clear vinyl overlay.

E. Underground-Line Warning Tape:
1. Tape:
   a. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications utility lines.
   b. Printing on tape shall be permanent and shall not be damaged by burial operations.
   c. Tape material and ink shall be chemically inert and not subject to degradation when exposed to acids, alkalis, and other destructive substances commonly found in soils.
2. Color and Printing:
   a. Comply with ANSI Z535.1, ANSI Z535.2, ANSI Z535.3, ANSI Z535.4, and ANSI Z535.5.
   b. Inscriptions for Red-Colored Tapes: "ELECTRIC LINE, HIGH VOLTAGE”.
   c. Inscriptions for Orange-Colored Tapes: "TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE".
3. Tag: Conductive:
   a. Detectable three-layer laminate, consisting of a printed pigmented polyolefin film, a solid aluminum-foil core, and a clear protective film that allows inspection of the continuity of the conductive core, bright-colored, continuous-printed on one side with the inscription of the utility, compounded for direct-burial service.
   b. Overall Thickness: 5 mils (0.125 mm).
   c. Foil Core Thickness: 0.35 mil (0.00889 mm).
   d. Weight: 28 lb/1000 sq. ft. (13.7 kg/100 sq. m).
   e. 3-Inch (75-mm) Tensile According to ASTM D 882: 70 lbf (311.3 N), and 4600 psi (31.7 MPa).

2.06 CABLE TIES

A. General-Purpose Cable Ties: Fungus inert, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.
1. Minimum Width: 3/16 inch, (5 mm).
2. Tensile Strength at 73 Deg F, (23 Deg C), according to ASTM D638: 12,000 psi, (82.7 MPa).
3. Temperature Range: Minus 40 to plus 185 deg F, (Minus 40 to plus 85 deg C).
4. Color: Black, except where used for color-coding.

B. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.
1. Minimum Width: 3/16 inch, (5 mm).
2. Tensile Strength at 73 Deg F, (23 Deg C), according to ASTM D638: 12,000 psi, (82.7 MPa).

3. Temperature Range: Minus 40 to plus 185 deg F, (Minus 40 to plus 85 deg C).
4. Color: Black.

2.07 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Retain paint system applicable for surface material and location (exterior or interior).

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 PREPARATION

A. Self-Adhesive Identification Products: Before applying electrical identification products, clean substrates of substances that could impair bond, using materials and methods recommended by manufacturer of identification product.

3.02 INSTALLATION

A. Verify and coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and operation and maintenance manual. Use consistent designations throughout Project.

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

C. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and operation and maintenance manual.

D. Apply identification devices to surfaces that require finish after completing finish work.

E. Install signs with approved legend to facilitate proper identification, operation, and maintenance of electrical systems and connected items.

F. System Identification for Raceways and Cables: Identification shall completely encircle cable or conduit. Place identification of two-color markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at 50-foot, (15-m) maximum intervals in straight runs, and at 25-foot (7.6-m) maximum intervals in congested areas.

G. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.

H. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 6 to 8 inches (150 to 200 mm) below finished grade. Use multiple tapes where width of multiple lines installed in a common trench exceeds 16 inches (400 mm) overall. Tape shall be conductive unless otherwise identified on drawings.

I. Cable Ties: General purpose, for attaching tags, except as listed below:
1. Outdoors: UV-stabilized nylon.

3.03 IDENTIFICATION SCHEDULE

A. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment. Install access doors or panels to provide view of identifying devices.

B. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, pull points, and locations of high visibility. Identify by system and circuit designation.

C. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use color coding conductor tape to identify the phase.
   1. Locate identification at changes in direction, at penetrations of walls and floors, at 50-foot (15-m) maximum intervals in straight runs, and at 25-foot (7.6-m) maximum intervals in congested areas.

D. Control-Circuit Conductor Identification: For conductors and cables in pull and junction boxes, manholes, and handholes, use self-adhesive labels with the conductor or cable designation, origin, and destination.

E. Control-Circuit Conductor Termination Identification: For identification at terminations, provide heat-shrink preprinted tubes or self-adhesive labels with the conductor designation.

F. Conductors to Be Extended in the Future: Attach write-on tags or marker tape to conductors and list source.

G. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal 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 the Operation and Maintenance Manual.

H. Locations of Underground Lines: Underground-line warning tape for power, lighting, communication, and control wiring and optical-fiber cable.

I. Instructional Signs: Self-adhesive labels, including the color code for grounded and ungrounded conductors.

J. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive warning labels.
   1. Comply with 29 CFR 1910.145.
   2. Identify system voltage with black letters on an orange background.
   3. Apply to exterior of door, cover, or other access.
   4. For 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.

K. Operating Instruction Signs: 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.

L. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and the 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. Indoor Equipment: Self-adhesive engraved laminated acrylic or melamine label.
   2. Outdoor Equipment: Engraved laminated acrylic or melamine label.
   3. Equipment to Be Labeled:
      a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be in the form of a self-adhesive, engraved, laminated acrylic or melamine label.

b. Enclosures and electrical cabinets.
c. Access doors and panels for concealed electrical items.
d. Switchgear.
e. Switchboards.
f. Transformers: Label that includes tag designation indicated on Drawings for the transformer, feeder, and panelboards or equipment supplied by the secondary.
g. Substations.
h. Emergency system boxes and enclosures.
i. Motor-control centers.
j. Enclosed switches.
k. Enclosed circuit breakers.
l. Enclosed controllers.
m. Variable-speed controllers.
n. Push-button stations.
o. Power-transfer equipment.
p. Contactors.
q. Remote-controlled switches, dimmer modules, and control devices.
r. Battery-inverter units.
s. Battery racks.
t. Power-generating units.
u. Monitoring and control equipment.
v. UPS equipment.

END OF SECTION

SECTION 26 32 13

ENGINE GENERATORS

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 packaged engine-generator sets for standby power supply with the following features:
   1. LP Gas Engine, **shall be convertible to Natural Gas in the future**.
   2. Unit-mounted cooling system.
   3. Unit-mounted control and monitoring.
   4. Fuel system.
   5. Sound Attenuated outdoor enclosure.

B. Generator shall meet EPA requirements for stationary emergency applications.

C. Related Requirements:
   1. Section 263600 "Transfer Switches" for transfer switches including sensors and relays to initiate automatic-starting and -stopping signals for engine-generator sets.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
   2. Include thermal damage curve for generator.
   3. Include time-current characteristic curves for generator protective device.
   4. Include fuel consumption in gallons per hour at 0.8 power factor at 0.5, 0.75 and 1.0 times generator capacity.
   5. Include generator efficiency at 0.8 power factor at 0.5, 0.75 and 1.0 times generator capacity.
   6. Include air flow requirements for cooling and combustion air in cfm at 0.8 power factor, with air supply temperature of 95, 80, 70, and 50 deg F. Provide drawings showing requirements and limitations for location of air intake and exhausts.
   7. Include generator characteristics, including, but not limited to kw rating, efficiency, reactances, and short-circuit current capability.

B. Shop Drawings:
   1. Include plans and elevations for engine-generator set and other components specified. Indicate access requirements affected by height of subbase fuel tank.
   2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   3. Identify fluid drain ports and clearance requirements for proper fluid drain.
   4. Design calculations for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.
   5. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include base weights.
   6. Include diagrams for power, signal, and control wiring. Complete schematic, wiring, and interconnection diagrams showing terminal markings for EPS equipment and functional relationship between all electrical components.

C. Provide a sizing report included with the shop drawing submittal for review that the proposed generator set will meet the starting and running requirements for this project. The summary table represents the loads and steps to be used in the sizing report.

1.04 INFORMATIONAL SUBMITTALS

A. Source quality-control reports, including, but not limited to the following:
   1. Certified summary of prototype-unit test report.
   2. Certified Test Reports: For components and accessories that are equivalent, but not identical, to those tested on prototype unit.
   3. Report of factory test on units to be shipped for this Project, showing evidence of compliance with specified requirements.
   4. Report of sound generation.
   5. Report of exhaust emissions showing compliance with applicable regulations.

B. Warranty.

1.05 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For packaged engine generators to include in emergency, operation, and maintenance manuals.
   1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
      a. List of tools and replacement items recommended to be stored at Project for ready access. Include part and drawing numbers, current unit prices, and source of supply.
      b. Operating instructions laminated and mounted adjacent to generator location.
      c. Training plan.

1.06 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Fuses: One for every 10 of each type and rating but no fewer than one of each.
   2. Indicator Lamps: Two for every six of each type used, but no fewer than two of each.
   3. Filters: One set each of lubricating oil, fuel, and combustion-air filters.
   4. Tools: Each tool listed by part number in operations and maintenance manual.

1.07 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved by manufacturer.

B. Testing Agency Qualifications: Member Company of NETA or an NRTL.
   1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

1.08 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace components of packaged engine generators and associated auxiliary components that fail in materials or workmanship within specified warranty period.
   1. Warranty Period: 2 years from date of Substantial Completion.

1.09 OPERATING PARAMETERS

A. Provide a sizing report included with the shop drawing submittal for review that the proposed generator set will meet the starting and running requirements for this project. The summary table represents the loads and steps to be used in the sizing report.

B. Load range: 30-100% of rated capacity.

C. Maximum Allowable Voltage dip: 35%

D. Maximum Allowable Frequency dip: 10%

E. Altitude: Less than 1200 feet

F. Ambient Temperature: 15 to plus 40 deg C.

G. Emissions: EPA, Stationary non-emergency application.

H. Fuel: LP Gas. (Generator shall have capability to be converted to Natural Gas fuel in the future)

I. Duty: Standby

J. Voltage/Frequency: 120/240V, 3-Phase, 4-wire, 60 Hz

K. Power Factor: .8, lagging.

L. Basis of Design: 60 kW/ 75kVA

M. Generator shall be sized to loads as outlined below:

N. Load step and summary list:
   1. Step 1:
      a. 1kW control panel load
      b. 5kW station load
      c. 20-hp submersible pump with FVNR
   2. Step 2:
      a. 20-hp submersible pump with FVNR

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Manufacture subject to one of the following:
   1. Caterpillar; Engine Div.
   2. Cummins Power Generation; Industrial Business Group.
   3. Kohler.
   4. Approved Equal.

B. Source Limitations: Obtain packaged generator sets and auxiliary components through one source from a single manufacturer.

2.02 PERFORMANCE REQUIREMENTS

A. ASME Compliance: Comply with ASME B15.1.

B. NFPA Compliance:
   1. Comply with NFPA 37.
   2. Comply with NFPA 70.

C. UL Compliance: Comply with UL 2200.

D. Engine Exhaust Emissions: Comply with current EPA requirements and applicable state and local government requirements for standby generator applications. Tier requirement for natural gas generator rated for stationary Emergency applications.

E. Noise Emission: Comply with applicable state and local government requirements for maximum noise level at adjacent property boundaries due to sound emitted by generator set including engine, engine exhaust, engine cooling-air intake and discharge, and other components of installation.

2.03 ASSEMBLY DESCRIPTION

A. Factory-assembled and -tested, water-cooled engine, with brushless generator and accessories.

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

C. Induction Method: Naturally aspirated.

D. Governor: Adjustable isochronous, with speed sensing.

E. Emissions: Comply with current EPA requirements.

F. Mounting Frame: Structural steel framework to maintain alignment of mounted components without depending on concrete foundation. Provide lifting attachments sized and spaced to prevent deflection of base during lifting and moving.
   1. Rigging Diagram: Inscribed on metal plate permanently attached to mounting frame to indicate location and lifting capacity of each lifting attachment and generator-set center of gravity.

G. Capacities and Characteristics:
   1. Power Output Ratings: Minimal nominal ratings as indicated on drawings at 0.8 power factor excluding power required for the continued and repeated operation of the unit and auxiliaries, with capacity as required to operate as a unit as evidenced by records of prototype testing.
   2. Unit shall be capable to operate loads as indicted on drawings with minimal capacity as shown. Upsize unit to meet load capabilities and specification requirements.
   3. Output Connections: Three-phase, four wire.
   4. Nameplates: For each major system component to identify manufacturer's name and address, and model and serial number of component.

H. Generator-Set Performance for Sensitive Loads:
   1. Oversizing generator compared with the rated power output of the engine is permissible to meet specified performance.
      a. Nameplate Data for Oversized Generator: Show ratings required by the Contract Documents rather than ratings that would normally be applied to generator size installed.
   2. Steady-State Voltage Operational Bandwidth: 1 percent of rated output voltage from no load to full load.
   3. Transient Voltage Performance: Not more than 10 percent variation for 50 percent step-load increase or decrease. Voltage shall recover and remain within the steady-state operating band within 0.5 second.
   4. Steady-State Frequency Operational Bandwidth: Plus or minus 0.25 percent of rated frequency from no load to full load.
   5. Steady-State Frequency Stability: When system is operating at any constant load within the rated load, there shall be no random speed variations outside the steady-state operational band and no hunting or surging of speed.
   6. Transient Frequency Performance: Less than 2-Hz variation for 50 percent step-load increase or decrease. Frequency shall recover and remain within the steady-state operating band within three seconds.
   7. Output Waveform: At no load, harmonic content measured line to neutral shall not exceed 2 percent total with no slot ripple. Telephone influence factor, determined according to NEMA MG 1, shall not exceed 50 percent.
   8. Sustained Short-Circuit Current: For a three-phase, bolted short circuit at system output terminals, system shall supply a minimum of 300 percent of rated full-load current for not less

than 10 seconds and then clear the fault automatically, without damage to winding insulation or other generator system components.

9. Excitation System: Performance shall be unaffected by voltage distortion caused by nonlinear load.
    a. Provide permanent magnet excitation for power source to voltage regulator.

2.04 ENGINE

A. Fuel: LP Gas. (Generator shall have capability of being converted to Natural Gas in the future)

B. Rated Engine Speed: 1800 rpm.

C. Maximum Piston Speed for Four-Cycle Engines: 2250 fpm (11.4 m/s).

D. Lubrication System: The following items are mounted on engine or skid:
    1. Filter and Strainer: Rated to remove 90 percent of particles 5 micrometers and smaller while passing full flow.
    2. Thermostatic Control Valve: Control flow in system to maintain optimum oil temperature. Unit shall be capable of full flow and is designed to be fail-safe.
    3. Crankcase Drain: Arranged for complete gravity drainage to an easily removable container with no disassembly and without use of pumps, siphons, special tools, or appliances.

E. Provide a dedicated receptacle for each of the following auxiliary heaters. Dedicated receptacle shall be fed from a dedicated circuit breaker in the generator power distribution panel:
    1. Jacket Coolant Heater: Electric-immersion type, factory installed in coolant jacket system. 120-volt single-phase and with cord and plug connection to dedicated receptacle.
        a. Provide ¼ turn isolation ball valves located on the inlet and outlet to isolate heater for replacement of element without draining the cooling system.
        b. Hose clamps to include screw and tension spring.
        c. Thermostatically controlled.

F. Cooling System: Closed loop, liquid cooled, with radiator factory mounted on engine-generator-set mounting frame and integral engine-driven coolant pump.
    1. Coolant: Solution of 50 percent ethylene-glycol-based antifreeze and 50 percent water, with anticorrosion additives as recommended by engine manufacturer.
    2. Size of Radiator: Adequate to contain expansion of total system coolant from cold start to 110 percent load condition.
    3. Expansion Tank: Constructed of welded steel plate and rated to withstand maximum closed-loop coolant system pressure for engine used. Equip with gage glass and petcock.
    4. Temperature Control: Self-contained, thermostatic-control valve modulates coolant flow automatically to maintain optimum constant coolant temperature as recommended by engine manufacturer.
    5. Coolant Hose: Flexible assembly with inside surface of nonporous rubber and outer covering of aging-, ultraviolet-, and abrasion-resistant fabric.
        a. Rating: 50-psig (345-kPa) maximum working pressure with coolant at 180 deg F (82 deg C), and non-collapsible under vacuum.
        b. End Fittings: Flanges or steel pipe nipples with clamps to suit piping and equipment connections.

G. Muffler/Silencer: Critical type, sized as recommended by engine manufacturer and selected with exhaust piping system to not exceed engine manufacturer's engine backpressure requirements.
    1. Minimum sound attenuation of 12 dB at 500 Hz.
    2. Sound level measured at a distance of 25 feet (8 m) from exhaust discharge after installation is complete shall be 76 dBA or less.

H. Air-Intake Filter: Standard-duty, engine-mounted air cleaner with replaceable dry-filter element and "blocked filter" indicator.

I. Starting System: 12 or 24-V electric, with negative ground.

1. Components: Sized so they are not damaged during a full engine-cranking cycle with ambient temperature at maximum specified in "Performance Requirements" Article.
2. Cranking Motor: Heavy-duty unit that automatically engages and releases from engine flywheel without binding.
3. Cranking Cycle: 30 seconds.
4. Maintenance Free Battery: Lead acid, with capacity within ambient temperature range specified in "Performance Requirements" Article to provide specified cranking cycle at least twice without recharging.
5. Battery Cable: Size as recommended by engine manufacturer for cable length indicated. Include required interconnecting conductors and connection accessories.
6. Battery Compartment: Factory fabricated of metal with acid-resistant finish and thermal insulation. Thermostatically controlled heater shall be arranged to maintain battery above 10 deg C regardless of external ambient temperature within range specified in "Performance Requirements" Article. Include accessories required to support and fasten batteries in place. Provide ventilation to exhaust battery gases.
7. Battery-Charging Alternator: Factory mounted on engine with solid-state voltage regulation and 35 A minimum continuous rating.
8. Battery Charger: Current-limiting, automatic-equalizing and float-charging type designed for lead-acid batteries. Unit shall comply with UL 1236 and include the following features:
    a. Operation: Equalizing-charging rate of 10 A shall be initiated automatically after battery has lost charge until an adjustable equalizing voltage is achieved at battery terminals. Unit shall then be automatically switched to a lower float-charging mode and shall continue to operate in that mode until battery is discharged again.
    b. Automatic Temperature Compensation: Adjust float and equalize voltages for variations in ambient temperature from minus 40 deg F (minus 40 deg C) to 140 deg F (plus 60 deg C) to prevent overcharging at high temperatures and undercharging at low temperatures.
    c. Automatic Voltage Regulation: Maintain constant output voltage regardless of input voltage variations up to plus or minus 10 percent.
    d. Ammeter and Voltmeter: Flush mounted in door. Meters shall indicate charging rates.
    e. Enclosure and Mounting: NEMA 250, Type 1, enclosure-mounted cabinet.

2.05 GASEOUS FUEL SYSTEM

A. LP Gas Piping: Comply with current codes and per details on drawings.

B. Gas Train: Comply with NFPA 37.

C. Engine Fuel System:
1. Vapor-Withdrawal System:
    a. Carburetor.
    b. Secondary Gas Regulators: One for each fuel type.
    c. Fuel-Shutoff Solenoid Valves: NRTL-listed, normally closed, safety shutoff valves; one for each fuel source.
    d. Fuel Filters: One for each fuel type.
    e. Manual Fuel Shutoff Valves: One for each fuel type.
    f. Flexible Fuel Connectors: Minimum one for each fuel connection.

D. Coordination
1. Gas Service Connections: Coordinate with utility companies and components they furnish as follows:
    a. Comply with requirements of gas supplier for providing gas services.
    b. Coordinate installation and connection of utilities and services, including provision for gas-metering components.
    c. Local utility shall provide underground service from main to metering equipment at Owners control panel. Contractor shall coordinate with local utility to sequence work.
    d. Coordinate with gas utility and orient generator so that gas connection to generator is on same side as the utility gas supply.

2.06 CONTROL AND MONITORING

A. Automatic Starting System Sequence of Operation: When mode-selector switch on the control and monitoring panel is in the automatic position, remote-control contacts in one or more separate automatic transfer switches initiate starting and stopping of generator set. When mode-selector switch is switched to the on position, generator set starts. The off position of same switch initiates generator-set shutdown. When generator set is running, specified system or equipment failures or derangements automatically shut down generator set and initiate alarms.

B. Provide minimum run time control set for 30 minutes with override only by operation of a remote emergency-stop switch.

C. Comply with UL 508A.

D. Configuration: Operating and safety indications, protective devices, basic system controls, and engine gages shall be grouped in a common control and monitoring panel mounted on the generator set. Mounting method shall isolate the control panel from generator-set vibration. Panel shall be powered from the engine-generator set battery.

E. Indicating Devices :
   1. AC voltmeter.
   2. AC ammeter.
   3. AC frequency meter.
   4. EPS supplying load indicator.
   5. Ammeter and voltmeter phase-selector switches.
   6. DC voltmeter (alternator battery charging).
   7. Engine-coolant temperature gage.
   8. Engine lubricating-oil pressure gage.
   9. Running-time meter.
   10. Current and Potential Transformers: Instrument accuracy class.
   11. Generator Running status indication

F. Protective Devices and Controls in Local Control Panel: Shutdown devices and common visual alarm indication including the following:
   1. Start-stop switch.
   2. Overcrank shutdown device.
   3. Overspeed shutdown device.
   4. Coolant high-temperature shutdown device.
   5. Coolant low-level shutdown device.
   6. Low lube oil pressure shutdown device.
   7. Overcrank alarm.
   8. Overspeed alarm.
   9. Coolant high-temperature alarm.
   10. Coolant low-temperature alarm.
   11. Coolant low-level alarm.
   12. Low lube oil pressure alarm.
   13. Lamp test.
   14. Contacts for local and remote common alarm.
   15. Main fuel tank low-level alarm.
   16. Run-Off-Auto switch.
   17. Control switch not in automatic position alarm.
   18. Battery-charger malfunction alarm.
   19. Generator Running alarm.

G. Supporting Items: Include sensors, transducers, terminals, relays, and other devices and include wiring required to support specified items. Locate sensors and other supporting items on engine or generator, unless otherwise indicated.

H. Connection to Datalink: A separate terminal block, factory wired to Form C dry contacts, for each alarm and status indication. Provide connections for datalink transmission of indications to remote data terminals via ModBus TCP/IP, connect to plant control system that utilizes Allen-Bradley FactoryTalk Software.

I. Supporting Items: Include sensors, transducers, terminals, relays, and other devices and include wiring required to support specified items. Locate sensors and other supporting items on engine or generator, unless otherwise indicated.

J. Remote Emergency-Stop Switch: Mount on enclosure exterior unless otherwise indicated; and labeled. Push button shall be protected from accidental operation.

2.07 GENERATOR OVERCURRENT AND FAULT PROTECTION

A. Overcurrent protective devices for the entire EPSS shall be coordinated to optimize selective tripping when a short circuit occurs. Coordination of protective devices shall consider both utility and EPSS as the voltage source.
   1. Overcurrent protective devices for the EPSS shall be accessible only to authorized personnel.

B. Generator Circuit Breaker: Molded-case, electronic-trip type; 100 percent rated; complying with UL 489.
   1. Tripping Characteristics: Adjustable long-time and short-time delay and instantaneous. Long time trip shall have capacity to reduce 50% of setting.
   2. Trip Settings: Selected to coordinate with generator thermal damage curve.
   3. Shunt Trip: Connected to trip breaker when generator set is shut down by other protective devices.
   4. Mounting: Adjacent to or integrated with control and monitoring panel.

2.08 GENERATOR, EXCITER, AND VOLTAGE REGULATOR

A. Comply with NEMA MG 1.

B. Drive: Generator shaft shall be directly connected to engine shaft. Exciter shall be rotated integrally with generator rotor.

C. Electrical Insulation: Class H or Class F.

D. Stator-Winding Leads: Brought out to terminal box to permit future reconnection for other voltages if required. Provide six lead alternator.

E. Range: Provide limited range of output voltage by adjusting the excitation level.

F. Construction shall prevent mechanical, electrical, and thermal damage due to vibration, overspeed up to 125 percent of rating, and heat during operation at 110 percent of rated capacity.

G. Enclosure: Dripproof.

H. Instrument Transformers: Mounted within control panel.

I. Voltage Regulator: Solid-state type, separate from exciter.
   1. Adjusting Rheostat on Control and Monitoring Panel: Provide plus or minus 5 percent adjustment of output-voltage operating band.
   2. Maintain voltage within 20 percent on one step, full load.
   3. Provide anti-hunt provision to stabilize voltage.
   4. Maintain frequency within 10 percent and stabilize at rated frequency within 2 seconds.

J. Strip Heater: Thermostatically controlled unit arranged to maintain stator windings above dew point.

K. Windings: Two-thirds pitch stator winding and fully linked amortisseur winding.

L. Subtransient Reactance: 12 percent, maximum.

2.09 OUTDOOR SOUND ATTENUATED GENERATOR-SET ENCLOSURE

A. Description: Vandal-resistant, sound-attenuating, weatherproof steel housing, wind resistant up to 100 mph (160 km/h). Multiple panels shall be lockable and provide adequate access to components requiring maintenance. Panels shall be hinged. Instruments and control shall be mounted within enclosure.
   1. Sound Attenuation: 76dB at 25 feet.

B. Description: Prefabricated or pre-engineered, galvanized-steel-clad, integral structural-steel-framed, enclosure; erected on concrete foundation.

C. Hinged Doors: With padlocking provisions.

D. Space Heater: Thermostatically controlled and sized to prevent condensation.

E. Lighting:
   1. Interior light with switch and LED weather-resistant lighting.
   2. Exterior light with switch and LED wall pack fixture mounted on housing.

F. Thermal Insulation: Manufacturer's standard materials and thickness selected in coordination with space heater to maintain winter interior temperature within operating limits required by engine generator components.

G. Engine Cooling Airflow through Enclosure: Maintain temperature rise of system components within required limits when unit operates at 110 percent of rated load for 2 hours with ambient temperature at top of range specified in system service conditions.
   1. Automatic Dampers: At engine cooling-air inlet and discharge. Damper shall be closed to reduce enclosure heat loss in cold weather when unit is not operating.
   2. Ventilation: Provide temperature-controlled exhaust fan interlocked to prevent operation when engine is running.

   One Convenience Outlets: Factory wired, GFCI.

H. Three (3) 20A, 120V circuits will be provided from lift station for shore power, (control system, battery charger, heaters, etc.).

I. Provide generator prime mover shutdown kit on exterior of enclosure to meet requirements of NEC Article 445.

2.10 VIBRATION ISOLATION DEVICES

A. Elastomeric Isolator Pads: Oil- and water-resistant elastomer or natural rubber, arranged in single or multiple layers, molded with a nonslip pattern and galvanized-steel baseplates of sufficient stiffness for uniform loading over pad area, and factory cut to sizes that match requirements of supported equipment.
   1. Material: Standard neoprene separated by steel shims.
   2. Shore "A" Scale Durometer Rating: 50.
   3. Number of Layers: One.
   4. Minimum Deflection: 1 inch (25 mm).

B. Restrained Spring Isolators: Freestanding, steel, open-spring isolators with seismic restraint.
   1. Housing: Steel with resilient vertical-limit stops to prevent spring extension due to wind loads or if weight is removed; factory-drilled baseplate bonded to 1/4-inch- (6-mm-) thick, elastomeric

isolator pad attached to baseplate underside; and adjustable equipment mounting and leveling bolt that acts as blocking during installation.
2. Outside Spring Diameter: Not less than 80 percent of compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of required deflection at rated load.
4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
6. Minimum Deflection: 1 inch (25 mm).

C. Comply with requirements in Section “Hydronic Piping Specialties" for vibration isolation and flexible connectors materials for steel piping.

D. Comply with requirements in Section "Metal Ducts" for vibration isolation and flexible connector materials for exhaust shroud and ductwork.

E. Vibration isolation devices shall not be used to accommodate misalignments or to make bends.

2.11 FINISHES

A. Indoor and Outdoor Enclosures and Components: Manufacturer's standard finish over corrosion-resistant pretreatment and compatible primer.

2.12 SOURCE QUALITY CONTROL

A. Prototype Testing: Factory test engine-generator set using same engine model, constructed of identical or equivalent components and equipped with identical or equivalent accessories.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine areas, equipment bases, and conditions, with Installer present, for compliance with requirements for installation and other conditions affecting packaged engine-generator performance.

B. Examine roughing-in for piping systems and electrical connections. Verify actual locations of connections before packaged engine-generator installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Comply with packaged engine-generator manufacturers' written installation and alignment instructions.

B. Equipment Mounting:
1. See drawings for concrete pad. Coordinate conduit routing with pad installation.
2. Coordinate size and location of concrete bases for packaged engine generators. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.

C. Install packaged engine-generator to provide access, without removing connections or accessories, for periodic maintenance.

D. Install packaged engine-generator with elastomeric isolator pads or restrained spring isolators having a minimum deflection of 1 inch (25 mm) on 4-inch- (100-mm-) high concrete base. Secure sets to anchor bolts installed in concrete bases.

E. Install condensate drain piping to muffler drain outlet full size of drain connection with a shutoff valve, stainless-steel flexible connector, and Schedule 40, black steel pipe with welded joints.

F. Electrical Wiring: Install electrical devices furnished by equipment manufacturers but not specified to be factory mounted.

3.03 CONNECTIONS

A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping and specialties.

B. Connect fuel, cooling-system, and exhaust-system piping adjacent to packaged engine-generator to allow service and maintenance.

C. Connect cooling-system water piping to engine-generator set and heat exchanger with flexible connectors.

D. Connect engine exhaust pipe to engine with flexible connector.

E. Connect fuel piping to engines with a gate valve and union and flexible connector.
   1. Natural-gas piping, valves, and specialties for gas distribution per details on drawings and applicable codes.
   2. Install manual shutoff valve in a remote location to isolate natural-gas supply to the generator enclosure or room.

F. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

3.04 IDENTIFICATION

A. Identify system components according to Section 230553 "Identification for HVAC Piping and Equipment" and Section 260553 "Identification for Electrical Systems."

B. Install a sign indicating the generator neutral is bonded to the main service neutral at the main service location.

3.05 FIELD QUALITY CONTROL

A. Perform tests and inspections.
   1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections.

B. Tests and Inspections:
   1. Perform tests recommended by manufacturer and each visual and mechanical inspection and electrical and mechanical test listed in the first two subparagraphs as specified in NETA Acceptance Testing Specification. Certify compliance with test parameters.
      a. Visual and Mechanical Inspection
         1) Compare equipment nameplate data with drawings and specifications.
         2) Inspect physical and mechanical condition.
         3) Inspect anchorage, alignment, and grounding.
         4) Verify the unit is clean.
      b. Electrical and Mechanical Tests
         1) Perform insulation-resistance tests in accordance with IEEE 43.
            a) Machines larger than 200 horsepower (150 kilowatts). Test duration shall be 10 minutes. Calculate polarization index.
            b) Machines 200 horsepower (150 kilowatts) or less. Test duration shall be one minute. Calculate the dielectric-absorption ratio.
         2) Test protective relay devices.
         3) Verify phase rotation, phasing, and synchronized operation as required by the application.

4) Functionally test engine shutdown for low oil pressure, overtemperature, overspeed, and other protection features as applicable.
5) Verify correct functioning of the governor and regulator.

2. Battery Tests: Equalize charging of battery cells according to manufacturer's written instructions. Record individual cell voltages.
   a. Measure charging voltage and voltages between available battery terminals for full-charging and float-charging conditions. Check electrolyte level and specific gravity under both conditions.
   b. Test for contact integrity of all connectors. Perform an integrity load test and a capacity load test for the battery.
   c. Verify acceptance of charge for each element of the battery after discharge.
   d. Verify that measurements are within manufacturer's specifications.
3. Battery-Charger Tests: Verify specified rates of charge for both equalizing and float-charging conditions.
4. System Integrity Tests: Methodically verify proper installation, connection, and integrity of each element of engine-generator system before and during system operation. Check for air, exhaust, and fluid leaks.
5. Exhaust-System Back-Pressure Test: Use a manometer with a scale exceeding 40-inch wg (120 kPa). Connect to exhaust line close to engine exhaust manifold. Verify that back pressure at full-rated load is within manufacturer's written allowable limits for the engine.
6. Exhaust Emissions Test: Comply with applicable government test criteria.
7. Voltage and Frequency Transient Stability Tests: Use recording oscilloscope to measure voltage and frequency transients for 50 and 100 percent step-load increases and decreases, and verify that performance is as specified.
8. Harmonic-Content Tests: Measure harmonic content of output voltage at 25 percent and 100 percent of rated linear load. Verify that harmonic content is within specified limits.
9. Noise Level Tests: Measure A-weighted level of noise emanating from generator-set installation, including engine exhaust and cooling-air intake and discharge, at four locations on the property line, and compare measured levels with required values.

C. Coordinate tests with tests for transfer switches and run them concurrently.

D. Test instruments shall have been calibrated within the last 12 months, traceable to NIST Calibration Services, and adequate for making positive observation of test results. Make calibration records available for examination on request.

E. Leak Test: After installation, charge exhaust, coolant, and fuel systems and test for leaks. Repair leaks and retest until no leaks exist.

F. Provide a 4 hour run test utilizing load bank. Monitor current, voltage, temperature, record reading every 15 minutes. Test shall be operated a ½ load for 1 hour, ¾ load for 1 hour, and full load for 1 hours.

G. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation for generator and associated equipment.

H. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

I. Remove and replace malfunctioning units and retest as specified above.

J. Retest: Correct deficiencies identified by tests and observations and retest until specified requirements are met.

K. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation resistances, time delays, and other values and observations. Attach a label or tag to each tested component indicating satisfactory completion of tests.

3.06 MAINTENANCE SERVICE

A. Initial Maintenance Service: Beginning at Substantial Completion, provide 12 months' full maintenance by skilled employees of manufacturer's designated service organization. Include quarterly exercising to check for proper starting, load transfer, and running under load. Include routine preventive maintenance as recommended by manufacturer and adjusting as required for proper operation. Provide parts and supplies same as those used in the manufacture and installation of original equipment.

3.07 DEMONSTRATION

A. Engage a factory-authorized service representative to provide startup services and train Owner's maintenance personnel to adjust, operate, and maintain packaged engine generators. Training session shall be a minimum of 4-hours on-site to review all components of the generator set.

END OF SECTION

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SECTION 26 36 00

TRANSFER SWITCHES

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 transfer switches rated 600 V and less, including the following:
   1. Automatic transfer switches, delayed transition.
   2. Front access only.
   3. Service Entrance Rated with Main breaker.

B. Related Requirements:
   1. Section 262313 "Engine Generators”.

1.03 SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, weights, operating characteristics, furnished specialties, and accessories.

B. Shop Drawings: Dimensioned plans, elevations, sections, and details showing minimum clearances, conductor entry provisions, gutter space, installed features and devices, and material lists for each switch specified.
   1. Single-Line Diagram: Show connections between transfer switch, power sources, and load; and show interlocking provisions for each combined transfer switch and bypass/isolation switch.
   2. Control wiring connections between generator, transfer switch and plant control system.

1.04 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.05 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
   1. Features and operating sequences, both automatic and manual.
   2. List of all factory settings of relays; provide relay-setting and calibration instructions, including software, where applicable.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Maintain a service center capable of providing training, parts, and emergency maintenance repairs within a response period of less than eight hours from time of notification.

B. Source Limitations: Obtain automatic transfer switches through one source from a single manufacturer.

C. 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.

D. Comply with NEMA ICS 1.

E. Comply with NFPA 70.

F. Comply with NFPA 99.

G. Comply with UL 1008 unless requirements of these Specifications are stricter.

1.07 FIELD 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:
   1. Notify Owner 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.

1.08 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace components of transfer switch or transfer switch components that fail in materials or workmanship within specified warranty period.
   1. Warranty Period: 24 months from date of Substantial Completion.

1.09 COORDINATION

A. Coordinate size and location of concrete bases.

B. Cast anchor-bolt inserts into bases

PART 2 PRODUCTS

2.01 MANUFACTURED UNITS

A. Manufacture subject to one of the following:
   1. ASCO
   2. Eaton.
   3. Emerson.
   4. GE Zenith Controls.
   5. Hubbell Power Systems, Inc.
   6. Cummins Power Generation

2.02 GENERAL TRANSFER-SWITCH PRODUCT REQUIREMENTS

A. Ratings as shown on the one-line diagram.

B. Indicated Current Ratings: Apply as defined in UL 1008 for continuous loading and total system transfer, including tungsten filament lamp loads not exceeding 30 percent of switch ampere rating, unless otherwise indicated.

C. Tested Fault-Current Closing and Withstand Ratings: Adequate for duty imposed by protective devices at installation locations in Project under the fault conditions indicated, based on testing according to UL 1008.

D. Solid-State Controls: Repetitive accuracy of all settings shall be plus or minus 2 percent or better over an operating temperature range of minus 20 to plus 70 deg C.

E. Resistance to Damage by Voltage Transients: Components shall meet or exceed voltage-surge withstand capability requirements when tested according to IEEE C62.41. Components shall meet or exceed voltage-impulse withstand test of NEMA ICS 1.

F. Electrical Operation: Accomplish by a nonfused, momentarily energized solenoid or electric-motor-operated mechanism, mechanically and electrically interlocked in both directions.

G. Switch Characteristics: Designed for continuous-duty repetitive transfer of full-rated current between active power sources.
   1. Limitation: Switches using molded-case switches or circuit breakers or insulated-case circuit-breaker components are not acceptable.
   2. Switch Action: Double throw; mechanically held in both directions.
   3. Contacts: Silver composition or silver alloy for load-current switching. Conventional automatic transfer-switch units, rated 225 A and higher, shall have separate arcing contacts.

H. Service-Rated Transfer Switch:
   1. Comply with UL 869A and UL 489.
   2. Provide terminals for bonding the grounding electrode conductor to the grounded service conductor.
   3. In systems with a neutral, the bonding connection shall be on the neutral bus.
   4. Provide removable link for temporary separation of the service and load grounded conductors.
   5. Surge Protective Device: Service rated.
   6. Service Disconnecting Means: Externally operated, manual mechanically actuated.

I. Annunciation, Control, and Programming Interface Components: Devices at transfer switches for communicating with remote programming devices, annunciators, or annunciator and control panels shall have communication capability matched with remote device.

J. Factory Wiring: Train and bundle factory wiring and label, consistent with Shop Drawings, either by color-code or by numbered or lettered wire and cable tape markers at terminations. Color-coding and wire and cable tape markers are specified in Section 260553 "Identification for Electrical Systems."
   1. Designated Terminals: Pressure type, suitable for types and sizes of field wiring indicated.
   2. Power-Terminal Arrangement and Field-Wiring Space: Suitable for top, side, or bottom entrance of feeder conductors as indicated.
   3. Control Wiring: Equipped with lugs suitable for connection to terminal strips.

K. Enclosures: General-purpose NEMA 250, Type 3R outdoor, complying with NEMA ICS 6 and UL 508, unless otherwise indicated.

2.03 AUTOMATIC TRANSFER SWITCHES

A. Integral main service circuit breaker disconnect switch rated for use as Service Equipment.

B. Automatic Delayed-Transition Transfer Switches: Pauses or stops in intermediate position to momentarily disconnect both sources, with transition controlled by programming in the automatic transfer-switch controller. Interlocked to prevent the load from being closed on both sources at the same time.
   1. Adjustable Time Delay: For override of normal-source voltage sensing to delay transfer and engine start signals for alternative source. Adjustable from zero to six seconds, and factory set for one second.
   2. Sources shall be mechanically and electrically interlocked to prevent closing both sources on the load at the same time.
   3. Fully automatic break-before-make operation with center off position.
   4. Fully automatic break-before-make operation with transfer when two sources have near zero phase difference.

C. Manual Switch Operation: Under load, with door closed and with either or both sources energized. Transfer time is same as for electrical operation. Control circuit automatically disconnects from electrical operator during manual operation.

D. Automatic Transfer-Switch Features:
   1. Controller operates through a period of loss of control power.
   2. Undervoltage Sensing for Each Phase of Normal Source: Sense low phase-to-ground voltage on each phase. Pickup voltage shall be adjustable from 85 to 100 percent of nominal, and dropout voltage is adjustable from 75 to 98 percent of pickup value. Factory set for pickup at 90 percent and dropout at 85 percent.
   3. Adjustable Time Delay: For override of normal-source voltage sensing to delay transfer and engine start signals. Adjustable from zero to six seconds, and factory set for one second.
   4. Voltage/Frequency Lockout Relay: Prevent premature transfer to generator. Pickup voltage shall be adjustable from 85 to 100 percent of nominal. Factory set for pickup at 90 percent. Pickup frequency shall be adjustable from 90 to 100 percent of nominal. Factory set for pickup at 95 percent.
   5. Time Delay for Retransfer to Normal Source: Adjustable from 0 to 30 minutes, and factory set for 10 minutes to automatically defeat delay on loss of voltage or sustained undervoltage of emergency source, provided normal supply has been restored.
   6. Test Switch: Simulate normal-source failure.
   7. Switch-Position Pilot Lights: Indicate source to which load is connected.
   8. Source-Available Indicating Lights: Supervise sources via transfer-switch normal- and emergency-source sensing circuits.
      a. Normal Power Supervision: Green light with nameplate engraved "Normal Source Available."
      b. Emergency Power Supervision: Red light with nameplate engraved "Emergency Source Available."
   9. Unassigned Auxiliary Contacts: Two normally open, single-pole, double-throw contacts for each switch position, rated 10 A at 240-V ac.
   10. Transfer Override Switch: Overrides automatic retransfer control so automatic transfer switch will remain connected to emergency power source regardless of condition of normal source. Pilot light indicates override status.
   11. Engine Starting Contacts: One isolated and normally closed, and one isolated and normally open; rated 10 A at 32-V dc minimum.
   12. Engine Shutdown Contacts: Time delay adjustable from zero to five minutes, and factory set for five minutes. Contacts shall initiate shutdown at remote engine-generator controls after retransfer of load to normal source.
   13. Engine-Generator Exerciser: Solid-state, programmable-time switch starts engine generator and transfers load to it from normal source for a preset time, then retransfers and shuts down engine after a preset cool-down period. Initiates exercise cycle at preset intervals adjustable from 7 to 30 days. Running periods are adjustable from 10 to 30 minutes. Factory settings are for 7-day exercise cycle, 20-minute running period, and 5-minute cool-down period. Exerciser features include the following:
      a. Exerciser Transfer Selector Switch: Permits selection of exercise with and without load transfer.
      b. Push-button programming control with digital display of settings.
      c. Integral battery operation of time switch when normal control power is not available.

2.04 SOURCE QUALITY CONTROL

A. Factory test and inspect components, assembled switches, and associated equipment. Ensure proper operation. Check transfer time and voltage, frequency, and time-delay settings for compliance with specified requirements. Perform dielectric strength test complying with NEMA ICS 1.

PART 3 EXECUTION

3.01 INSTALLATION

A. Mount switch as shown on the drawings.

B. Identify components according to Section 260553 "Identification for Electrical Systems."

C. Set field-adjustable intervals and delays, relays, and engine exerciser clock.

3.02 CONNECTIONS

A. Wiring to Remote Components: Match type and number of cables and conductors to control and communication requirements of transfer switches as recommended by manufacturer. Increase raceway sizes at no additional cost to Owner if necessary to accommodate required wiring.

B. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

C. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.03 IDENTIFICATION

A. Provide arc flash and available arc fault current labeling on the equipment per NEC 110.16 and 110.24.

3.04 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

B. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
   1. After installing equipment and after electrical circuitry has been energized, test for compliance with requirements.
   2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
   3. Measure insulation resistance phase-to-phase and phase-to-ground with insulation-resistance tester. Include external annunciation and control circuits. Use test voltages and procedure recommended by manufacturer. Comply with manufacturer's specified minimum resistance.
      a. Check for electrical continuity of circuits and for short circuits.
      b. Inspect for physical damage, proper installation and connection, and integrity of barriers, covers, and safety features.
      c. Verify that manual transfer warnings are properly placed.
      d. Perform manual transfer operation.
   4. After energizing circuits, demonstrate interlocking sequence and operational function for each switch at least three times.
      a. Simulate power failures of normal source to automatic transfer switches and of emergency source with normal source available.
      b. Simulate loss of phase-to-ground voltage for each phase of normal source.
      c. Verify time-delay settings.
      d. Verify pickup and dropout voltages by data readout or inspection of control settings.
      e. Verify proper sequence and correct timing of automatic engine starting, transfer time delay, retransfer time delay on restoration of normal power, and engine cool-down and shutdown.

C. Coordinate tests with tests of generator and run them concurrently.

D. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation and contact resistances and time delays. Attach a label or tag to each tested component indicating satisfactory completion of tests.

E. Remove and replace malfunctioning units and retest as specified above.

F. Prepare test and inspection reports.

3.05 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain transfer switches and related equipment. A minimum of 4-hours of on-site training shall be provided.

B. Coordinate this training with that for generator equipment.

END OF SECTION

SECTION 40 90 10

LIFT STATION CONTROLS AND DEVICES

PART 1 GENERAL

1.01 GENERAL

A. This Section describes the requirements for lift station controls and devices.

1.02 REFERENCES

A. National Fire Protection Association (NFPA), latest adopted version.

B. National Electrical Manufactures Association (NEMA)
   1. NEMA ICS-2 Industrial Control Devices, Controllers, and Assemblies.
   2. NEMA 250 Enclosures for Electrical Equipment.

C. Underwriters Laboratories (UL)
   1. UL 83 Thermoplastic Insulated Wires and Cables.
   2. UL 508 Industrial Control Equipment.
   3. UL 698A Industrial Control Panels relating to Hazardous (Classified) Locations.
   4. UL 913 Intrinsically Safe Apparatus and Associated Apparatus for use in Class I, Class II and III, Division 1, Hazardous (Classified) Locations.

1.03 SUMMARY OF WORK

A. Modifications shall be provided to the existing lift station to accommodate the new standby generator as described herein. The Work includes labor, material, equipment (control devices, instrumentation, transfer switch, etc.), software, programming, wiring, and supervision necessary to fabricate, install, start-up, and test a complete and operable control system.

B. A new standby generator and automatic transfer switch shall be provided at the location indicated on the plan sheets. In addition to control functions as outlined herein, the lift station control panel shall be modified to communicate alarm conditions via a cellular alarm dialer. Modifications to the Lift Station Control Panel shall include:
   1. Cellular alarm remote telemetry unit, (RTU).
   2. Backup generator and Automatic Transfer Switch.
   3. Control cabling, instrumentation, and field wiring.
   4. Upgrade the control power transformer and provide three (3) additional 20A, 1-pole circuit breakers for generator shore power.

C. It is the intent of the Contract Documents that all equipment specified in this Section of the specifications be supplied by a single-source supplier (“Systems Integrator”). The supplier shall assume full responsibility along with the Contractor for furnishing, installing and start-up procedures to make the system operate per the intent of the Contract Documents.

D. It shall be the responsibility of the Contractor to furnish a complete and fully operating system. The Contractor shall be responsible for all details which may be necessary to install, adjust and place in operation the complete installation.

E. It shall be the responsibility of the Contractor and supplier to examine all new and existing equipment that is transmitting a signal to, or receiving a signal from, equipment specified in this Section. The Contractor shall be responsible for providing signal converters, buffer amplifiers, and isolation devices to make signal levels, reference to ground, etc. compatible between devices specified in this Section and existing equipment or equipment specified in other Sections.

F. The labor specified herein includes but is not limited to engineering software development, panel fabrication and installation, equipment calibration and adjustment, testing, training, and documentation.

G. This section includes coordination with electrical contractor to ensure that the proper number and type of conductors are installed. It shall be the responsibility of the Systems Integrator to coordinate this work with the installing electrician.

1.04 SUBMITTALS

A. Technical data in conformance with Division 1 and including:
   1. All equipment and components indicated on the Drawings and specified in Part 2 of this Section.

B. Shop Drawings in conformance with Division 1 and including:
   1. Panel Drawings including system schematic drawings, terminal numbering, wire numbering, component schematic drawings, dimension drawings, layout drawing sand nameplate schedule.
   2. Overall system diagram showing all components, converters, cables, and connectors.

C. Operational and Maintenance data in conformance with Division 1 and including:
   1. Panel equipment, field devices and instruments, including “as-built” system schematics.
   2. Electronic files on removable media containing final PLC program and final operator interface application files.
   3. Electronic files on removable media containing final system record drawings, wiring diagrams and panel details. The drawings files shall be in AutoCAD format (.DWG files).
   4. Complete software documentation including programming information and operator’s guides. Include hard copies of all operator interface unit.
   5. All applicable software licenses registered to the Owner.

D. Start-up report from system supplier per requirements of Division 1.

E. Provide hard copies of all submittals.

1.05 QUALITY ASSURANCE

A. All materials, equipment, and parts shall be new and unused of current manufacture.

B. System Integrator shall be responsible for providing all necessary accessories required for a complete and operational system.

C. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than five years of documented experience.

D. Products: Listed and classified by UL or testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicted.

E. Control panels shall be meet the requirements of UL-508A and shall be UL labeled or third party certified. Control panels with intrinsically safe circuits shall meet the requirements of UL-698A and shall be labeled as such.

1.06 FUNCTIONAL DESCRIPTIONS LIFT STATION CONTROL PANEL

A. Lift Station:
   1. Provide modifications to the lift station as follows:
      a. Replace the existing 2kVA control power transformer with a new 5kVA transformer to provide additional capacity for the generator shore power.
      b. Provide three (3) new 1-pole, 20A circuit breakers in the panel to accommodate shore power for the backup generator.
      c. A new cellular alarm RTU shall be provided.

d. Provide relaying and modifications to the program as necessary for the alarms as listed below.

2. Alarm Handling:
   a. Local alarms at the lift station shall not change.
3. The following points shall be broadcast via the cellular RTU:
   a. Normal Power Fail
   b. Generator Fail
   c. High Wet Well Level
   d. Generator Running.
   e. One additional alarm to be determined by the Owner.

1.07 QUALITY ASSURANCE

A. Systems integrator shall be:
   1. Energenecs, Inc., 700 E Milan Dr, Saukville, WI 53080, www.energenecs.com
   2. Contact Brian Akason at (262) 377-6360. (brian.akason@energenecs.com)

PART 2 PRODUCTS

A. Control relays and timing relays
   1. Plug-in type with dust cover, socket and locking spring when relay mounted horizontally.
   2. Coil: continuous operation at 120 VAC ±10 percent unless shown otherwise.
   3. Contacts, 3 pole, double throw, minimum.
      a. 10 amps, make-break, 120 VAC, resistive.
      b. Insulation resistance: 1000 megaohms at 500 VDC.
      c. Dielectric: 2000 VAC, 60 Hz.
   4. Operating time
      a. 35 milliseconds (nominal) energization.
      b. 100 milliseconds (nominal) de-energization.
   5. Mechanical life: 10^6 operations.
   6. Timing relays shall be of the same manufacturer and series as control relays. Provide electronic timers with range as indicated.

B. Indicating lights
   1. Sunlight visible, 30.5mm, high visibility LED.
   2. A “Push-to-Test” pushbutton shall be mounted on the inner door to illuminate all pilot lights when pushed.
   3. Heavy-duty, oil-tight.
   4. NEMA 4 rating.
   5. Allen Bradley 800T, or equal.
   6. Colors.
      a. Running: Green.
      b. Power on: White.
      c. Alarm: Red.
      d. Alert: Amber

C. Terminals
   1. NEMA style, barrier type, 0.4-inch spacing, nominal.
   2. 600V RMS, 55 amp rating.
   3. UL listed.
   4. Allen-Bradley 1492-CA1 series, or equal.
   5. Terminals for larger power circuits shall be 600 VAC barrier-type, sized for the conductors.

2.02 CELLULAR ALARM DIALER

A. 4 digital inputs, 2 analog outputs.

B. Cellular Communication.

C. Nema 4X enclosure.

D. 120V input power.

E. 12V battery backup.

F. High Tide Technologies, or equal. include pre-paid 1 year subscription. Coordinate with Owner for cellular provider and callouts.

2.03 SPARE PARTS

A. Contractor shall furnish the following spare parts to the Owner. Spares shall be delivered in boxes labeled on the outside with manufacturer and part number identified on the box:
   1. One (1) spare relay for each type of relay used.
   2. Two (2) fuses of each type used.

B. Provide the following special tools:
   1. Mounting ring wrench(s) for pushbuttons, switches, and lights.
   2. Fuse puller.

PART 3 EXECUTION

3.01 WORKMANSHIP

A. All work shall be performed in a neat and workmanlike manner consistent with the high-quality standards of the electrical trade. “A neat and workmanlike manner” shall be as required by NFPA 70, Section 110.12; and shall conform to NECA 1, Standard Practices for Good Workmanship in Electrical Contracting. Each electrician shall be knowledgeable and well-trained in the particular tasks to be performed.

3.02 LABELING

A. Label all field mounted control devices, instrumentation, switches, etc., with tag number and item description.

B. Labels shall be engraved laminated plastic with 1/4 inch high lettering. Labels shall be attached with stainless steel screws to the device or nearby wall.

3.03 CALIBRATION, ADJUSTING AND TESTING

A. Devices requiring field calibration shall be calibrated in the presence of the Engineer’s representative and documented.

3.04 PROJECT MANAGEMENT

A. Supplier shall provide engineering and administrative services necessary to fulfill the requirements of this specification.

B. Supplier shall provide the services of an experienced project manager as the overall coordinator during the course of the project.

3.05 TESTING, START-UP, AND TRAINING

A. Supplier shall provide a skilled programmer/instrumentation engineer or technician who shall complete troubleshooting and start-up to place the entire system into satisfactory operation. The engineer or technician shall make the necessary inspection of the completed installation, make the necessary final field adjustments, and make program revisions as required for start-up.

B. Verify motor rotation and proper phase connection prior to operating pump motors.

C. Conduct a 2-hour demonstration of all system features and functions to Owner and Engineer.

D. During start-up, make necessary adjustments, including minor wiring or PLC program changes if needed, to obtain proper operation of the lift station controls.

E. Instruct the Owner's personnel in the proper operation and maintenance of the lift station controls.

F. Record changes to the controls. Revise wiring diagrams and schematic diagrams to show final installation.

G. Insert revised diagrams, final program printouts, and final operator interface screen printouts into each operation and maintenance manual in place of original diagrams.

H. Contractor shall coordinate with the Owner for connection and operation of the Lift Station using a portable generator connection.
   1. Verify proper phasing of the generator receptacle.
   2. Verify operation of the pumps while connected to the generator.

I. Contractor shall test and demonstrate operation of the lift station under generator power. Utility main breaker shall be used to simulate loss of normal power.
   1. Verify proper phase rotation prior to running the pump motors.
   2. Demonstrate operation of lift station on generator power, including startup and running of both pumps.
   3. Demonstrate return to normal power operation using the utility main breaker.

3.06 ACCEPTANCE TESTING

A. After the installation is complete, and proper operation has been demonstrated, a 60-day acceptance test shall begin. The entire system shall be required to operate for 60 days with no malfunctions, field repairable malfunctions excepted. Any malfunction during the 60-day test which cannot be corrected within 24 hours by the supplier shall be considered a non-field repairable malfunction and after repairs are complete, the test shall be repeated.

B. The acceptance test shall apply to all equipment furnished under this Section.

3.07 SUPPLIES

A. Contractor shall provide all expandable items for equipment installed under this contract. For system startup, checkout, and during the acceptance test.

END OF SECTION

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