



City of Bixby Bixby Public Works Authority Meeting Agenda

Monday, January 26, 2026

**Immediately Following the
City Council Meeting**

**Bixby Municipal Building
111 N. Cabaniss Ave., Bixby,
OK 74008**

Public comments are limited to items on the agenda. Those wishing to speak on agenda items will need to appear in the City Council Chamber.

Call to Order

Chairman

Roll Call

Shannon Duran, City Clerk

Consent Agenda

Secretary's Report

Consider and Approve:

- 1) Minutes for the Bixby Public Works Authority Meeting dated 1/12/26.
- 2) Discuss and/or take action on Water Tap Application for 90 + Water Taps for Mountain Creek Ranch Development with approximately 235.16 acres located on the Northeast Corner of 181st Street South and South 161st East Ave, Bixby, OK, in Tulsa County, OK.

Regular Agenda

- 1) Adjournment

Notice of Posting

This Notice and Agenda was posted on the bulletin board this day of January 22, 2025, on or before 5:00 p.m., at City Municipal Building, 111 N. Cabaniss Avenue, Bixby, Oklahoma, 74008.

Respectfully Submitted

Shannon Duran
City Clerk

Note: All cell phones and pagers must be turned off or operated silently during all meetings.

21 O.S. Section 280 provides the following: A. It is unlawful for any person, alone or in concert with others and without authorization, to willfully disturb, interfere or disrupt state business, agency operations or any employee, agent, official or representative of the state. B. It is unlawful for any person who is without authority or who is causing any disturbance, interference or disruption to willfully refuse to disperse or leave any property, building or structure owned, leased or occupied by state officials, employees, agents or representatives or used in any manner to conduct state business or operations after proper notice by a peace officer, sergeant-at-arms, or other security personnel. C. Any violation of the provisions of this section shall be a misdemeanor punishable by imprisonment in the county jail for a term Oklahoma Statutes - Title 21. Crimes and Punishments Page 94 of not more than one (1) year, by a fine not exceeding One Thousand Dollars (\$1,000.00), or by both such fine and imprisonment. D. For purposes of this section, "disturb, interfere or disrupt" means any conduct that is violent, threatening, abusive, obscene, or that jeopardizes the safety of self or others.

For Special Accommodations

Persons who require a special accommodation to participate in this meeting should contact City Clerk, Shannon Duran: City Municipal Building, 111 N. Cabaniss Avenue, Bixby, Oklahoma, 74008, 918-366-4430 or email [City Clerk, Shannon Duran](mailto:sduran@bixbyok.gov) (sduran@bixbyok.gov), as far in advance as possible and preferably at least 48-hours before the date of the meeting. Persons using a Telecommunication Device for the Deaf may contact Oklahoma Relay at 1-800-722-0353 and voice calls should be made to 1-800-522-8506 to communicate via telephone with hearing telephone users and vice versa.

Consent Agenda Item Commentary

Item Title

Minutes for the Bixby Public Works Authority Meeting dated 1/12/26.

Initiator**Staff Information Source****Background****Exhibits**

1. BPWA Minutes 1/12/26

Key Issue**Council Action****Recommendation****Item No:** 1.**Meeting Date**

January 26, 2026

Meeting

20260126 Bixby Public Works Authority Agenda

Bixby Public Works Authority Meeting Minutes

Bixby Municipal Building
111 N. Cabaniss Ave., Bixby, OK 74008
January 12, 2026 at 6:00 PM

The agenda for the regularly scheduled meeting of the Bixby Public Works Authority of the city of Bixby was posted on the bulletin board at the Bixby Municipal Building, 111 N. Cabaniss Ave., Bixby, OK 74008 on January 8, 2026, on or before 5:00 p.m.

Call to Order

Mayor Girard called the meeting to order at 6:06 pm.

Roll Call

Candy Karpe, Assistant City Clerk, called the roll, and the following were present:

Members Present:

Mayor Girard
Vice Mayor Schultz
Councilor Hirshey
Councilor David
Councilor Payne

Staff Present:

Joey Wiedel, City Manager
JT Hammons, City Attorney
Shannon Duran, City Clerk
Charles Barnes, Finance Director
Dylan Warner, Public Works Director
Todd Blish, Police Chief
Joe Sherrell, Fire Chief

Consent Agenda

- 1) Minutes for the Special Bixby Public Works Authority Meeting dated 12/16/25.

Mayor Girard said Item 1 on the Consent Agenda is up for discussion and consideration.

Mayor Girard asks for a motion to approve item 1. Vice Mayor Schultz made a motion to approve, seconded by Mayor Girard.

The vote was taken with the following results:

Carried:5-0

Ayes: Schultz, Girard, David, Payne, Hirshey

Nays: 0

Regular Agenda

- 1) Discuss and/or take action on Water Tap Application for Pete and Susan Matlock located at 16365 South 145th East Ave, Bixby, OK, in Tulsa County Parcel No. 97427742733080.

Mayor Girard said Item 1 on the Regular Agenda is up for discussion and consideration.
Item presented by: Dylan Warner
Others who spoke: Pete Matlock

Discussion ensued about placing a water tap outside the city limits. The 2019 moratorium was read to council with regard to installing a water tap outside the city limits. A cost estimate of \$125 a liner foot for 1350 feet. Mr Matlock spoke about the history of this request. His total cost estimate from the City in December 2024 was \$1170 for a 1-inch water tap. In September 2025, they decided to install the water tap. At that time, they were notified by Public Works about the moratorium and the actual cost of the installation. Mr Matlock would like to have his water tap approved at the price he was quoted when he inquired about the tap before purchasing the land. A recommendation was made that a standardized tap fee that is higher than the City tap fee for anybody that is outside the city limits.

No action was taken on this item to allow the public works director, the city manager and city attorney to review the moratorium and see if it needs to be revoked or amended.

- 2) Adjournment.

Mayor Girard adjourned the meeting at 6:31 pm.

Mayor

City Clerk

Consent Agenda Item Commentary

Item Title

Discuss and/or take action on Water Tap Application for 90 + Water Taps for Mountain Creek Ranch Development with approximately 235.16 acres located on the Northeast Corner of 181st Street South and South 161st East Ave, Bixby, OK, in Tulsa County, OK.

Initiator

Dylan Warner

Staff Information Source

Gwen Plante

Background

Mr. Boone is requesting approximately 90 + Water Taps for Mountain Creek Ranch Development with approximately 235.16 acres located on the Northeast Corner of 181st Street South and South 161st East Ave, Bixby, OK, in Tulsa County, OK.

Mr. Boone will be responsible for obtaining any off-site easements.

Exhibits

1. Boone Trust/Mountain Creek Ranch Development Water Tap Applications

Key Issue

Water Tap Approval

Council Action

Approve water tap (outside the City limits)

Recommendation

Approval

Item No: _____

Meeting Date

January 26, 2026

Meeting

Bixby Public Works Authority Agenda January 26, 2026.

Bixby Public Works Authority

Water Tap Application

Outside of City Limits

\$200.00 Non-refundable fee

(Transaction Code: 116.200 Please reference Name/Address)

Name: Robert B Boone & Pamela R Rev Trust

Address: 17629 S. 161st E Ave

City, State and Zip: Bixby, OK 74008

Telephone No.: [REDACTED]

Email Address: [REDACTED]

Please note, ALL items listed below must be completed and submitted with this application prior to the City reviewing.

Complete		Condition	Staff Approval/Date
Yes	No	⊗ Attached - Request is to upgrade booster + 90 Taps	
✓		Provide site sketch showing tap location ⊗	
✓		Provide legal description for tap location and plat of survey, or Tax map with property to be served highlighted. Also provide proof of ownership. Δ	
✓		Provide analysis for Booster Pump Station design and performance to City Engineer*	
✓		Provide analysis for line sizing to City Engineer*	
N/A		Obtain any and all off-site easements	
✓		Note Service Line Size to be used: <u>1"</u> <u>TO FUTURE HOMES</u>	
✓		Note Meter Line Size to be used: <u>6" Min. THROUGHOUT NEIGHBORHOOD</u>	
✓		Applicant Certification signed and dated.	

**Δ 3 PARCELS AFFECTED - SEE ATTACHED PROPERTY REPORTS + OWNERSHIP AFFIDAVIT
PRELIMINARY PLAT PENDING APPROVAL W/ TULSA COUNTY**

*May not apply. If it does apply, the information will need to be submitted with the application. A plumber will be able to help with this information. If a Booster Pump Station is needed provide the model and specifications.

OFFICE USE ONLY:

Received by: _____ Date: _____

City Council Agenda Date: _____

_____ Approved

_____ Denied

Bixby Public Works Authority

Water Tap Application

(Transaction Code: 116.200 Please reference Name/Address)

Applicant Certification

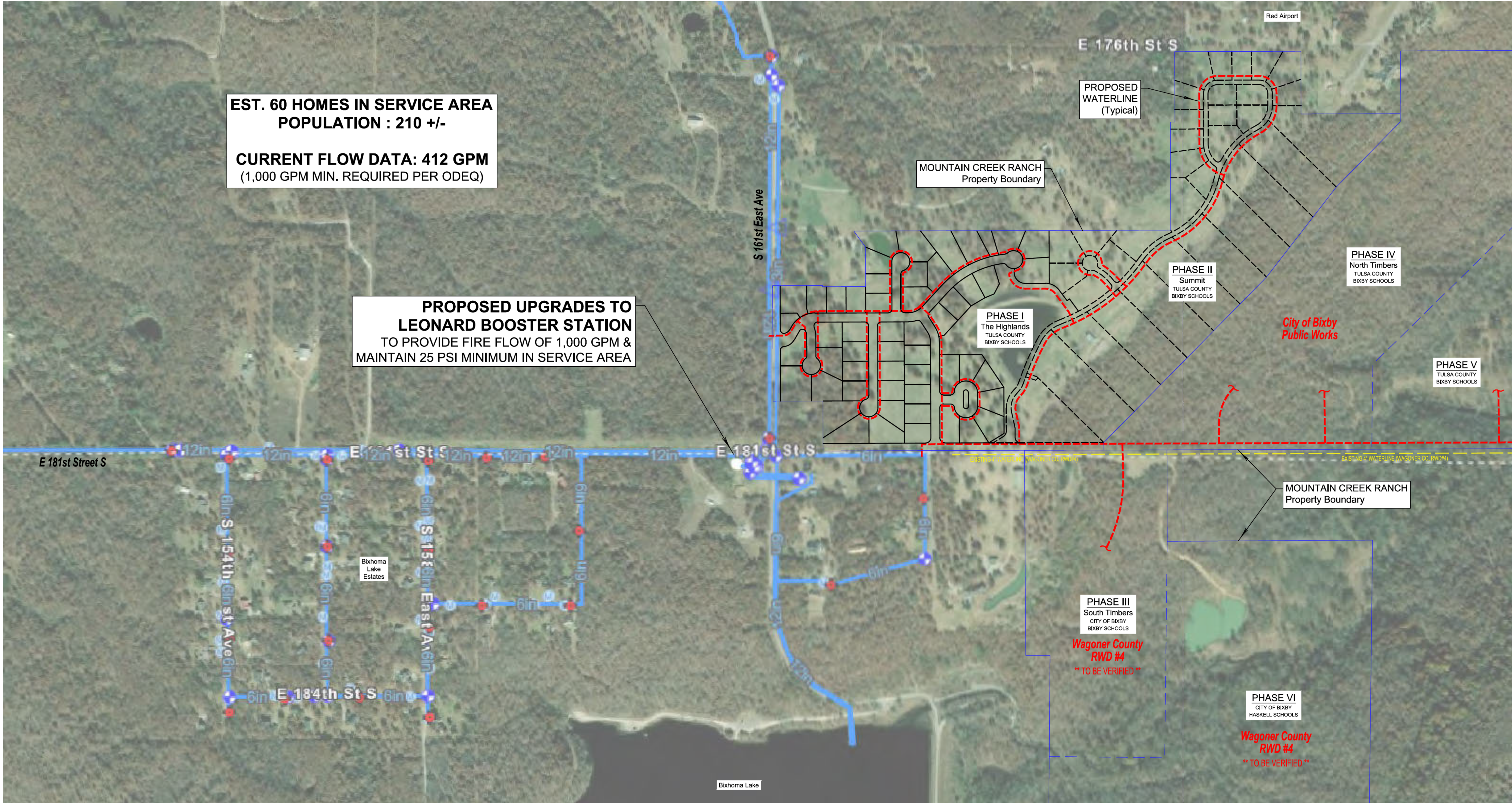
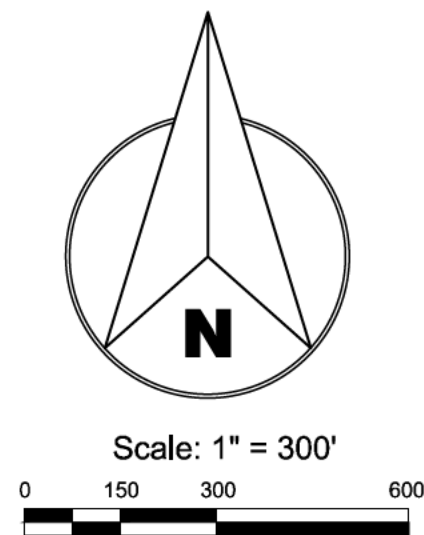
I, Brad Boone (printed name) on the 24 day of November 2025, hereby agree to my responsibility to own, operate, and maintain in good working order all improvements required to provide water service to the location for which I have received approval for a water tap from the Bixby Public Works Authority (BPWA). I recognize that failure to operate and maintain all improvements within good working order as determined by the BPWA will constitute just cause for suspension of water service by the BPWA until such time as improvements are brought into compliance with BPWA requirements.

Brad Boone
Signature

11/24/25
Date

Mountain Creek Ranch

Waterline Improvements Plan





The Highlands



General Information

Account Number	R97435743532010
Situs Address	17629 S 161 AV E BIXBY 74008
Owner Name	BOONE, ROBERT B REV TRUST & BOONE, PAMELA R REV TRUST
Owner Mailing Address	18133 S 172ND EAST AVE BIXBY, OK 740087795
Land Area	81.75 acres / 3,561,160 sq ft
Market Value	\$22,547
Last Year's Taxes	\$190.95
Legal Description	Subdivision: UNPLATTED (97435) Legal: SW LESS N1173 THEREOF & LESS BEG SWC SW TH N330.66 E330.66 S330.66 W330.66 TO POB & LESS BEG 1203S NWC SW TH E333 S333 W333 N333 POB & LESS BEG 1173S NWC SW TH E 534.27 SE131.06 S261.64 W285.70 N338 W333 W30 TO POB SEC 35 17 14 81.753ACS Section: 35 Township: 17 Range: 14



R97435743532010 (09/2024)

Tax Information

	2023	2024	2025
Fair Cash Value	\$17,145	\$15,274	\$22,547
Taxable Value	\$17,145	\$15,274	\$15,732
Assessment Ratio			
Gross Assessed	\$1,886	\$1,680	\$1,730
Exemptions	\$0	\$0	\$0
Net Assessed	\$1,886	\$1,680	\$1,730
Tax Rate	4B	4B	4B
Tax Rate Mills	118.070000	113.660000	116.900000
Estimated Taxes	\$223	\$191	\$202
Notice of Value Date (if changed from prev yr)	3/29/2023	3/29/2023	3/25/2025

Values

	2023	2024	2025
Land Value	\$7,145	\$5,274	\$5,347
Improvement Value	\$10,000	\$10,000	\$17,200
Fair Cash (Market) Value	\$17,145	\$15,274	\$22,547

Exemptions

	2023	2024	2025
Homestead	-	-	-
Additional Homestead	-	-	-
Senior Valuation Freeze	-	-	-
100% Disabled Veteran	-	-	-

Current Improvements

Tax Year	Property Type	Yr Blt	Livable	Stories	Story Height	Baths	Roof
Imp #	Foundation	Exterior			Use		HVAC Type
2025	Out Building	2002	0 SF	1.00	8	0.00	
3.00					Calving Barns - Sheds		None

Recent Sales

Sale Date	Grantor	Grantee	Sale Price	Doc Type	Book-Page/Doc #
6/19/2024	BOONE, ROBERT B & PAMELA K TTEES ROBERT B & PAMELA K BOONE TRUST	BOONE, ROBERT B REV TRUST & BOONE, PAMELA R REV TRUST	\$0	General Warranty Deed	2024050131
11/5/1999			\$0	General Warranty Deed	2000297144 BK-06291PG-01291



General Information

Account Number	R97435743548010
Situs Address	
Owner Name	BOONE, ROBERT B REV TRUST
Owner Mailing Address	18133 S 172ND EAST AVE BIXBY, OK 740087795
Land Area	80.00 acres / 3,484,800 sq ft
Market Value	\$80,000
Last Year's Taxes	\$1,000.21
Legal Description	Subdivision: UNPLATTED (97435) Legal: S/2 SE SEC 35 17 14 80AC Section: 35 Township: 17 Range: 14

Tax Information

	2023	2024	2025
Fair Cash Value	\$80,000	\$80,000	\$80,000
Taxable Value	\$80,000	\$80,000	\$80,000
Assessment Ratio			
Gross Assessed	\$8,800	\$8,800	\$8,800
Exemptions	\$0	\$0	\$0
Net Assessed	\$8,800	\$8,800	\$8,800
Tax Rate	4B	4B	4B
Tax Rate Mills	118.070000	113.660000	116.900000
Estimated Taxes	\$1,039	\$1,000	\$1,029
Notice of Value Date (if changed from prev yr)	-	-	-

Values

	2023	2024	2025
Land Value	\$80,000	\$80,000	\$80,000
Improvement Value	\$0	\$0	\$0
Fair Cash (Market) Value	\$80,000	\$80,000	\$80,000

Exemptions

	2023	2024	2025
Homestead	-	-	-
Additional Homestead	-	-	-
Senior Valuation Freeze	-	-	-
100% Disabled Veteran	-	-	-

Current Improvements

There are no current improvements for this account.

Recent Sales

Sale Date	Grantor	Grantee	Sale Price	Doc Type	Book-Page/Doc #
10/14/2016	FEARS, LEONARD A III	BOONE, ROBERT B REV TRUST	\$80,000	General Warranty Deed	2016096123
7/23/2007			\$0	Quit Claim Deed	2007081280



General Information

Account Number	R97435743556010
Situs Address	
Owner Name	BOONE, ROBERT B REV TRUST ET AL
Owner Mailing Address	C/O BRAD BOONE 18133 S 172ND EAST AVE BIXBY, OK 740087795
Land Area	73.41 acres / 3,197,740 sq ft
Market Value	\$3,152
Last Year's Taxes	\$39.44
Legal Description	Subdivision: UNPLATTED (97435) Legal: N/2 SE LESS BEG 1769W NEC SE TH S416 E657 N416 W657 POB & LESS BEG NWC SE TH S466.69 E30 N466.69 W30 TO POB SEC 35 17 14 73.409ACS Section: 35 Township: 17 Range: 14

Tax Information

	2023	2024	2025
Fair Cash Value	\$3,153	\$3,153	\$3,152
Taxable Value	\$3,153	\$3,153	\$3,152
Assessment Ratio			
Gross Assessed	\$347	\$347	\$347
Exemptions	\$0	\$0	\$0
Net Assessed	\$347	\$347	\$347
Tax Rate	4B	4B	4B
Tax Rate Mills	118.070000	113.660000	116.900000
Estimated Taxes	\$41	\$39	\$41
Notice of Value Date (if changed from prev yr)	3/29/2023	3/29/2023	3/29/2023

Values

	2023	2024	2025
Land Value	\$3,153	\$3,153	\$3,152
Improvement Value	\$0	\$0	\$0
Fair Cash (Market) Value	\$3,153	\$3,153	\$3,152

Exemptions

	2023	2024	2025
Homestead	-	-	-
Additional Homestead	-	-	-
Senior Valuation Freeze	-	-	-
100% Disabled Veteran	-	-	-

Current Improvements

There are no current improvements for this account.

Recent Sales

Sale Date	Grantor	Grantee	Sale Price	Doc Type	Book-Page/Doc #
1/17/2018	TRUST CO OF OK TRUSTEE ROBERT, B & PAMELA R BOONE INVESTMENT TRUSTS	BOONE, ROBERT B REV TRUST & , PAMELA R BOONE REV TRUST	\$0	Trustee's Deed	2020084354
8/27/2010	BOONE, ROBERT B AND PAMELA R TRUSTEES ROBERT B &	TRUST CO OF OK TRUSTEE ROBERT B & PAMELA R BOONE INVETMENT TRUSTS	\$0	General Warranty Deed	2010088687
9/22/1999			\$0	General Warranty Deed	2000297158 BK-06273PG-00714

CITY OF BIXBY, OKLAHOMA

LEONARD BOOSTER STATION UPGRADE

FOR

BOONE PROPERTIES LLC

NOVEMBER 2025



GENERAL NOTES

- BEFORE MAKING ANY UTILITY CROSSINGS, THE CONTRACTOR SHALL NOTIFY THE PROPER AGENT FOR THE UTILITY SO THAT HE OR SHE MAY BE PRESENT TO MARK THE EXACT LOCATION OF THE UTILITY TO BE CROSSED. THE CONTRACTOR SHALL BE HELD RESPONSIBLE FOR ANY DAMAGE TO ANY UTILITY IN THE AREA THAT IS CAUSED BY CONSTRUCTION PROCEDURES.
- LOCATIONS OF EXISTING WATER LINES ON THE PLANS ARE ONLY ACCURATE IN A SCHEMATIC SENSE. THE CONTRACTOR WILL BE RESPONSIBLE FOR FIELD VERIFYING THE EXACT LOCATIONS OF ALL EXISTING WATER LINES. CONTRACTOR SHALL PROVIDE LABOR AND MATERIALS TO FIX ANY BREAKS THAT OCCUR DURING CONSTRUCTION.

PROJECT CONTACTS

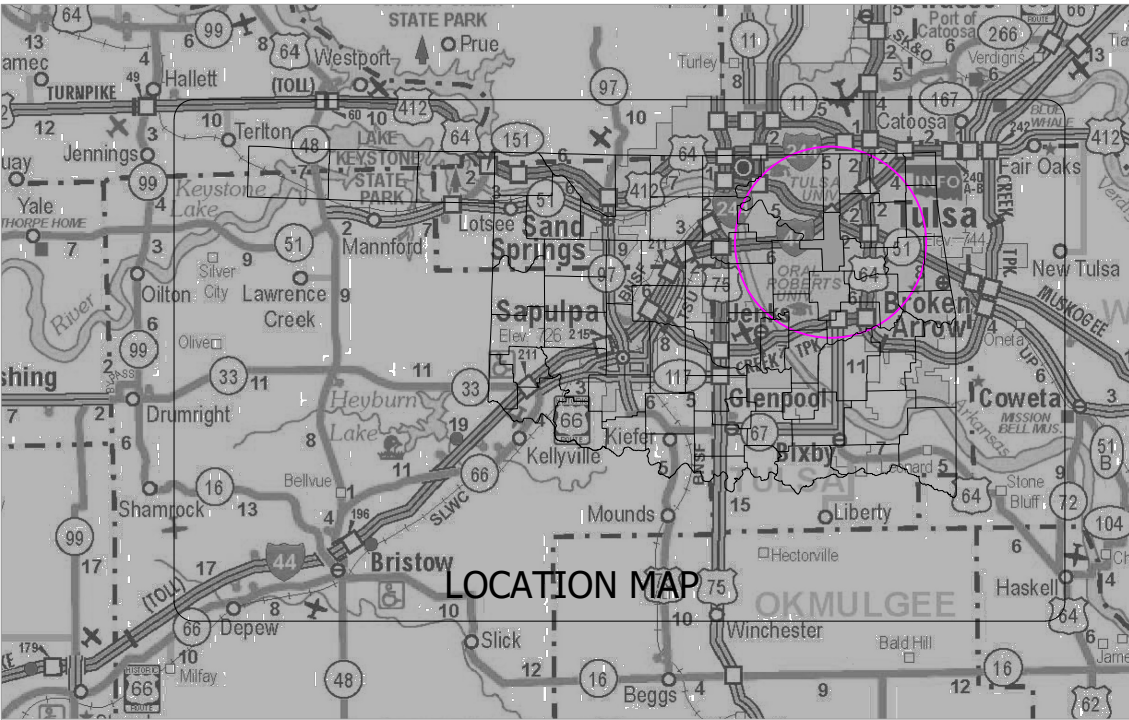
HEATH WRIGHT
UTILITY OPERATIONS MANAGER
CITY OF BIXBY
116 W NEEDLES AVENUE, P.O. BOX 70
BIXBY, OK. 74008

BARTLETT & WEST, INC.
1200 SW EXECUTIVE DRIVE
TOPEKA, KS 66615
LOUIS FUNK, P.E.
(785) 272-2252

OG&E ELECTRIC
1-800-522-6543



ENLARGED LOCATION MAP



SHEET INDEX

- G-100 COVER
- D-100 BPS PIPING PLAN
- E-100 ELECTRICAL SITE PLAN
- E-101 ELECTRICAL PLAN
- E-501 ELECTRICAL DETAILS & SCHEDULES

Bartlett & West

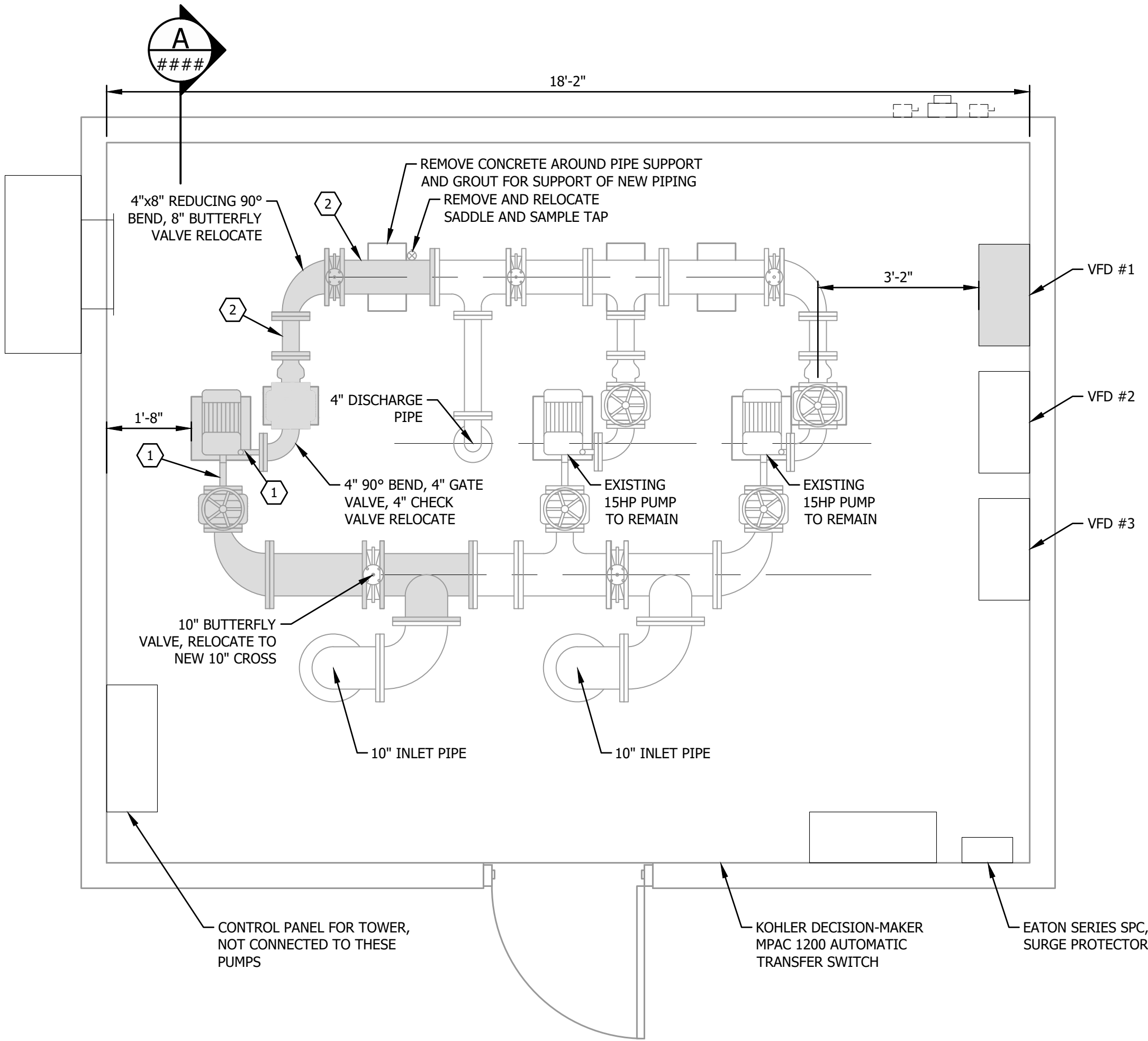
1200 SW EXECUTIVE DRIVE · TOPEKA KS 66615-3850
PHONE 785-272-2252 · FAX 785-272-7349
WWW.BARTLETTANDWEST.COM

COVER SHEET, PROJECT CONTACTS
SHEET INDEX AND LOCATOR MAP

BOONE PROPERTIES LLC
LEONARD BPS UPGRADE
BIXBY, OKLAHOMA

FOR
PERMITTING
USE ONLY

DESIGNED BY:	KS
DRAWN BY:	DOJ
APPROVED BY:	LPF
DESIGN PROJ:	20385.000
CONST PROJ:	----
SCALE:	AS NOTED
DATE:	11/07/2025
DRAWING NO:	G-100
SHEET NO:	1 of 5

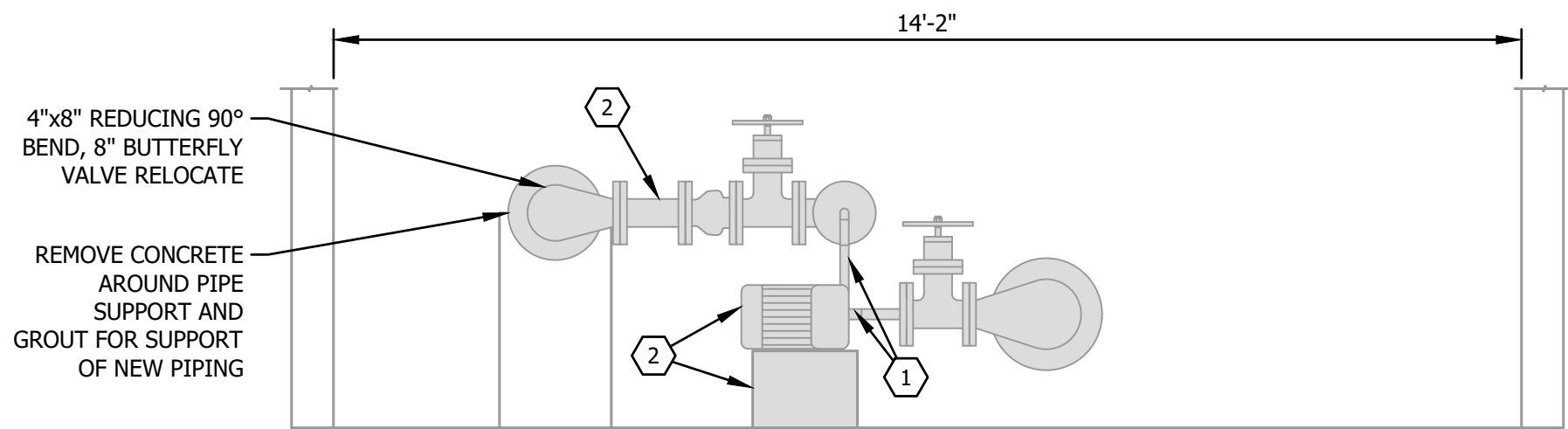


DEMOLITION PLAN
SCALE: 1/2"=1'-0"

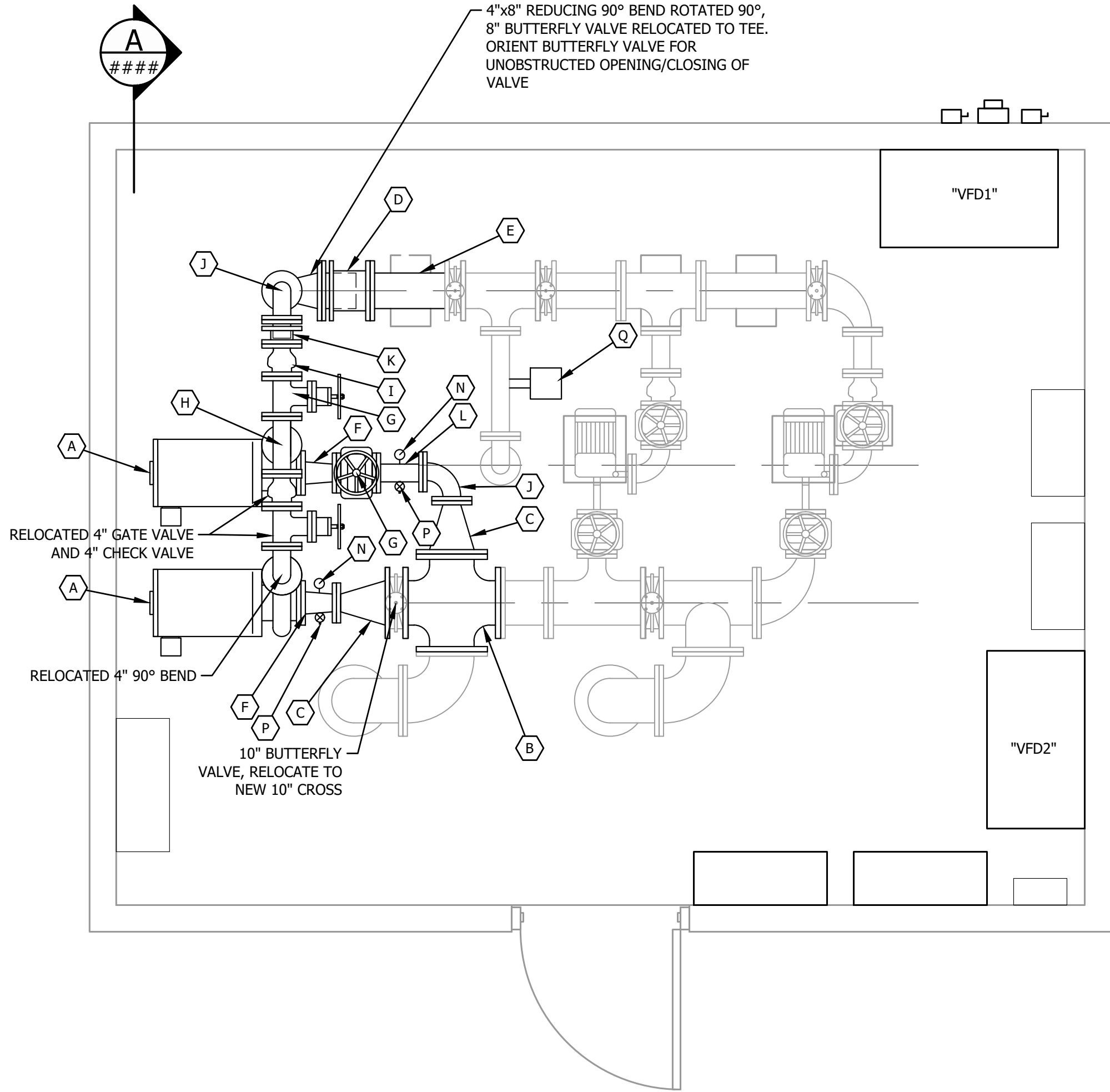
PUMP STATION OPERATION:
CONTRACTOR TO ENGAGE SERVICE OF HAYNES EQUIPMENT TO MODIFY THE EXISTING SCADA CONTROL PANEL SUCH THAT THE NEW PUMP AND VFD BEGIN OPERATION WHEN THE PRESSURE (FROM EXISTING PRESSURE TRANSDUCER) FALLS BELOW A USER-SPECIFIED MINIMUM THRESHOLD (INITIALLY SET TO 50 PSI). THE VFD SHALL MODULATE SUCH THAT A USER-SPECIFIED MAXIMUM % SPEED (INITIALLY SET TO 60%). THE NEW PUMP SHALL CEASE OPERATION WHEN THE VFD SPEED FALLS BELOW 30%, AT WHICH TIME ONE OF THE SMALLER PUMPS SHALL BEGIN OPERATION, MODULATING TO MAINTAIN A CONSTANT DOWNSTREAM PRESSURE OF 70 PSI, AS IN THE CURRENT MODE OF OPERATION.

THE SCADA EQUIPMENT SHALL BE UPDATED TO INCLUDE THE NEW PUMP STATION OPERATION FOR CONTROLS, SOFTWARE, PRESSURE SENSORS, AND INTEGRATION WITH THE EXISTING PUMPS.

WHEN SCADA IMPROVEMENTS ARE COMPLETE, CONTRACTOR SHALL COORDINATE TRAINING FOR USE OF THE NEW EQUIPMENT AND SCADA OPERATIONS BETWEEN HAYNES EQUIPMENT AND THE CITY OF BIXBY STAFF.

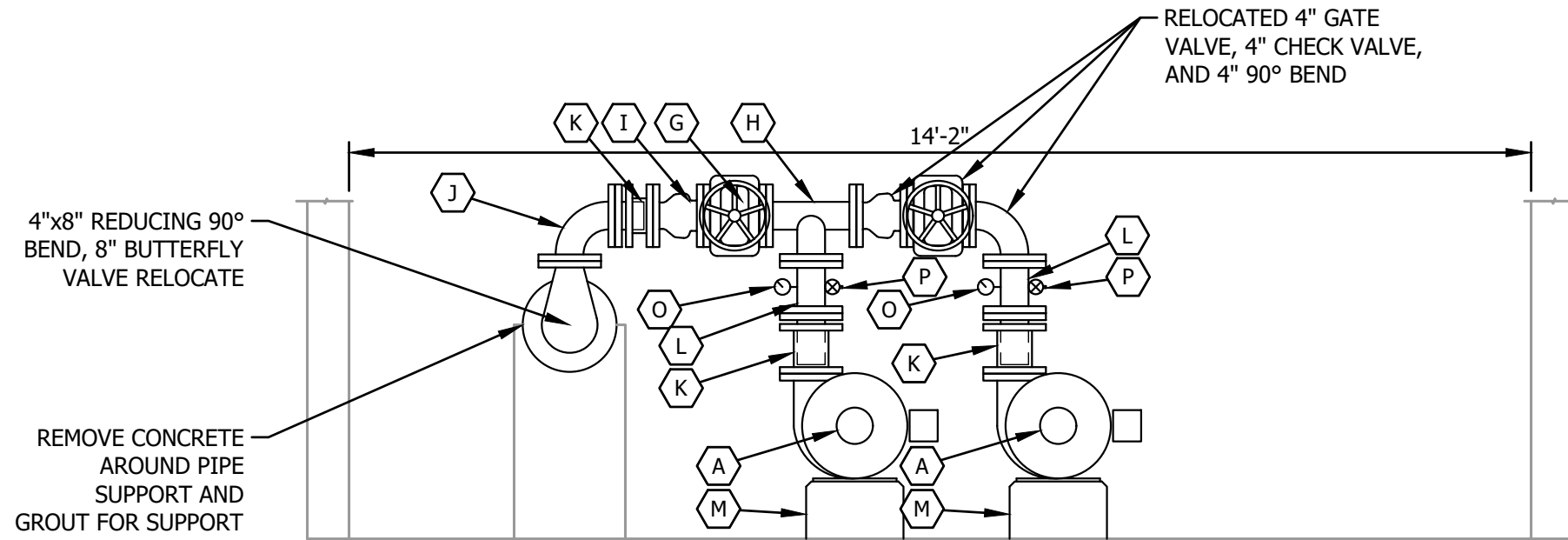


DEMOLITION SECTION
D100 SCALE: 1/2"=1'-0"

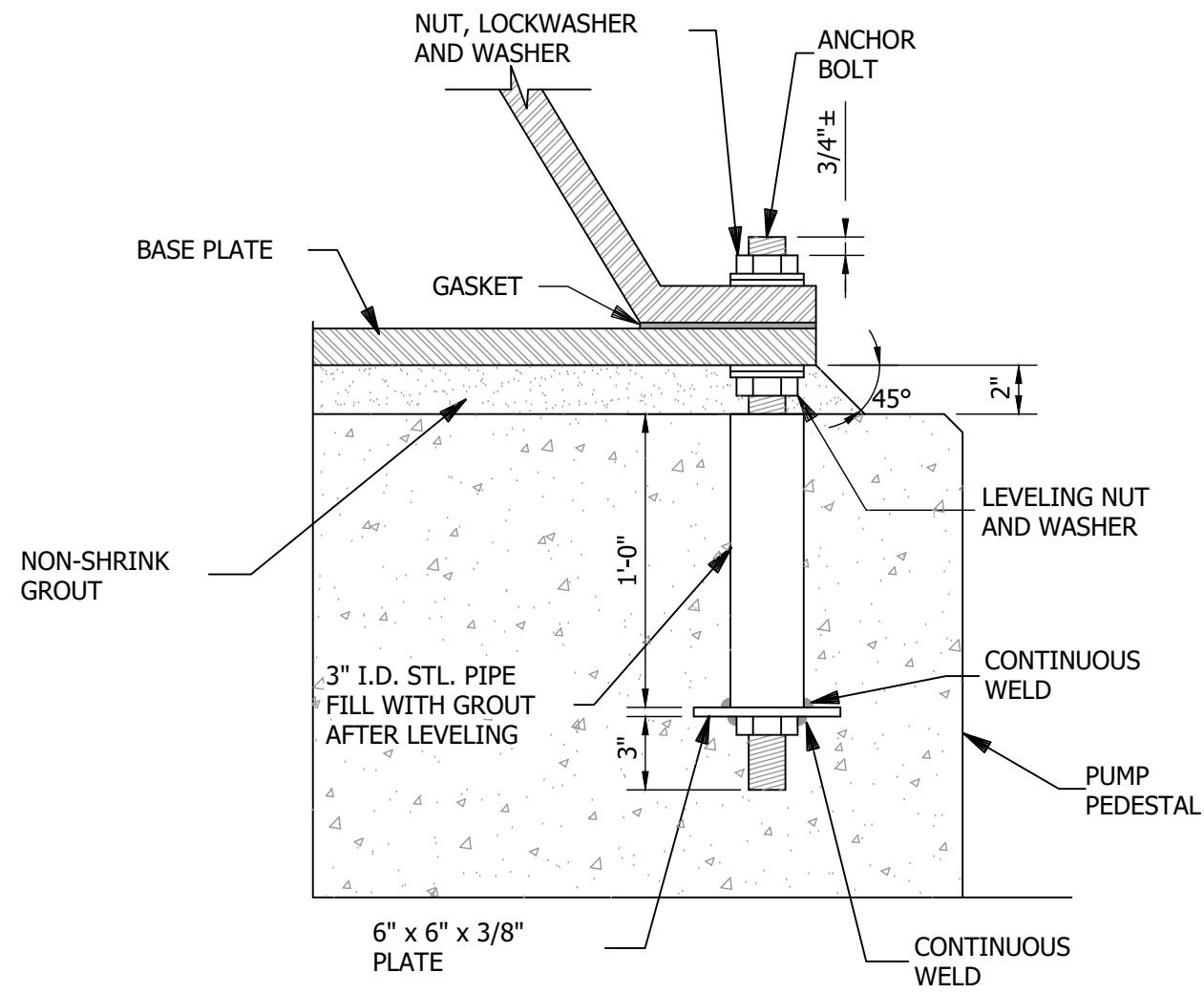


PUMP REPLACEMENT PLAN
SCALE: 1/2"=1'-0"

NOTE: CONTRACTOR SHALL FIELD VERIFY ALL DIMENSIONS BEFORE ORDERING PUMP, PIPING, AND CONNECTIONS.



PUMP REPLACEMENT SECTION
D100 SCALE: 1/2"=1'-0"



PUMP BASE DETAIL

GENERAL NOTES

- CONTRACTOR TO FIELD MEASURE ALL PIPING PRIOR TO ORDERING MATERIALS.
- CONTRACTOR SHALL PROVIDE 2-YEAR MAINTENANCE BOND TO THE CITY OF BIXBY FOR THE IMPROVEMENTS IN THIS PROJECT.
- TEST FIRE FLOW PUMP TO ACHIEVE 600 GPM SET AT 50% WITH THE GENERATOR RUNNING THE PUMP.

DEMOLITION NOTES:

- DEMOLITION NOTES:
REMOVE PUMP AND MOTOR. SALVAGE TO OWNER.
REMOVE 14"x15"x11" PUMP PEDESTAL. REMOVE 1-1/2" PIPING AND BLIND FLANGES. SALVAGE TO OWNER.
- REMOVE SPOOL PIECES, REPLACE WITH FLANGED COUPLING ADAPTERS TO ACCOMMODATE INSTALLATION OF LARGER PUMP.

PUMP INSTALLATION NOTES:

- INSTALL 60HP END-SUCTION CENTRIFUGAL PUMP AND MOTOR. SEE PUMP SPECS FOR PACO 40959 LC PUMP.
- 10" CROSS
- 10"x4" FL REDUCER
- 8" FL COUPLING ADAPTER
- 8" SPOOL
- 5"x4" FL REDUCER
- 4" FL GATE VALVE
- 4" TEE
- 4" CHECK VALVE
- 4" FL 90° BEND
- 4" FL COUPLING ADAPTER
- 4" SPOOL
- PUMP BASE. SEE DETAIL THIS SHEET
- COMPOUND GAUGE
- PRESSURE GAUGE
- SMOOTH NOSED SAMPLING TAP
- INSERTION METER W/TOTALIZER

BOOSTER PUMP STATION PIPING PLAN

BOONE PROPERTIES LLC
LEONARD BPS UPGRADE
BIXBY, OKLAHOMA

FOR
PERMITTING
USE ONLY
###

DESIGNED BY:	KS
DRAWN BY:	DOJ
APPROVED BY:	LPF
DESIGN PROJ:	20385.000
CONST PROJ:	----
SCALE:	AS NOTED
DATE:	03/02/2021
DRAWING NO:	
SHEET NO:	D100

Drawing Name: W:\Proj\20000\20385\20385_000\AutoCad\Plan Set\20385_000E_E100 Electrical Site Plan.dwg Layout Name: E-100 Electrical Site Plan.dwg Plotted on: 12/2/2025 10:28:26 AM
Last edit on: 12/2/2025 9:38 AM by: KCS01732



ELECTRICAL SITE PLAN

SCALE: 1"=10'



REFERENCE NOTES:

- 1 MOUNT GENERATOR E-STOP BUTTON AT 48" AFG. ROUTE WIRE IN 3/4"C TO GENERATOR AND MAKE FINAL CONNECTION. COORDINATE WIRE TYPE AND CONNECTION REQUIREMENTS WITH GENERATOR SUPPLIER. PROVIDE SIGNAGE AT E-STOP MARKED AS "GENERATOR EMERGENCY SHUTDOWN".
- 2 PROVIDE CONCRETE PAD FOR GENERATOR. REFER TO DETAIL 1/E-501.
- 3 CONNECT TO GENERATOR CONTROL PANEL, BATTERY CHARGER AND JACKET HEATER. E/C TO COORDINATE STUB UP LOCATIONS AND CIRCUIT BREAKER AND WIRE SIZES WITH GENERATOR MANUFACTURER SHOP DRAWINGS.
- 4 REFER TO SHEET E-101 FOR WORK IN THIS AREA.
- 5 ROUTE 1-1/4" LPG LINE TO "G1" GAS REGULATOR. FIELD VERIFY EXACT LOCATION. MAKE ALL FINAL CONNECTIONS.
- 6 EXISTING PROPANE TANK TO REMAIN.
- 7 STUB NEW 1-1/4" LPG LINE UP AT PERIMETER OF GENERATOR PAD. PROVIDE SHUT-OFF VALVE AND UNION AND MAKE FINAL CONNECTION TO GENERATOR. COORDINATE WITH GENERATOR MANUFACTURER. ROUTE PIPE TO AVOID ANY CONFLICT WITH SERVICING AND MAINTENANCE OF GENERATOR.
- 8 DISCONNECT POWER AND CONTROLS & REMOVE EXISTING GENERATOR, ASSOCIATED CONDUIT AND WIRE. SALVAGE EXISTING GENERATOR BACK TO OWNER. EXISTING CONCRETE PAD TO REMAIN.
- 9 DISCONNECT LPG LINE FROM EMERGENCY GENERATOR, REMOVE GAS LINE TO BELOW GRADE, MINIMUM 24". ABANDON EXISTING LPG LINE BELOW GRADE.
- 10 DISCONNECT EXISTING LPG LINE FROM TANK. EXISTING VAPORIZER TO REMAIN. REMOVE LPG LINE TO MINIMUM 24" BELOW GRADE.
- 11 CONNECT NEW LPG LINE TO EXISTING TANK VAPORIZER, WITH UNION AND SHUT-OFF VALVE.

GENERAL NOTES:

1. COORDINATE WITH OWNER ON GENERATOR LOCATION TO MAINTAIN MINIMUM 5'-0" CLEARANCE FROM BUILDING, AND 10'-0" FROM FRESH AIR INTAKES.
2. COORDINATE ROUTING OF BELOW GRADE CONDUIT AND LPG PIPING WITH EXISTING UNDERGROUND UTILITIES.
3. CONTRACTOR SHALL COORDINATE WITH ELECTRICAL UTILITY COMPANY, PAY ALL NECESSARY FEES ASSOCIATED WITH ELECTRICAL SERVICE, FURNISH AND INSTALL ALL NECESSARY ITEMS REQUESTED BY ELECTRICAL UTILITY COMPANY, INCLUDING BUT NOT LIMITED TO CONDUIT, AND CONDUCTOR. ALL MATERIALS AND LABOR SHALL BE ACCOUNTED FOR IN ORIGINAL BID PRICE.
4. ALL ELECTRICAL WORK ASSOCIATED WITH THE NEW ELECTRICAL SERVICES SHALL COMPLY WITH THE LATEST EDITION OF THE OG&E ELECTRIC SERVICE STANDARDS MANUAL. COORDINATE INSTALLATION OF NEW ELECTRIC UTILITY SERVICE AND MODIFICATION OF EXISTING ELECTRICAL SERVICE WITH OG&E.
CONTACT:

NAME: KEITH MELSON
PHONE: 918-684-4647
EMAIL: MELSONDK@OGE.COM
5. EXISTING ELECTRICAL INFORMATION IS BASED ON PRELIMINARY SITE INVESTIGATION. E/C SHALL FIELD VERIFY EXACT EXISTING CONDITIONS PRIOR TO CONSTRUCTION AND REPORT BACK TO ENGINEER ANY DISCREPANCIES OR ALTERNATE SERVICE CONNECTION ARRANGEMENTS.
6. OWNER SHALL HAVE FIRST RIGHT OF REFUSAL FOR ALL REMOVED ELECTRICAL EQUIPMENT. E/C SHALL DISPOSE OF ANY EQUIPMENT NOT SALVAGED TO THE OWNER.

FEEDER SCHEDULE:

- 1 REFER TO ELECTRICAL IMPROVEMENT RISER DIAGRAM FOR FEEDER SIZE AND QUANTITY.

ELECTRICAL SITE PLAN

BOONE PROPERTIES LLC
LEONARD BPS UPGRADE
BIXBY, OKLAHOMA

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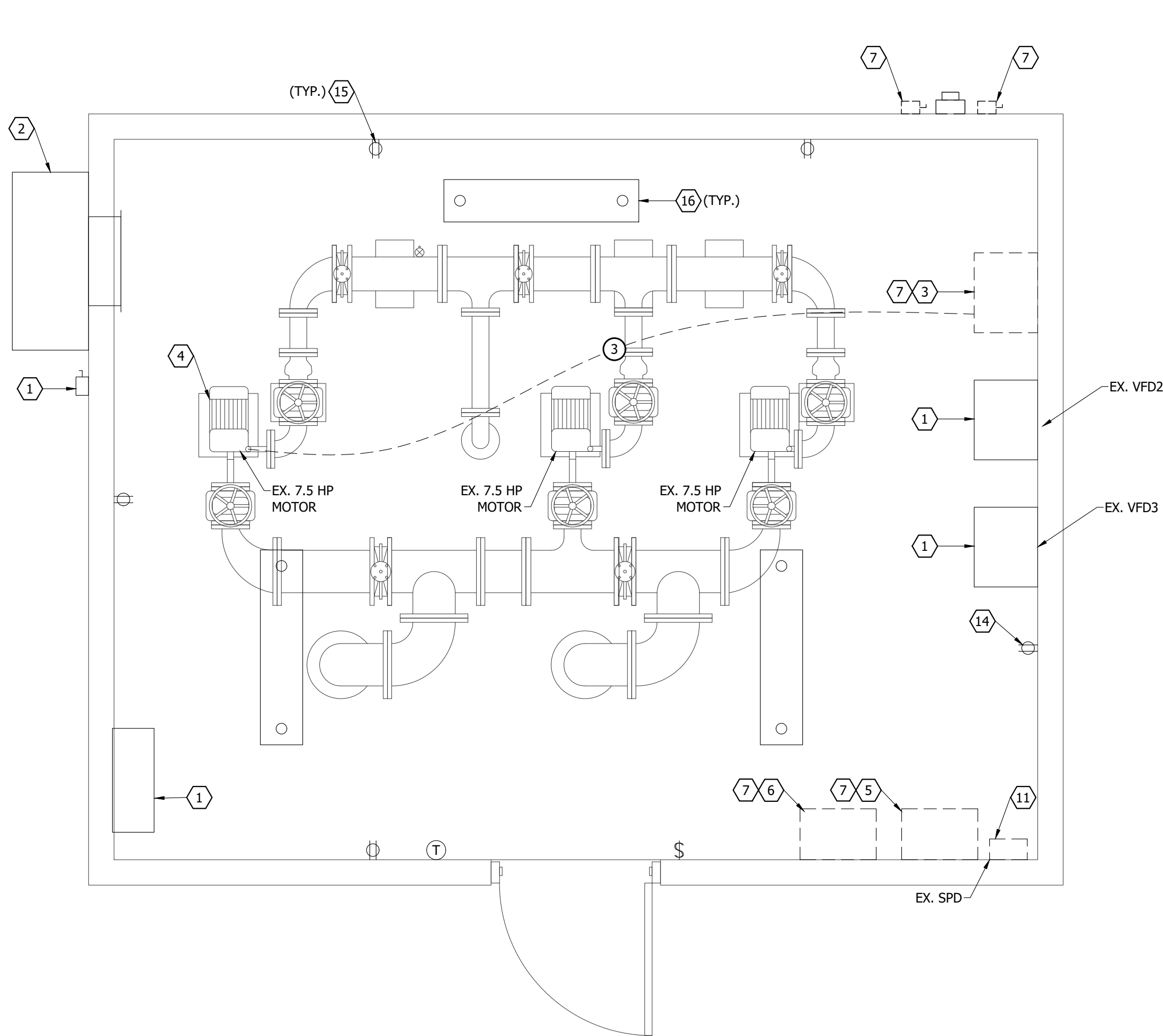
DESIGNED BY:	JLM
DRAWN BY:	ART
APPROVED BY:	LPF
DESIGN PROJ:	20385.000
CONST PROJ:	----
SCALE:	AS NOTED
DATE:	03/02/2021
DRAWING NO:	ME-100
SHEET NO:	3 of 5

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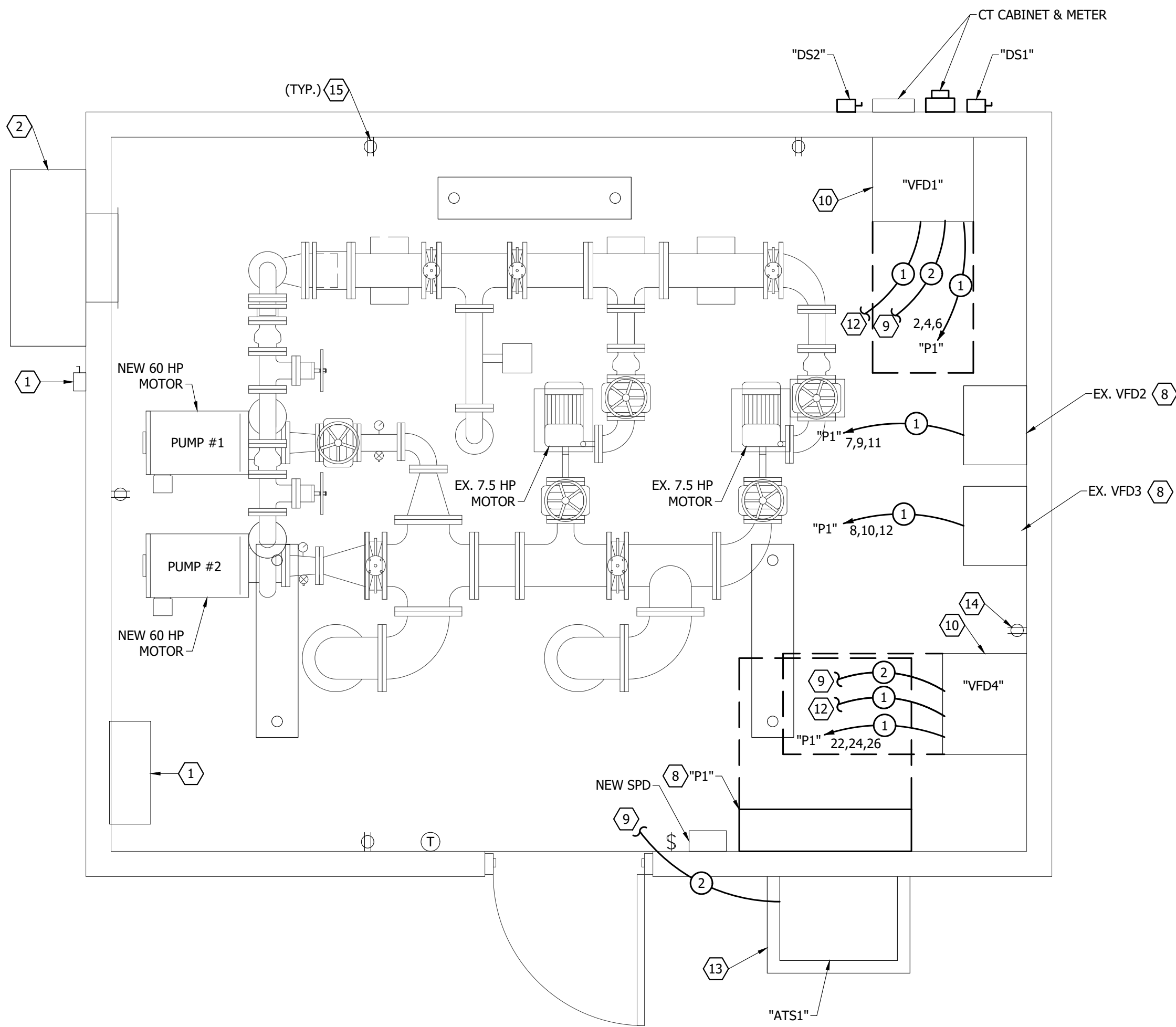
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Last edit on: 12/2/2025 9:32 AM by: KCS01732 Drawing Name: W:\Proj\20000\20385\20385.000\AutoCad\Plan Set\20385.000E-E101 Electrical Plan.dwg Layout Name: 3 E-101 ELECTRICAL PLAN Plotted by: KCS01732 Plotted on: 12/5/2025 10:28:33 AM



 **ELECTRICAL DEMOLITION PLAN**
SCALE: 1/2"=1'-0"



 **ELECTRICAL IMPROVEMENT PLAN**
SCALE: 1/2"=1'-0"

REFERENCE NOTES:

- EXISTING ELECTRICAL EQUIPMENT, ASSOCIATED CONDUIT AND WIRE TO REMAIN.
- EXISTING HVAC UNIT TO REMAIN.
- REMOVE EXISTING VFD & ASSOCIATED WIRE AND CONDUIT BACK TO PANEL.
- DISCONNECT ELECTRICAL POWER FROM EXISTING PUMP MOTOR. REMOVE EXISTING WIRE AND CONDUIT BACK TO VFD.
- REMOVE EXISTING 225A, 240V, 3-PHASE PANEL. RETAIN EXISTING BRANCH CIRCUITRY FOR RECONNECTION TO NEW PANEL.
- REMOVE EXISTING KOHLER TRANSFER SWITCH AND ASSOCIATED WIRE & CONDUIT. SALVAGE EXISTING TRANSFER SWITCH BACK TO OWNER.
- REMOVE EXISTING 250A DISCONNECT SWITCH AND ASSOCIATED WIRE AND CONDUIT. REFER TO DETAIL 2/E-501.
- EXTEND AND CONNECT EXISTING BRANCH CIRCUITRY TO NEW PANEL. REFER TO PANEL SCHEDULE. NEW CONDUIT AND WIRE SHALL MATCH EXISTING.
- EXTEND AND CONNECT TO EXISTING CONTROL PANEL.
- PROVIDE NEW VFD FOR NEW PUMP. REFER TO VFD SCHEDULE. SET CONTROLS TO LIMIT VFD TO RUN AT 50% WHEN TRANSFER SWITCH IS IN EMERGENCY MODE.
- REMOVE EXISTING SURGE PROTECTION DEVICE & ASSOCIATED WIRE AND CONDUIT.
- EXTEND AND CONNECT TO ASSOCIATED MOTOR. MAKE ALL FINAL CONNECTIONS. PROVIDE LIQUID TIGHT FLEXIBLE CONDUIT FROM CEILING DOWN TO MOTOR CONNECTION. CONDUIT FROM VFD, ALONG STRUCTURE SHALL BE GALVANIZED RIGID STEEL.
- PROVIDE 6" THICK CONCRETE HOUSEKEEPING PAD. PAD SHALL EXTEND 4" BEYOND EQUIPMENT FOOTPRINT.
- RELOCATE EXISTING RECEPTACLE, 3. BOX, ASSOCIATED CONDUIT AND WIRE TO THIS LOCATION TO ACCOMMODATE INSTALLATION OF NEW VFD.
- EXISTING ELECTRICAL DEVICE TO REMAIN. (TYPICAL)
- EXISTING LIGHT FIXTURE TO REMAIN. (TYPICAL)

GENERAL NOTES:

- ALL EXISTING ELECTRICAL DEVICES TO REMAIN UNLESS NOTE OTHERWISE.
- E/C SHALL COORDINATE ELECTRICAL UTILITY CONNECTION REQUIREMENTS WITH OG & E UTILITY.
- E/C SHALL PROVIDE MARKING ON PANEL TO INDICATE HIGH-LEG OF PHASES PER NEC. LABEL SHALL BE ORANGE IN COLOR.
- EXISTING ELECTRICAL INFORMATION IS BASED ON PRELIMINARY SITE INVESTIGATION. E/C SHALL FIELD VERIFY EXACT EXISTING CONDITIONS PRIOR TO CONSTRUCTION AND REPORT BACK TO ENGINEER ANY DISCREPANCIES OR ALTERNATE SERVICE CONNECTION ARRANGEMENTS.
- OWNER SHALL HAVE FIRST RIGHT OF REFUSAL FOR ALL REMOVED ELECTRICAL EQUIPMENT. E/C SHALL DISPOSE OF ANY EQUIPMENT NOT SALVAGED TO THE OWNER.

FEEDER SCHEDULE:

- REFER TO ELECTRICAL IMPROVEMENT RISER DIAGRAM.
- 1" C WITH CONTROL WIRES.
- EXISTING FEEDER TO BE REMOVED.

LEGEND:

-  INDICATES DIRECTION OF PLAN NORTH
-  PLAN NOTE REFERENCE
-  UTILITY METER
-  DISCONNECT SWITCH
-  "A" CEILING MOUNTED LIGHTING FIXTURE AND TAG
-  BRANCH CIRCUIT HOMERUN TO PANEL
-  BRANCH CIRCUIT OR FEEDER - SEE SCHEDULE FOR CONDUCTOR & CONDUIT QUANTITY & SIZE
-  SINGLE POLE SWITCH
-  DUPLEX RECEPTACLE
-  THERMOSTAT

GENERAL:
AFF ABOVE FINISHED FLOOR
AFG ABOVE FINISHED GRADE
CL CENTERLINE ELEVATION
DN DOWN
EX EXISTING

ELECTRICAL PLAN

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DESIGNED BY:	JLM
DRAWN BY:	SDM
APPROVED BY:	JLM
DESIGN PROJ:	20385.000
CONST PROJ:	----
SCALE:	AS NOTED
DATE:	NOV 2025
DRAWING NO:	E-101
SHEET NO:	4 of 5

Drawing Name: W:\Proj\20000\20385\20385.000\AutoCad\Plan_Sch\20385.000E_E501 Electrical Details and Schedules.dwg Layout Name: 4 E-501 ELECTRICAL DETAILS AND SCHEDULES Plotted on: 12/5/2025 10:28:43 AM
Last edit on: 12/2/2025 3:27 PM by: KC501732

CIRCUIT BREAKER PANELBOARD SCHEDULE

MARK: "P1"						MOUNTING: SURFACE		42K		AIC RATING (MINIMUM)	
VOLTAGE: 120/240		PHASE: 3		WIRE: 4		POLES: 42		MAIN LUGS: 600 AMP		MAIN C/B: 600 AMP	
CIRC. NO.	LOAD DESCRIPTION	CIRC. BRKR	LOAD (VA)	PHASE LOAD IN VA			LOAD (VA)	CIRC. BRKR.	LOAD DESCRIPTION	CIRC. NO.	
				A	B	C					
1	NEW SURGE PROTECTOR	60A3P		21067			21067	225A3P	NEW VFD1	2	
3	-	-			21067		21067	-	-	4	
5	-	-				21067	21067	-	-	6	
7	EX. VFD2 (7.5 HP)	45A3P	3010	6020			3010	45A3P	EX. VFD 3 (7.5 HP)	8	
9	-	-	3010		6020		3010	-	-	10	
11	-	-	3010			6020	3010	-	-	12	
13	EX. CONTROL PANEL	20A1P	1000	1000				30A2P	EX. AC & HEATER	14	
15	GENERATOR BATTERY CHARGER	20A1P	1000		1000			-	-	16	
17	BLANK	-				0		-	BLANK	18	
19	EX. LIGHTS	20A1P		0				20A1P	EX. RECEPTACLES	20	
21	EX. TANK MIXER	30A1P			21067		21067	225A3P	NEW VFD4	22	
23	BLANK	-				21067	21067	-	-	24	
25	SPARE	20A1P		21067			21067	-	-	26	
27	SPARE	20A1P			0			20A1P	SPARE	28	
29	BLANK	-				0		-	BLANK	30	
31	GENERATOR BLOCK HEATER	20A2P	750	750					SPACE	32	
33	SPACE	-	750		750				SPACE	34	
35	BLANK	-				0			BLANK	36	
37	SPACE			0					SPACE	38	
39	SPACE				0				SPACE	40	
41	BLANK	-				0			BLANK	42	
TOTALS:					49904	49904	48154				
MAX. PHASE VA:		49904	MAX. PHASE AMPS:		416	MAX. PHASE DIVERSIFIED VA:		42340	MAX. PHASE DIVERSIFIED AMPS:		416

GENERATOR SET SCHEDULE

MARK	MFGR	DUTY	RATED OUTPUT (KW)	VOLTAGE	POLES	EPA RATING	ALTERNATOR TEMP RISE (C)	FUEL TYPE	MOCP (AMPS)	ENCLOSURE TYPE
G1	REHLKO	STANDBY	100	240	3	TIER 2	130	PROPANE	300	75 dB @ 23-FEET

- NOTES:
- MOCP TO BE 100% RATED.
 - PROVIDE SECOND STAGE REGULATOR SET AT 11" W.C. WITH GENERATOR.

TRANSFER SWITCH SCHEDULE

MARK	MFGR	OPERATION AUTO/MANUAL	MODEL	ACCESSORIES	POLES	AMP	VOLTAGE	ENCLOSURE NEMA TYPE
ATS1	ASCO	AUTOMATIC	7000	SP, IL, MH, ES, TD, SN	3	400	240	3R

ABBREVIATIONS

B - BYPASS-ISOLATION SWITCH
SP - SWITCH POSITION CONTACTS
IL - INDICATOR LAMPS
MH - MECHANICALLY HELD-ELECTRICALLY OPERATED
ES - ENGINE START CONTACTS

TD - TIME DELAY TRANSFER (ADJUSTABLE)
(ENGINE START TIME DELAY- 0-30 MIN)
(TRANSFER TIME DELAY- 0-10 MIN)
SE - SERVICE ENTRANCE RATED
SN - SOLID NEUTRAL

DISCONNECT SWITCH SCHEDULE

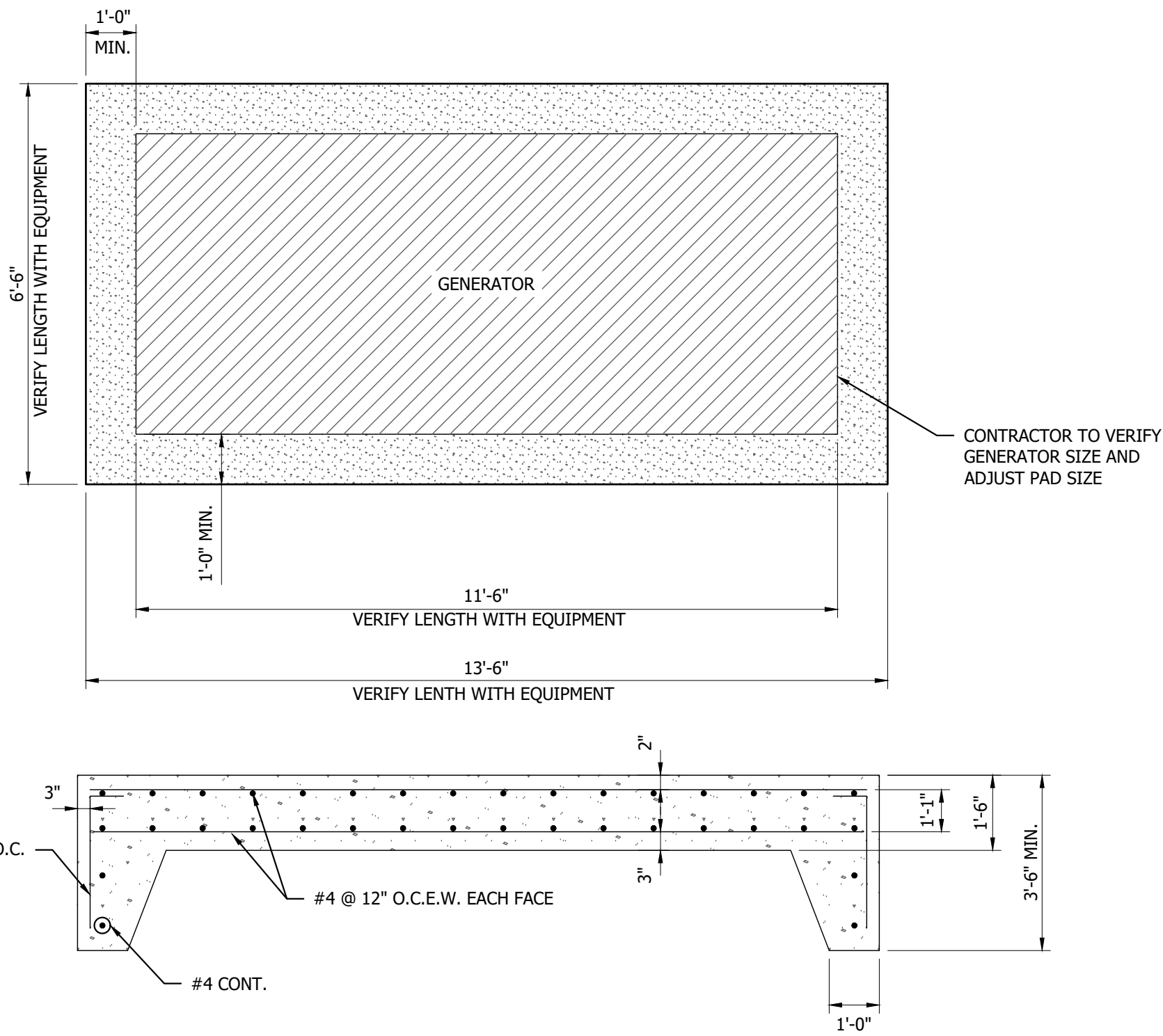
MARK	EQUIPMENT SERVED	SWITCH		FUSE		ENCLOSURE		NOTES
		VOLTAGE	AMP	POLE	AMP	TYPE	NEMA TYPE	
DS1	UTILITY	240	600	3	600	FRNRK	3R	2
DS2	MAIN	240	600	3	600	FRNRK	3R	1

- NOTES:
- SERVICE ENTRANCE RATED
 - COORDINATE WITH OG&E FOR REQUIREMENTS

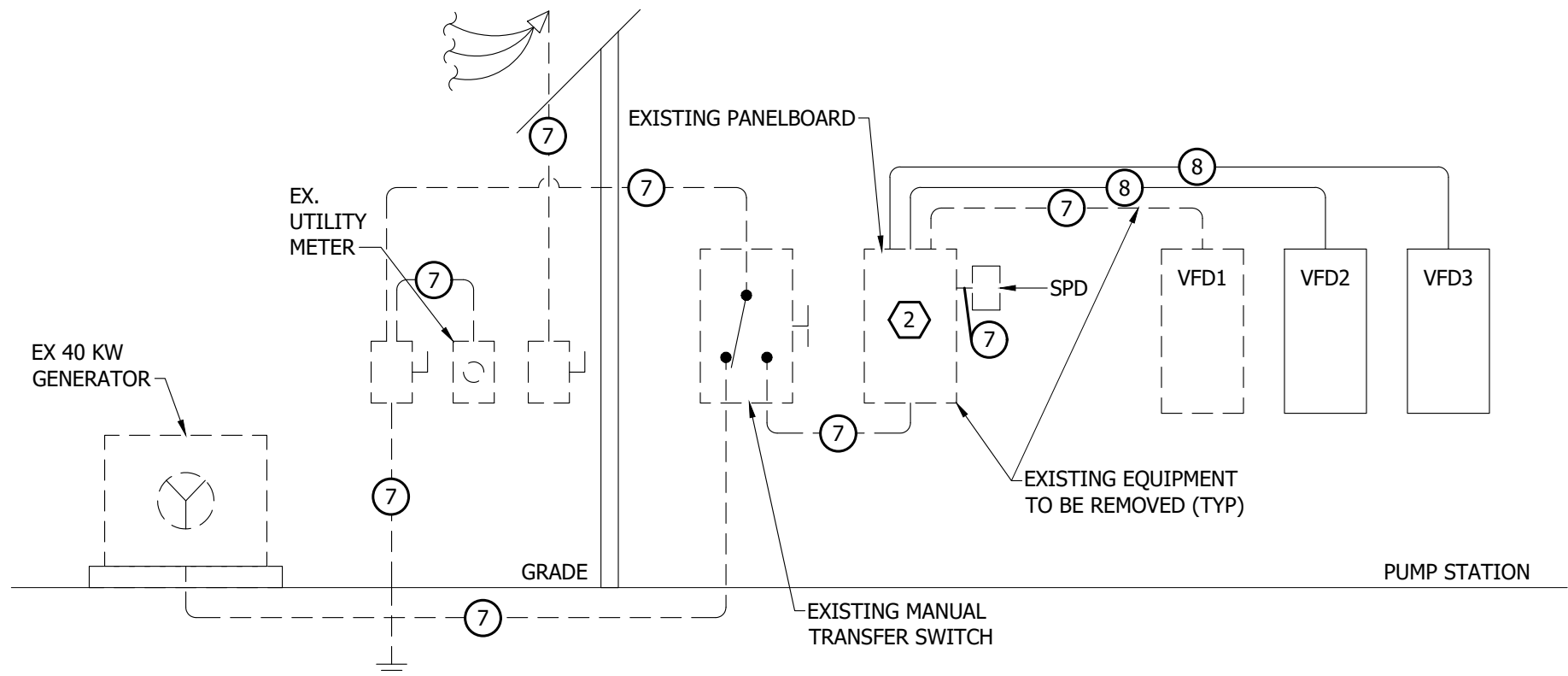
VARIABLE FREQUENCY DRIVE SCHEDULE

MARK	EQUIPMENT SERVED	LOAD			DRIVE		MOUNTING TYPE			NOTES
		HP	VOLT	PHASE	FLA*	TYPE	FLOOR	WALL	MCC	
VFD1	PUMP 1	60	240	3	154	PWM		X		1, 2, 3
VFD4	PUMP 2	60	240	3	154	PWM		X		1, 2, 3

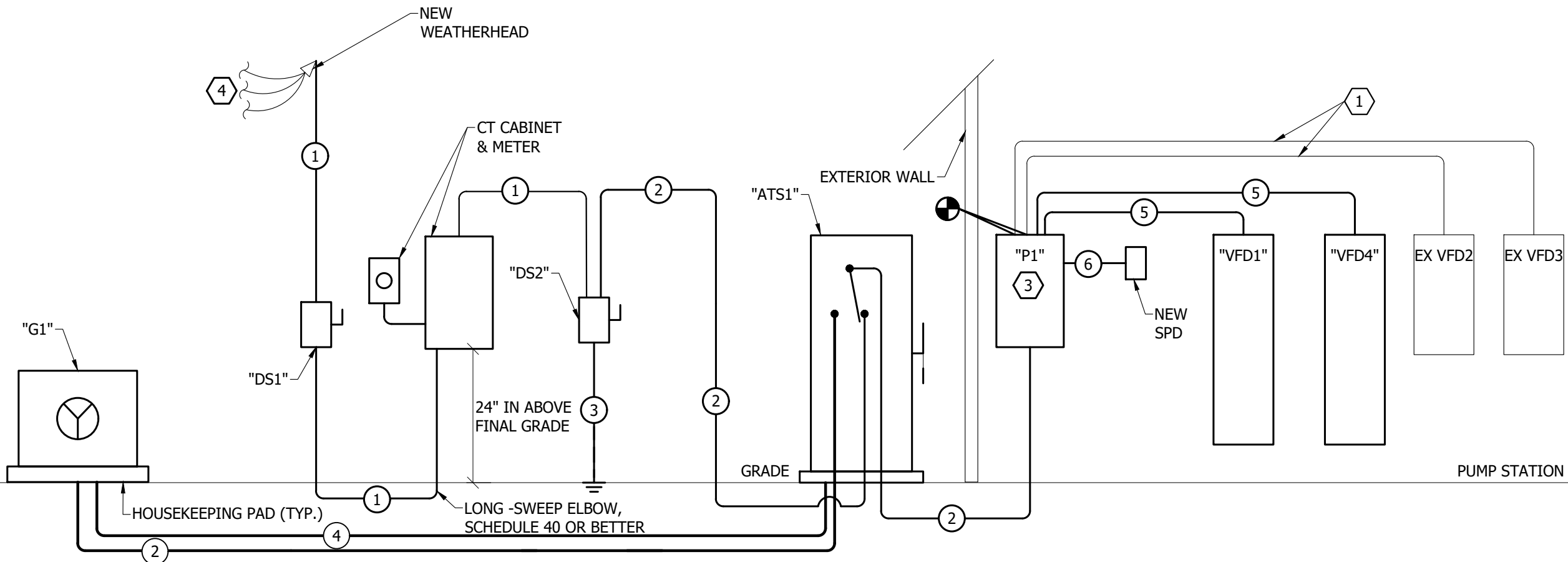
- NOTES:
- NEMA 12 ENCLOSURE
 - DELUXE KEYPAD (NO CODE NUMBERING)
 - PROVIDE LOW HARMONIC DRIVE
 - *VERIFY FLA WITH PUMP MANUFACTURER (MOTORS MAY BE SUBMERSIBLE OR HAVE VARYING FLA)



1 GENERATOR PAD DETAIL
NOT TO SCALE



2 ELECTRICAL DEMOLITION RISER DIAGRAM
NOT TO SCALE



3 ELECTRICAL IMPROVEMENT RISER DIAGRAM
NOT TO SCALE

FEEDER SCHEDULE:

- 4-500 IN 3" C.
- 4-500 & 1-3G IN 3" C.
- 1-1/0G IN 3/4" C.
- 1" C WITH PULL STRING.
- 3-4/0 & 1-4G VFD CABLE IN 2.5" C.
- 4-4 & 1-10G IN 1.5" C.
- EXISTING FEEDER TO BE REMOVED.
- EXISTING FEEDER TO BE REUSED.

REFERENCE NOTES:

- EXTEND AND CONNECT EXISTING WIRE AND CONDUIT TO NEW PANEL "P1".
- DISCONNECT EXISTING LOADS FROM PANEL. PREPARE EXISTING LOAD FEEDERS FOR CONNECT TO NEW PANEL "P1".
- CONNECT EXISTING LOADS TO NEW PANEL "P1". REFER TO PANEL "P1" SCHEDULE FOR EXISTING LOADS.
- COORDINATE ELECTRICAL SERVICE CONNECTION WITH UTILITY COMPANY.

ELECTRICAL SCHEDULES AND DETAILS

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DESIGNED BY:	JLM
DRAWN BY:	SDM
APPROVED BY:	JLM
DESIGN PROJ:	20385.000
CONST PROJ:	----
SCALE:	AS NOTED
DATE:	NOV 2025
DRAWING NO:	E-501
SHEET NO:	5 of 5

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TABLE OF CONTENTS

BIDDING REQUIREMENTS, CONTRACT FORMS, AND CONTRACT CONDITIONS

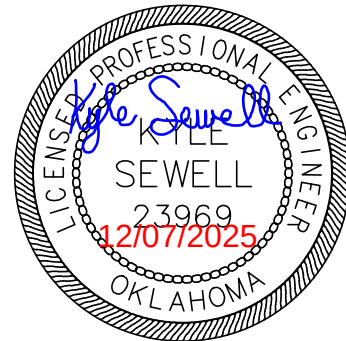
Advertisement for Bids
Instructions to Bidders
Bid Form
Bid Bond
Notice of Award
Agreement
Notice to Proceed
Performance Bond
Payment Bond
Maintenance Bond
Application for Payment
Certificate of Substantial Completion
General Conditions
Supplemental Conditions
Contract Change Order
Noncollusion Affidavit

TECHNICAL SPECIFICATIONS

Division 1-15

DIVISION 1 - GENERAL REQUIREMENTS

01005 - Administrative Provisions
01025 - Measurement and Payment
01300 - Submittals
01400 - Quality Control
01600 - Material and Equipment
01666 - Testing Piping Systems
01700 - Contract Closeout



DIVISION 3 - CONCRETE

03200 – Concrete Reinforcement
03300 – Cast-in-Place Concrete

Division 26

DIVISION 9 – FINISHES

09900 – Painting

DIVISION 15 – MECHANICAL

15060 – Pipe and Pipe Fittings

15100 – Valves

15160 – Pumps

- Grundfos Pump Spec

DIVISION 26 – ELECTRICAL

231126 – Facility Liquified-Petroleum Gas Piping

260500 – Common Work Results for Electrical

260510 – Common Motor Requirements

260519 – Low-Voltage Electrical Power Conductors and Cables

260523 – Control-Voltage Electrical Power Cables

260526 – Grounding and Bonding for Electrical Systems

260529 – Hangers and Supports for Electrical Systems

260533 – Raceway and Boxes for Electrical Systems

260553 – Identification for Electrical Systems

262416 - Panelboards

262813 – Fuses

262816 – Enclosed Switches and Circuit Breakers

262923 – Variable-Frequency Motor Controllers

- ABB ACQ 580 VFD Info
- ACQ 580-01 Motor Controller

263213 – Engine Generators

263600 – Transfer Switches

264313 – Surge Protection for Low-Voltage Electrical Power Circuits

SECTION 01005

ADMINISTRATIVE PROVISIONS

PART 1 GENERAL

1.01 REQUIREMENTS INCLUDED

- A. Title of Work, and Type of Contract.
- B. Work Sequence.
- C. Contractor Use of Premises.
- D. Coordination.
- E. Reference Standard.

1.02 WORK COVERED BY CONTRACT DOCUMENTS

- A. Work under these contract documents includes construction of pump upgrade, variable frequency drive, electrical and control upgrades for the Leonard Booster Pump Station.

1.03 WORK SEQUENCE

- A. Provide written construction schedule prior to commencement of Work. Revised schedules shall be submitted in the event changes occur in the original schedule.

1.04 CONTRACTOR USE OF PREMISES

- A. Limit use of premises for Work and for construction operations. Easement limits and ownership boundaries will be respected at all times.

1.05 OWNER AND CONTRACTOR RESPONSIBILITIES

- A. Owner's Responsibilities:
 - 1. Review and deliver shop drawings, product data, and samples, to Contractor.
 - 2. On delivery, inspect products jointly with Contractor.
 - 3. Provide ingress/egress easements for access to well site.
 - 4. Provide construction staking of the center of the water supply well.

B. Contractor's Responsibilities:

1. Review shop drawings, product data, and samples prior to submitting to Owner.
2. Receive and unload product data, and samples.
3. Handle, store, install and finish products.
4. Repair or replace items damaged by work of this Contract.

1.06 COORDINATION

- A. Verify characteristics of elements of interrelated operating equipment are compatible; coordinate work of various Sections having interdependent responsibilities for installing, connecting to, and placing in service, such equipment.
- B. Coordinate work with other contractors performing work on premises.
- C. Coordinate Work with major suppliers of material and any Sub-contractors.

1.07 REFERENCE STANDARDS

- A. For products specified by association or trade standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.
- B. The date of the standard is that in effect as of the Bid date, except when a date is specified.
- C. Obtain copies of standards when required by Contract Documents. Maintain copy at job site during progress of the specified Work.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01025

MEASUREMENT AND PAYMENT

PART 1 GENERAL

1.01 REQUIREMENTS INCLUDED

- A. The outline of measurement and payment in this section is intended to provide a general guideline to the Contractor in preparation of bids and submitting pay requests. Listings of work included in each bid item are not intended to include all work, but are only to provide general guidance to the Contractor in allocating costs. All work will be paid for on a unit price basis with payment made for the quantity of each item completed.

1.02 WORK REQUIRED

- A. Booster Pump Station
 1. Measurement: Lump Sum (L.S.)
 2. Items Included: Interior piping, valves, booster pump, VFD, mechanical/electrical equipment, and cleanup.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01300

SUBMITTALS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Submittal procedures.
- B. Construction progress schedules.
- C. Proposed products list.
- D. Shop Drawings.
- E. Product Data.
- F. Samples.
- G. Manufacturer's Instructions.
- H. Manufacturer's certificates.

1.02 RELATED SECTIONS

- A. Section 01400 - Quality Control: Manufacturer's field services and reports.
- B. Section 01700 - Contract Closeout: Contract warranty and manufacturer's certificates.

1.03 SUBMITTAL PROCEDURES

- A. Transmit each submittal with Engineer accepted form.
- B. Identify Project, Contractor, Subcontractor or Supplier; pertinent Drawing Sheet and Detail, and Specification Section Number, as appropriate.
- C. Apply Contractor's stamp, signed or initialed certifying that review, verification of products required, field dimensions, adjacent construction work, and coordination of information, is in accordance with the requirements of the Work and Contract Documents.
- D. Schedule submittals to expedite the Project, and deliver to Engineer at business address. Coordinate submission of related items.

- E. Identify variations from Contract Documents and Product or system limitations which may be detrimental to successful performance of the completed work.
- F. Provide space for Contractor and Engineer review stamps.
- G. Revise and resubmit submittals as required, identify all changes made since previous submittal.
- H. Distribute copies of reviewed submittals to concerned parties. Instruct parties to promptly report any inability to comply with provision.

1.04 SHOP DRAWINGS

- A. Submit the number of opaque reproductions which Contractor requires, plus three copies which will be retained by Engineer.
- B. After review, distribute in accordance with Article on Procedures above and for Record Documents described in Section 01700 - Contract Closeout.

1.05 PRODUCT DATA

- A. Submit the number of copies which the Contractor requires, plus three copies which will be retained by the Engineer.
- B. Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturers' standard data to provide information unique to this Project.
- C. After review, distribute in accordance with Article on Procedures above and provide copies for Record Documents described in Section 01700 - Contract Closeout.

1.06 MANUFACTURER'S INSTRUCTIONS

- A. When specified in individual Specification Section, submit manufacturer's printed instructions for delivery, storage, assembly, installation, start-up, adjusting, and finishing, in quantities specified for Product Data.
- B. Identify conflicts between manufacturer's instructions and Contract Documents.

1.07 MANUFACTURER'S CERTIFICATES

- A. When specified in individual Specification Sections, submit manufacturers' certificate to Engineer for review, in quantities specified for Product Data.

- B. Indicate material or product conforms to or exceeds specified requirements. Submit supporting reference date, affidavits, and certifications as appropriate.
- C. Certificates may be recent or previous test results on material or Product, but must be acceptable to Engineer.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01400
QUALITY CONTROL

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Quality assurance and control of installation.
- B. References.
- C. Field samples.
- D. Inspection and testing laboratory services.
- E. Manufacturers' field services and reports.

1.02 RELATED SECTIONS

- A. Section 01300 - Submittals: Submission of Manufacturers' Instructions and Certificates.
- B. Section 01600 - Material and Equipment: Requirements for material and product quality.

1.03 QUALITY ASSURANCE/CONTROL OF INSTALLATION

- A. Monitor quality control over suppliers, manufacturers, Products, services, site control, and workmanship, to produce Work of specified quality.
- B. Comply fully with manufacturers' instructions, including each step in sequence.
- C. Should manufacturer's instructions conflict with Contract Documents, request clarification from Engineer before proceeding.
- D. Comply with specified standards as a minimum quality for the Work except when more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.
- E. Perform work by persons qualified to produce workmanship of specified quality.
- F. Secure Products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion or disfigurement.

1.04 REFERENCES

- A. Conform to reference standard by date of issue current on date of contract documents unless date of standard is specified in individual sections.
- B. Obtain copies of standards when required by Contract Documents.
- C. Should specified reference standards conflict with Contract Documents, request clarification from Engineer before proceeding.
- D. The contractual relationship of the parties to the Contract shall not be altered from the Contract Documents by mention or inference otherwise in any reference document.

1.05 FIELD SAMPLES

- A. Install field samples at the site as required by individual Specifications Sections for review.
- B. Acceptable samples represent a quality level for the Work.
- C. Where field sample is specified in individual Sections to be removed, clear area after field sample has been accepted by Engineer.

1.06 INSPECTION AND TESTING LABORATORY SERVICES

- A. Owner will appoint, employ, and pay for services of an independent firm to perform inspection and testing, except where noted otherwise.
- B. The independent firm will perform inspections, tests, and other services specified in individual Specification Section and as required by the Engineer.
- C. Reports will be submitted by the independent firm to the Engineer, in duplicate, indicating observations and results of tests and indicating compliance or non-compliance with Contract Documents.
- D. Cooperate with independent firm; furnish samples of materials, design mix, equipment, tools, storage and assistance as requested.
 - 1. Notify Engineer and independent firm 24 hours prior to expected time for operations requiring services.
 - 2. Make arrangements with independent firm and pay for additional samples and tests required for Contractor's use.
- E. Retesting required because of non-conformance to specified requirements shall be performed by the same independent firm on instructions by the Engineer. Payment for retesting will be charged to the Contractor by deducting inspection or testing charges from the Contract Price.

1.07 MANUFACTURERS' FIELD SERVICES AND REPORTS

- A. Submit qualifications of observer to Engineer 30 days in advance of required observations. Observer subject to approval of Engineer.
- B. When specified in individual Specification Sections, require material or Product suppliers or manufacturers to provide qualified staff personnel to observe site conditions, conditions of surfaces and installation, quality of workmanship, start-up of equipment, test, adjust, and balance of equipment and to initiate instructions when necessary.
- C. Individuals to report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers' written instructions.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01600

MATERIAL AND EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Products.
- B. Transportation and Handling.
- C. Storage and Protection.
- D. Product Options.
- E. Substitutions.

1.02 RELATED SECTIONS

- A. Section 01400 - Quality Control: Product quality monitoring.

1.03 PRODUCTS

- A. Products: Means new material, machinery, components, equipment, fixtures and systems forming the Work. Does not include machinery and equipment used for preparation, fabrication, conveying and erection of the Work. Products may also include existing materials or components required for reuse.
- B. Provide interchangeable components of the same manufacturer, for similar components where possible.

1.04 TRANSPORTATION AND HANDLING

- A. Transport and handle products in accordance with manufacturer's instructions.
- B. Promptly inspect shipments to assure that products comply with requirements, quantities are correct and products are undamaged.
- C. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement or damage.

1.05 STORAGE AND PROTECTION

- A. Store and protect products in accordance with manufacturer's instructions, with seals and labels intact and legible. Store sensitive products in weather-tight, climate controlled enclosures.
- B. For exterior storage of fabricated products, place on sloped supports, above ground.
- C. Provide off-site storage and protection when site does not permit on-site storage or protection.
- D. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to avoid condensation.
- E. Store loose granular materials on solid surfaces in a well-drained area. Prevent mixing with foreign matter.
- F. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.
- G. Arrange storage of products to permit access for inspection. Periodically inspect to assure products are undamaged, and are maintained under specified conditions.

1.06 PRODUCT OPTIONS

- A. Products Specified by Reference Standards or by Description Only: Any product meeting those standards or description.
- B. Products Specified by Naming One or More Manufacturers: Products or manufacturers named and meeting specifications, no options or substitutions allowed.
- C. Products Specified by Naming One or More Manufacturers with a Provision for Substitutions: Submit a request for substitution for any manufacturer not named.

1.07 SUBSTITUTIONS

- A. Engineer will consider requests for Substitutions only within 15 days after date of Notice to Proceed.
- B. Substitutions may be considered when a product becomes unavailable through no fault of the Contractor.
- C. Document each request with complete data substantiating compliance of proposed Substitution with Contract Documents.

- D. A request constitutes a representation that Contractor:
1. Has investigated proposed product and determined that it meets or exceeds the quality level of the specified product.
 2. Will provide the same warranty for the Substitution as for the specified product.
 3. Will coordinate installation and make changes to other Work which may be required for the Work to be complete with no additional cost to Owner.
 4. Waives claims for additional costs or time extension which may subsequently become apparent.
 5. Will reimburse Owner for review or redesign services associated with re-approval by authorities.
- E. Substitutions will not be considered when they are indicated or implied on shop drawing or product data submittals, without separate written request, or when acceptance will require revision to the Contract Documents.
- F. Substitution Submittal Procedure:
1. Submit three copies of request for Substitution for consideration. Limit each request to one proposed Substitution.
 2. Submit shop drawings, product data, and certified test results attesting to the proposed product equivalence.
 3. The Engineer will notify Contractor, in writing, of decision to accept or reject request.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01666
TESTING PIPING SYSTEMS

PART 1 GENERAL

1.01 WORK INCLUDED

- A. Pressure testing of water distribution systems.
- B. Pressure test reports.

1.02 RELATED WORK

- A. Section 02675 - Disinfection of water distribution system.

PART 2 PRODUCTS -- NOT USED

PART 3 EXECUTION

3.01 PREPARATION

- A. Verify that test section is fully isolated. Remove all air from the pipeline. Make temporary taps to remove air, if necessary.
- B. Verify lowest elevation within the section of piping to be tested.
- C. Test section shall be no greater than one mile except where required due to lack of isolation valves.
- D. Perform all pressure tests in the presence of Engineer or his representative.
- E. All water distribution system piping shall be pressure tested with water.

3.02 EXECUTION

- A. Pressurize pipeline to 100 percent of maximum allowable pressure rating at the lowest elevation within the test section. If multiple pressure classes are within the test section, insure that the test pressure does not exceed 100 percent of the pressure rating in any portion of that section.
- B. Record test location, test section, beginning pressure, date, and time on the form included in this section.
- C. Inspect exposed piping and fittings during test for visible leakage or defects.

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- D. Test section to remain pressurized for no less than 2 hours.
- E. The maximum permissible pressure drop during the test shall be 5 pounds per square inch.
- F. Pipelines shall be repressurized at the end of the test period. The maximum quantity of water necessary to repressurize to the test pressure shall not exceed the following:

$$L = \frac{S \times D \times P^{0.5} \times T}{148,000}$$

Where L = Leakage in gallons

S = Length of pipe tested

D = Nominal pipe diameter in inches

P = Pressure rating of the pipeline tested (PSI)

T = Duration of test in hours

- G. Test sections which exceed the pressure drop or leakage criteria shall be repaired and retested.

END OF SECTION

PROJECT _____
INSPECTOR _____

PRESSURE TEST REPORT

DATE	TEST SECTION		TEST POINT	PRESSURE (PSI)			LEAKAGE (GAL.)	REMARKS
	FROM	TO		BEG	60 MIN	120 MIN		

SECTION 01700
CONTRACT CLOSEOUT

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Closeout Procedures.
- B. Final Cleanup.
- C. Operation and Maintenance Data.
- D. Project Record Documents.

1.02 RELATED REQUIREMENTS

- A. Section 01500 - Construction Facilities and Temporary Controls.

1.03 CLOSEOUT PROCEDURES

- A. Comply with procedures stated in General Conditions of the Contract for issuance of Certificate of Substantial Completion.
- B. When Contractor considers Work has reached final form, submit written certification that Contract Documents have been reviewed, Work has been inspected, and that Work is ready for Engineer's pre-final inspection.
- C. At pre-final inspection, a final punch list will be prepared.
- D. Based on items on final punch list, a certificate of substantial completion may be issued.
- E. When final punch list items have been completed, notify Engineer or his representative to arrange for final inspection.
- F. Final payment and contract closeout will proceed after final inspection.
- G. In addition to submittals required by the conditions of the Contract, provide submittals required by governing authorities, and submit a final statement of accounting giving total adjusted Contract Sum, previous payments, and sum remaining due.

1.04 FINAL CLEAN-UP

- A. Execute prior to final inspection.
- B. Remove all remaining brush, rocks or debris from the Project. Grade smooth all areas where backfilled soil is mounded excessively or left in rough condition.
- C. Wash interior of buildings and vaults. Touchup paint where necessary.
- D. Remove waste and surplus materials, rubbish, and construction facilities from the Project and from the site.

1.05 PROJECT RECORD DOCUMENTS

- A. Store documents separate from those used for construction.
- B. Keep documents current; do not permanently conceal any Work until required information has been recorded.
- C. At Contract closeout, submit documents with transmittal letter containing date, Project title, Contractor's name and address, list of documents, and signature of Contractor.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 03200
CONCRETE REINFORCEMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Reinforcing steel bars, wire fabric and accessories for cast-in-place concrete.

1.02 RELATED SECTIONS

- A. Section 03300 - Cast-in-Place Concrete.

1.03 REFERENCES

- A. ASTM A615 - Deformed and Plain Billet Steel Bars for Concrete Reinforcement.

PART 2 PRODUCTS

2.01 REINFORCEMENT

- A. Wire Fabric: ASTM A185.
- B. Reinforcing Steel: ASTM A615, yield grade; plain, billet steel bars.

2.02 ACCESSORIES

- A. Tie Wire: Minimum 16 gage annealed type.

PART 3 EXECUTION

3.01 PLACEMENT

- A. Place, support and secure reinforcement against displacement. Do not deviate from required position.
- B. Do not displace or damage vapor barrier.
- C. Accommodate placement of formed openings.

3.02 FIELD QUALITY CONTROL

- A. Section 01400 - Quality Control: Field inspection and testing.

END OF SECTION

SECTION 03300

CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.01 WORK INCLUDED

- A. Formwork, shoring, bracing, and anchorage.
- B. Concrete reinforcement and accessories.
- C. Concrete for pipeline thrust blocking.

1.02 REFERENCES

- A. Where not modified or exceeded by drawings or these specifications, the "Specifications for Structural Concrete for Buildings" ACI 301 (including ACI and CRSI Standards and Recommendations therein), latest edition, and the local building code shall be the specifications for all concrete construction for this project, as if hereto attached or herein repeated. Maintain copy at site.
- B. Detail and place reinforcement in accordance with ACI Building Code 318-77 and the Manual of Standard Practice for Detailing Reinforced Concrete Structures, ACI 315-78.

1.03 QUALITY ASSURANCE

- A. Test materials, trial mix designs and the resulting concrete for compliance with technical requirements of specifications by employing a qualified, experienced testing agency to provide testing services required under ACI 301-72, 16.3. Promptly provide Engineer one copy of all tests performed, each designating the location from which the sample was taken.
- B. During work progress, make, cure, and test at least the following number of samples, each sample constituting three cylinder specimens:

<u>Buildings</u>	
<u>Member</u>	<u>Number of Samples</u>
Foundations	1
Floor	1

<u>Water Storage Tank Foundations</u>	
<u>Member</u>	<u>Number of Samples</u>
Foundations	2 per pour

Make cylinders of first sample of 2500 PSI, 3000 PSI, 3500 PSI and 4000 PSI concrete and test at 7 days. Test remaining samples at 28 days, unless otherwise directed by Engineer.

- C. Conform to ACI 305R when concreting during hot weather; to ACI 306R in cold weather.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Portland cement: ASTM C150, Type I.
- B. Fine and coarse aggregates: ASTM C33 for normal weight concrete.
- C. Water: Clean and not detrimental to concrete.
- D. Air-entraining admixture: ASTM C260.
- E. Reinforcement bars: Deformed, new stock, billet steel, conforming to ASTM 615-81, Grade 40 minimum, including Supplementary Requirements S1.
- F. Furnish an additional 200 linear feet of #4 bars and place same at direction of Engineer.
- G. Capillary Water Barrier: 6 mil thick clear polyethylene film, type recommended for below grade application.
- H. Joint Filler: Non-extruding type, 1/2" thick-full depth of slab or joint.
- I. Non-Shrink Grout: Premixed compound with non-metallic aggregate, cement, water reducing and plasticizing agents; capable of minimum compressive strength of 3500 psi.
- J. Form Release Agent: Colorless material which will not stain concrete, absorb moisture or impair natural bonding or color characteristics of coating intended for use on concrete.

2.02 FORMS

- A. Use dressed earth as form for footings and trench walls. Form other concrete with plywood or metal panels. Chamfer corners of walls, columns and beams 3/4" x 3/4".

- B. Build forms to withstand pressures without deflection. Use ties that disconnect or snap no closer than 3/4" from surface.
- C. Do not apply form release agent where concrete surfaces receive special finishes or applied coatings which may be affected by agent.

2.03 CONCRETE MIX

- A. For strength and durability, proportion to comply with following requirements for working stress, normal weight concrete, using 3/4" maximum size aggregate and fine aggregate in amount of 40% to 50% combined aggregate weight.

	<u>Min PSI at 28 Days</u>	<u>Min/Max Inches Slump</u>	<u>Max gal Water per CY</u>	<u>Min bags Cement per CY</u>
<u>Usage (non-air entrained)</u>				
Anchor pads and thrust blocking	2500	5 max.	41	5-1/2
Footings, substructure walls, interior slabs on grade and on forms, and bond beams	3500	2-5	36	6
<u>Usage (air-entrained)</u>				
Exterior slabs on grade and all items not included above	4000	2-5	34	6-1/4

Note: 75% of minimum strength required at 7 days.

- B. Other combinations of materials established by trial mixes, made in accordance with Method 1, ACI 301-72, 3.8.2.1, meeting requirements for strength and durability in a), above, may be substituted if approved by Engineer. Mixes containing fly-ash will not be approved.

PART 3 EXECUTION

3.01 CONSTRUCTION AND CONTRACTION JOINTS

- A. Make and locate construction joints not shown on drawings to least impair the strength of structure. Make joints perpendicular to main reinforcement, key

the joint and continue reinforcement through joint. Consult Engineer for permissible joint locations.

3.02 EMBEDDED ITEMS

- A. Provide inserts, anchors, bolts, dowels, sleeves, slots and other fastening devices required for attachment of other work. Accurately locate in co-operation with other trades and secure in position before concrete is poured. Do not install sleeves in any structural member except upon approval of Engineer.

3.03 PLACING REINFORCEMENT

- A. Unless indicated, set reinforcement with the following clearances from face of concrete: Footings 3-1/2", formed slabs 3/4", foundation walls 2".
- B. Avoid splices at points of maximum tensile stress. Lap bar splices 32 bar diameters unless indicated otherwise by drawings.
- C. At corners and intersections provide lap splice bars, or bend and run bars continuous. At openings in walls and slabs, at each layer of reinforcement, surround opening with #5 bar and provide diagonal #5 x 4-0 bar at each corner.
- D. Field bending of bars partly embedded in concrete is not permitted.
- E. Reinforce bond beams as indicated on drawings.
- F. Provide spacers, chairs, ties and other devices for spacing and supporting reinforcement. On ground, support by small concrete blocks (3-1/2 x 3-1/2 max.) or metal chairs or tie to #3 bars stubbed into ground. Over formwork provide metal or plastic chairs spaced to prevent excessive deflection and not over 48". Where concrete surface will be exposed to weather or to view, use galvanized or plastic accessories in contact with formwork.
- G. Wire tie at least 50% of the crossings of reinforcement, and as otherwise necessary to prevent displacement. Wire tie all splice laps and fabric laps.

3.04 MIXING AND DELIVERY

- A. Furnish ready mixed concrete mixed and delivered in conformance with the Specifications for Ready Mixed Concrete (ASTM C94, 1986 Revision).
- B. Specifically schedule deliveries that concrete can be placed as rapidly as delivered and without delays between deliveries.

- C. Contractor's superintendent shall mark each ticket for location concrete was used.
- D. At jobsite, additional water to adjust slump for placing (without exceeding maximum slump) may be added only if additional cement is added to prevent exceeding required water-cement ratio and batch is additionally mixed at least half required mixing time.
- E. Discharge all concrete from delivery truck within 1-1/2 hours (1 hour when temperatures exceed 80 degrees F) after introduction of water into mix.

3.05 PLACING CONCRETE

- A. Clean footings, forms and reinforcement of ice, excess water, mud, oil, hardened concrete and other foreign materials.
- B. Sprinkle semi-porous subgrades with water to eliminate suction.
- C. Mix, transport and convey to final deposit as rapidly as practical by methods which prevent separation or loss of ingredients and assure concrete quality is retained. Within a section, deposit concrete continuously or in layers that no concrete will be deposited on concrete that has sufficiently hardened to form seams of weakness. Deposit no partially hardened or contaminated concrete.
- D. Force coarse aggregate away from form to bring a full surface of mortar against form without excessive surface voids. Consolidate all concrete by vibrator and supplementary spading and rodding. Insert and withdraw vibrators 18" apart; each insertion generally 5 to 15 second duration, to consolidate without causing segregation. Over-vibrating and transporting concrete within forms by vibrator not permitted. Maintain spare vibrator during concrete placing.
- E. Notify Engineer minimum 24 hours prior to commencement of concreting operations.
- F. Allow 48-hour cure period between pours on footings and pedestals at tank sites.
- G. Install capillary water barrier under interior floor slabs on fill. Lap joints minimum 6 inches (150 mm) and seal. Do not disturb capillary water barrier while placing reinforcement.

3.06 WEATHER CONDITIONS

- A. Unless protected, do not place concrete during rain, sleet or snow. Do not

allow rain to damage surface finish.

- B. Generally, mix and place concrete when outside temperature is at least 40°F, and if less than 45°F, temperature shall be rising. For placing at lower temperatures, heat ingredients and otherwise prepare so that temperature of fresh concrete as placed is between 50°F and 70°F. Provide means for maintaining concrete temperature of at least 50°F for 72 hours after placing. Keep protective housings or coverings in place and intact at least 24 hours after artificial heating is discontinued.
- C. Calcium chloride may be used only in accordance with "Recommended Practice for Cold Weather Concreting" (ACI 306) when approved by Engineer.

3.07 FORM REMOVAL AND CURING

- A. Keep formwork for slabs and other parts that support the weight of concrete in place until concrete has reached at least 80% of specified 28 day strength. Formwork for other parts may be removed as soon as concrete has hardened sufficiently to resist damage from removal operations.
- B. Cure and protect in accordance with ACI 301-72, Chapter 12.

3.08 FINISHES OF FORMED SURFACES

- A. Surfaces not exposed to view: Remove ties; patch tie holes and major defects; rub off fins exceeding 1/4".
- B. Surfaces exposed to view, painted: Ties removed and patched; free from joint misalignment, fins and voids other than pin-holes; panels straight and generally smooth, free from oil and grease and suitable for good paint finish.

3.09 FLATWORK

- A. Underlay interior slabs on grade with capillary water barrier over leveling bed. Lap edges 6" in direction of concrete pouring. Repair holes, other than those for grade stakes, with additional piece lapping hole edges 12".
- B. Place concrete using stiffest consistency practical for work and conforming to placing specifications. Work well around reinforcement.
- C. Finishing Schedule:

Slab

Finish

Floors intended as walking surfaces

and for receiving floor coverings Trowel

- D. Consult ACI 301-72, 11.7 for finish requirements. Finish in true planes, level except at drains and other slopes indicated, and not exceeding the following tolerances for vertical slope at any point and in any direction:

<u>Finish</u>	<u>Percent of Slope</u>
Trowel or broomed	0.4

- E. Grind smooth surface defects that would "telegraph" through applied floor coverings.
- F. Broom finishes: Immediately after troweling, slightly roughen concrete surface (to the degree scheduled) by brushing with fiber bristle broom at right angles to main traffic flow.
- G. Floor Drains:
- 4" Floor Drain: 36" dia. basin, 1/2" deep. Slope balance of floor 1-1/2" to basin.

END OF SECTION

SECTION 09900

PAINTING

PART 1 GENERAL

1.01 WORK INCLUDED

- A. Surface preparation, surface finish schedule, interior and exterior painting for new pump station and related pipeline improvements.

1.02 REFERENCES

- A. ANSI/ASTM D16 - Definitions of Terms Relating to Paint, Varnish, Lacquer, and Related Products.
- B. ASTM D2016 - Test Method for Moisture Content of Wood.
- C. Steel Structures Painting Manual, Vol. 2, Systems and Specifications - Definitions of Steel Structures Painting Council (SSPC) Surface preparation specifications referred to in this section:

SSPC - SP1	Solvent Cleaning
SSPC - SP2	Hand Tool Cleaning
SSPC - SP3	Power Tool Cleaning
SSPC - SP7	Brush-off Blast Cleaning

1.03 QUALITY ASSURANCE

- A. Product Manufacturer: Company specializing in manufacturing quality paint and finish products with 10 years experience.
- B. Applicator: Company specializing in commercial painting and finishing with 3 years experience.

1.03 SUBMITTALS

- A. Submit product data under provisions of Section 01300.
- B. Provide product data on all finishing products.
- C. Colors to be selected by Engineer prior to commencement of work.

- D. Submit list of paint proposed for use on each item to be painted. Include description of each type of paint and manufacturer's instructions for thickness of coats.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store and protect products to site under provisions of Section 01600.
- B. Deliver products to site in sealed, unopened, labeled containers. Labels shall list manufacture's name, type of paint, color designation coverage, surface preparation requirements, drying time, clean-up, and instructions for mixing, reducing, and applying. Inspect to verify acceptance.
- C. Store paint materials at ambient temperatures between 45°F minimum and 95°F maximum, in well ventilated area, unless required otherwise by manufacturer's instructions.
- D. Comply with health (OSHA) and fire regulations.

1.06 ENVIRONMENTAL REQUIREMENTS

- A. Provide continuous ventilation and heating facilities to maintain surface and ambient temperatures between 45 and 95°F for 24 hours before, during, and 48 hours after application of finishes, unless required otherwise by manufacturer's instructions.
- B. Manufacturer's data on air and surface temperature limits and relative humidity shall be strictly adhered to during application and cure time.
- C. Paints, except water-thinned types, shall be applied only to surfaces that are completely free of surface moisture as determined by sight or touch.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS - PAINT

- A. Tnemec Company, Inc., Sherwin-Williams
- B. Substitutions: Under provisions of Section 01600.

2.02 MATERIALS

- A. Coatings: Ready mixed, except field catalyzed coatings. Process pigments to a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating.

- B. Coatings: Good flow and brushing properties; capable of drying or curing free of streaks and sags.
- C. Accessory Materials: Linseed oil, shellac, turpentine, paint thinners and other materials not specifically indicated but required to achieve the finishes specified, of commercial quality.

2.03 FINISHES

- A. Refer to schedule at end of Section for surface finish.

PART 3 EXECUTION

3.01 INSPECTION

- A. Verify that surfaces are ready to receive work as instructed by the product manufacturer.
- B. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.
- C. Beginning of installation means acceptance of substrate.
- D. All surface preparation and painting shall be performed in the field unless otherwise noted.

3.02 SURFACE PREPARATION

- A. General
 - 1. Items that are not to be painted shall be removed or protected by masking prior to surface preparation and painting operations.
 - 2. Remove hardware, electrical device cover plates, and removable trim.
 - 3. Apply protective masking and/or covering to electrical components, and required labels or equipment identification, performance rating, name or nomenclature plates.
- B. Ferrous Metal Surfaces:
 - 1. Ferrous Surfaces that have not been shop-coated shall be solvent cleaned in accordance with SSPC-SP1.

2. Surfaces that contain loose rust, loose mill scale and other foreign substances shall be mechanically cleaned in accordance with SSPC-SP3 or blast cleaned in accordance with SSPC-SP7.
3. After cleaning, one coat of primer shall be applied in accordance with the paint schedule at the end of this section.

C. Galvanized Steel and Non-Ferrous Metal.

1. Galvanized steel and non-ferrous metal surfaces that have not been shop-coated shall be solvent cleaned in accordance with SSPC-SP1.
2. White rust shall be removed from galvanized steel by hand or power brushing in accordance with SSPC-SP2 or SP3.

D. Concrete and Masonry.

1. New concrete and masonry shall not be coated for at least 30 days to permit proper cure and dry out.
2. Concrete shall be visually inspected and tested for moisture content before painting using a polyethylene cover test as described in manufacturer's surface preparation and application guide.
3. All surfaces to be painted shall be examined for surface defects such as fins, protrusions, bulges and mortar spatter. These defects shall be corrected by grinding or scraping prior to painting the surface.
4. Concrete floor surface shall be either brush-off blasted or acid-etched according to paint manufacturer's recommended surface preparation procedure for concrete floors.
5. Concrete/masonry wall surfaces shall be solvent cleaned or washed with a hot tri-sodium phosphate solution (2 lbs. trisodium phosphate per gallon of hot water) to remove surface contamination. Cleaning operation shall be repeated until the contamination is removed. Cleaned area shall be flushed with potable water to remove residual cleaning solution and allowed to dry thoroughly before painting.
6. Abrasive blasting shall be used to remove laitance and solid contaminants according to paint manufacturer's recommendations.
7. Voids and cracks shall be patched using a patching compound compatible with the paint system.

8. Wire brushing may be used for touch-up work to remove loose material from surface and open up some of the holes and voids.

E. Wood.

1. Wood surface deposits of sap or pitch shall be removed by scraping and wiping clean with rags dampened with mineral spirits.
2. Knots and pitch pockets shall be sealed with shellac reduced with equal parts of shellac thinner before priming.
3. Rough spots shall be sanded smooth. Sanding dust shall be removed.
4. After prime coat is dry, cracks, holes, and nail holes shall be filled with plastic wood filler. After filler material is hard, repaired surface shall be sanded smooth and flush.
5. Wood filler used shall be compatible with subsequent coatings.

F. Factory or Shop-Painted Items

1. All factory finish-painted items shall be touched up to provide acceptable finish painting. Mis-matched touch-up color and surface or equipment painted with undesirable color(s) shall be repainted according to the requirements of this section.
2. All shop-primed items shall be touched up as required to restore abraded and scratched areas, rendering surfaces suitable for finish painting.
3. Shop-primed items shall receive the surface preparation and finish painting as required by this section. Spot test to check compatibility of field applied primer with shop primed surfaces.

3.03 PAINT APPLICATION

- A. Piping shall not be painted until the piping has been tested and approved.
- B. The manufacturer's recommended pot life limits for all multi-component materials shall be strictly observed. When pot life has been exceeded, the material shall be discarded, even if it still looks like it is satisfactory to use.
- C. All paint materials shall be evenly spread to cover and hide the underlying surface without holidays, thin spots, runs or sags.

- D. Apply succeeding coats only over thoroughly cured previous coats and in full accordance with product manufacturer's instructions.
- E. Tools and application equipment shall be clean and in good operating condition. Type of equipment, pressure settings and application technique shall be in accordance with manufacturer's recommendation to assure proper atomization and application characteristics. Only high quality brushes and roller applicators, as recommended by the paint manufacturer, may be used for non-spray application of coatings.

3.04 CLEAN UP

- A. Spilled, splashed or spattered paint shall be promptly removed as work proceeds.
- B. Cotton waste, cloth rags, and materials which may constitute a fire hazard shall be kept in closed metal containers and removed from the job site daily.

3.05 PAINT SCHEDULES

- A. Schedules and manufacturer's designations herein indicate selections of Tnemec materials as a basis of type and quality.
- B. Exterior Surfaces:

<u>Painting Surface</u>	<u>Undercoat</u>	<u>Interm. Coat</u>	<u>Finish Coat</u>	<u>Sheen</u>
1. Exposed galvanized metal	Series 66 Hi-Build Epoxoline (DFT=3.0-5.0 mils)		Series 73 Endura Shield (DFT = 2.0-3.0 mils)	semi-gloss (SG)
2. Steel Doors & Frames and other shop-primed steel	Series 66 Hi-Build Epoxoline (DFT=3.0-5.0 mils)	Series 73 Endura-Shield (DFT=2.0-3.0 mils)	Series 73 Endura-Shield (DFT=2.0-3.0 mils)	SG
3. CMU (Block) Walls	54-660 Masonry Filler	Series 66 Hi-Build Epoxoline (DFT=3.0-5.0 mils)	Series 73 Endura-Shield (DFT=3.0-5.0 mils)	SG

- C. Interior Surfaces:

<u>Painting Surface</u>	<u>Undercoat</u>	<u>Interm. Coat</u>	<u>Finish Coat</u>	<u>Sheen</u>
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1. Cast iron, Ductile iron & Steel pipe	Series 66 Hi-Build Epoxoline (DFT=3.0- 5.0 mils)	---	Series 66 Hi-Build Epoxoline (DFT=4.0- 6.0 mils)	SG
2. Pumps, Valves, Motors, Equipment	Series 66 Hi-Build Epoxoline (DFT=3.0- 5.0 mils)		Series 66 Hi-Build Epoxoline (DFT=4.0- 6.0 mils)	SG
3. CMU (Block) Walls	54-660 Masonry Filler	Series 66 Hi-Build Epoxoline (DFT=3.0- 5.0 mils)	Series 66 Hi-Build Epoxoline (DFT=4.0- 6.0 mils)	SG
4. Exposed Galvanized Metal	Series 66 Hi-Build Epoxoline (DFT=3.0- 5.0 mils)		Series 66 Hi-Build Epoxoline (DFT=4.0- 6.0 mils)	SG
5. Steel Doors & Frames	Series 66 Hi-Build Epoxoline (DFT=3.0- 5.0 mils)	Series 73 Endura- Shield (DFT=2.0 3.0 mils)	Series 73 Endura- Shield (DFT=2.0- 3.0 mils)	SG
6. Exposed Plywood & Wood Trim	Series 66 Hi-Build Epoxoline (DFT=2.0- 3.0 mils)		Series 66 Hi-Build Epoxoline (DFT=2.0- 3.0 mils)	
7. Concrete Floor & Pump Bases	Series 67 Tneme-Tread (DFT=2.0- 3.0 mils)		Series 67 Tneme-Tread (DFT=2.0- 3.0 mils)	Skid Resistant

Paint caulking (other than colored caulking) to match adjacent materials.

D. Surfaces not requiring field paint application.

1. Aluminum and stainless steel not specified on the drawings to be painted.
3. Items finish painted by the manufacturer or specified to be finish painted under other sections of the specification.

3.06 COLORS

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- A. Interior colors are expected to be limited to four basic paint colors plus white. Door and door frame shall be the same color. Ceiling shall be white. Valve handles shall be Safety Red-SC09.

END OF SECTION

SECTION 15060
PIPE AND PIPE FITTINGS

PART 1 GENERAL

1.01 WORK INCLUDED

- A. Pipe, fittings, and connections.

1.02 RELATED WORK

- A. Section 15100 - Valves.

1.03 REFERENCES

- A. ANSI/ASME B16.22 - Wrought Copper and Bronze Solder-Joint Pressure Fittings.
- B. ANSI/ASTM A53 - Pipe, Steel, Black, and Hot-Dipped Zinc-Coated, Welded and Seamless.
- C. ANSI/ASTM A120 - Pipe, Steel, Black, and Hot, Dipped Zinc-Coated (Galvanized), Welded and Seamless, for Ordinary Uses.
- D. ANSI/ASTM A126 - Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
- E. ANSI/ASTM D1784 - Rigid Poly Vinyl Chloride (PVC) Compounds.
- F. ANSI/ASTM D2564 - Solvent Cements for Poly Vinyl Chloride (PVC) Plastic Pipe and Fittings.
- G. ANSI/AWS D.1.1 - Structural Welding Code.
- H. ANSI/AWWA C153 - Ductile-Iron Compact Fittings.
- I. ANSI/AWWA C111 - Rubber Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
- J. ANSI/AWWA C115 - Flanged Ductile-Iron Pipe with Ductile Iron or Gray Iron Threaded Flanges.
- K. ANSI/AWWA C151 - Ductile-Iron Pipe, Centrifugally Cast for Water or Other Liquids.

- L. AWWA C605 – Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water.
- M. AWWA C900 - Polyvinyl Chloride (PVC) Pressure Pipe.
- N. AWWA C901 - Polyethylene (P.E.) Pressure Pipe and Tubing.
- O. AWWA C906 - Polyethylene (P.E.) Pressure Pipe and Fittings.
- P. ASTM B88 - Seamless Copper Water Tube.
- Q. ASTM D2855 - Practice for Making Solvent-Cemented Joints with Poly Vinyl Chloride (PVC) Pipe and Fittings.
- R. FS WW-P-521 - Pipe Fittings, Flange Fittings, and Flanges: Steel and Malleable Iron (Threaded and Butt Welding) Class 150.
- S. ASTM F477 - Elastometric Seals (gaskets) for Joining Plastic Pipe.

1.04 SUBMITTALS

- A. Submit product data under provisions of Section 01300.
- B. Provide data sheets for each type of piping. Provide conformation that proposed pipe, fittings, and appurtenances meet the referenced specification.

1.05 QUALITY ASSURANCE

- A. Welding Materials and Procedures: Conform to ASME Code.
- B. Employ certified welders in accordance with ASME Section 9.

PART 2 PRODUCTS

2.01 PIPE AND TUBE

- A. PVC Plastic Pipe: ANSI/ASTM D1784 compound specifications, 2,000 psi design stress for water at 73.4° F., designated as PVC 1120. Pipe shall bear the NSF seal of approval and shall conform to the Department of Commerce PS22-70 (SSDR-PR). Pipe shall have integral bell, gasketed joints or shall be jointed with a double gasket coupling. Integral bell joints and double gasket couplings shall conform to ASTM D-3139. Double gasket couplings shall have a pipe stop in the center of the coupling. Molecularly oriented PVC shall comply with ASTM F1483 specifications, with gaskets meeting ASTM F477 and joints in compliance with ASTM D3139. Each male pipe end shall be marked with a line to indicate the full seating depth of the pipe. Pipe shall be the

pressure class indicated on the drawings. Solvent weld joints are not acceptable.

- B. PVC Plastic Pipe: AWWA C900 where required.
- C. Steel Pipe: ANSI/ASTM A120; galvanized; Schedule 40 or Schedule 80 weight.
- D. Ductile Iron Water Pipe: ANSI/AWWA C151.
- E. Cast Iron Water Pipe Flanged: ANSI/AWWA C151.
- F. Buried Ductile Iron pipe, fittings, and joints shall be wrapped with 8-mil polyethylene in accordance with AWWA C105.
- G. Ductile Iron Pipe (not direct buried) shall be factory primed and then field painted per Section 09900 – Painting.
- H. Copper Water Tube: ASTM B88, Type K, hard; seamless.
- I. Polyethylene (PE) Pipe (3" and smaller): AWWA C901, PE 3406, 200 psi rated.
- J. Polyethylene (PE) Pipe (4" and larger): AWWA C906, PE 3408.
- K. Restrained Joint PVC Pipe: Certainteed "Yelomine" or "Certa-Lok" Pipe with grooved joint and retainer for stream crossings, where required.
- L. Ductile Iron Restrained Joint Pipe and Fittings: ANSI/AWWA C151; Boltless design; minimum allowable joint design deflection = 5 degrees; "US Pipe TR Flex", or approved equal.

2.02 PIPE FITTINGS

- A. Steel Pipe Fittings: ANSI/ASME B16.3.
- B. Ductile Iron Pipe Fittings: ANSI/AWWA C110/A21-10, C153/A21.53. ASTM C564, rubber gasket joints. ANSI/AWWA C111, rubber gasket joints concrete lined and coated.
- C. Copper Pipe Fittings: ANSI/ASME B16.22, pressure fittings.
- D. Fittings for PVC Pipe: ANSI/AWWA C110/A21.10, C153/A21.53. ASTM C564 rubber gasket joints (transition gaskets for PVC pipe). ANSI/AWWA C111, rubber gasket joints. Use ductile iron restrained joint fittings. MIDCO or approved equal.

- E. PVC Pipe Fittings: ANSI/AWWA C153/A21.53 ASTM C564, rubber gasket joints. Ductile iron push-on fittings 1-1/2 through 3", solvent weld 1" and smaller.
- F. Solvent for PVC Jointing: ANSI/ASTM D2564.
- G. Copper to Polyethylene (PE) Pipe Transition Couplings: "Ford" No. C46-44.
- H. Pipe Saddles: "Ford" Style S70/S90 for 1-1/2" through 12".
- I. Pipe Couplings: "Dresser" Style 40 (Long Coupling-18" min.)
- J. Tubing Couplings: "Ford" Pack Joint Couplings.

PART 3 EXECUTION

3.01 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel PVC pipe.
- B. Remove scale and dirt, inside and outside, before assembly.
- C. Remove welding slag or foreign material from pipe and fitting materials.

3.02 STEEL PIPE CONNECTIONS

- A. Screw joint steel piping up to and including 1-1/2 inch (38 mm). Weld piping 2-1/2 inch (64 mm) and larger, including branch connections. Screw or weld 2 inch (50 mm) piping.
- B. Die cut screwed joints with full cut standard taper pipe threads with red lead and linseed oil or other non-toxic joint compound applied to make threads only.
- C. Use main sized saddle branch connections or directly connecting branch lines to mains in steel piping if main is one pipe size larger than the branch for up to 6 inch (150 mm) mains and if main is two pipe sizes larger than branch for 8 inch (200 mm) and larger mains. Do not project branch pipes inside the main pipe.

3.03 DUCTILE IRON PIPE CONNECTIONS

- A. Joints for Bell and Spigot Pipe: Neoprene gasketing system.
- B. Joints for Plain End Pipe: Gasket and clamp, mechanical fastener.
- C. Clamp water pipe at fittings with 3/4 inch (19 mm) rods, anchor, and support.

- D. Make connections to equipment and branch mains with unions.
- E. Provide non-conducting connections wherever jointing dissimilar metals in open systems.

3.04 PLASTIC PIPE CONNECTIONS

- A. Solvent Weld Joint: Form solvent joints in PVC Pipe and fittings to ANSI/ASTM D2855.

3.05 COPPER PIPE CONNECTIONS

- A. Form hot soldered joints in copper, brass, or bronze fittings with 95-5 solder.
- B. Make connections to equipment and branch mains with unions.

3.06 POLYETHYLENE PIPE CONNECTIONS (2" AND LARGER PIPE)

- A. Heat fuse joints per manufacturer's installation standards. Manufacturer's representative shall be present during joining of pipe sections if Contractor cannot show adequate experience.

3.07 PVC GASKET JOINT CONNECTION

- A. Inspect gasket, bell, and spigot thoroughly. Wipe gasket clean of excess dirt. Ensure that spigot end is tapered uniformly. File any rough or sharp spots to a smooth finish. Ensure that bell is smooth and uniform.
- B. Thoroughly coat the exposed gasket surface with lubricant. Apply lubricant to spigot end, completely coating the pipe to the full insertion mark.
- C. Align the bell and spigot ends of the pipes to be joined. Insert the spigot into the bell by hand or with the use of a bar and block. Insert until insertion mark in spigot end is flush with the end of the bell. Mechanical methods for inserting the spigot into the bell are not accepted without written recommendation by the pipe manufacturer.
- D. Piping 4 inches in diameter and smaller may be assembled in a continuous string adjacent to the trench with no more than 200 feet preceding backfill operations. The assembled pipe string may then be placed into the trench as trenching progresses. Additional care must be taken so that process does not overstress the joints or pipeline. Each joint shall be checked to ensure that the insertion mark on the spigot end remains flush with the end of the bell and that no damage has occurred during placement operations.

- E. Piping 6 inches and larger shall be lowered into the trench by supporting the last joint with a board across the trench. The board shall then be moved to the next joint as it is installed and the previous joint lowered into the trench.
- F. Under no circumstances shall pipe or appurtenances be rolled, dropped or dumped into the trench.
- G. Install pipeline in the center of the trench at the cover depth indicated on the plans.
- H. Other methods of pipeline placement into the trench shall be submitted to the Owner and Engineer for approval prior to the commencement of the Work.

3.08 INSTALLATION GUIDELINES

- A. Install pipe in accordance with manufacturer's recommendations.
- B. Prevent water, soil, and other foreign material from entering the pipe during laying operations. Install pipe cap during any time that pipe is left unattended.
- C. Soil, vegetation, and any other material that has collected in any pipe section shall be removed by swabbing prior to installation.
- D. Pig all main pipelines 2 inches and larger. Swab type pigs to be used.

3.09 SEPARATION OF WATER MAINS AND SEWERS

- A. Horizontal distance shall be no less than 10 feet measured from edge to edge. Undisturbed earth shall remain between pipelines.
- B. Vertical separation distance for water pipelines crossing above sewer lines is 2 feet. If vertical separation is less than 2 feet, the sewer line shall be encased in concrete for a distance of 10 feet on each side of the water line. The minimum thickness of the concrete is 6 inches.

3.10 SEPARATION OF WATER MAINS AND OTHER POLLUTION SOURCES

- A. Provide 15 feet horizontal separation from individual or industrial septic tanks, absorption fields, waste stabilization ponds, wastewater lines discharging into roadside ditches, feedlots, or other pollution sources.
- B. Water lines shall not be constructed through septic tank tile absorption fields or feedlots.

END OF SECTION

SECTION 15100

VALVES

PART 1 GENERAL

1.01 WORK INCLUDED

- A. Operational valves.
- B. Testing.

1.02 RELATED WORK

- A. Section 01666 - Testing Piping Systems.
- B. Section 15060 - Pipe and Pipe Fittings.

1.03 SUBMITTALS

- A. Submit detailed shop drawings under provisions of Section 01300. Clearly indicate make, model, location, type, size and pressure rating.

PART 2 PRODUCTS

2.01 RESILIENT WEDGE GATE VALVES

- A. Valves shall comply with AWWA C509 and the following:
 - 1. The minimum rated working pressure shall be 200 psi. Valves shall have non-rising stems. Valve stems shall be cast integral with stem collar and furnished of cast, forged, or rolled bronze. Stem nuts shall be independent of the wedge and shall be made of solid bronze. Bronze for internal working parts, including stems, shall not contain more than 2% aluminum nor more than 7% zinc. Bronze shall conform to ASTM B62 or ASTM B584 (Alloy C83600), except the stem bronze shall have a minimum tensile strength of 60,000 psi, a minimum yield strength of 30,000 psi, and aluminum of 10% elongation in 2-inches (ASTM B584 or B783, Alloy C87600 or C99500). All body bolts shall be 316 stainless steel. Cast-iron wedge shall have sealing surfaces of the wedge permanently bonded with resilient materials to meet ASTM tests for rubber to metal bond, ASTM D429.
- B. Provide reduction thrust bearings both above and below the stem collar. Stuffing boxes shall be O-ring seal type with two rings located in stem above thrust collar. Each valve shall have a smooth unobstructed waterway free from any sediment pockets.

- C. Flanges shall be Class 125 per ANSI B16.1; mechanical joint ends shall comply with ANSI A21.11.
- D. Iron body, bronze trim, non-rising stem, resilient seat, MJ ends, stainless steel bolts. Mueller A-2360 or approved equal.

2.02 BALL VALVES

- A. Ball valves, 2-inches and smaller, shall be bronze body per ASTM B 62. Provide Type 316 stainless-steel ball. Valves shall have screwed ends (ANSI B1.20.1), non-blowout stems, reinforced Teflon seats, and have plastic coated lever operators. Valves shall have a pressure rating of at least 300 psi WOG at a temperature of 150° F.

2.03 AIR RELEASE VALVE

- A. Acceptable manufacturer: Val-Matic or equal.
- B. Provide air release valves where indicated on Drawings to slowly release pockets of air that accumulate at high points in piping system.
- C. Provide automatic float operated, compound lever valves designed to release accumulated air from piping system while in operation and under pressure.
- D. Provide float able to withstand an external pressure of 1,000 psig without collapsing.
- E. Provide field adjustable and replaceable orifice button.
- F. Materials of construction:

<u>Item</u>	<u>Material</u>	<u>Specification</u>
Body and Cover	Cast iron	ASTM A 48, Class 30 or ASTM A 126, Class B
Float and needle	Stainless Steel	ASTM A 240 ANSI Type 304, 316
Linkage, orifice air-release mechanism	Stainless Steel	ASTM A 240 ANSI Type 304, 316
Seat	Buna-N	---

2.04 PRESSURE RELIEF AND SURGE ANTICIPATOR VALVE

- A. Hydraulically operated, pilot controlled. Furnish with shut off cocks to isolate pilot control.
- B. Cla Val No. 52-03, Singer, Golden Anderson, or approved equal.
- C. Provide stainless steel tubing.
- D. Pressure rating = 225 psi, minimum.

2.05 WEIGHTED SWING CHECK VALVES

- A. The valve body shall be full flow equal to nominal pipe diameter area at all points through the valve and shall be equipped with a threaded adjustable open stop. The valve body, cover and disc shall be constructed of ASTM A536 Grade 65-45-12 ductile iron.
- B. The body seat shall be constructed of ASTM A276, Type 304 stainless steel, O-ring sealed and field replaceable without removing the valve from the line. The end flanges shall contain integrally case mounting pads.
- C. The disc shall be of one-piece construction and connected to the shaft with a disc arm and two pivot pins to provide pivot action to allow self-adjusting seating at all pressures. The EPDM disc seat shall be resilient with integral O-ring type sealing surface for drop tight shut-off at high and low pressures and for easy replacement in the field without removing the valve from the line.
- D. Factory equipped with a lever and weight assembly. The lever shall be equipped with three holes for adjusting the bolted weight assembly. When the valve is closed, the lever and weight shall be located 30 degrees below horizontal.
- E. Factory equipped with a lever and air cushion assembly mounted between the weight assembly and the valve body. The air cushion assembly shall consist of a clevis mounted tie-rod type closed cylinder with speed control valves.
- F. The exterior and interior of the valve shall be coated with an NSF/ANSI 61 approved fusion bonded epoxy coating.
- G. Valmatic 7800AC or approved equal

2.06 HOSE BIBBS

- A. Bronze or red brass, replaceable hexagonal disc, hose thread spout, chrome-plated where exposed.
- B. Non-freeze type with chrome-plated polished bronze wall plate recessed box, hose thread spout, removable key, anti-siphon, 1" ips bronze casing, 3/4" male union ell, integral back flow preventer.

- C. High pressure 3/4" assembly, 300 psi rated globe valve with hose threads outlet, replaceable disc.

2.07 CORPORATION STOP

- A. Conformance with AWWA C800.
- B. Ford (match District standard).

2.08 VALVE COATING AND LINING

- A. Coat the exterior of valves for exposed service per Section 09900, System No. 26. Apply the specified prime and finish coat at the place of manufacture. Finish coat to match the color of adjacent piping. Coat handwheel operator and actuator the same color as the valve.
- B. Coat the exterior of valves for buried service per Section 09900, System No. 7. Apply the specified prime and finish coat at the place of manufacture.
- C. Line the interior metal parts of metal valves 4-inches and larger, excluding seating areas and bronze and stainless-steel pieces, per Section 09900, System No. 10. Apply lining at the place of manufacture. Alternately, apply a fusion-bonded lining suitable for potable water service in compliance with AWWA C550.

2.09 VALVE CONNECTIONS

- A. Provide valves suitable to connect to adjoining piping as specified for pipe joints. Use pipe size valves.
- B. Thread pipe sizes 3 inches and smaller.
- C. Flange pipe sizes 4 inches and larger.
- D. Solder or screw to solder adapters for copper tubing.
- E. Buried valves for PVC pipe size 2-inch through 3-inch shall have hub ends with compression gaskets, especially designed for PVC pipe.
- F. Buried valves for PVC pipe sizes 4-inch and larger shall have standard mechanical joint ends with duck-tipped transition gaskets for restraint to PVC pipe.

2.10 PRESSURE RATINGS

- A. Unless otherwise indicated, use valves suitable for 200 minimum psig (862 kPa) WSP and 450 degrees F (232 degrees C).

2.11 VALVE BOXES

- A. 6" PVC Pipe with cast iron drop-in top. C&B 2615-6.

PART 3 EXECUTION

3.01 JOINTS

- A. Bolt holes of flanged valves shall straddle the horizontal and vertical centerlines of the pipe run to which the valves are attached. Clean flanges by wire brushing before installing flanged valves. Clean flange bolts and nuts by wire brushing, lubricate threads with oil and graphite, and tighten nuts uniformly and progressively. If flanges leak under pressure testing, loosen or remove the nuts and bolts, reseal or replace the gasket, reinstall or retighten the bolts and nuts, and retest the joints. Joints shall be watertight.
- B. Clean threaded joints by wire brushing or swabbing. Apply Teflon joint compound or Teflon tape to pipe threads before installing threaded valves. Joints shall be watertight.

3.02 BURIED VALVE INSTALLATION

- A. Install gate valves for buried service. Installation shall be plumb and valve shall be at normal bury depth. Place and compact backfill as specified.
- B. Connect the valve, install concrete blocks and valve box as shown on drawings. Check stuffing box and bonnet bolts for proper tightness.
- C. Provide 8-mil polyethylene wrap per AWWA C105 around all buried ductile iron, cast iron, or steel body valves.

3.03 VALVE LEAKAGE TESTING

- A. Test valves for leakage at the same time that the connecting pipelines are tested. See Section 01666 for pressure testing requirements. Protect or isolate any parts of valves, operators, or control and instrumentation systems whose pressure rating is less than the pressure test. Valves shall show zero leakage. Repair or replace leaking valves and retest.

3.04 VALVE FIELD TESTING

- A. Operate manual valves through 5 full cycles of opening and closing. Valves shall operate from full open to full close without sticking or binding. If valves stick or bind, repair or replace the valve and repeat the tests.

END OF SECTION

SECTION 15160

PUMPS

PART 1 GENERAL

1.01 WORK INCLUDED

- A. This section includes all pumps except where integral with a manufactured piece of equipment.

1.02 RELATED WORK

- A. Section 15060 - Pipe and Pipe Fittings.
- B. Section 15100 - Valves.

1.03 SUBMITTALS

- A. Submit shop drawings under provisions of Section 01300.
- B. Submit certified pump curves showing pump performance characteristics with pump and system operating point plotted.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Paco
- B. Substitutions: Under provisions of Section 01600.

2.02 GENERAL

- A. Statically and dynamically balance rotating parts.
- B. Grease fittings to be accessible without removal of covers or guards.
- C. Corrosion resistant nameplate securely fastened to pump with the following date engraved or stamped in legible characters:
 - 1. Name of manufacturer.
 - 2. Pump serial number.
 - 3. Year built.
 - 4. Design head and discharge.
 - 5. Pump speed (rpm).

- E. Furnish pump and motor as a unit.

2.03 BOOSTER PUMPS

- A. Open-coupled, end-suction centrifugal pump designed for booster service.
- B. Casing: Cast iron, ASTM A48 CL20.
- C. Impeller and wear rings: Bronze, ASTM B584. Fully enclosed impeller, replaceable wear rings.
- D. Mechanical seal: Carbon/ceramic, Buna N, and stainless steel.
- E. Motor: Open-coupled design with ball bearings to carry radial/axial thrust loads. Designed for continuous operation. Overload protection is required. Horsepower rating may not be exceeded at any point on the pump performance curve.
- F. Pump Design Criteria
 - Static Head = 95 Ft. = 41 psi
 - Friction Loss = 20 Ft. = 8 psi
 - Pumping Head = 185 Ft. = 80 psi
 - Minimum Incoming Head = 0 Ft. = 0 psi
 - Total Dynamic Head = 185 Ft. at 1000 GPM
- G. Pump Schedule:
 - Pump Type: End Suction centrifugal
 - Manufacturer: Paco
 - Model No. 40959 LCS
 - Number of Stages: One
 - Impeller Diameter: 7.56-inch
 - Suction: 5-inch NPT
 - Discharge: 4-inch NPT
 - Design Condition: 1000 GPM @ 185 Ft. TDH
 - Efficiency @ Design Conditions 81%
 - Motor Voltage 220 Volt, 3 Phase
 - Motor Horsepower 60 HP
 - Motor Speed 3550 RPM
 - Number of Pumps One (1)

PART 3 EXECUTION

3.01 PREPARATION

- A. Provide drains for pump bases and stuffing boxes.
- B. Support piping adjacent to pumps such that no weight is carried on the pump casings. Provide supports under elbows on pump suction and discharge line sizes 4-inch and over.

3.02 INSTALLATION

- A. Install pumps in accordance with manufacturer's instructions.
- B. Coordinate installation of pump controls with telemetry system representative.

3.03 TESTING

- A. When installation is complete, test each pump to verify that performance requirements are met.

END OF SECTION

Pump Performance Datasheet

Customer	:	Quote Number / ID	: 568132
Customer ref. / PO	:	Model	: 40959 LC
Tag Number	: 001	Stages	: 1
Service	:	Based on curve number	: RC1979-SS Rev 0
Quantity	: 1	Basic model number	: -
		Date last saved	: 11/03/2020 8:46 AM

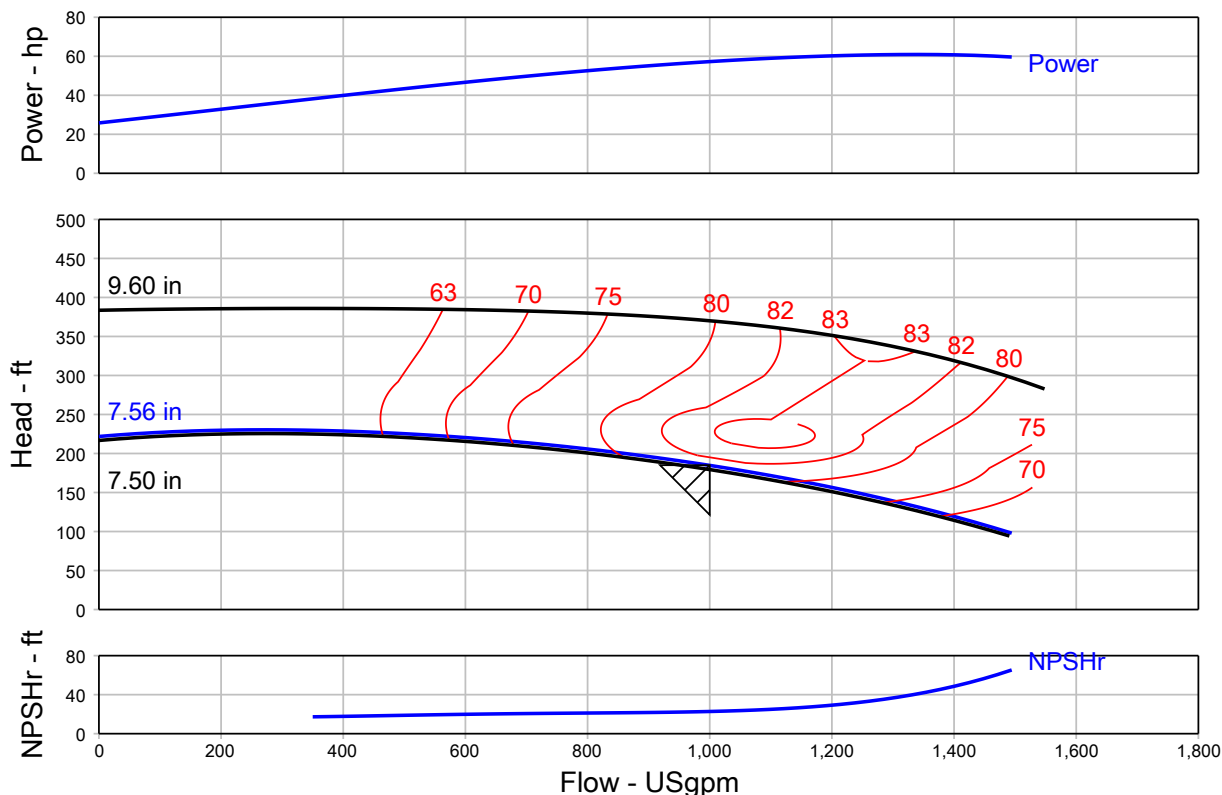
Operating Conditions		Liquid	
Flow, rated	: 1,000.0 USgpm	Liquid type	: Cold Water
Differential head / pressure, rated (requested)	: 185.0 ft	Additional liquid description	:
Differential head / pressure, rated (actual)	: 184.6 ft	Solids diameter, max	: 0.00 in
Suction pressure, rated / max	: 0.00 / 0.00 psi.g	Solids concentration, by volume	: 0.00 %
NPSH available, rated	: Ample	Temperature, max	: 68.00 deg F
Site Supply Frequency	: 60 Hz	Fluid density, rated / max	: 1.000 / 1.000 SG

Performance		Material	
Speed, rated	: 3550 rpm	Material selected	: Cast iron

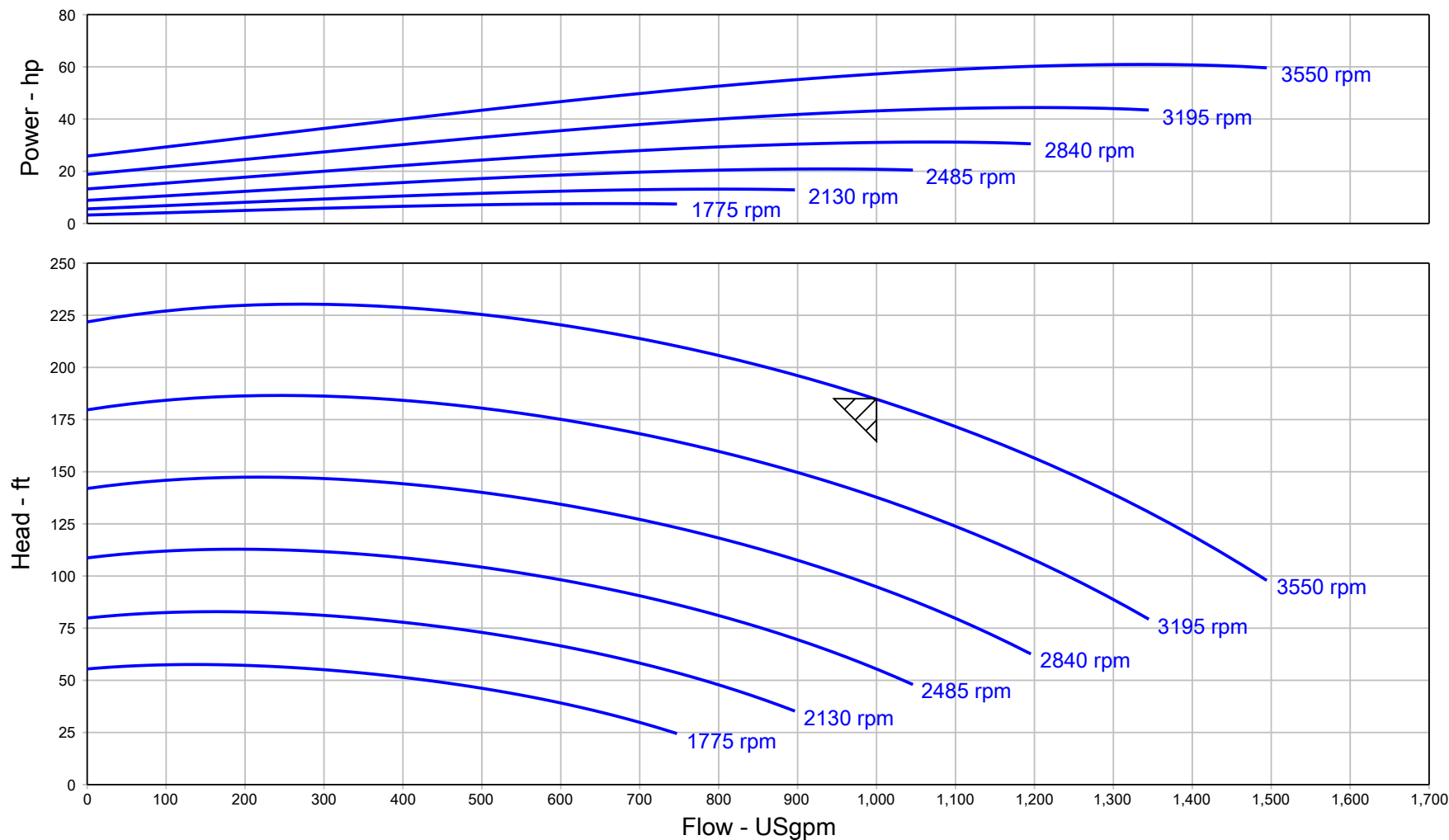
Impeller diameter, rated	: 7.56 in	Pressure Data	
Impeller diameter, maximum	: 9.60 in	Maximum working pressure	: 99.68 psi.g
Impeller diameter, minimum	: 7.50 in	Maximum allowable working pressure	: 175.0 psi.g
Efficiency	: 81.45 %	Maximum allowable suction pressure	: 175.0 psi.g
NPSH required / margin required	: 22.75 / 0.00 ft	Hydrostatic test pressure	: 263.0 psi.g
nq (imp. eye flow) / S (imp. eye flow)	: 31 / 173 Metric units		
MCSF	: 400.9 USgpm		

Head, maximum, rated diameter	: 230.3 ft	Driver & Power Data (@Max density)	
Head rise to shutoff	: 20.06 %	Motor sizing specification	: Rated power (based on duty point)
Flow, best eff. point	: 1,000.9 USgpm	Margin over specification	: 0.00 %
Flow ratio, rated / BEP	: 99.91 %	Service factor	: 1.00
Diameter ratio (rated / max)	: 78.75 %	Power, hydraulic	: 46.64 hp
Head ratio (rated dia / max dia)	: 49.92 %	Rated power (based on duty point)	: 57.26 hp
Cq/Ch/Ce/Cn [ANSI/HI 9.6.7-2010]	: 1.00 / 1.00 / 1.00 / 1.00	Max power (non-overloading)	: 60.91 hp
Selection status	: Acceptable	Nameplate motor rating	: 60.00 hp / 44.74 kW

Energy Indexes	
PEI (CL)	: 0.96
ER (CL)	: 4



Multi-Speed Performance Curve



Project name	: Default	Tag Number	: 001	Speed, rated	: 3550 rpm
Consulting engineer	:	Service	:	Flow, rated	: 1,000.0 USgpm
Customer	:	Model	: 40959 LC	Differential head / pressure, rated	: 185.0 ft
Customer ref. / PO	:	Quantity	: 1	Fluid density, rated / max	: 1.000 / 1.000 SG
Quote Number / ID	: 568132	Quoted By (Sales Office)	: Specifiers	Viscosity	: 1.00 cP
Date last saved	: 11/03/2020 8:46 AM	Quoted By (Sales Engineer)	: Tony Moraska	Cq/Ch/Ce/Cn [ANSI/HI 9.6.7-2010]	: 1.00 / 1.00 / 1.00 / 1.00
		Stages	: 1	Based on curve number	: RC1979-SS Rev 0

Pump Performance - Additional Data

Project name	: Default	Tag Number	: 001
Consulting engineer	:	Service	:
Customer	:	Model	: 40959 LC
Customer ref. / PO	:	Quantity	: 1
Quote Number / ID	: 568132	Quoted By (Sales Office)	: Specifiers
Date last saved	: 11/03/2020 8:46 AM	Quoted By (Sales Engineer)	: Tony Moraska
Stages	: 1	Speed, rated	: 3550 rpm
Performance Data		Stage, Speed and Solids Limits	
Head, maximum diameter, rated flow	: 370.1 ft	Stages, maximum	: 1
Head, minimum diameter, rated flow	: 179.4 ft	Stages, minimum	: 1
Head, maximum, rated diameter	: 230.3 ft	Pump speed limit, maximum	: 3600 rpm
Efficiency adjustment factor, total	: 1.00	Pump speed limit, minimum	: 2500 rpm
Power adjustment, total	: 0.00 hp	Curve speed limit, maximum	: 3600 rpm
Head adjustment factor, total	: 1.00	Curve speed limit, minimum	: 2500 rpm
Flow adjustment factor, total	: 1.00	Variable speed limit, minimum	: 400 rpm
NPSHR adjustment factor, total	: 1.00	Solids diameter limit	: 0.75 in
NPSH margin dictated by pump supplier	: 0.00 ft	Energy Indexes	
NPSH margin dictated by user	: 0.00 ft	ER (CL)	: 4
NPSH margin used (added to 'required' values)	: 0.00 ft	PEI (CL)	: 0.96
Mechanical Limits		Typical Driver Data	
Torque, rated power, rated speed	: 1.61 hp/100 rpm	Driver speed, full load	: 3550 rpm
Torque, maximum power, rated speed	: 1.72 hp/100 rpm	Driver speed, rated load	: 3552 rpm
Torque, driver power, full load speed	: 1.69 hp/100 rpm	Driver efficiency, 100% load	: N/A
Torque, driver power, rated speed	: 1.69 hp/100 rpm	Driver efficiency, 75% load	: N/A
Torque, pump shaft limit	: 3.61 hp/100 rpm	Driver efficiency, 50% load	: N/A
Radial load, worst case	: -		
Radial load limit	: -		
Impeller peripheral speed, rated	: -		
Impeller peripheral speed limit	: -		
Various Performance Data		Flow (USgpm)	Head (ft)
Shutoff, rated diameter	0.00	221.8	-
Shutoff, maximum diameter	0.00	383.6	-
MCSF	400.9	228.7	57.92
Rated flow, minimum diameter	1,000.0	179.4	81.07
Rated flow, maximum diameter	1,000.0	370.1	79.79
BEP flow, rated diameter	1,000.9	184.7	81.45
120% rated flow, rated diameter	1,200.0	156.6	78.77
End of curve, rated diameter	1,494.4	97.90	61.96
End of curve, minimum diameter	1,490.6	94.29	61.16
End of curve, maximum diameter	1,548.1	282.7	77.63
Maximum value, rated diameter	-	230.3	81.45
Maximum value, maximum diameter	-	-	83.26
System differential pressure		@ Density, rated	
Differential pressure, rated flow, rated diameter (psi)		79.96	79.96
Differential pressure, shutoff, rated diameter (psi)		95.99	95.99
Differential pressure, shutoff, maximum diameter (psi)		166.0	166.0
Discharge pressure		@ Suction pressure, rated	@ Suction pressure, max
Discharge pressure, rated flow, rated diameter (psi.g)		79.96	79.96
Discharge pressure, shutoff, rated diameter (psi.g)		95.99	95.99
Discharge pressure, shutoff, maximum diameter (psi.g)		166.0	166.0
Ratios			
Maximum flow / rated flow, rated diameter	: 149.44 %	Head rated diameter / head minimum diameter, rated flow	: 103.00 %
Construction			
Impeller Material	: SS Impeller	Motor Phase & Voltage	: Three Phase, 230/460V
Motor Enclosure	: ODP		

Construction Datasheet

Project name : Default				Tag Number : 001	
Consulting engineer :				Service :	
Customer :				Model : 40959 LC	
Customer ref. / PO :				Quantity : 1	
Quote Number / ID : 568132				Quoted By (Sales Office) : Specifiers	
Date last saved : 11/03/2020 8:46 AM				Quoted By (Sales Engineer) : Tony Moraska	
Construction				Motor Information	
Nozzle	Size (in.)	Nozzle Configuration	Pos'n	Manufacturer : Baldor	
Suction	5	125# ANSI	End	Frame Size : 326JM	
Discharge	4	125# ANSI	Top	Power : 60.00 hp	
Orientation / Configuration : Horizontal				RPM : 3600 rpm	
Rotation : Clockwise				Enclosure : ODP	
Wear Ring Configuration : Single - Case				Operating Power Supply : 230/460/3/60	
Discharge Elbow Size : -				Efficiency : Premium	
Subplate : -				Service factor : 1.15	
Sump Depth (feet) : -				Motor Application : Suitable for Variable Speed Drive	
Bearing Frame : -				Motor Options/Accessories : -	
Bearing Frame Foot : -				Cord Length (feet) : -	
Bearing Type (Radial/Thrust) : In motor				Materials	
Bearing Lubrication : -				Case : Cast Iron, ASTM A48 - Class 30	
Thrust Bearing : -				Motor Bracket : Cast Iron, ASTM-A48, CL 30	
Intermediate Bearing : -				Impeller : Stainless Steel, AISI-304 (H304)	
Lower Bearing : -				Impeller Cap Screw and Washer : Stainless Steel, AISI-303	
Bearing Housing Accessories : -				Impeller Key : Stainless Steel, AISI 316	
PACO Construction code : 10N6-40959-1A0008-1911P				Case wear ring : Tin Bronze, ASTM B584-90500 (B18)	
Baseplate, Coupling and Guard				Impeller wear ring : -	
Baseplate : Not Applicable				Pump Shaft : Steel, AISI-1040	
Drip Pan : -				Sleeve : Bronze, III932, C89835	
Coupling : -				Line Shaft : -	
Guard : Not Applicable				Column : -	
Seal & Packing Construction				Discharge Pipe : -	
Sealing Method : Single Seal, Type 21S				Discharge Elbow : -	
Seal Material : Buna Carbon Ceramic SS-Spring and Hardware				Suction Elbow : -	
Packing Gland : -				Subplate : -	
Lantern Ring : -				Hardware : Steel, Grade 5	
Recirculation Lines : None				O Rings : Buna N	
Weights (Approx.)				Pump Coatings : Standard Manufacturer's Paint	
Pump : 138.0 lb					
Baseplate : -					
Driver : 478.0 lb					
Estimated Shipping gross weight : 616.0 lb					

Grundfos Series LC - End Suction Centrifugal Pump, Close Coupled

QUOTE NUMBER / ID 568132	UNIT TAG 001	LC 40959
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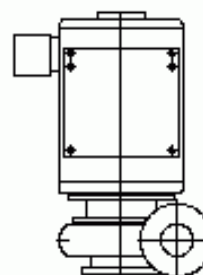
MATERIALS OF CONSTRUCTION			
PART	MATERIAL	PART	MATERIAL
Rotation Options	Clockwise	Impeller Washer	S.S., AISI-303
Base/Stand Type	None	Impeller Key	Steel, AISI 1045
Connections	FPT (threaded)/ 125# ANSI	Sleeve Material	Bronze, III932, C89835 or No Sleeves
Wear Ring Type	Case Wear Ring	Wear Ring Material	NiAl-Bronze, ASTM-B148, C95500
Pump Coatings	Standard Paint	Packing Gland	Not Applicable
NSF-50 Certification	Optional	Lantern Ring	None
NSF-61 Certification	Optional	Seal Type	Type 21
Motor Drip Canopy	Optional	Seal Material	Ceramic/Carbon/Buna
Casing	Cast Iron, ASTM-A48, CL 30	O-Rings	Buna N
Motor Shaft	Steel, AISI 1045 or S.S	Seal Flush Options	No External flush
Backplate/Seal Plate	Cast Iron, ASTM-A48, CL 30	Gaskets	Vegetable Fiber
Motor Bracket	Cast Iron, ASTM-A48, CL 30	Casing Bolts	Steel, Grade 5
Impeller	Stainless Steel, AISI-304	Impeller Cap Screw	Stainless Steel, AISI-316

* All materials based on STANDARD configuration

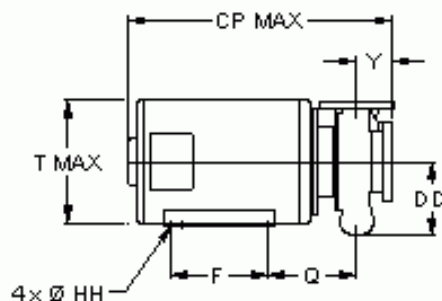
General Arrangement

Project name : Default
 Consulting engineer :
 Customer :
 Customer ref. / PO :
 Quote Number / ID : 568132
 Date last saved : 11/03/2020 8:46 AM

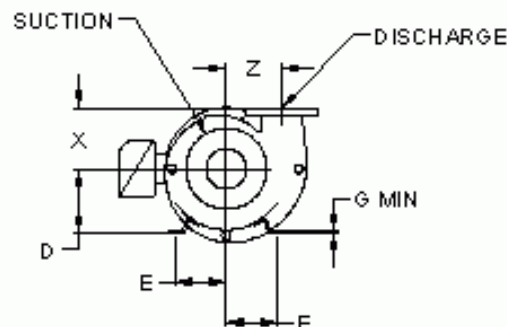
Tag Number : 001
 Service :
 Model : 40959 LC
 Quantity of pumps : 1
 Quoted By (Sales Office) : Specifiers
 Quoted By (Sales Engineer) : Tony Moraska



PLAN



SIDE VIEW



END VIEW

NOT FOR CONSTRUCTION, Unless certified and referenced on order

Units	Frame	Suct(in)	Disch(in)	CP	D	DD	E	F	G	HH	Q	T	X	Y	Z	Weight ea
inches	326JM	5	4	34.00	8.00	9.00	6.25	12.00	0.31	0.66	11.06	15.13	7.50	4.31	6.88	616.0

Conditions of Service			Motor Data			
Flow: 1,000.0 USgpm	Fluid: Cold Water	HP: 60	Encl: ODP	Phase: 3	Efficiency: Premium	
TDH: 185.0 ft	Temp.: 68.00 deg F	RPM: 3550 rpm	Hz: 60	Voltage: 230/460	S.F.: 1.15	

Close Coupled End Suction Pump Specifications

Part I – GENERAL

1.1 WORK INCLUDED

A. Contractor shall furnish and install Grundfos end suction close coupled pump, PACO Model LC complete with pump and motor in accordance with manufacturer's recommendations and plans.

1.2 REFERENCE STANDARDS

The work in this section is subject to the requirements of applicable portions of the following standards:

- A. HI – Hydraulic Institute
- B. ANSI – American National Standards Institute
- C. ASTM – American Society for Testing and Materials
- D. IEEE – Institute of Electrical and Electronics Engineers
- E. NEMA – National Electrical Manufacturers Association
- F. NEC – National Electrical Code
- G. ISO – International Standards Organization
- H. UL – Underwriters Laboratories, Inc.
- I. CSA –Canadian Standards Association
- J. OSHA – Occupational Safety & Health Administration
- K. ASME – American Society of Mechanical Engineers
- L. IEC– International Electrotechnical Commission
- M. ETL – Electrical Testing Laboratories
- N. NSF – National Sanitation Foundation

Part 2 – PRODUCTS

2.1 Close Coupled End Suction Pumps

- A. Furnish and install close coupled end suction pumps as per plans and pump schedule.
- B. The pump and electric motor shall be factory assembled at the pump manufacturer's facility. The pump manufacturer shall have complete unit responsibility.

2.1.1 PUMPS

- A. The pumps shall be close coupled, single stage, end suction top discharge design, cast iron stainless steel fitted construction.
- B. The pumps shall have the following features:
 - 1. All pumps shall be of the back pull-out design so that the rotating element can be removed

from the casing without disconnecting the suction or discharge piping. The casing material shall be close-grained cast iron ASTM A48 - Class 30 with a minimum tensile strength of 30,000 P.S.I. Volute shall have integrally cast suction and discharge connections, gauge ports at nozzles, and vent and drain ports. Pumps with specific speed greater than 1600 shall have double volute casing. Pumps with discharge size 3" and larger shall have suction splitter to reduce pre-rotation and improve efficiency. Casings shall be designed for scheduled working pressure and can withstand hydrostatic test at 150% of the maximum working pressure under which the pump could operate at design speed.

2. Pumps with impeller diameter larger than 5" shall be fitted with bronze renewable case wear rings.
3. Pumps with discharge size 2.5" and larger shall have full flanged connections on both suction and discharge. Suction and discharge flanges shall be drilled to ANSI Class 125# standards and be machined flat face.
4. Pumps with discharge sizes 2" and below shall have NPT threaded connection.
5. The motor shaft shall be of cold rolled steel AISI 1024 with bronze sleeves covering the wetted area of the shaft. Motors with 56J frame shall have a motor shaft of stainless steel AISI 416.
6. The pump manufacturer shall recommend the proper mechanical seal based on the pressure, temperature and liquid outlined on the equipment schedule. Mechanical seals, at a minimum, shall have ceramic stationary seats, carbon rotating rings, buna elastomers and stainless steel hardware. Application of a mechanical seal shall be internally flushed type, without requiring external flushing lines. Seals shall be capable of being inspected and easily replaced without removing the piping or volute.
7. Impeller shall be of the enclosed francis vane type, single suction design, made of Stainless Steel 304 (UNS S30400), both hydraulically and dynamically balanced to ISO 1940-1:2003 balance grade G6.3 and keyed to the shaft. The impeller shall be trimmed to meet the specific hydraulic requirements.
8. Pump Construction. The standard material of construction for the pump shall be as below. Special material shall be available as option to suit the liquid pumped.
 - Volute: Cast Iron ASTM A48 - Class 30
 - Case Wear ring: Tin Bronze ASTM B584-90500
 - Impeller: Stainless Steel 304 (UNS S30400)
 - Shaft: Cold Roll Steel AISI 1024 or Stainless Steel AISI 416
 - Shaft Sleeve: Bronze III932 C89835
 - Mechanical Seals: Carbon – Ceramic with Buna Elastomers and Stainless Steel hardware

C. Pump rotation shall be clockwise as viewed from the motor end.

- D. Cast iron base with integrally cast drip lip, grouting holes and tapped drain outlet shall be provided upon requirement.
- E. Pump shall be of a maintainable design for ease of maintenance and should use machine fit parts that are easily disassembled.
- F. Each pump shall be painted with one coat of high quality factory approved paint and name-plated before shipment from the factory.
- G. Where noted on schedule the pump shall also be NSF-50 or NSF-61 certified.
- H. Pumps shall be manufactured and assembled in an ISO-9001 certified facility.

2.1.2 MOTORS

- A. Motors shall meet scheduled horsepower, speed, voltage, and enclosure design. Pump and motors shall be factory assembled.
- B. Motors shall be suitably sized per ISO5199 and shall meet NEMA specifications and conform to the standards outlined in EISA 2007.

2.2 INSTALLATION

The pump shall be installed per manufacturer's recommendations and according to the standards of the Hydraulics Institute.

2.3 TESTING

Where noted on schedule, pumping equipment may require one or more of the following:

Certified Performance test

Hydro static test

NPSH Test

Any other factory test as noted in the pump Schedule

The testing shall be in accordance with Hydraulic Institute level B or the latest HI standard as noted in the pump schedule.

2.4 WARRANTY

The warranty period shall be a non-prorated period of 12 months from date of installation, not to exceed 18 months from date of manufacture. Warranty shall cover against defective material and/or faulty workmanship.

END OF SECTION

SECTION 231126
FACILITY LIQUEFIED-PETROLEUM GAS PIPING

PART 1 GENERAL

1.01 SUMMARY

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

1.02 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. LPG: Liquefied-petroleum gas.

1.03 PERFORMANCE REQUIREMENTS

- A. Minimum Operating-Pressure Ratings:
 - 1. For Piping Containing Only Vapor:
 - a. Piping and Valves: 125 psig unless otherwise indicated.
 - 2. For Piping Containing Liquid:
 - a. Piping between Shutoff Valves: 350 psig unless otherwise indicated.
 - b. Piping Other Than Above: 250 psig unless otherwise indicated.
 - c. Valves and Fittings: 250 psig unless otherwise indicated.
 - 3. Minimum Operating Pressure of Service Meter: 5 psig.

1.04 ACTION SUBMITTALS

- A. Product Data: For each type of the following:
 - 1. Piping specialties.
 - 2. Corrugated stainless-steel tubing with associated components.
 - 3. Valves. Include pressure rating, capacity, settings, and electrical connection data of selected models.
 - 4. Pressure regulators. Indicate pressure ratings and capacities.
 - 5. Dielectric fittings.

1.05 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Plans and details, drawn to scale, on which LPG piping is shown and coordinated with other installations, using input from installers of the items involved.
- B. Site Survey: Plans, drawn to scale, on which LPG piping is shown and coordinated with other services and utilities.
- C. Qualification Data: For qualified professional engineer.
- D. Welding certificates.
- E. Field quality-control reports.

1.06 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For LPG equipment and accessories to include in emergency, operation, and maintenance manuals.

1.07 QUALITY ASSURANCE

- A. Steel Support Welding Qualifications: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code - Steel".

- B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.
- 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.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Handling Flammable Liquids: Remove and dispose of liquids from existing LPG piping according to requirements of authorities having jurisdiction.
- B. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
- C. Store pipes and tubes with protective PE coating to avoid damaging coating and protect from direct sunlight.
- D. Protect stored PE pipes and valves from direct sunlight.

1.09 PROJECT CONDITIONS

- A. Perform site survey, research public utility records, and verify existing utility locations. Contact utility-locating service for area where Project is located.
- B. Interruption of Existing LPG Service: Do not interrupt LPG service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide purging and startup of LPG supply according to requirements indicated:
 - 1. Notify Engineer no fewer than two days in advance of proposed interruption of LPG service.
 - 2. Do not proceed with interruption of LPG service without Engineer's written permission.

PART 2 PRODUCTS

2.01 PIPES, TUBES, AND FITTINGS

- A. Steel Pipe: ASTM A 53/A 53M, black steel, Schedules 40 and 80, Type E or S, Grade B.
 - 1. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern.
 - 2. Wrought-Steel Welding Fittings: ASTM A 234 for butt-welding and socket welding.
 - 3. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends.
 - 4. Forged-Steel Flanges and Flanged Fittings: ASME B16.5, minimum Class 150, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
 - a. Material Group: 1.1.
 - b. End Connections: Threaded or butt welding to match pipe.
 - c. Lapped Face: Not permitted underground.
 - d. Gasket Materials: ASME B16.20, metallic, flat, asbestos free, aluminum o-rings, and spiral-wound metal gaskets.
 - e. Bolts and Nuts: ASME B18.2.1, carbon steel aboveground, and stainless steel underground.
 - 5. Protective Coating for Underground Piping: Factory-applied, three-layer coating of epoxy, adhesive, and PE.
 - a. Joint Cover Kits: Epoxy paint, adhesive, and heat-shrink PE sleeves.
 - 6. Mechanical Couplings:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Dresser Piping Specialties; Division of Dresser, Inc.
 - 2) Smith-Blair, Inc.
 - b. Stainless-steel flanges and tube with epoxy finish.
 - c. Buna-nitrile seals.
 - d. Stainless-steel bolts, washers, and nuts.
 - e. Coupling shall be capable of joining PE pipe to PE pipe, steel pipe to PE pipe, or steel pipe to steel pipe.

- f. Steel body couplings installed underground on plastic pipe shall be factory equipped with anode.
- B. Corrugated, Stainless Steel Tubing: Comply with ANSI/IAS LC 1.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. OmegaFlex, Inc.
 - b. Parker Hannifin Corporation; Parflex Division.
 - c. Titeflex.
 - d. Tru-Flex Metal Hose Corp.
 2. Tubing: ASTM A 240, corrugated, Series 300 stainless steel.
 3. Coating: PE with flame retardant.
 - a. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1) Flame-Spread Index: 25 or less.
 - 2) Smoke-Developed Index: 50 or less.
 4. Fittings: Copper-alloy mechanical fittings with ends made to fit and listed for use with corrugated stainless-steel tubing and capable of metal-to-metal seal without gaskets. Include brazing socket or threaded ends complying with ASME B1.20.1.
 5. Striker Plates: Steel, designed to protect tubing from penetrations.
 6. Manifolds: Malleable iron or steel with factory-applied protective coating. Threaded connections shall comply with ASME B1.20.1 for pipe inlet and corrugated tubing outlets.
 7. Operating-Pressure Rating: 5 psig.
- C. PE Pipe: ASTM D 2513, SDR 11.
 1. PE Fittings: ASTM D 2683, socket-fusion type or ASTM D 3261, butt-fusion type with dimensions matching PE pipe.
 2. PE Transition Fittings: Factory-fabricated fittings with PE pipe complying with ASTM D 2513, SDR 11; and steel pipe complying with ASTM A 53, black steel, Schedule 40, Type E or S, Grade B.
 3. Anodeless Service-Line Risers: Factory fabricated and leak tested.
 - a. Underground Portion: PE pipe complying with ASTM D 2513, SDR 11 inlet.
 - b. Casing: Steel pipe complying with ASTM A 53, Schedule 40, black steel, Type E or S, Grade B with corrosion-protective coating covering. Vent casing aboveground.
 - c. Aboveground Portion: PE transition fitting.
 - d. Outlet shall be threaded or flanged or suitable for welded connection.
 - e. Tracer wire connection.
 - f. Ultraviolet shield.
 - g. Stake supports with factory finish to match steel pipe casing or carrier pipe.
 4. Transition Service-Line Risers: Factory fabricated and leak tested.
 - a. Underground Portion: PE pipe complying with ASTM D 2513, SDR 11 inlet connected to steel pipe complying with ASTM A 53, Schedule 40, Type E or S, Grade B, with corrosion-protective coating for aboveground outlet.
 - b. Outlet shall be threaded or flanged or suitable for welded connection.
 - c. Bridging sleeve over mechanical coupling.
 - d. Factory-connected anode.
 - e. Tracer wire connection.
 - f. Ultraviolet shield.
 - g. Stake supports with factory finish to match steel pipe casing or carrier pipe.
 5. Plastic Mechanical Couplings, NPS 1-1/2 and smaller: Capable of joining PE pipe to PE pipe.
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Lyall, R. W. & Company, Inc.
 - 2) Mueller Co.; Gas Products Div.

- 3) Perfection Corporation; a subsidiary of American Meter Company.
- b. PE body with molded-in, stainless-steel support ring.
- c. Buna-nitrile seals.
- d. Acetal collets.
- e. Electro-zinc-plated steel stiffener.
6. Plastic Mechanical Couplings, NPS 2 and larger: Capable of joining PE pipe to PE pipe, steel pipe to PE pipe, or steel pipe to steel pipe.
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Lyall, R. W. & Company, Inc.
 - 2) Mueller Co.; Gas Products Div.
 - 3) Perfection Corporation; a subsidiary of American Meter Company.
 - b. Fiber-reinforced plastic body.
 - c. PE body tube.
 - d. Buna-nitrile seals.
 - e. Acetal collets.
 - f. Stainless-steel bolts, nuts, and washers.
7. Steel Mechanical Couplings: Capable of joining plain-end PE pipe to PE pipe, steel pipe to PE pipe, or steel pipe to steel pipe.
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Dresser Piping Specialties; Division of Dresser, Inc.
 - 2) Smith-Blair, Inc.
 - b. Stainless-steel flanges and tube with epoxy finish.
 - c. Buna-nitrile seals.
 - d. Stainless-steel bolts, washers, and nuts.
 - e. Factory-installed anode for steel-body couplings installed underground.

2.02 PIPING SPECIALTIES

- A. Flexible Piping Joints:
 1. Approved for LPG service.
 2. Stainless-steel bellows with woven, flexible, bronze, wire-reinforcing protective jacket.
 3. Minimum working pressure of 250 psig and 250 deg F operating temperature.
 4. Flanged- or threaded-end connections to match equipment connected and shall be capable of minimum 3/4-inch misalignment.
 5. Maximum 36-inch length for liquid LPG lines.
- B. Appliance Flexible Connectors:
 1. Indoor, Fixed-Appliance Flexible Connectors: Comply with ANSI Z21.24.
 2. Indoor, Movable-Appliance Flexible Connectors: Comply with ANSI Z21.69.
 3. Outdoor, Appliance Flexible Connectors: Comply with ANSI Z21.75.
 4. Corrugated stainless-steel tubing with polymer coating.
 5. Operating-Pressure Rating: 0.5 psig.
 6. End Fittings: Zinc-coated steel.
 7. Threaded Ends: Comply with ASME B1.20.1.
 8. Maximum Length: 72 inches.
- C. Quick-Disconnect Devices: Comply with ANSI Z21.41.
 1. Copper-alloy convenience outlet and matching plug connector.
 2. Nitrile seals.
 3. Hand operated with automatic shutoff when disconnected.
 4. For indoor or outdoor applications.
 5. Adjustable, retractable restraining cable.
- D. Y-Pattern Strainers:
 1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.

2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.
 3. Strainer Screen: 40-mesh startup strainer and perforated stainless-steel basket with 50 percent free area.
 4. CWP Rating: 125 psig.
- E. Basket Strainers:
1. Body: ASTM A 126, Class B, high-tensile cast iron with bolted cover and bottom drain connection.
 2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.
 3. Strainer Screen: 40-mesh startup strainer and perforated stainless-steel basket with 50 percent free area.
 4. CWP Rating: 125 psig.
- F. T-Pattern Strainers:
1. Body: Ductile or malleable iron with removable access coupling and end cap for strainer maintenance.
 2. End Connections: Grooved ends.
 3. Strainer Screen: 40-mesh startup strainer and perforated stainless-steel basket with 57 percent free area.
 4. CWP Rating: 750 psig.
- G. Weatherproof Vent Cap: Cast- or malleable-iron increaser fitting with corrosion-resistant wire screen, with free area at least equal to cross-sectional area of connecting pipe and threaded-end connection.

2.03 JOINING MATERIALS

- A. Joint Compound and Tape: Suitable for LPG.
- B. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.04 MANUAL GAS SHUTOFF VALVES

- A. Metallic Valves, NPS 2 and smaller for Liquid Service: Comply with ASME B16.33 and UL 842.
 1. CWP Rating: 250 psig.
 2. Threaded Ends: Comply with ASME B1.20.1.
 3. Socket ends for brazed joints.
 4. Tamperproof Feature: Locking feature for valves indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
 5. Listing by CSA or agency acceptable to authorities having jurisdiction for valves 1 inch and smaller.
 6. Valves 1-1/4 inch and larger shall be suitable for LPG service, with "WOG" indicated on valve body.
- B. General Requirements for Metallic Valves, NPS 2 and smaller for Vapor Service: Comply with ASME B16.33.
 1. CWP Rating: 125 psig.
 2. Threaded Ends: Comply with ASME B1.20.1.
 3. Dryseal Threads on Flare Ends: Comply with ASME B1.20.3.
 4. Tamperproof Feature: Locking feature for valves indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
 5. Listing: Listed and labeled by an NRTL acceptable to authorities having jurisdiction for valves 1 inch and smaller.
 6. Service Mark: Valves 1-1/4 inch to NPS 2 shall have initials "WOG" permanently marked on valve body.
- C. General Requirements for Metallic Valves, NPS 2-1/2 and larger: Comply with ASME B16.38.
 1. CWP Rating: 125 psig.

2. Flanged Ends: Comply with ASME B16.5 for steel flanges.
 3. Tamperproof Feature: Locking feature for valves indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
 4. Service Mark: Initials "WOG" shall be permanently marked on valve body.
- D. Bronze Plug Valves: MSS SP-78.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Lee Brass Company.
 - b. McDonald, A. Y. Mfg. Co.
 2. Body: Bronze, complying with ASTM B 584.
 3. Plug: Bronze.
 4. Ends: Threaded, socket, or flanged as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
 5. Operator: Square head or lug type with tamperproof feature where indicated.
 6. Pressure Class: 125 psig.
 7. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
 8. Service: Suitable for LPG service with "WOG" indicated on valve body.
- E. Cast-Iron, Nonlubricated Plug Valves: MSS SP-78.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. McDonald, A. Y. Mfg. Co.
 - b. Mueller Co.; Gas Products Div.
 - c. Xomox Corporation; a Crane company.
 2. Body: Cast iron, complying with ASTM A 126, Class B.
 3. Plug: Bronze or nickel-plated cast iron.
 4. Seat: Coated with thermoplastic.
 5. Stem Seal: Compatible with LPG.
 6. Ends: Threaded or flanged as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
 7. Operator: Square head or lug type with tamperproof feature where indicated.
 8. Pressure Class: 125 psig.
 9. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
 10. Service: Suitable for LPG service with "WOG" indicated on valve body.
- F. Cast-Iron, Lubricated Plug Valves: MSS SP-78.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Flowserve.
 - b. Homestead Valve; a Division of Olson Technologies, Inc.
 - c. McDonald, A. Y. Mfg. Co.
 - d. Milliken Valve Company.
 - e. Mueller Co.; Gas Products Div.
 - f. R&M Energy Systems; a subsidiary of Robbins & Myers, Inc.
 2. Body: Cast iron, complying with ASTM A 126 Class B.
 3. Plug: Bronze or nickel-plated cast iron.
 4. Seat: Coated with thermoplastic.
 5. Stem Seal: Compatible with LPG.
 6. Ends: Threaded or flanged as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
 7. Operator: Square head or lug type with tamperproof feature where indicated.
 8. Pressure Class: 125 psig.

9. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
 10. Service: Suitable for LPG service with "WOG" indicated on valve body.
- G. PE Ball Valves: Comply with ASME B16.40.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Kerotest Manufacturing Corp.
 - b. Lyall, R. W. & Company, Inc.
 - c. Perfection Corporation; a subsidiary of American Meter Company.
 2. Body: PE.
 3. Ball: PE.
 4. Stem: Acetal.
 5. Seats and Seals: Nitrile.
 6. Ends: Plain or fusible to match piping.
 7. CWP Rating: 80 psig.
 8. Operating Temperature: Minus 20 to plus 140 deg F.
 9. Operator: Nut or flat head for key operation.
 10. Include plastic valve extension.
 11. Include tamperproof locking feature for valves where indicated on Drawings.
- H. Valve Boxes:
1. Cast-iron, two-section box.
 2. Top section with cover with "GAS" lettering.
 3. Bottom section with base to fit over valve and barrel a minimum of 5 inches in diameter.
 4. Adjustable cast-iron extensions of length required for depth of bury.
 5. Include tee-handle, steel operating wrench with socket end fitting valve nut or flat head and with stem of length required to operate valve.

2.05 PRESSURE REGULATORS

- A. General Requirements:
1. Single stage and suitable for LPG.
 2. Steel jacket and corrosion-resistant components.
 3. Elevation compensator.
 4. End Connections: Threaded for regulators NPS 2 and smaller; flanged for regulators NPS 2-1/2 and larger.
- B. Service Pressure Regulators: Comply with ANSI Z21.80.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Actaris.
 - b. American Meter Company.
 - c. Fisher Control Valves and Regulators; Division of Emerson Process Management.
 - d. Invensys.
 - e. Richards Industries; Jordan Valve Div.
 2. Body and Diaphragm Case: Cast iron or die-cast aluminum.
 3. Springs: Zinc-plated steel; interchangeable.
 4. Diaphragm Plate: Zinc-plated steel.
 5. Seat Disc: Nitrile rubber resistant to gas impurities, abrasion, and deformation at the valve port.
 6. Orifice: Aluminum; interchangeable.
 7. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
 8. Single-port, self-contained regulator with orifice no larger than required at maximum pressure inlet and no pressure sensing piping external to the regulator.
 9. Pressure regulator shall maintain discharge pressure setting downstream and not exceed 150 percent of design discharge pressure at shutoff.

10. Overpressure Protection Device: Factory mounted on pressure regulator.
 11. Atmospheric Vent: Factory- or field-installed, stainless-steel screen in opening if not connected to vent piping.
 12. Maximum Inlet Pressure: 100 psig.
- C. Line Pressure Regulators: Comply with ANSI Z21.80.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Actaris.
 - b. American Meter Company.
 - c. Eclipse Combustion, Inc.
 - d. Fisher Control Valves and Regulators; Division of Emerson Process Management.
 - e. Invensys.
 - f. Maxitrol Company.
 - g. Richards Industries; Jordan Valve Div.
 2. Body and Diaphragm Case: Cast iron or die-cast aluminum.
 3. Springs: Zinc-plated steel; interchangeable.
 4. Diaphragm Plate: Zinc-plated steel.
 5. Seat Disc: Nitrile rubber resistant to gas impurities, abrasion, and deformation at the valve port.
 6. Orifice: Aluminum; interchangeable.
 7. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
 8. Single-port, self-contained regulator with orifice no larger than required at maximum pressure inlet and no pressure sensing piping external to the regulator.
 9. Pressure regulator shall maintain discharge pressure setting downstream and not exceed 150 percent of design discharge pressure at shutoff.
 10. Overpressure Protection Device: Factory mounted on pressure regulator.
 11. Atmospheric Vent: Factory- or field-installed, stainless-steel screen in opening if not connected to vent piping.
 12. Maximum Inlet Pressure: 2 psig.
- D. Appliance Pressure Regulators: Comply with ANSI Z21.18.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Canadian Meter Company Inc.
 - b. Eaton Corporation; Controls Div.
 - c. Harper Wyman Co.
 - d. Maxitrol Company.
 - e. SCP, Inc.
 2. Body and Diaphragm Case: Die-cast aluminum.
 3. Springs: Zinc-plated steel; interchangeable.
 4. Diaphragm Plate: Zinc-plated steel.
 5. Seat Disc: Nitrile rubber.
 6. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
 7. Factory-Applied Finish: Minimum three-layer polyester and polyurethane paint finish.
 8. Regulator may include vent limiting device, instead of vent connection, if approved by authorities having jurisdiction.
 9. Maximum Inlet Pressure: 1 psig.

2.06 DIELECTRIC FITTINGS

- A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
- B. Dielectric Unions:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Capitol Manufacturing Company.

- b. Central Plastics Company.
 - c. Hart Industries International, Inc.
 - d. McDonald, A. Y. Mfg. Co.
 - e. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - f. Wilkins; a Zurn company.
- 2. Description:
 - a. Standard: ASSE 1079.
 - b. Pressure Rating: 150 psig.
 - c. End Connections: Solder-joint copper alloy and threaded ferrous.
- C. Dielectric Flanges:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Capitol Manufacturing Company.
 - b. Central Plastics Company.
 - c. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - d. Wilkins; a Zurn company.
 - 2. Description:
 - a. Standard: ASSE 1079.
 - b. Factory-fabricated, bolted, companion-flange assembly.
 - c. Pressure Rating: 150 psig.
 - d. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.
- D. Dielectric-Flange Kits:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Advance Products & Systems, Inc.
 - b. Calpico Inc.
 - c. Central Plastics Company.
 - d. Pipeline Seal and Insulator, Inc.
 - 2. Description:
 - a. Nonconducting materials for field assembly of companion flanges.
 - b. Pressure Rating: 150 psig.
 - c. Gasket: Neoprene or phenolic.
 - d. Bolt Sleeves: Phenolic or polyethylene.
 - e. Washers: Phenolic with steel backing washers.

2.07 LABELING AND IDENTIFYING

- A. Detectable Warning Tape: Acid- and alkali-resistant PE film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches wide and 4 mils thick, continuously inscribed with a description of utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored yellow.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine roughing-in for LPG piping system to verify actual locations of piping connections before equipment installation.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Close equipment shutoff valves before turning off LPG to premises or piping section.
- B. Inspect LPG piping according to NFPA 58 and the International Fuel Gas Code to determine that LPG utilization devices are turned off in piping section affected.

- C. Comply with NFPA 58 and the International Fuel Gas Code requirements for prevention of accidental ignition.

3.03 OUTDOOR PIPING INSTALLATION

- A. Comply with NFPA 58 and the International Fuel Gas Code requirements for installation and purging of LPG piping.
- B. Install underground, LPG piping buried at least 36 inches below finished grade.
- C. Install underground, PE, LPG piping according to ASTM D 2774.
- D. Steel Piping with Protective Coating:
 - 1. Apply joint cover kits to pipe after joining to cover, seal, and protect joints.
 - 2. Repair damage to PE coating on pipe as recommended in writing by protective coating manufacturer.
 - 3. Replace pipe having damaged PE coating with new pipe.
- E. Install fittings for changes in direction and branch connections.
- F. Joints for connection to inlets and outlets on vaporizers, air mixers, regulators, and valves may be flanged or threaded to match the equipment.
- G. Install pressure gauge upstream and downstream from each service regulator. Pressure gauges are specified in Section 230519 "Meters and gauges for HVAC Piping".

3.04 VALVE INSTALLATION

- A. Install manual gas shutoff valve for each gas appliance ahead of corrugated stainless-steel tubing, aluminum, or copper connector.
- B. Install regulators and overpressure protection devices with maintenance access space adequate for servicing and testing.

3.05 PIPING JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Threaded Joints:
 - 1. Thread pipe with tapered pipe threads complying with ASME B1.20.1.
 - 2. Cut threads full and clean using sharp dies.
 - 3. Ream threaded pipe ends to remove burrs and restore full ID of pipe.
 - 4. Apply appropriate tape or thread compound to external pipe threads unless dryseal threading is specified.
 - 5. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- D. Welded Joints:
 - 1. Construct joints according to AWS D10.12, using qualified processes and welding operators.
 - 2. Bevel plain ends of steel pipe.
 - 3. Patch factory-applied protective coating as recommended by manufacturer at field welds and where damage to coating occurs during construction.
- E. Flanged Joints: Install gasket material, size, type, and thickness appropriate for LPG service. Install gasket concentrically positioned.
- F. Flared Joints: Cut tubing with roll cutting tool. Flare tube end with tool to result in flare dimensions complying with SAE J513. Tighten finger tight, then use wrench. Do not overtighten.
- G. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.
 - 1. Plain-End Pipe and Fittings: Use butt fusion.
 - 2. Plain-End Pipe and Socket Fittings: Use socket fusion.

3.06 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements for pipe hangers and supports specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment".
- B. Install hangers for horizontal steel piping with the following maximum spacing and minimum rod sizes:
 - 1. NPS 1 and smaller: Maximum span, 96 inches; minimum rod size, 3/8 inch.
 - 2. NPS 1-1/4: Maximum span, 108 inches; minimum rod size, 3/8 inch.
 - 3. NPS 1-1/2 and NPS 2: Maximum span, 108 inches; minimum rod size, 3/8 inch.
 - 4. NPS 2-1/2 to NPS 3-1/2: Maximum span, 10 feet; minimum rod size, 1/2 inch.
 - 5. NPS 4 and larger: Maximum span, 10 feet; minimum rod size, 5/8 inch.
- C. Install hangers for horizontal, corrugated stainless-steel tubing with the following maximum spacing and minimum rod sizes:
 - 1. NPS 3/8: Maximum span, 48 inches; minimum rod size, 3/8 inch.
 - 2. NPS 1/2: Maximum span, 72 inches; minimum rod size, 3/8 inch.
 - 3. NPS 3/4 and larger: Maximum span, 96 inches; minimum rod, 3/8 inch.

3.07 CONNECTIONS

- A. Install LPG piping electrically continuous, and bonded to gas appliance equipment grounding conductor of the circuit powering the appliance according to NFPA 70.
- B. Install piping adjacent to appliances to allow service and maintenance of appliances.
- C. Connect piping to appliances using manual gas shutoff valves and unions. Install valve within 72 inches of each gas-fired appliances and equipment. Install union between valve and appliances or equipment.
- D. Sediment Traps: Install tee fitting with capped nipple in bottom to form drip, as close as practical to inlet of each appliance.

3.08 VAPORIZER INSTALLATION

- A. Install vaporizer with access space for periodic maintenance.
- B. Set vaporizers on and anchor to concrete base.
- C. Connect liquid line from pump set, and vapor supply to distribution piping.
- D. Install backup connection from vapor space of container to inlet of pressure-regulating valve at vaporizer discharge to bypass the vaporizer during maintenance. Install shutoff valves to change source from vaporizer to storage container.

3.09 LABELING AND IDENTIFYING

- A. Comply with requirements in Section 230553 "Identification for HVAC Piping and Equipment" for piping and valve identification.
- B. Install detectable warning tape directly above gas piping, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

3.10 PAINTING

- A. Paint exposed, exterior metal piping, valves, service regulators, service meters and meter bars, earthquake valves, and piping specialties, except components with factory-applied paint or protective coating.
 - 1. Alkyd System: MPI EXT 5.1D.
 - a. Prime Coat: Alkyd anticorrosive metal primer.
 - b. Intermediate Coat: Exterior alkyd enamel matching topcoat.
 - c. Topcoat: Exterior alkyd enamel (gloss).
 - d. Color: Gray.
- B. Damage and Touchup: Repair marred and damaged factory-applied finishes with materials and by procedures to match original factory finish.

3.11 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 - 1. Test, inspect, and purge LPG according to NFPA 58 and the International Fuel Gas Code and requirements of authorities having jurisdiction.
- C. LPG piping will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

3.12 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain LPG equipment.

3.13 OUTDOOR PIPING SCHEDULE

- A. Underground LPG liquid piping shall be the following:
 - 1. Schedule 40 steel pipe with wrought-steel fittings and welded joints, or mechanical couplings. Coat pipe and fittings with protective coating for steel piping.
- B. Aboveground LPG liquid piping shall be the following:
 - 1. NPS 2 and smaller: Schedule 40 steel pipe, malleable-iron threaded fittings and threaded joints. Coat pipe and fittings with protective coating for steel piping.
 - 2. NPS 2-1/2 and larger: Schedule 40, steel pipe with wrought-steel fittings and welded joints, or mechanical couplings. Coat pipe and fittings with protective coating for steel piping.
- C. Underground LPG vapor piping shall be the following:
 - 1. PE pipe and fittings joined by heat-fusion, or mechanical couplings; service-line risers with tracer wire terminated in an accessible location.
 - 2. Schedule 40, steel pipe with wrought-steel fittings and welded joints, or mechanical couplings. Coat pipe and fittings with protective coating for steel piping.
- D. Aboveground LPG vapor piping shall be the following:
 - 1. Schedule 40, steel pipe with malleable-iron fittings and threaded joints.
 - 2. Schedule 40, steel pipe with wrought-steel fittings and welded joints, or mechanical couplings.
- E. Containment Conduit: Schedule 40, steel pipe with wrought-steel fittings and welded joints. Coat pipe and fittings with protective coating for steel piping.

3.14 ABOVEGROUND MANUAL GAS SHUTOFF VALVE SCHEDULE

- A. Aboveground Liquid Piping:
 - 1. Two-piece, full-port, bronze ball valves with bronze trim.
- B. Valves for pipe NPS 2 and smaller at service meter shall be the following:
 - 1. One-piece, bronze ball valve with bronze trim.
 - 2. Bronze plug valve.
- C. Valves for pipe NPS 2-1/2 and larger at service meter shall be the following:
 - 1. Bronze plug valve.
 - 2. Cast-iron, nonlubricated plug valve.
- D. Distribution piping valves for pipe NPS 2 and smaller shall be the following:
 - 1. One-piece, bronze ball valve with bronze trim.
 - 2. Bronze plug valve.
- E. Distribution piping valves for pipe NPS 2-1/2 and larger shall be the following:
 - 1. Bronze plug valve.
 - 2. Cast-iron, nonlubricated plug valve.
- F. Valves in branch piping for single appliance shall be the following:
 - 1. One-piece, bronze ball valve with bronze trim.

2. Bronze plug valve.

END OF SECTION

SECTION 260500

COMMON WORK RESULTS FOR ELECTRICAL

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. Electrical equipment coordination and installation.
 - 2. Sleeves for raceways and cables.
 - 3. Sleeve seals.
 - 4. Grout.
 - 5. Common electrical installation requirements.

1.03 DEFINITIONS

- A. EPDM: Ethylene-propylene-diene terpolymer rubber.
- B. NBR: Acrylonitrile-butadiene rubber.

1.04 SUBMITTALS

- A. Product Data: For sleeve seals.

1.05 COORDINATION

- A. Coordinate arrangement, mounting, and support of electrical equipment:
 - 1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
 - 2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
 - 3. To allow right of way for piping and conduit installed at required slope.
 - 4. So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.
- B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.
- C. Coordinate location of access panels and doors for electrical items that are behind finished surfaces or otherwise concealed.

PART 2 PRODUCTS

2.01 SLEEVES FOR RACEWAYS AND CABLES

- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.
- B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- C. Sleeves for Rectangular Openings: Galvanized sheet steel.
 - 1. Minimum Metal Thickness:
 - a. For sleeve cross-section rectangle perimeter less than 50 inches and no side more than 16 inches, thickness shall be 0.052 inch.
 - b. For sleeve cross-section rectangle perimeter equal to, or more than, 50 inches and 1 or more sides equal to, or more than, 16 inches, thickness shall be 0.138 inch.

2.02 SLEEVE SEALS

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

2.03 GROUT

- A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.
- B. Packaging: Premixed and factory packaged.
- C. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 EXECUTION

3.01 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

- A. Comply with NECA 1.
- B. Comply with NEMA VE 2 for cable tray and cable penetrations.

- C. Enclosures: 304 stainless steel will NOT be acceptable for any enclosures. 316 stainless or non-metallic enclosures for NEMA 4 or NEMA 4X.
- D. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.
- E. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.
- F. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.
- G. Right of Way: Give to piping systems installed at a required slope.

3.02 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Electrical penetrations occur when raceways, cables, wireways, cable trays, or busways penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.
- B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- D. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with fire stop system used are fabricated during construction of floor or wall.
- E. Cut sleeves to length for mounting flush with both surfaces of walls.
- F. Extend sleeves installed in floors 2 inches above finished floor level.
- G. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway or cable, unless indicated otherwise.
- H. Seal space outside of sleeves with grout for penetrations of concrete and masonry
 - 1. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.
- I. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint.
- J. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway and cable penetrations. Install sleeves and seal raceway and cable penetration sleeves with firestop materials.
- K. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.
- L. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- M. Underground, Exterior-Wall Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch annular clear space between raceway or cable and sleeve for installing mechanical sleeve seals.

3.03 SLEEVE-SEAL INSTALLATION

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

3.04 FIRESTOPPING

- A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for electrical installations to restore original fire-resistance rating of assembly.

END OF SECTION

SECTION 260510

COMMON MOTOR REQUIREMENTS

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 COORDINATION

- A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
 - 1. Motor controllers.
 - 2. Torque, speed, and horsepower requirements of the load.
 - 3. Ratings and characteristics of supply circuit and required control sequence.
 - 4. Ambient and environmental conditions of installation location.

1.03 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of motors that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Motor winding failure.
 - 2. Warranty Period: Five years from date of Substantial Completion.

PART 2 PRODUCTS

2.01 GENERAL MOTOR REQUIREMENTS

- A. Comply with requirements in this Section except when stricter requirements are specified in plumbing equipment schedules or Sections.
- B. Comply with NEMA MG 1 unless otherwise indicated.

2.02 MOTOR CHARACTERISTICS

- A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet above sea level.
- B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.03 POLYPHASE MOTORS

- A. Description: NEMA MG 1, Design B, medium induction motor.
- B. Manufacturers:
 - 1. US Motor

2. General Electric Company
 3. Westinghouse
 4. Franklin
 5. Approved Equal.
- C. Efficiency: Premium efficient, as defined in NEMA MG 1.
- D. Verify motors to be used with VFD's. Provide motors rated for VFD's where motors are to be used with VFD's.
- E. Service Factor: 1.15.
- F. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters. Insulation of windings to be 1000 volt minimum.
- G. Multispeed Motors: Separate winding for each speed.
- H. Rotor: Random-wound, squirrel cage.
- I. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.
- J. Temperature Rise: Class B.
- K. Insulation: Class F.
- L. Peak Voltage Rating of stator wiring to be a minimum of 2,200 volts.
- M. Code Letter Designation:
1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
 2. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.
- N. Enclosure Material: Cast iron frame and end bells.
- O. Thermal Protection: Comply with NEMA MG 1.
- P. Provide shaft grounding (diverter) ring on drive end of all vertical motors.
- Q. Provide shaft grounding (diverter) ring on drive end and insulated bearing on the non-drive end of all motors 25 hp and larger controlled by variable-frequency motor controllers.

2.04 SINGLE-PHASE MOTORS

- A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:
1. Permanent-split capacitor.
 2. Split phase.
 3. Capacitor start, inductor run.
 4. Capacitor start, capacitor run.
- B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.
- C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.

D. Motors 1/20 HP and Smaller: Shaded-pole type.

E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

PART 3 EXECUTION (NOT APPLICABLE)

END OF SECTION

SECTION 260519

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 DEFINITIONS

- A. VFC: Variable frequency controller.

1.03 ACTION SUBMITTALS

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

PART 2 PRODUCTS

2.01 CONDUCTORS AND CABLES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Alcan Products Corporation; Alcan Cable Division.
 - 2. Alpha Wire.
 - 3. Belden Inc.
 - 4. Encore Wire Corporation.
 - 5. General Cable Technologies Corporation.
 - 6. Southwire Incorporated.
- B. Aluminum and Copper Conductors: Comply with NEMA WC 70/ICEA S-95-658.
- C. Conductor Insulation: Comply with NEMA WC 70/ICEA S-95-658 for Type THHN-2-THWN-2.
- D. Multiconductor Cable: Not allowed.

2.02 VFC CABLE, TYPE TC

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Alpha Wire.
 - 2. Belden Inc.
 - 3. Encore Wire Corporation.
 - 4. General Cable Technologies Corporation.
 - 5. Southwire Incorporated.
- B. Factory assembled, insulated, current-carrying conductors with an equipment grounding conductor in a nonmetallic jacket.

- C. Listed and labeled as defined in NFPA 70, by a qualified testing agency; and marked for intended location and use.
- D. Comply with UL 1277.
- E. Comply with ICEA S-3-532/NEMA WC 57 for Type TC cables used for control, thermocouple extension and instrumentation.
- F. Comply with ICEA S-95-658/NEMA WC 60 for Type TC cables used for power distribution.
- G. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide.
- H. Conductors: Copper, complying with ASTM B3 for bare annealed copper and with ASTM B8 for stranded conductors.
- I. Ground Conductor: Bare
- J. Conductor Insulation: Type XHHN-2. Comply with UL 44
- K. Shield: Metallic.

2.03 CONNECTORS AND SPLICES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. AFC Cable Systems, Inc.
 - 2. Hubbell Power Systems, Inc.
 - 3. O-Z/Gedney; a brand of the EGS Electrical Group.
 - 4. 3M; Electrical Markets Division.
 - 5. Tyco Electronics.
- B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

2.04 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 NFPA 70.

PART 3 EXECUTION

3.01 CONDUCTOR MATERIAL APPLICATIONS

- A. Feeders: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- C. VFC Cable: Extra-flexible stranded for all sizes.

3.02 CONDUCTOR INSULATION AND WIRING METHODS

- A. Service Entrance: Type THHN-2-THWN-2, single conductors in raceway.
- B. Exposed Feeders: Type THHN-2-THWN-2, single conductors in raceway.
- C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspace: Type THHN-2-THWN-2, single conductors in raceway.
- D. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-2-THWN-2, single conductors in raceway.
- E. Exposed Branch Circuits, Including in Crawlspace: Type THHN-2-THWN-2, single conductors in raceway.
- F. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN-2-THWN-2, single conductors in raceway.
- G. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-2-THWN-2, single conductors in raceway.
- H. VFC Cable: Type TC-ER cable with braided shield.

3.03 INSTALLATION OF CONDUCTORS AND CABLES

- A. Complete raceway installation between conductor and cable termination points according to Division 26 Section "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.
- D. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
- E. Support cables according to Division 26 Section "Hangers and Supports for Electrical Systems."

3.04 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 and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
- C. Wiring at Outlets: Install conductor at each outlet, with at least 12 inches of slack.

3.05 IDENTIFICATION

- A. Identify and color-code conductors and cables according to Division 26 Section "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.

3.06 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Division 26 Section "Common Work Results for Electrical."

3.07 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly.

3.08 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors 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.
- B. Test and Inspection Reports: Prepare a written report to record the following:
 - 1. Procedures used.
 - 2. Results that comply with requirements.
 - 3. Results that do not comply with requirements and corrective action taken to achieve compliance with requirements.
- C. Cables will be considered defective if they do not pass tests and inspections.

END OF SECTION 260519

SECTION 260523

CONTROL-VOLTAGE ELECTRICAL POWER 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 DEFINITIONS

- A. EMI: Electromagnetic interference.
- B. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control and signaling power-limited circuits.
- C. RCDD: Registered Communications Distribution Designer.
- D. UTP: Unshielded twisted pair.

1.03 ACTION SUBMITTALS

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

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.

2.02 PERFORMANCE REQUIREMENTS

- A. Flame Travel and Smoke Density in Plenums: As determined by testing identical products according to NFPA 262 by a qualified testing agency. Identify products for installation in plenums with appropriate markings of applicable testing agency.
 - 1. Flame Travel Distance: 60 inches or less.
 - 2. Peak Optical Smoke Density: 0.5 or less.
 - 3. Average Optical Smoke Density: 0.15 or less.
- B. Flame Travel and Smoke Density for Riser Cables in Non-Plenum Building Spaces: As determined by testing identical products according to UL 1666.
- C. Flame Travel and Smoke Density for Cables in Non-Riser Applications and Non-Plenum Building Spaces: As determined by testing identical products according to UL 1685.

2.03 LOW-VOLTAGE CONTROL CABLE

- A. Paired Cable: NFPA 70, Type CMG.
 - 1. One pair, twisted, No. 16 AWG, stranded tinned-copper conductors.

2. PVC insulation.
3. Unshielded.
4. PVC jacket.
5. Flame Resistance: Comply with UL 1685.

2.04 CONTROL-CIRCUIT CONDUCTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Encore Wire Corporation.
 2. General Cable Technologies Corporation.
 3. Southwire Company.
- B. Class 1 Control Circuits: Stranded copper, Type THHN-2-THWN-2, in raceway, complying with UL 83.
- C. Class 2 Control Circuits: Stranded copper, Type THHN-2-THWN-2, in raceway, complying with UL 83.
- D. Class 3 Remote-Control and Signal Circuits: Stranded copper, Type THHN-2-THWN-2, in raceway, complying with UL 83.

2.05 SOURCE QUALITY CONTROL

- A. Cable will be considered defective if it does not pass tests and inspections.
- B. Prepare test and inspection reports.

PART 3 EXECUTION

3.01 INSTALLATION OF RACEWAYS AND BOXES

- A. Comply with requirements in Division 26 Section "Raceways and Boxes for Electrical Systems" for raceway selection and installation requirements for boxes, conduits, and wireways as supplemented or modified in this Section.
 1. Outlet boxes shall be no smaller than 2 inches wide, 3 inches high, and 2-1/2 inches deep.
 2. Flexible metal conduit shall not be used.
- B. Comply with TIA-569-B for pull-box sizing and length of conduit and number of bends between pull points.
- C. Install manufactured conduit sweeps and long-radius elbows if possible.

3.02 INSTALLATION OF CONDUCTORS AND CABLES

- A. Comply with NECA 1 and NFPA 70.
- B. General Requirements for Cabling:
 1. Comply with TIA-568-C Series of standards.
 2. Comply with BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems" and Ch. 6, "Optical Fiber Structured Cabling Systems."
 3. Terminate all conductors and optical fibers; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, and cross-connect and patch panels.
 4. Cables may not be spliced.

5. Secure and support cables at intervals not exceeding 30 inches and not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
 6. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems" and Ch. 6, "Optical Fiber Structured Cabling Systems." Install lacing bars and distribution spools.
 7. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
 8. Cold-Weather Installation: Bring cable to room temperature before dereeling. Do not use heat lamps for heating.
 9. Pulling Cable: Comply with BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems" and Ch. 6, "Optical Fiber Structured Cabling Systems." Monitor cable pull tensions.
 10. Support: Do not allow cables to lay on removable ceiling tiles.
 11. Secure: Fasten securely in place with hardware specifically designed and installed so as to not damage cables.
- C. Installation of Control-Circuit Conductors:
1. Install wiring in raceways. Comply with requirements specified in Division 26 Section "Raceways and Boxes for Electrical Systems."
- D. Separation from EMI Sources:
1. Comply with BICSI TDMM and TIA-569-B recommendations for separating unshielded copper voice and data communications cable from potential EMI sources including electrical power lines and equipment.
 2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:
 - a. Electrical Equipment or Circuit Rating Less Than 2 kVA: A minimum of 5 inches.
 - b. Electrical Equipment or Circuit Rating between 2 and 5 kVA: A minimum of 12 inches.
 - c. Electrical Equipment or Circuit Rating More Than 5 kVA: A minimum of 24 inches.
 3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:
 - a. Electrical Equipment or Circuit Rating Less Than 2 kVA: A minimum of 2-1/2 inches.
 - b. Electrical Equipment or Circuit Rating between 2 and 5 kVA: A minimum of 6 inches.
 - c. Electrical Equipment or Circuit Rating More Than 5 kVA: A minimum of 12 inches.
 4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
 - a. Electrical Equipment or Circuit Rating Less Than 2 kVA: No requirement.
 - b. Electrical Equipment or Circuit Rating between 2 and 5 kVA: A minimum of 3 inches.
 - c. Electrical Equipment or Circuit Rating More Than 5 kVA: A minimum of 6 inches.
 5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or 5 HP and Larger: A minimum of 48 inches.
 6. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches.

3.03 REMOVAL OF CONDUCTORS AND CABLES

- A. Remove abandoned conductors and cables. Abandoned conductors and cables are those installed that are not terminated at equipment and are not identified for future use with a tag.

3.04 CONTROL-CIRCUIT CONDUCTORS

A. Minimum Conductor Sizes:

1. Class 1 remote-control and signal circuits; No 14 AWG.
2. Class 2 low-energy, remote-control, and signal circuits; No. 16 AWG.
3. Class 3 low-energy, remote-control, alarm, and signal circuits; No 12 AWG.

3.05 FIRESTOPPING

- A. Comply with TIA-569-B, Annex A, "Firestopping."
- B. Comply with BICSI TDMM, "Firestopping" Chapter.

3.06 GROUNDING

- A. For data communication wiring, comply with ANSI-J-STD-607-A and with BICSI TDMM, "Bonding and Grounding (Earthing)" Chapter.
- B. For low-voltage control wiring and cabling, comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems."

3.07 IDENTIFICATION

- A. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
- B. Identify data and communications system components, wiring, and cabling according to TIA-606-A; label printers shall use label stocks, laminating adhesives, and inks complying with UL 969.

3.08 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 1. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
- B. Document data for each measurement. Print data for submittals in a summary report that is formatted using Table 10.1 in BICSI TDMM as a guide or transfer the data from the instrument to the computer, save as text files, print, and submit.
- C. End-to-end cabling will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

END OF SECTION 260523

SECTION 260526

GROUNDING AND 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 ACTION SUBMITTALS

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

1.03 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For grounding to include the following in emergency, operation, and maintenance manuals:

1.04 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with UL 467 for grounding and bonding materials and equipment.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Burndy; Part of Hubbell Electrical Systems.
 - 2. Dossert; AFL Telecommunications LLC.
 - 3. ERICO International Corporation.
 - 4. Fushi Copperweld Inc.
 - 5. Galvan Industries, Inc.; Electrical Products Division, LLC.
 - 6. Harger Lightning and Grounding.
 - 7. ILSCO.
 - 8. O-Z/Gedney; A Brand of the EGS Electrical Group.
 - 9. Robbins Lightning, Inc.
 - 10. Siemens Power Transmission & Distribution, Inc.

2.02 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

2.03 CONDUCTORS

- A. Insulated Conductors: Copper or tinned-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 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 wide and 1/16 inch thick.
 - 7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

2.04 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 exothermic-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.

2.05 GROUNDING ELECTRODES

- A. Ground Rods: Copper-clad steel; 3/4 inch diameter by 10 feet in length.

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 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. Install a main bonding jumper between the neutral and ground buses.

3.03 GROUNDING AT THE SERVICE

- 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

3.04 EQUIPMENT GROUNDING

- A. Install insulated equipment grounding conductors with all feeders and branch circuits.
- B. Isolated Equipment Enclosure Circuits: For designated equipment supplied by a branch circuit or feeder, isolate equipment enclosure from supply circuit raceway with a nonmetallic raceway fitting listed for the purpose. Install fitting where raceway enters enclosure, and install a separate insulated equipment grounding conductor. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service, unless otherwise indicated.

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 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 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.
- D. Grounding and Bonding for Piping:
 - 1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes, using a bolted clamp connector or by bolting a lug-type connector to a pipe flange, using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
 - 2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
 - 3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.

- E. Grounding for Steel Building Structure: Install a driven ground rod at base of each corner column and at intermediate exterior columns at distances not more than 60 feet apart.

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 each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, at ground test wells, and at individual ground rods. Make tests at ground rods before any conductors are connected.
 - a. Measure ground resistance not less 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. Grounding system will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.
- E. Report measured ground resistances that exceed the following values:
 - 1. Power and Lighting Equipment or System with Capacity 500 kVA and Less: 10 ohms.
 - 2. Power and Lighting Equipment or System with Capacity 500 to 1000 kVA: 5 ohms.
 - 3. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: 3 ohms.
- F. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION

SECTION 260529

HANGERS AND SUPPORTS 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 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. IMC: Intermediate metal conduit.
- C. RMC: Rigid metal conduit.

1.03 PERFORMANCE REQUIREMENTS

- A. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.
- B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
- C. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of five times the applied force.

1.04 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Steel slotted support systems.
 - 2. Nonmetallic slotted support systems.
- B. Shop Drawings: Show fabrication and installation details and include calculations for the following:
 - 1. Trapeze hangers. Include Product Data for components.
 - 2. Steel slotted channel systems. Include Product Data for components.
 - 3. Nonmetallic slotted channel systems. Include Product Data for components.
 - 4. Equipment supports.

1.05 INFORMATIONAL SUBMITTALS

- A. Welding certificates.

1.06 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Comply with NFPA 70.

1.07 COORDINATION

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

PART 2 PRODUCTS

2.01 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Steel Slotted Support Systems: Preformed steel channels and angles with minimum 13/32-inch diameter holes at a maximum of 8 inches o.c. in at least one surface. Comply with MFMA-4, factory-fabricated components for field assembly.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Allied Tube & Conduit.
 - b. Cooper B-Line, Inc.
 - c. ERICO International Corporation.
 - d. GS Metals Corp.
 - e. Thomas & Betts Corporation.
 - f. Unistrut; Atkore International.
 - 2. Material for Channel, Fittings, and Accessories: Galvanized steel.
 - 3. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
 - 4. Channel Dimensions: Selected for applicable load criteria.
 - 5. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Raceway and Cable Supports: As described in NECA 1 and NECA 101.
- C. Conduit and Cable Support Devices: Steel and malleable-iron hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- D. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.
- E. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- F. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
 - 1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - (1) Hilti Inc.
 - (2) ITW Ramset/Red Head; Illinois Tool Works, Inc.
 - (3) MKT Fastening, LLC.
 - (4) Simpson Strong-Tie Co., Inc.

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

2.02 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

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

PART 3 EXECUTION

3.01 APPLICATION

- A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.
- B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as scheduled in NECA 1, where it's Table 1 lists maximum spacings less than stated in NFPA 70. Minimum rod size shall be 1/4 inch in diameter.
- C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
 1. Secure raceways and cables to these supports with single-bolt conduit clamps using spring friction action for retention in support channel.
- D. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

3.02 SUPPORT INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.
- B. Raceway Support Methods: In addition to methods described in NECA 1, EMT, IMC, and RMC may be supported by openings through structure members, as permitted in NFPA 70.
- C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.

- D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
1. To Wood: Fasten with lag screws or through bolts.
 2. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
 3. To Existing Concrete: Expansion anchor fasteners.
 4. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches thick.
 5. To Steel: Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69.
 6. To Light Steel: Sheet metal screws.
 7. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate.
- E. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.03 INSTALLATION OF FABRICATED METAL SUPPORTS

- A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
- B. Field Welding: Comply with AWS D1.1/D1.1M.

3.04 CONCRETE BASES

- A. Construct concrete bases of dimensions indicated but not less than 4 inches larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.
- B. Use 3000-psi, 28-day compressive-strength concrete.
- C. Anchor equipment to concrete base.
1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 2. Install anchor bolts to elevations required for proper attachment to supported equipment.
 3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.05 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION

SECTION 260533

RACEWAY 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 DEFINITIONS

- A. ARC: Aluminum rigid conduit.
- B. GRC: Galvanized rigid steel conduit.
- C. IMC: Intermediate metal conduit.

1.03 ACTION SUBMITTALS

- A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.
- B. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.

PART 2 PRODUCTS

2.01 METAL CONDUITS, TUBING, AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. AFC Cable Systems, Inc.
 - 2. Allied Tube & Conduit.
 - 3. Anamet Electrical, Inc.
 - 4. Calbond.
 - 5. Electri-Flex Company.
 - 6. O-Z/Gedney.
 - 7. Robroy Industries.
 - 8. Wheatland Tube Company.
- B. Listing and Labeling: Metal conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. GRC: Comply with ANSI C80.1 and UL 6.
 - 1. Comply with NEMA RN 1.
 - 2. Coating Thickness: 0.040 inch, minimum.
- D. EMT: Comply with ANSI C80.3 and UL 797.
- E. FMC: Comply with UL 1; zinc-coated steel.

- F. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.
- G. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.
 - 1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886 and NFPA 70.
 - 2. Fittings for EMT:
 - a. Material: Steel.
 - b. Type: Setscrew or compression.
 - 3. 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.
 - 4. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch, with overlapping sleeves protecting threaded joints
- H. Joint Compound for IMC, GRC, or ARC: 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, TUBING, AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. AFC Cable Systems, Inc.
 - 2. Anamet Electrical, Inc.
 - 3. Arnco Corporation.
 - 4. CANTEX Inc.
 - 5. CertainTeed Corporation.
 - 6. Condux International, Inc.
 - 7. Electri-Flex Company.
 - 8. Lamson & Sessions; Carlon Electrical Products.
 - 9. RACO; Hubbell.
 - 10. Thomas & Betts Corporation.
- B. Listing and Labeling: Nonmetallic conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application
- C. RNC: Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.
- D. LFNC: Comply with UL 1660.
- E. Fittings for RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.
- F. Fittings for LFNC: Comply with UL 514B.
- G. Solvent cements and adhesive primers shall have a VOC content of 510 and 550 g/L or less, respectively, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.03 BOXES, ENCLOSURES, AND CABINETS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Cooper Technologies Company; Cooper Crouse-Hinds.

2. EGS/Appleton Electric.
 3. Erickson Electrical Equipment Company.
 4. Hoffman.
 5. Hubbell Incorporated.
 6. O-Z/Gedney.
 7. RACO; Hubbell.
 8. Robroy Industries.
 9. Spring City Electrical Manufacturing Company.
 10. Thomas & Betts Corporation.
 11. Wiremold / Legrand.
- 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. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.
- D. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.
- E. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- F. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1, cast aluminum with gasketed cover.
- G. Box extensions used to accommodate new building finishes shall be of same material as recessed box.
- H. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1 with continuous-hinge cover with flush latch unless otherwise indicated.
1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
 2. Nonmetallic Enclosures: Plastic.
 3. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.
- I. Cabinets:
1. NEMA 250, Type 1 galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
 2. Hinged door in front cover with flush latch and concealed hinge.
 3. Key latch to match panelboards.
 4. Metal barriers to separate wiring of different systems and voltage.
 5. Accessory feet where required for freestanding equipment.
 6. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

PART 3 EXECUTION

3.01 RACEWAY APPLICATION

- A. Refer to Conduit & Boxes Schedule on plans.
- B. Outdoors: Apply raceway products as specified below, unless otherwise indicated:
1. Exposed Conduit: Rigid steel conduit.

2. Concealed Conduit, Aboveground: EMT.
 3. Underground Conduit: RNC, Type EPC-40-PVC, direct buried.
 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.
- C. Indoors: Apply raceway products as specified below unless otherwise indicated:
1. Exposed, Not Subject to Physical Damage: EMT.
 2. Exposed, Not Subject to Severe Physical Damage: EMT.
 3. Exposed and Subject to Severe Physical Damage: Rigid steel conduit.
 4. Concealed in Ceilings and Interior Walls and Partitions: EMT.
 5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
 6. Damp or Wet Locations: Rigid steel conduit.
 7. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4, nonmetallic in damp or wet locations.
- D. Minimum Raceway Size: 1/2-inch trade size.
- E. Raceway Fittings: Compatible with raceways and suitable for use and location.
1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings, unless otherwise indicated.
 2. EMT: Use compression, steel fittings. Comply with NEMA FB 2.10.
 3. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.
- F. Install nonferrous conduit or tubing for circuits operating above 60 Hz. Where aluminum raceways are installed for such circuits and pass through concrete, install in nonmetallic sleeve.
- G. Install surface raceways only where indicated on Drawings.
- H. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F.

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. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
- C. Complete raceway installation before starting conductor installation.
- D. Complete with requirements in Division 26 Section "Hangers and Supports for Electrical Systems" for hangers and supports.
- E. Arrange stub-ups so curved portions of bends are not visible above the finished slab.
- F. 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 of changes in direction.

- G. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
- H. Support conduit within 12 inches of enclosures to which attached.
- I. 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.
- J. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors, including conductors smaller than No. 4 AWG.
- K. 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 trade size and insulated throat metal bushings on 1-1/2-inch trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.
- L. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.
- M. 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.
- N. Cut conduit perpendicular to the length. For conduits 2-inch trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.
- O. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.
- P. 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.
- Q. 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 a building or structure.
 - 2. Where otherwise required by NFPA 70.
- R. Comply with manufacturer's written instructions for solvent welding RNC and fittings.
- S. Expansion-Joint Fittings:
 - 1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F and that has straight-run length that exceeds 25 feet. Install in each run of aboveground RMC and EMT conduit that is located where environmental temperature change may exceed 100 deg F and that has straight-run length that exceeds 100 feet.
 - 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 temperature change.
 - b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.
 - c. Indoor Spaces: Connected with the Outdoors without Physical Separation: 125 deg F 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 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 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.
- T. Flexible Conduit Connections: Use maximum of 36 inches of flexible conduit for lighting fixtures, 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.
- U. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to top of box unless otherwise indicated.
- V. Locate boxes so that cover or plate will not span different building finishes.
- W. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.
- X. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

3.03 INSTALLATION OF UNDERGROUND CONDUIT

A. Direct-Buried Conduit:

1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Division 31 Section "Earth Moving" for pipe less than 6 inches in nominal diameter.
2. Install backfill as specified in Division 31 Section "Earth Moving."
3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Division 31 Section "Earth Moving."
4. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through the floor, unless otherwise indicated. Encase elbows for stub-up ducts throughout the length of the elbow.
5. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through the floor.
 - a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches of concrete for a minimum of 12 inches 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 from edge of foundation or equipment base. Install insulated grounding bushings on terminations at equipment.
6. Warning Planks: Bury warning planks approximately 12 inches above direct-buried conduits but a minimum of 6 inches below grade. Align planks along centerline of conduit.
7. Underground Warning Tape: Comply with requirements in Division 26 Section "Identification for Electrical Systems."

3.04 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Division 26 Section "Common Work Results for Electrical."

3.05 FIRESTOPPING

- A. Install firestopping at penetrations of fire-rated floor and wall assemblies.

3.06 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 or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION

SECTION 260553

IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 ACTION SUBMITTALS

- A. Product Data: For each electrical identification product indicated.
- B. Samples: For each type of label and sign to illustrate size, colors, lettering style, mounting provisions, and graphic features of identification products.
- C. Identification Schedule: An index of nomenclature of electrical equipment and system components used in identification signs and labels.

1.03 QUALITY ASSURANCE

- A. Comply with ANSI A13.1 and IEEE C2.
- B. Comply with NFPA 70.
- C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.
- D. Comply with ANSI Z535.4 for safety signs and labels.
- E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

1.04 COORDINATION

- A. Coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual; and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.
- B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- C. Coordinate installation of identifying devices with location of access panels and doors.
- D. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 PRODUCTS

2.01 POWER RACEWAY IDENTIFICATION MATERIALS

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

- B. Colors for Raceways Carrying Circuits at 600 V or Less:
 - 1. Black letters on an orange field.
 - 2. Legend:
 - a. Indicate voltage and system or service type.
 - b. Panel of origin.
 - c. Equipment served.
- C. Snap-Around Labels for Raceways Carrying Circuits at 600 V or Less: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.
- D. Snap-Around, Color-Coding Bands for Raceways Carrying Circuits at 600 V or Less: Slit, pretensioned, flexible, solid-colored acrylic sleeve, 2 inches long, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

2.02 POWER AND CONTROL CABLE IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.
- B. Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing ends of legend label.
- C. Self-Adhesive, Self-Laminating Polyester Labels: Preprinted, 3-mil- thick flexible label with acrylic pressure-sensitive adhesive that provides a clear, weather- and chemical-resistant, self-laminating, protective shield over the legend. Labels sized to fit the cable diameter such that the clear shield overlaps the entire printed legend.
- D. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.
- E. Snap-Around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeve, 2 inches long, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

2.03 CONDUCTOR IDENTIFICATION MATERIALS

- A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.
- B. Legend:
 - 1. Panel of origin.
 - 2. Circuit number.
- C. Self-Adhesive, Self-Laminating Polyester Labels: Preprinted, 3-mil- thick flexible label with acrylic pressure-sensitive adhesive that provides a clear, weather- and chemical-resistant, self-laminating, protective shield over the legend. Labels sized to fit the conductor diameter such that the clear shield overlaps the entire printed legend.
- D. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.
- E. Snap-Around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeve, 2 inches long, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.
- F. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

2.04 UNDERGROUND-LINE WARNING TAPE

A. Tape:

1. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications utility lines.
2. Printing on tape shall be permanent and shall not be damaged by burial operations.
3. Tape material and ink shall be chemically inert, and not subject to degrading when exposed to acids, alkalis, and other destructive substances commonly found in soils.

B. Color and Printing:

1. Comply with ANSI Z535.1 through ANSI Z535.5.
2. Inscriptions for Red-Colored Tapes: ELECTRIC LINE, HIGH VOLTAGE,
3. Inscriptions for Orange-Colored Tapes: TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE.

C. Tag: Type I :

1. Pigmented polyolefin, bright-colored, continuous-printed on one side with the inscription of the utility, compounded for direct-burial service.
2. Thickness: 4 mils.
3. Weight: 18.5 lb/1000 sq. ft.
4. 3-Inch Tensile According to ASTM D 882: 30 lbf and 2500 psi.

2.05 WARNING LABELS AND SIGNS

A. Comply with NFPA 70 and 29 CFR 1910.145.

B. Baked-Enamel Warning Signs:

1. Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application.
2. 1/4-inch grommets in corners for mounting.
3. Nominal size, 7 by 10 inches.

C. Metal-Backed, Butyrate Warning Signs:

1. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with 0.0396-inch galvanized-steel backing; and with colors, legend, and size required for application.
2. 1/4-inch grommets in corners for mounting.
3. Nominal size, 10 by 14 inches.

D. Warning label and sign shall include, but are not limited to, the following legends:

1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES."

2.06 INSTRUCTION SIGNS

A. Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch thick for signs up to 20 sq. inches and 1/8 inch thick for larger sizes.

1. Engraved legend with black letters on white face.
2. Punched or drilled for mechanical fasteners.
3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

2.07 EQUIPMENT IDENTIFICATION LABELS

- A. Self-Adhesive, Engraved, Laminated Acrylic or Melamine Label: Adhesive backed, with white letters on a dark-gray background. Minimum letter height shall be 3/8 inch.
- B. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. White letters on a dark-gray background. Minimum letter height shall be 3/8 inch.

2.08 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Select 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 INSTALLATION

- A. Verify identity of each item before installing identification products.
- B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.
- C. Apply identification devices to surfaces that require finish after completing finish work.
- D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.
- E. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
- F. Attach plastic raceway and cable labels that are not self-adhesive type with clear vinyl tape with adhesive appropriate to the location and substrate.
- G. System Identification Color-Coding Bands for Raceways and Cables: Each color-coding band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.
- H. Aluminum Wraparound Marker Labels and Metal Tags: Secure tight to surface of conductor or cable at a location with high visibility and accessibility.
- I. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 6 to 8 inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trench exceeds 16 inches overall.
- J. Painted Identification: Comply with requirements in painting Sections for surface preparation and paint application.

3.02 IDENTIFICATION SCHEDULE

- A. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits: Identify with self-adhesive label. Install labels on all conduit 6-foot and longer at 10-foot maximum intervals. Information on raceway to include Voltage, panel of origin and equipment being fed. Where conduits pass through walls, labels shall be applied on each side of the wall.
- B. Accessible Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with labels with the wiring system legend and system voltage. System legends shall be as follows:
 - 1. Emergency Power.
 - 2. Normal Power.
- C. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, panelboard gutters, wireway gutters, manholes, and handholes, use color-coding conductor tape to identify the phase. Install conductor identification label on each conductor.
 - 1. Color-Coding for Phase and Voltage Level Identification, 600 V or Less: Use colors listed below for ungrounded service, feeder and branch-circuit conductors.
 - a. Color shall be factory applied.
 - b. Colors for 240/120-V Circuits:
 - (1) Phase A: Black.
 - (2) Phase B: Red.
 - (3) Phase C: Blue.
 - c. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.
- D. Install instructional sign including the color-code for grounded and ungrounded conductors using adhesive-film-type labels.
- E. Conductors to Be Extended in the Future: Attach marker tape to conductors and list source.
- F. 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.
- G. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable.
 - 1. Limit use of underground-line warning tape to direct-buried cables.
 - 2. Install underground-line warning tape for both direct-buried cables and cables in raceway.
- H. Workspace Indication: Install floor marking tape to show working clearances in the direction of access to live parts. Workspace shall be as required by NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.

- I. 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.
- J. Arc Flash Warning Labeling: Self-adhesive labels.
- 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. Emergency Operating Instruction Signs: Install instruction signs with white legend on a red background with minimum 3/8-inch high letters for emergency instructions at equipment used for power transfer.
- M. 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. Labeling Instructions:
 - a. Indoor Equipment: Self-adhesive, engraved, laminated acrylic or melamine label. Unless otherwise indicated, provide a single line of text with 1/2-inch high letters on 1-1/2-inch high label; where two lines of text are required, use labels 2 inches high.
 - b. Outdoor Equipment: Engraved, laminated acrylic or melamine label. Stenciled legend 4 inches high.
 - c. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
 - d. Unless provided with self-adhesive means of attachment, fasten labels with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure.
 - 2. Equipment to Be Labeled:
 - a. Panelboards:
 - (1) Cover Label:
 - (a) Equipment ID as scheduled.
 - (2) Interior Label Legend:
 - (a) Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be self-adhesive, engraved, laminated acrylic or melamine label.
 - b. Enclosures and electrical cabinets.
 - (1) Cover Label:
 - (a) Equipment ID.
 - c. Emergency system boxes and enclosures.
 - (1) Cover Label:
 - (a) Equipment ID.

- d. Variable-speed controllers.
 - (1) Cover Label:
 - (a) Equipment ID as scheduled.
 - (2) Interior Label Legend:
 - (a) Equipment served.
 - (b) Nameplate horsepower.
 - (c) Full Load Amps.
 - (d) Code Letter.
 - (e) Service Factor.
 - (f) Voltage Phase Rating.
- e. Power transfer equipment.
 - (1) Cover Label:
 - (a) Equipment ID as scheduled.

END OF SECTION

SECTION 262416

PANELBOARDS

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 DEFINITIONS

- A. SPD: Surge Protective Device.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of panelboard, switching and overcurrent protective device, transient voltage suppression device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: For each panelboard and related equipment.
 - 1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
 - 2. Detail enclosure types and details for types other than NEMA 250, Type 1.
 - 3. Detail bus configuration, current, and voltage ratings.
 - 4. Short-circuit current rating of panelboards and overcurrent protective devices.
 - 5. Include evidence of NRTL listing for series rating of installed devices.
 - 6. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
 - 7. Include wiring diagrams for power, signal, and control wiring.
 - 8. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device.

1.04 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
 - 1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
 - 2. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.

1.05 MAINTENANCE MATERIAL SUBMITTALS

- 1. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - a. Keys: Two spares for each type of panelboard cabinet lock.

- b. Circuit Breakers Including GFCI and Ground Fault Equipment Protection (GFEP) Types:
Two spares for each panelboard.

1.06 QUALITY ASSURANCE

- A. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.
- B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- 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 PB 1.
- E. Comply with NFPA 70.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Remove loose packing and flammable materials from inside panelboards; install temporary electric heating (250 W per panelboard) to prevent condensation.
- B. Handle and prepare panelboards for installation according to NEMA PB 1.

1.08 PROJECT CONDITIONS

- A. Environmental Limitations:
 - 1. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
 - 2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 - a. Ambient Temperature: Not exceeding minus 22 deg F to plus 104 deg F.
 - b. Altitude: Not exceeding 6600 feet.
- B. Service Conditions: NEMA PB 1, usual service conditions, as follows:
 - 1. Ambient temperatures within limits specified.
 - 2. Altitude not exceeding 6600 feet.
- C. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
 - 1. Notify Engineer no fewer than two days in advance of proposed interruption of electric service.
 - 2. Do not proceed with interruption of electric service without Owner's written permission.
 - 3. Comply with NFPA 70E.

1.09 COORDINATION

- A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

1.10 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace transient voltage suppression devices that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Five years from date of Substantial Completion.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS FOR PANELBOARDS

- 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 NEMA PB 1.
- C. Comply with NFPA 70.
- D. Enclosures: Flush- and surface-mounted cabinets.
 - 1. Rated for environmental conditions at installed location.
 - a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
 - b. Outdoor Locations: NEMA 250, Type 3R.
 - c. Wash-Down Areas: NEMA 250, Type 4X, stainless steel.
 - d. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
 - e. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.
 - 2. Height: 84 inches maximum.
 - 3. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box.
 - 4. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.
 - 5. Finishes:
 - a. Panels and Trim: Steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
 - b. Back Boxes: Same finish as panels and trim.
 - c. Fungus Proofing: Permanent fungicidal treatment for overcurrent protective devices and other components.
 - 6. Directory Card: Inside panelboard door, mounted in metal frame with transparent protective cover.

- E. Incoming Mains Location: Top and bottom.
- F. Phase, Neutral, and Ground Buses:
 - 1. Material: Hard-drawn copper, 98 percent conductivity.
 - 2. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
- G. Conductor Connectors: Suitable for use with conductor material and sizes.
 - 1. Material: Hard-drawn copper, 98 percent conductivity.
 - 2. Main and Neutral Lugs: Mechanical type.
 - 3. Ground Lugs and Bus-Configured Terminators: Mechanical type.
- H. Service Equipment Label: NRTL labeled for use as service equipment for panelboards or load centers with one or more main service disconnecting and overcurrent protective devices.
- I. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.
- J. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals.

2.02 SECONDARY POWER ARRESTERS (LIGHTING ARRESTERS)

- A. Provide secondary power arresters on the main service entrance panel.
- B. Secondary power arresters shall be supplied by:
 - 1. Square D, Schneider Electric, Inc.
 - 2. Joslyn Surge Tec.
- C. Secondary Power Arresters shall be based on the Joslyn Surge Tec., metal oxide secondary surge arresters. They shall meet all the requirements of the ANSI/IEEE C62.11 arrester standard.
 - 1. Arresters to have a failure indication.

2.03 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - 2. Siemens Energy & Automation, Inc.
 - 3. Square D; a brand of Schneider Electric.
- B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.
- C. Mains: As indicated.
- D. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.
- E. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

2.04 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - 2. Siemens Energy & Automation, Inc.
 - 3. Square D; a brand of Schneider Electric.
- B. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.
 - 1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
 - 2. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:
 - a. Standard frame sizes, trip ratings, and number of poles.
 - b. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
 - c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.
 - d. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage with field-adjustable 0.1- to 0.6-second time delay.
 - e. Multipole units enclosed in a single housing or factory assembled to operate as a single unit.
 - f. Handle Padlocking Device: Fixed attachment for locking circuit breaker handle in off position.
 - g. Handle Clamp: Loose attachment for holding circuit breaker handle in on position.

2.05 ACCESSORY COMPONENTS AND FEATURES

- A. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Receive, inspect, handle, and store panelboards according to NEMA PB 1.1.
- B. Examine panelboards before installation. Reject panelboards that are damaged or rusted or have been subjected to water saturation.
- C. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Install panelboards and accessories according to NEMA PB 1.1.
- B. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.

- C. Mount top of trim 72 inches above finished floor unless otherwise indicated.
- D. Mount panelboard cabinet plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.
- E. Install overcurrent protective devices and controllers not already factory installed.
- F. Install filler plates in unused spaces.
- G. Arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing.
- H. Comply with NECA 1.
- I. Provide Secondary Power Arresters (lightning arresters) on all electric service entrances.

3.03 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Section 260553 "Identification for Electrical Systems."
- B. Create a directory to indicate installed circuit loads after balancing panelboard loads; incorporate Owner's final room designations. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.
- C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- D. Device Nameplates: Label each branch circuit device in distribution panelboards with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- E. Arc-Flash Warning Labels:
 - 1. Comply with requirements in Section 260573.19 "Arc-Flash Hazard Analysis." Produce a 3.5-by-5-inch self-adhesive equipment label for each work location included in the analysis.
 - 2. Comply with requirements in Section 260553 "Identification for Electrical Systems." Produce a 3.5-by-5-inch self-adhesive equipment label for each work location included in the analysis. Labels shall be machine printed, with no field-applied markings.
 - a. Label shall have an orange header with the wording, "WARNING, ARC-FLASH HAZARD," and shall include the following information taken directly from the arc-flash hazard analysis:
 - (1) Location designation.
 - (2) Nominal voltage.
 - (3) Flash protection boundary.
 - (4) Hazard risk category.
 - (5) Incident energy.
 - (6) Working distance.
 - (7) Engineering report number, revision number, and issue date.
 - b. Labels shall be machine printed, with no field-applied markings.

3.04 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. Acceptance Testing Preparation:
 1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
 2. Test continuity of each circuit.
- C. Tests and Inspections:
 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
- D. Panelboards will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.05 ADJUSTING

- A. Adjust moving parts and operable component to function smoothly and lubricate as recommended by manufacturer.

3.06 PROTECTION

- A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions.

END OF SECTION

SECTION 262813

FUSES

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 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material, dimensions, descriptions of individual components, and finishes for spare-fuse cabinets. Include the following for each fuse type indicated:
 - 1. Ambient Temperature Adjustment Information: If ratings of fuses have been adjusted to accommodate ambient temperatures, provide list of fuses with adjusted ratings.
 - a. For each fuse having adjusted ratings, include location of fuse, original fuse rating, local ambient temperature, and adjusted fuse rating.
 - b. Provide manufacturer's technical data on which ambient temperature adjustment calculations are based.
 - 2. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.
 - 3. Current-limitation curves for fuses with current-limiting characteristics.
 - 4. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse.
 - 5. Coordination charts and tables and related data.
 - 6. Fuse sizes for elevator feeders and elevator disconnect switches.

1.03 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For fuses to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
 - 1. Ambient temperature adjustment information.
 - 2. Current-limitation curves for fuses with current-limiting characteristics.
 - 3. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse.
 - 4. Coordination charts and tables and related data.

1.04 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: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.

1.05 QUALITY ASSURANCE

- A. Source Limitations: Obtain fuses, for use within a specific product or circuit, from single source from single manufacturer.
- B. 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.
- C. Comply with NEMA FU 1 for cartridge fuses.
- D. Comply with NFPA 70.
- E. Comply with UL 248-11 for plug fuses.

1.06 PROJECT CONDITIONS

- A. Where ambient temperature to which fuses are directly exposed is less than 40 deg F or more than 100 deg F, apply manufacturer's ambient temperature adjustment factors to fuse ratings.

1.07 COORDINATION

- A. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit current levels.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Cooper Bussmann, Inc.
 - 2. Ferraz Shawmut, Inc.
 - 3. Littelfuse, Inc.

2.02 CARTRIDGE FUSES

- A. Characteristics: NEMA FU 1, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine fuses before installation. Reject fuses that are moisture damaged or physically damaged.
- B. Examine holders to receive fuses for compliance with installation tolerances and other conditions affecting performance, such as rejection features.
- C. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.
- D. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 FUSE APPLICATIONS

A. Cartridge Fuses:

1. Service Entrance: As indicated.
2. Feeders: As indicated.
3. Control Circuits: Class CC, time delay, control transformer duty.

3.03 INSTALLATION

- #### A.
- Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.

3.04 IDENTIFICATION

- #### A.
- Install labels complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems" and indicating fuse replacement information on inside door of each fused switch and adjacent to each fuse block, socket, and holder.

END OF SECTION

SECTION 262816

ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 DEFINITIONS

- A. NC: Normally closed.
- B. NO: Normally open.
- C. SPDT: Single pole, double throw.

1.03 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Enclosed switches and circuit breakers shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 - 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."

1.04 ACTION SUBMITTALS

- A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.
 - 1. Enclosure types and details for types other than NEMA 250, Type 1.
 - 2. Current and voltage ratings.
 - 3. Short-circuit current ratings (interrupting and withstand, as appropriate).
 - 4. Include evidence of NRTL listing for series rating of installed devices.
 - 5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.
 - 6. Include time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device.
- B. Shop Drawings: For enclosed switches and circuit breakers. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Wiring Diagrams: For power, signal, and control wiring.

1.05 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
 - 1. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.

2. Time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device.

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: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
 2. Fuse Pullers: Two for each size and type.

1.07 QUALITY ASSURANCE

- A. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single source from single manufacturer.
- B. 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.
- C. Comply with NFPA 70.

1.08 PROJECT CONDITIONS

- A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 1. Ambient Temperature: Not less than minus 22 deg F and not exceeding 104 deg F.
 2. Altitude: Not exceeding 6600 feet.
- B. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
 1. Notify Engineer no fewer than seven days in advance of proposed interruption of electric service.
 2. Indicate method of providing temporary electric service.
 3. Do not proceed with interruption of electric service without Owner's written permission.
 4. Comply with NFPA 70E.

1.09 WARRANTY

- A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace components that fail in materials or workmanship with specified warranty period.
 1. Warranty Period: One year from date of Substantial Completion.

1.10 COORDINATION

- A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

PART 2 PRODUCTS

2.01 FUSIBLE SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - 2. Siemens Energy & Automation, Inc.
 - 3. Square D; a brand of Schneider Electric.
- B. Type HD, Heavy Duty, Single Throw, 240 or 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate indicated fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- C. Accessories:
 - 1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
 - 2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
 - 3. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
 - 4. Auxiliary Contact Kit: Two NO/NC (Form "C") auxiliary contact(s), arranged to activate before switchblades open.
 - 5. Hookstick Handle: Allows use of a hookstick to operate the handle.
 - 6. Lugs: Mechanical type, suitable for number, size, and conductor material.
 - 7. Service-Rated Switches: Labeled for use as service equipment.

2.02 ENCLOSURES

- A. Enclosed Switches and Circuit Breakers: NEMA AB 1, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.
 - 1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
 - 2. Outdoor Locations: NEMA 250, Type 3R.
 - 3. Wash-Down Areas: NEMA 250, Type 4X, stainless steel.
 - 4. Other Wet or Damp, Indoor Locations: NEMA 250, NEMA Type 4.
 - 5. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

- B. Install individual wall-mounted switches with tops at uniform height unless otherwise indicated.
- C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
- D. Install fuses in fusible devices.
- E. Comply with NECA 1.
- F. NEMA 4 or NEMA 4x enclosures must be 316 stainless steel or non-metallic.

3.03 IDENTIFICATION

- A. Comply with requirements in Division 26 Section "Identification for Electrical Systems."
 - 1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
 - 2. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.04 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Acceptance Testing Preparation:
 - 1. Test insulation resistance for each enclosed switch and circuit breaker, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
- C. Tests and Inspections:
 - 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
 - 3. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Enclosed switches will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports, including a certified report that identifies enclosed switches and circuit breakers and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.05 ADJUSTING

- A. Adjust moving parts and operable components to function smoothly and lubricate as recommended by manufacturer.

END OF SECTION

SECTION 262923

VARIABLE-FREQUENCY MOTOR CONTROLLERS

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 DEFINITIONS

- A. CPT: Control power transformer.
- B. EMI: Electromagnetic interference.
- C. LED: Light-emitting diode.
- D. NC: Normally closed.
- E. NO: Normally open.
- F. OCPD: Overcurrent protective device.
- G. PID: Control action, proportional plus integral plus derivative.
- H. RFI: Radio-frequency interference.
- I. VFC: Variable-frequency motor controller.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type and rating of VFC indicated.
 - 1. Include dimensions and finishes for VFCs.
 - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings: For each VFC indicated.
 - a. Include mounting and attachment details.
 - b. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - c. Include diagrams for power, signal, and control wiring.
 - d. Include Harmonic analysis for IEEE519 Compliance: Harmonic analysis for specific project including total harmonic voltage distortion and total harmonic current distortion (TDD). VFC manufacturer shall provide calculations, specific to this installation, showing total harmonic voltage distortion is less than 5%. Analysis shall indicate any requirement for any input or output line filtering in addition to the required 5% line reactors specified. VFC manufacturer shall provide any additional filtering and/or devices to meet IEEE519 requirements.

1.04 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For manufacturer and testing agency.
- B. Seismic Qualification Certificates: For each VFC, accessories, and components, from manufacturer.
 - 1. Certificate of compliance.
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which the certification is based, and their installation requirements.
- C. Product Certificates: For each VFC from manufacturer.
- D. Harmonic Analysis Report: Provide Project-specific calculations and manufacturer's statement of compliance with IEEE 519.
- E. Source quality-control reports.
- F. Field quality-control reports.
- G. Sample Warranty: For special warranty.

1.05 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For VFCs to include in emergency, operation, and maintenance manuals.
 - 1. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
 - a. Manufacturer's written instructions for testing and adjusting thermal-magnetic circuit breaker and MCP trip settings.
 - b. Manufacturer's written instructions for setting field-adjustable overload relays.
 - c. Manufacturer's written instructions for testing, adjusting, and reprogramming microprocessor control modules.
 - d. Manufacturer's written instructions for setting field-adjustable timers, controls, and status and alarm points.
 - e. Load-Current and Overload-Relay Heater List: Compile after motors have been installed, and arrange to demonstrate that selection of heaters suits actual motor nameplate, full-load currents.
 - f. Load-Current and List of Settings of Adjustable Overload Relays: Compile after motors have been installed, and arrange to demonstrate that switch settings for motor-running overload protection suit actual motors to be protected.

1.06 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Power Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
 - 2. Control Power Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.
 - 3. Indicating Lights: Two of each type and color installed.
 - 4. Auxiliary Contacts: Furnish one spare(s) for each size and type of magnetic controller installed.
 - 5. Power Contacts: Furnish three spares for each size and type of magnetic contactor installed.

1.07 QUALITY ASSURANCE

- A. Source Limitations: Obtain VFCs of a single type through one source from a single manufacturer.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use..
- C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for VFCs, minimum clearances between VFCs, and adjacent surfaces and other items. Comply with indicated maximum dimensions and clearances.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. If stored in space that is not permanently enclosed and air conditioned, remove loose packing and flammable materials from inside controllers and install temporary electric heating, with at least 250 W per controller.

1.09 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace VFCs that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Five years from date of Substantial Completion.

1.10 COORDINATION

- A. Coordinate layout and installation of VFCs with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases.
- C. Coordinate features of VFCs, installed units, and accessory devices with pilot devices and control circuits to which they connect.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. ABB Power Distribution, Inc.; ABB Control, Inc., Subsidiary (Model ACH 550).
 - 2. Eaton Electrical Sector; Eaton Corporation; Cutler-Hammer Business Unit (smaller than 100 HP - Model DG1, 100 HP and larger – Model CPX9000).
 - 3. Rockwell Automation, Inc; Allen-Bradley Brand (Model 700).

2.02 SYSTEM DESCRIPTION

- A. General Requirements for VFCs:
 - 1. VFCs and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - 2. Comply with NEMA ICS 7, NEMA ICS 61800-2, and UL 508A.
- B. Application: Constant torque.

- C. VFC Description: Variable-frequency motor controller, consisting of power converter that employs pulse-width-modulated inverter, factory built and tested in an enclosure, with integral disconnecting means and overcurrent and overload protection; listed and labeled by an NRTL as a complete unit; arranged to provide self-protection, protection, and variable-speed control of one or more three-phase induction motors by adjusting output voltage and frequency.
1. Units suitable for operation of NEMA MG 1, Design A and Design B motors, as defined by NEMA MG 1, Section IV, Part 30, "Application Considerations for Constant Speed Motors Used on a Sinusoidal Bus with Harmonic Content and General Purpose Motors Used with Adjustable-Voltage or Adjustable-Frequency Controls or Both."
 2. Units suitable for operation of inverter-duty motors as defined by NEMA MG 1, Section IV, Part 31, "Definite-Purpose Inverter-Fed Polyphase Motors."
 3. Listed and labeled for integrated short-circuit current (withstand) rating by an NRTL acceptable to authorities having jurisdiction.
- D. Design and Rating: Match load type, such as fans, blowers, and pumps; and type of connection used between motor and load such as direct or through a power-transmission connection.
1. Units serving motors smaller than 100 HP shall be 6-pulse or 18-pulse type VFC.
 2. Units serving motors 100 HP and larger shall be 18-pulse VFC.
- E. Output Rating: Three phase; 10 to 60 Hz, with voltage proportional to frequency throughout voltage range.
- F. Unit Operating Requirements:
1. Input AC Voltage Tolerance: Plus 10 and minus 10 percent of VFC input voltage rating.
 2. Input AC Voltage Unbalance: Not exceeding 3 percent.
 3. Input Frequency Tolerance: Plus or minus 3 percent of VFC frequency rating.
 4. Minimum Efficiency: 96 percent at 60 Hz, full load.
 5. Minimum Displacement Primary-Side Power Factor: 96 percent under any load or speed condition.
 6. Minimum Short-Circuit Current (Withstand) Rating: 65 kA.
 7. Ambient Temperature Rating: Not less than 32 deg F and not exceeding 104 deg F.
 8. Humidity Rating: Less than 95 percent (noncondensing).
 9. Altitude Rating: Not exceeding 3300 feet.
 10. Vibration Withstand: Comply with NEMA ICS 61800-2.
 11. Overload Capability: 1.1 times the base load current for 60 seconds; minimum of 1.8 times the base load current for three seconds.
 12. Starting Torque: Minimum 100 percent of rated torque from 3 to 60 Hz.
 13. Speed Regulation: Plus or minus 5 percent.
 14. Output Carrier Frequency: Selectable; 0.5 to 15 kHz.
 15. Stop Modes: Programmable; includes fast, free-wheel, and dc injection braking.
- G. Inverter Logic: Microprocessor based, 16 bit, isolated from all power circuits.
- H. Isolated Control Interface: Allows VFCs to follow remote-control signal over a minimum 40:1 speed range.
1. Signal: Electrical.
- I. Internal Adjustability Capabilities:
1. Minimum Speed: 5 to 25 percent of maximum rpm.
 2. Maximum Speed: 80 to 100 percent of maximum rpm.

3. Acceleration: 0.1 to 999.9 seconds.
 4. Deceleration: 0.1 to 999.9 seconds.
 5. Current Limit: 30 to minimum of 150 percent of maximum rating.
- J. Self-Protection and Reliability Features:
1. Surge Suppression: Factory installed as an integral part of the VFC, complying with UL 1449 SPD, Type 1 or Type 2.
 2. Surge Suppression: Field-mounted surge suppressors complying with Division 26 Section "Surge Protection for Low-Voltage Electrical Power Circuits," UL 1449 SPD, Type 2.
 3. Loss of Input Signal Protection: Selectable response strategy, including speed default to a percent of the most recent speed, a preset speed, or stop; with alarm.
 4. Under- and overvoltage trips.
 5. Inverter overcurrent trips.
 6. VFC and Motor-Overload/Overtemperature Protection: Microprocessor-based thermal protection system for monitoring VFCs and motor thermal characteristics, and for providing VFC overtemperature and motor-overload alarm and trip; settings selectable via the keypad.
 7. Critical frequency rejection, with three selectable, adjustable deadbands.
 8. Instantaneous line-to-line and line-to-ground overcurrent trips.
 9. Loss-of-phase protection.
 10. Reverse-phase protection.
 11. Short-circuit protection.
 12. Motor overtemperature fault.
- K. Automatic Reset/Restart: Attempt three restarts after drive fault or on return of power after an interruption and before shutting down for manual reset or fault correction. Bidirectional autospeed search shall be capable of starting into rotating loads spinning in either direction and returning motor to set speed in proper direction, without damage to controller, motor, or load.
- L. Power-Interruption Protection: To prevent motor from re-energizing after a power interruption until motor has stopped, unless "Bidirectional Autospeed Search" feature is available and engaged.
- M. Bidirectional Autospeed Search: Capable of starting VFC into rotating loads spinning in either direction and returning motor to set speed in proper direction, without causing damage to drive, motor, or load
- N. Torque Boost: Automatically varies starting and continuous torque to at least 1.5 times the minimum torque to ensure high-starting torque and increased torque at slow speeds.
- O. Motor Temperature Compensation at Slow Speeds: Adjustable current fall-back based on output frequency for temperature protection of self-cooled, fan-ventilated motors at slow speeds.
- P. Input Line Conditioning: Integral 5 percent impedance line reactors to reduce the harmonics to the power line and protection from AC line transients. Impedance may be accomplished with dual (positive and negative DC bus) reactors or AC line reactors. AC line reactors are required if only one DC reactor utilized. Additional conditioning or filtering as determined by THD/TDD analysis performed by VFC manufacturer.
- Q. VFC Output Filtering: As determined by THD/TDD analysis performed by VFC manufacturer. dV/dt output filter comprised of three-phase load reactor and resistor/capacitor clipping circuit shall be provide for all VFCs serving submersible motors.
- R. Integral Disconnecting Means: NEMA KS 1, fusible switch with pad-lockable, door-mounted handle mechanism.
1. Disconnect Rating: Not less than 115 percent of VFC input current rating.

2. Disconnect Rating: Not less than 115 percent of NFPA 70 motor full-load current rating or VFC input current rating, whichever is larger.
3. Auxiliary Contacts: NO or NC, arranged to activate before switch blades open.
4. Auxiliary contacts "a" and "b" arranged to activate with circuit-breaker handle.
5. NC alarm contact that operates only when circuit breaker has tripped.

2.03 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: VFCs shall withstand the effects of earthquake motions determined according to ASCE/SEI 7. The designated VFCs shall be tested and certified by an NRTL as meeting the ICC-ES AC 156 test procedure requirements
 1. The term "withstand" means "the unit will remain in place without separation of any parts when subjected to the seismic forces specified."

2.04 CONTROLS AND INDICATION

- A. Status Lights: Door-mounted LED indicators displaying the following conditions:
 1. Power on.
 2. Run.
 3. Overvoltage.
 4. Line fault.
 5. Overcurrent.
 6. External fault.
- B. Panel-Mounted Operator Station: Manufacturer's standard front-accessible, sealed keypad and plain-English-language digital display; allows complete programming, program copying, operating, monitoring, and diagnostic capability.
 1. Keypad: In addition to required programming and control keys, include keys for HAND, OFF, and AUTO modes.
 2. Security Access: Provide electronic security access to controls through identification and password with at least three levels of access: View only; view and operate; and view, operate, and service.
 - a. Control Authority: Supports at least four conditions: Off, local manual control at VFC, local automatic control at VFC, and automatic control through a remote source.
- C. Historical Logging Information and Displays:
 1. Real-time clock with current time and date.
 2. Running log of total power versus time.
 3. Total run time.
 4. Fault log, maintaining last four faults with time and date stamp for each.
- D. Indicating Devices: Digital display mounted flush in VFC door and connected to display VFC parameters including, but not limited to:
 1. Output frequency (Hz).
 2. Motor speed (rpm).
 3. Motor status (running, stop, fault).
 4. Motor current (amperes).

5. Motor torque (percent).
 6. Fault or alarming status (code).
 7. PID feedback signal (percent).
 8. DC-link voltage (V dc).
 9. Set point frequency (Hz).
 10. Motor output voltage (V ac).
- E. Control Signal Interfaces:
1. Electric Input Signal Interface:
 - a. A minimum of two programmable analog inputs: Operator-selectable "x"- to "y"-mA dc.
 - b. A minimum of six multifunction programmable digital inputs.
 2. Remote Signal Inputs: Capability to accept any of the following speed-setting input signals from the BAS or other control systems:
 - a. 0- to 10-V dc.
 - b. 4- to 20-mA dc.
 - c. Potentiometer using up/down digital inputs.
 - d. Fixed frequencies using digital inputs.
 3. Output Signal Interface: A minimum of one programmable analog output signal (operator-selectable "x"- to "y"-mA dc), which can be configured for any of the following:
 - a. Output frequency (Hz).
 - b. Output current (load).
 - c. DC-link voltage (V dc).
 - d. Motor torque (percent).
 - e. Motor speed (rpm).
 - f. Set point frequency (Hz).
 4. Remote Indication Interface: A minimum of two programmable dry-circuit relay outputs (120-V ac, 1 A) for remote indication of the following:
 - a. Motor running.
 - b. Set point speed reached.
 - c. Fault and warning indication (overtemperature or overcurrent).
 - d. PID high- or low-speed limits reached.
- F. PID Control Interface: Provides closed-loop set point, differential feedback control in response to dual feedback signals. Allows for closed-loop control of fans and pumps for pressure, flow, or temperature regulation.
1. Number of Loops: One.

2.05 LINE CONDITIONING AND FILTERING

- A. Input Line Conditioning: Based on the manufacturer's harmonic analysis study and report, provide input filtering, as required, to limit total demand (harmonic current) distortion and total harmonic voltage demand at the defined point of common coupling to meet IEEE 519 recommendations.
- B. Output Line Conditioning: Provide dV/dt output filter comprised of three-phase load reactor and resistor/capacitor clipping circuit for VFC's with lead lengths of longer than 60 feet.

- C. Provide factory installed RFI filters for electrical noise reduction to prevent interference with sensitive electrical equipment or wireless devices.
- D. EMI/RFI Filtering: CE marked, certify compliance with IEC 61800-3 for Category C2.

2.06 FEATURES

- A. Communication Port: RS-232 port, USB 2.0 port, or equivalent connection capable of connecting a printer and a notebook computer to be used with an external system within a multidrop LAN configuration. Interface shall allow all parameter settings of VFC to be programmed via BMX control. Provide and install communications equipment for VFC to retain these settings within the nonvolatile memory. Coordinate with controls contractor but must provide communications for Ethernet IP and ModBus or other to match SCADA system.

2.07 ENCLOSURES

- A. VFC Enclosures: NEMA 250, to comply with environmental conditions at installed location.
 - 1. Dry and Clean Indoor Locations: Type 1.
 - 2. Outdoor Locations: Type 3R.
 - 3. Other Wet or Damp Indoor Locations: Type 4.
 - 4. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: Type 12.

2.08 ACCESSORIES

- A. General Requirements for Control-Circuit and Pilot Devices: NEMA ICS 5; factory installed in VFC enclosure cover unless otherwise indicated.
 - 1. Push Buttons: Covered.
 - 2. Pilot Lights: Push to test.
 - 3. Selector Switches: Rotary type.
 - 4. Stop and Lockout Push-Button Station: Momentary-break, push-button station with a factory-applied hasp arranged so padlock can be used to lock push button in depressed position with control circuit open.
- B. Control Relays: Auxiliary and adjustable solid-state time-delay relays.
- C. Phase-Failure, Phase-Reversal, and Undervoltage and Overvoltage Relays: Solid-state sensing circuit with isolated output contacts for hard-wired connections. Provide adjustable undervoltage, overvoltage, and time-delay settings.
- D. Supplemental Digital Meters:
 - 1. Elapsed-time meter.
 - 2. Kilowatt meter.
 - 3. Kilowatt-hour meter.
- E. Breather and drain assemblies, to maintain interior pressure and release condensation in NEMA 250, Type 12 enclosures installed outdoors or in unconditioned interior spaces subject to humidity and temperature swings.
- F. Space heaters, with NC auxiliary contacts, to mitigate condensation in NEMA 250, Type 12 enclosures installed outdoors or in unconditioned interior spaces subject to humidity and temperature swings.
- G. Cooling Fan and Exhaust System: For NEMA 250, Type 12; UL 508 component recognized: Supply fan, with stainless-steel intake and exhaust grills; 120-V ac; obtained from integral CPT.

- H. Spare control-wiring terminal blocks; unwired.

2.09 SOURCE QUALITY CONTROL

- A. Testing: Test and inspect VFCs according to requirements in NEMA ICS 61800-2.
 - 1. Test each VFC while connected to a motor that is comparable to that for which the VFC is rated.
 - 2. Verification of Performance: Rate VFCs according to operation of functions and features specified.
- B. VFCs will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine areas, surfaces, and substrates to receive VFCs, with Installer present, for compliance with requirements for installation tolerances, and other conditions affecting performance of the Work.
- B. Examine VFC before installation. Reject VFCs that are wet, moisture damaged, or mold damaged.
- C. Examine roughing-in for conduit systems to verify actual locations of conduit connections before VFC installation.
- D. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Wall-Mounting Controllers: Install with tops at uniform height and with disconnect operating handles not higher than 79 inches above finished floor, unless otherwise indicated, and by bolting units to wall or mounting on lightweight structural-steel channels bolted to wall. For controllers not on walls, provide freestanding racks complying with Division 26 Section "Hangers and Supports for Electrical Systems."
- B. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
- C. Install fuses in each fusible-switch VFC.
- D. Install fuses in control circuits if not factory installed. Comply with requirements in Division 26 Section "Fuses."
- E. Install heaters in thermal-overload relays. Select heaters based on actual nameplate full-load amperes after motors are installed.
- F. Install, connect, and fuse thermal-protector monitoring relays furnished with motor-driven equipment.
- G. Comply with NECA 1.

3.03 CONTROL WIRING INSTALLATION

- A. Install wiring between VFCs and remote devices and facility's central-control system. Comply with requirements in Division 26 Section "Control-Voltage Electrical Power Cables."
- B. Bundle, train, and support wiring in enclosures.

- C. Connect hand-off-automatic switch and other automatic-control devices where applicable.
 - 1. Connect selector switches with control circuit in both hand and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor overload protectors.

3.04 IDENTIFICATION

- A. Identify VFCs, components, and control wiring. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
 - 1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
 - 2. Label each VFC with engraved nameplate.
 - 3. Label each enclosure-mounted control and pilot device.
- B. Operating Instructions: Frame printed operating instructions for VFCs, including control sequences and emergency procedures. Fabricate frame of finished metal, and cover instructions with clear acrylic plastic. Mount on front of VFC units.
- C. Arc-Flash Warning Labels:
 - 1. Comply with requirements in Section 260573.19 "Arc-Flash Hazard Analysis." Produce a 3.5-by-5-inch self-adhesive equipment label for each work location included in the analysis.
 - 2. Comply with requirements in Section 260553 "Identification for Electrical Systems." Produce a 3.5-by-5-inch self-adhesive equipment label for each work location included in the analysis. Labels shall be machine printed, with no field-applied markings.
 - a. The label shall have an orange header with the wording, "WARNING, ARC-FLASH HAZARD," and shall include the following information taken directly from the arc-flash hazard analysis:
 - (1) Location designation.
 - (2) Nominal voltage.
 - (3) Flash protection boundary.
 - (4) Hazard risk category.
 - (5) Incident energy.
 - (6) Working distance.
 - (7) Engineering report number, revision number, and issue date.
 - b. Labels shall be machine printed, with no field-applied markings.

3.05 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 tests and inspections with the assistance of a factory-authorized service representative.
- C. Acceptance Testing Preparation:
 - 1. Test insulation resistance for each VFC element, bus, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
- D. Tests and Inspections:
 - 1. Inspect VFC, wiring, components, connections, and equipment installation. Test and adjust controllers, components, and equipment.

2. Test insulation resistance for each VFC element, component, connecting motor supply, feeder, and control circuits.
3. Test continuity of each circuit.
4. Verify that voltages at VFC locations are within 10 percent of motor nameplate rated voltages. If outside this range for any motor, notify Architect before starting the motor(s).
5. Test each motor for proper phase rotation.
6. Perform each electrical test and visual and mechanical inspection, except optional tests, stated in NETA ATS. Certify compliance with test parameters.
7. Correct malfunctioning units on-site, where possible, and retest to demonstrated compliance; otherwise, replace with new units and retest.
8. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

E. VFCs will be considered defective if they do not pass tests and inspections.

F. Prepare test and inspection reports, including a certified report that identifies the VFC and describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations made after remedial action.

3.06 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.

3.07 ADJUSTING

A. Program microprocessors for required operational sequences, status indications, alarms, event recording, and display features. Clear events memory after final acceptance testing and prior to Substantial Completion.

B. Set field-adjustable switches, auxiliary relays, time-delay relays, timers, and overload-relay pickup and trip ranges.

C. Adjust the trip settings of instantaneous-only circuit breakers and thermal-magnetic circuit breakers with adjustable, instantaneous trip elements. Initially adjust to 6 times the motor nameplate full-load amperes and attempt to start motors several times, allowing for motor cool-down between starts. If tripping occurs on motor inrush, adjust settings in increments until motors start without tripping. Do not exceed 8 times the motor full-load amperes (or 11 times for NEMA Premium Efficient motors if required). Where these maximum settings do not allow starting of a motor, notify Owner before increasing settings.

D. Set the taps on reduced-voltage autotransformer controllers.

3.08 PROTECTION

A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions until controllers are ready to be energized and placed into service.

B. Replace VFCs whose interiors have been exposed to water or other liquids prior to Substantial Completion.

3.09 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, reprogram, and maintain VFCs.

END OF SECTION

SECTION 263213
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 DEFINITIONS

- A. Operational Bandwidth: The total variation from the lowest to highest value of a parameter over the range of conditions indicated, expressed as a percentage of the nominal value of the parameter.
- B. LP: Liquid petroleum.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of packaged engine generator indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. In addition, include the following:
 - 1. Thermal damage curve for generator.
 - 2. Time-current characteristic curves for generator protective device.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 1. Dimensioned outline plan and elevation drawings of engine-generator set and other components specified.
 - 2. Design Calculations: Signed and sealed by a qualified professional engineer. Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.
 - 3. Vibration Isolation Base Details: Signed and sealed by a qualified professional engineer. Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include base weights.
 - 4. Wiring Diagrams: Power, signal, and control wiring.

1.04 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency.
- B. Source quality-control test reports.
 - 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. Certified Summary of Performance Tests: Certify compliance with specified requirement to meet performance criteria for sensitive loads.
 - 4. Report of factory test on units to be shipped for this Project, showing evidence of compliance with specified requirements.
 - 5. Report of sound generation.

6. Report of exhaust emissions showing compliance with applicable regulations.
 7. Certified Torsional Vibration Compatibility: Comply with NFPA 110.
- C. Field quality-control test reports.
- D. Warranty: Special warranty specified in this Section.

1.05 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For packaged engine generators to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
1. 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.

1.06 MAINTENANCE MATERIAL SUBMITTALS

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

1.07 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
1. Maintenance Proximity: Not more than four hours' normal travel time from Installer's place of business to Project site.
 2. Engineering Responsibility: Preparation of data for vibration isolators and seismic restraints of engine skid mounts, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.
- B. Manufacturer Qualifications: A qualified manufacturer. Maintain, within 200 miles of Project site, a service center capable of providing training, parts, and emergency maintenance repairs.
- C. Testing Agency Qualifications: An agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL), and that is acceptable to authorities having jurisdiction.
1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.
- D. Source Limitations: Obtain packaged generator sets and auxiliary components through one source from a single manufacturer.
- E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- F. Comply with ASME B15.1.
- G. B11 Compliance: Comply with ANSI B11.19

- H. Comply with NFPA 37.
- I. Comply with NFPA 70.
- J. Comply with NFPA 110 requirements for Level 1 emergency power supply system.
- K. Comply with UL 2200.
- L. Engine Exhaust Emissions: Comply with Tier 2 requirements and applicable state and local government requirements.
- M. 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.

1.08 PROJECT CONDITIONS

- A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:
 - 1. Notify Engineer no fewer than two days in advance of proposed interruption of electrical service.
 - 2. Do not proceed with interruption of electrical service without Owner's written permission.
- B. Environmental Conditions: Engine-generator system shall withstand the following environmental conditions without mechanical or electrical damage or degradation of performance capability:
 - 1. Ambient Temperature: Minus 15 to plus 40 deg C.
 - 2. Relative Humidity: 0 to 95 percent.
 - 3. Altitude: Sea level to 1000 feet.

1.09 COORDINATION

- A. Coordinate size and location of concrete bases for package engine generators. Cast anchor-bolt inserts into bases.

1.10 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which 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: Five years from date of Substantial Completion.

1.11 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.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Kohler Co.
 - 2. Onan/Cummins Power Generation; Industrial Business Group.
 - 3. MTU Onsite Energy Corporation.
 - 4. Or Approved Equal.

2.02 ENGINE-GENERATOR SET

- A. Factory-assembled and -tested, engine-generator set.
- B. Mounting Frame: Maintain alignment of mounted components without depending on concrete foundation; and have lifting attachments.
 - 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.
- C. Capacities and Characteristics:
 - 1. Power Output Ratings: Nominal ratings as indicated.
 - 2. Output Connections: Three-phase, four wire.
 - 3. Nameplates: For each major system component to identify manufacturer's name and address, and model and serial number of component.
- D. Generator-Set Performance:
 - 1. Steady-State Voltage Operational Bandwidth: 3 percent of rated output voltage from no load to full load.
 - 2. Transient Voltage Performance: Not more than 20 percent variation for 50 percent step-load increase or decrease. Voltage shall recover and remain within the steady-state operating band within three seconds.
 - 3. Steady-State Frequency Operational Bandwidth: 0.5 percent of rated frequency from no load to full load.
 - 4. 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.
 - 5. Transient Frequency Performance: Less than 5 percent variation for 50 percent step-load increase or decrease. Frequency shall recover and remain within the steady-state operating band within five seconds.
 - 6. Output Waveform: At no load, harmonic content measured line to line or line to neutral shall not exceed 5 percent total and 3 percent for single harmonics. Telephone influence factor, determined according to NEMA MG 1, shall not exceed 50 percent.
 - 7. Sustained Short-Circuit Current: For a 3-phase, bolted short circuit at system output terminals, system shall supply a minimum of 250 percent of rated full-load current for not less than 10 seconds and then clear the fault automatically, without damage to generator system components.
 - 8. Start Time: Comply with NFPA 110, Type 10, system requirements.
- E. 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 3-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.
10. Start Time: Comply with NFPA 110, Type 10, system requirements.

2.03 ENGINE

- A. Fuel: Propane.
- B. Rated Engine Speed: 1800 rpm.
- C. Maximum Piston Speed for Four-Cycle Engines: 2250 fpm.
- 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. Engine Fuel System:
 1. Main Fuel Pump: Mounted on engine. Pump ensures adequate primary fuel flow under starting and load conditions.
 2. Relief-Bypass Valve: Automatically regulates pressure in fuel line and returns excess fuel to source.

- F. Coolant Jacket Heater: Electric-immersion type, factory installed in coolant jacket system. Comply with NFPA 110 requirements for Level 1 equipment for heater capacity.
- G. Governor: Adjustable isochronous, with speed sensing.
- H. 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 maximum working pressure with coolant at 180 deg F, and noncollapsible under vacuum.
 - b. End Fittings: Flanges or steel pipe nipples with clamps to suit piping and equipment connections.
- I. 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 25 dB at 500 Hz.
 2. Sound level measured at a distance of 10 feet from exhaust discharge after installation is complete shall be 85 dBA or less.
- J. Air-Intake Filter: Heavy-duty, engine-mounted air cleaner with replaceable dry-filter element and "blocked filter" indicator.
- K. Starting System: 12-V electric, with negative ground.
1. Components: Sized so they will not be damaged during a full engine-cranking cycle with ambient temperature at maximum specified in Part 1 "Project Conditions" Article.
 2. Cranking Motor: Heavy-duty unit that automatically engages and releases from engine flywheel without binding.
 3. Cranking Cycle: As required by NFPA 110 for system level specified.
 4. Battery: Adequate capacity within ambient temperature range specified in Part 1 "Project Conditions" 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 Part 1 "Project Conditions" Article. Include accessories required to support and fasten batteries in place.
 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. 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 C to 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. Safety Functions: Sense abnormally low battery voltage and close contacts providing low battery voltage indication on control and monitoring panel. Sense high battery voltage and loss of ac input or dc output of battery charger. Either condition shall close contacts that provide a battery-charger malfunction indication at system control and monitoring panel.
- f. Enclosure and Mounting: NEMA 250, Type 1, wall-mounted cabinet.

2.04 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. Operation of a remote emergency-stop switch also shuts down generator set.
- B. 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.
- C. Indicating and Protective Devices and Controls: As required by NFPA 110 for Level 1 system, and the following:
 1. AC voltmeter.
 2. AC ammeter.
 3. AC frequency meter.
 4. DC voltmeter (alternator battery charging).
 5. Engine-coolant temperature gage.
 6. Engine lubricating-oil pressure gage.
 7. Running-time meter.
 8. Ammeter-voltmeter, phase-selector switch(es).
 9. Generator-voltage adjusting rheostat.
 10. Fuel tank derangement alarm.
 11. Fuel tank high-level shutdown of fuel supply alarm.
 12. Generator overload.
- D. 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.

- E. Connection to Data Link: A separate terminal block, factory wired to Form C dry contacts, for each alarm and status indication is reserved for connections for data-link transmission of indications to remote data terminals. Data system connections to terminals are covered in Division 26 Section "Electrical Power Monitoring and Control."
- F. Common Remote Audible Alarm: Comply with NFPA 110 requirements for Level 1 systems. Include necessary contacts and terminals in control and monitoring panel.
 - 1. Overcrank shutdown.
 - 2. Coolant low-temperature alarm.
 - 3. Control switch not in auto position.
 - 4. Battery-charger malfunction alarm.
 - 5. Battery low-voltage alarm.
- G. Remote Emergency-Stop Switch: Flush; wall mounted, unless otherwise indicated; and labeled. Push button shall be protected from accidental operation.

2.05 GENERATOR OVERCURRENT AND FAULT PROTECTION

- A. Generator Circuit Breaker: Molded-case, thermal-magnetic type; 100 percent rated; complying with NEMA AB 1 and UL 489.
 - 1. Tripping Characteristic: Designed specifically for generator protection.
 - 2. Trip Rating: Matched to generator rating.
 - 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.
- 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.
 - 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.
- C. Generator Circuit Breaker: Insulated-case, electronic-trip type; 100 percent rated; complying with UL 489.
 - 1. Tripping Characteristics: Adjustable long-time and short-time delay and instantaneous.
 - 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.
- D. Generator Disconnect Switch: Molded-case type, 100 percent rated.
 - 1. Rating: Matched to generator output rating.
 - 2. Shunt Trip: Connected to trip switch when signaled by generator protector or by other protective devices.

2.06 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.
- E. 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.
- F. Enclosure: Dripproof.
- G. Instrument Transformers: Mounted within generator enclosure.
- H. Voltage Regulator: Solid-state type, separate from exciter, providing performance as specified.
 - 1. Adjusting rheostat on control and monitoring panel shall provide plus or minus 5 percent adjustment of output-voltage operating band.
- I. Strip Heater: Thermostatically controlled unit arranged to maintain stator windings above dew point.
- J. Windings: Two-thirds pitch stator winding and fully linked amortisseur winding.
- K. Subtransient Reactance: 12 percent, maximum.

2.07 OUTDOOR GENERATOR-SET ENCLOSURE

- A. Description: Vandal-resistant, weatherproof steel housing, wind resistant up to 100 mph. Multiple panels shall be lockable and provide adequate access to components requiring maintenance. Panels shall be removable by one person without tools. Instruments and control shall be mounted within enclosure. Design sound levels shall be 75 dBA, as measured at a distance of 23 feet (7 m) around the housing in a free field environment. Additional wall and insulation thickness, plus air discharge and intake hoods or sound attenuators shall be installed to meet design sound levels.
- B. 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. Louvers: Fixed-engine, cooling-air inlet and discharge. Storm-proof and drainable louvers prevent entry of rain and snow.
 - 2. Automatic Dampers: At engine cooling-air inlet and discharge. Dampers shall be closed to reduce enclosure heat loss in cold weather when unit is not operating.

2.08 MOTORS

- A. General requirements for motors are specified in Division 26 Section "Common Motor Requirements."
 - 1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
 - 2. Controllers, Electrical Devices, and Wiring: Electrical devices and connections are specified in Division 26 Sections.

2.09 VIBRATION ISOLATION DEVICES

A. Elastomeric Isolator Pads:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Ace Mountings Co., Inc.
 - b. Isolation Technology, Inc.
 - c. Kinetics Noise Control, Inc.
 - d. Mason Industries, Inc.
 - e. Vibration Eliminator Co., Inc.
 - f. Vibration Isolation.
 - g. Vibration Mountings & Controls, Inc.
2. Fabrication: Single or multiple layers of sufficient durometer stiffness for uniform loading over pad area.
3. Size: Factory or field cut to match requirements of supported equipment.
4. Pad Material: Oil and water resistant with elastomeric properties.
5. Surface Pattern: Smooth pattern.
6. Infused nonwoven cotton or synthetic fibers.
7. Load-bearing metal plates adhered to pads.
8. Sandwich-Core Material: Resilient and elastomeric.
 - a. Surface Pattern: Smooth pattern.
 - b. Infused nonwoven cotton or synthetic fibers.

B. Restrained Spring Isolators: Freestanding, Steel, Open-Spring Isolators with Vertical-Limit Stop Restraint in Two-Part Telescoping Housing:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Ace Mountings Co., Inc.
 - b. Isolation Technology, Inc.
 - c. Kinetics Noise Control, Inc.
 - d. Mason Industries, Inc.
 - e. Vibration Eliminator Co., Inc.
 - f. Vibration Isolation.
 - g. Vibration Mountings & Controls, Inc.
2. Two-Part Telescoping Housing: A steel top and bottom frame separated by an elastomeric material and enclosing the spring isolators. Housings are equipped with adjustable snubbers to limit vertical movement.
 - a. Drilled base housing for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig.
 - b. Threaded top housing with adjustment bolt and cap screw to fasten and level equipment.
3. Outside Spring Diameter: Not less than 80 percent of compressed height of the spring at rated load.
4. Minimum Additional Travel: 50 percent of required deflection at rated load.

5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

2.10 FINISHES

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

2.11 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.
 1. Tests: Comply with NFPA 110, Level 1 Energy Converters and with IEEE 115.
- B. Project-Specific Equipment Tests: Before shipment, factory test engine-generator set and other system components and accessories manufactured specifically for this Project. Perform tests at rated load and power factor. Include the following tests:
 1. Test components and accessories furnished with installed unit that are not identical to those on tested prototype to demonstrate compatibility and reliability.
 2. Full load run.
 3. Maximum power.
 4. Voltage regulation.
 5. Transient and steady-state governing.
 6. Single-step load pickup.
 7. Safety shutdown.
 8. Provide 14 days' advance notice of tests and opportunity for observation of tests by Owner's representative.
 9. Report factory test results within 10 days of completion of test.

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 of 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 and with NFPA 110.
- B. Install packaged engine generator to provide access, without removing connections or accessories, for periodic maintenance.
- C. Install packaged engine generator on cast-in-place concrete equipment bases.

1. Comply with requirements for vibration isolation devices specified in this section.

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

3.03 CONNECTIONS

- A. Connect fuel, cooling-system, and exhaust-system piping adjacent to packaged engine generator to allow service and maintenance.
- B. Connect engine exhaust pipe to engine with flexible connector.
- C. Connect fuel piping to engines with a gate valve and union and flexible connector.
- D. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- E. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.04 IDENTIFICATION

- A. Identify system components according to Division 26 Section "Identification for Electrical Systems."

3.05 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.
- B. Perform tests and inspections and prepare test reports.
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.
- C. Tests and Inspections:
1. Perform tests recommended by manufacturer and each electrical test and visual and mechanical inspection for "AC Generators and for Emergency Systems" specified in NETA Acceptance Testing Specification. Certify compliance with test parameters.
2. NFPA 110 Acceptance Tests: Perform tests required by NFPA 110 that are additional to those specified here including, but not limited to, single-step full-load pickup test.
3. 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.
4. Battery-Charger Tests: Verify specified rates of charge for both equalizing and float-charging conditions.

5. 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.
 6. Exhaust-System Back-Pressure Test: Use a manometer with a scale exceeding 40-inch wg. 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.
 7. Exhaust Emissions Test: Comply with applicable government test criteria.
 8. 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.
 9. Harmonic-Content Tests: Measure harmonic content of output voltage under 25 percent and at 100 percent of rated linear load. Verify that harmonic content is within specified limits.
 10. 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.
 11. On-site "cold Start" test.
 12. Two hour (minimum) full load test with load bank.
 13. One step rated load pickup test.
 14. Contractor to provide resistive load bank and make all temporary connections for all testing.
- D. Coordinate tests with tests for transfer switches and run them concurrently.
- E. Test instruments shall have been calibrated within the last 12 months, traceable to standards of NIST, and adequate for making positive observation of test results. Make calibration records available for examination on request.
- F. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
- G. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
- 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 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain packaged engine generators. Refer to Division 01 Section "Demonstration and Training."
- B. Contractor to provide all fuel for testing and start up. Provide full tank of fuel for generator at job close (after all testing and acceptance testing).

END OF SECTION 263213

SECTION 263600
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 ACTION 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, bypass/isolation switch, power sources, and load; and show interlocking provisions for each combined transfer switch and bypass/isolation switch.

1.03 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For manufacturer.
- B. Field quality-control test reports.

1.04 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 Division 01 Section "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.

1.05 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. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
 - 1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.
- C. Source Limitations: Obtain all transfer switches through one source from a single manufacturer.

- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- E. Comply with NEMA ICS 1.
- F. Comply with NFPA 70.
- G. Comply with NFPA 110.
- H. Comply with UL 1008 unless requirements of these Specifications are stricter.

1.06 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 Engineer no fewer than two days in advance of proposed interruption of electrical service.
 - 2. Do not proceed with interruption of electrical service without Owner's written permission.

1.07 COORDINATION

- A. Coordinate transfer switch compatibility with generator manufacturer.

PART 2 PRODUCTS

2.01 MANUFACTURED UNITS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Molded Case Transfer Switches:
 - a. Eaton
 - b. Emerson; ASCO Power Technologies, LP.
 - c. GE Zenith Controls.
 - d. Kohler Power Systems; Generator Division.
 - e. Onan/Cummins Power Generation; Industrial Business Group.

2.02 GENERAL TRANSFER-SWITCH PRODUCT REQUIREMENTS

- A. 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.
- B. 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.
 - 1. Where transfer switch includes internal fault-current protection, rating of switch and trip unit combination shall exceed indicated fault-current value at installation location.
 - 2. Short-time withstand capability for three cycles.
- C. 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.

- D. 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.
- E. Electrical Operation: Accomplish by a nonfused, momentarily energized solenoid or electric-motor-operated mechanism, mechanically and electrically interlocked in both directions.
- F. 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.
- G. Neutral Switching. Where four-pole switches are indicated, provide neutral pole switched simultaneously with phase poles.
- H. Neutral Terminal: Solid and fully rated, unless otherwise indicated.
- I. 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 Division 26 Section "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.
- J. Enclosures: General-purpose NEMA 250, Type 1, complying with NEMA ICS 6 and UL 508, unless otherwise indicated.

2.03 AUTOMATIC TRANSFER SWITCHES

- A. Comply with Level 1 equipment according to NFPA 110.
- B. Switching Arrangement: Double-throw type, incapable of pauses or intermediate position stops during normal functioning, unless otherwise indicated.
- 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. Digital Communication Interface: Matched to capability of remote annunciator or annunciator and control panel.
- E. Transfer Switches Based on Molded-Case-Switch Components: Comply with NEMA AB 1, UL 489, and UL 869A.
- F. Automatic Open-Transition Transfer Switches: Interlocked to prevent the load from being closed on both sources at the same time.
 - 1. Sources shall be mechanically and electrically interlocked to prevent closing both sources on the load at the same time.

- G. Motor Disconnect and Timing Relay: Controls designate starters so they disconnect motors before transfer and reconnect them selectively at an adjustable time interval after transfer. Control connection to motor starters is through wiring external to automatic transfer switch. Time delay for reconnecting individual motor loads is adjustable between 1 and 60 seconds, and settings are as indicated. Relay contacts handling motor-control circuit inrush and seal currents are rated for actual currents to be encountered.
- H. Programmed Neutral Switch Position: Switch operator has a programmed neutral position arranged to provide a midpoint between the two working switch positions, with an intentional, time-controlled pause at midpoint during transfer. Pause is adjustable from 0.5 to 30 seconds minimum and factory set for 0.5 second, unless otherwise indicated. Time delay occurs for both transfer directions. Pause is disabled unless both sources are live.
- I. Automatic Transfer-Switch Features:
1. 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.
 2. 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.
 3. 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.
 4. 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.
 5. Test Switch: Simulate normal-source failure.
 6. Switch-Position Pilot Lights: Indicate source to which load is connected.
 7. 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."
 8. Unassigned Auxiliary Contacts: Two normally open, single-pole, double-throw contacts for each switch position, rated 10 A at 240-V ac.
 9. 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.
 10. Engine Starting Contacts: One isolated and normally closed, and one isolated and normally open; rated 10 A at 32-V dc minimum.
 11. 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.
 12. 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.

2.05 IDENTIFICATION

- A. Nameplates: Label each transfer switch with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- B. Arc-Flash Warning Labels:
 - 1. Comply with requirements in Section 260573.19 "Arc-Flash Hazard Analysis." Produce a 3.5-by-5-inch self-adhesive equipment label for each work location included in the analysis.
 - 2. Comply with requirements in Section 260553 "Identification for Electrical Systems." Produce a 3.5-by-5-inch self-adhesive equipment label for each work location included in the analysis. Labels shall be machine printed, with no field-applied markings.
 - a. Label shall have an orange header with the wording, "WARNING, ARC-FLASH HAZARD," and shall include the following information taken directly from the arc-flash hazard analysis:
 - (1) Location designation.
 - (2) Nominal voltage.
 - (3) Flash protection boundary.
 - (4) Hazard risk category.
 - (5) Incident energy.
 - (6) Working distance.
 - (7) Engineering report number, revision number, and issue date.
 - b. Labels shall be machine printed, with no field-applied markings.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Identify components according to Division 26 Section "Identification for Electrical Systems."
- B. 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 Division 26 Section "Grounding and Bonding for Electrical Systems."
- C. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.03 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust 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. Perform contact-resistance test across main contacts and correct values exceeding 500 microhms and values for 1 pole deviating by more than 50 percent from other poles.
 - f. 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.
 5. Ground-Fault Tests: Coordinate with testing of ground-fault protective devices for power delivery from both sources.
 - a. Verify grounding connections and locations and ratings of sensors.
- 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.

3.04 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain transfer switches and related equipment as specified below. Refer to Division 01 Section "Demonstration and Training."
- B. Coordinate this training with that for generator equipment.

END OF SECTION

SECTION 264313

SURGE PROTECTION FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS

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 DEFINITIONS

- A. ATS: Acceptance Testing Specifications.
- B. MCOV: Maximum continuous operating voltage.
- C. Mode(s), also Modes of Protection: The pair of electrical connections where VPR applies.
- D. MOV: Metal-oxide varistor; an electronic component with a significant non-ohmic current-voltage characteristic.
- E. OCPD: Overcurrent protective device.
- F. SCCR: Short-circuit current rating.
- G. SPD: Surge protective device.
- H. VPR: Voltage protection rating.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
 - 1. Include rated capacities, operating weights, electrical characteristics, furnished specialties, and accessories.
 - 2. Copy of UL Category Code VZCA certification, as a minimum, listing the tested values for VPRs, Inominal ratings, MCOVs, type designations, OCPD requirements, model numbers, system voltages, and modes of protection.

1.04 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For SPDs to include in emergency, operation, and maintenance manuals.

1.05 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. Replaceable Protection Modules: One of each size and type installed.

1.06 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a testing agency, and marked for intended location and application.
- B. MCOV of the SPD shall be the nominal system voltage.
- C. Comply with UL 1449.
- D. Comply with NFPA 70.

1.07 PROJECT CONDITIONS

- A. Service Conditions: Rate SPDs for continuous operation under the following conditions unless otherwise indicated:
 - 1. Maximum Continuous Operating Voltage: Not less than 115 percent of nominal system operating voltage.
 - 2. Operating Temperature: 30 to 120 deg F.
 - 3. Humidity: 0 to 85 percent, noncondensing.
 - 4. Altitude: Less than 20,000 feet above sea level.

1.08 COORDINATION

- A. Coordinate location of field-mounted SPDs to allow adequate clearances for maintenance.

1.09 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of surge suppressors that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Five years from date of Substantial Completion.

PART 2 PRODUCTS

2.01 PANELBOARD SUPPRESSORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. ABB USA.
 - 2. Advanced Protection Technologies Inc. (APT).
 - 3. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - 4. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 - 5. LEA International.
 - 6. Liebert Corporation; a division of Emerson Network Power.
 - 7. Siemens Energy & Automation, Inc.
 - 8. Square D; a brand of Schneider Electric.
- B. Surge Protection Devices:
 - 1. LED indicator lights for power and protection status.
 - 2. Audible alarm, with silencing switch, to indicate when protection has failed.

3. Form-C contacts rated at 5 A and 250-V ac, one normally open and one normally closed, for remote monitoring of protection status. Contacts shall reverse on failure of any surge diversion module or on opening of any current-limiting device. Coordinate with building power monitoring and control system.
- C. Surge Protection Devices:
1. Comply with UL 1449, Type 2.
 2. Comply with UL 1283.
 3. Short-circuit current rating complying with UL 1449 Type 2, and matching or exceeding the panelboard short-circuit rating and redundant suppression circuits; with individually fused metal-oxide varistors.
 4. Fuses, rated at 200-kA interrupting capacity.
- A. Peak Surge Current Rating: The minimum single-pulse surge current withstand rating per phase shall not be less than 100 kA. The peak surge current rating shall be the arithmetic sum of the ratings of the individual MOVs in a given mode.
- B. Protection modes and UL 1449 VPR for 240/120-V, 3-phase, 4-wire circuits with high leg shall be as follows:
1. Line to Neutral: 700 V, 1200 V from high leg.
 2. Line to Ground: 700 V, 1200 V from high leg.
 3. Neutral to Ground: 700 V.
- C. Protection modes and UL 1449 VPR for 240 V, 480 V, or 600 V, 3-phase, 3-wire, delta circuits shall be as follows:
1. Line to Line: 1800 V for 480 V, 1200 V for 240 V.
 2. Line to Ground: 1800 V for 480 V, 1200 V for 240 V.
- D. SCCR: Equal or exceed 200 kA.
- E. I-Nominal Rating: 20 kA.

2.02 ENCLOSURES

- A. Indoor Enclosures: NEMA 250 Type 1.

2.03 CONDUCTORS AND CABLES

1. Power Wiring: Same size as SPD leads, complying with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

PART 3 EXECUTION

3.01 INSTALLATION

- A. Comply with NECA 1.
- B. Install SPDs for panelboards and auxiliary panels with conductors or buses between suppressor and points of attachment as short and straight as possible. Do not exceed manufacturer's recommended lead length. Do not bond neutral and ground.
1. Provide multiple, **60-A** circuit breaker as a dedicated disconnecting means for SPD unless otherwise indicated.

- C. Install an OCPD or disconnect as required to comply with the UL listing of the SPD.
- D. Install SPDs with conductors between suppressor and points of attachment as short and straight as possible, and adjust circuit-breaker positions to achieve shortest and straightest leads. Do not splice and extend SPD leads unless specifically permitted by manufacturer. Do not exceed manufacturer's recommended lead length. Do not bond neutral and ground.
- E. Use crimped connectors and splices only. Wire nuts are unacceptable.
- F. Wiring:
 - 1. Power Wiring: Comply with wiring methods in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.02 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 - 1. Perform each visual and mechanical inspection and electrical test stated in NETA ATS, "Surge Arresters, Low-Voltage Surge Protection Devices" Section. Certify compliance with test parameters.
 - 2. After installing SPDs but before electrical circuitry has been energized, test for compliance with requirements.
 - 3. Complete startup checks according to manufacturer's written instructions.
- C. An SPD will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

3.03 STARTUP SERVICE

- A. Complete startup checks according to manufacturer's written instructions.
- B. Do not perform insulation resistance tests of the distribution wiring equipment with the SPD installed. Disconnect before conducting insulation resistance tests, and reconnect immediately after the testing is over.
- C. Energize SPDs after power system has been energized, stabilized and tested.

END OF SECTION



The Highlands