

GAGE DRAIN PUMP STATION – DIVISION I

BIDDING DOCUMENTS



Prepared For:

SAGINAW COUNTY PUBLIC WORKS COMMISSIONER

Prepared By:



Project I.D. Number 122901SG2015

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Brian J. Wendling
Public Works Commissioner
Governmental Center
111 S. Michigan Ave., Suite 103
Saginaw, MI 48602
Phone 989-790-5258
Fax 989-790-5259

SAGINAW COUNTY PUBLIC WORKS COMMISSIONER
GAGE DRAIN
NOTICE OF LETTING AND DAY OF REVIEW OF APPORTIONMENTS AND
DAY OF REVIEW OF DRAINAGE DISTRICT BOUNDARIES

NOTICE OF LETTING

DATE: February 23, 2021
TIME: 10:00 a.m.
LOCATION: Spicer Group, Inc.
230 S. Washington Avenue
Saginaw, MI 48607
QUESTIONS: (989) 790-5258

The Saginaw County Public Works Commissioner will meet on the above date, time and location to receive construction bids for the Gage Drain. Bids will then be opened and publicly announced.

The Gage Drain will be let in 2 Divisions as follows, each section having the length, average depth and width as shown on plans and/or described below:

Said Drain is an existing open channel drain that is approximately 7 miles in length and contains a storm water pump station containing 3 pumps, a self-cleaning trash rack, and appurtenances. This Notice of Letting, the plans, specifications, and bid proposal shall be considered a part of the contract. The following items will be required and a contract let for same:

GAGE DRAIN PUMP STATION - DIVISION I

SITework

1	Lump Sum	Site Clearing
1	Lump Sum	Temporary Dewatering and Cofferdams
1	Lump Sum	Demolition
1	Lump Sum	Sitework and Grading
250	Sq. Yds.	Heavy Riprap Bank Protection
1	Lump Sum	Chain Link Fence - 8' Tall (Complete Including Gates)
1	Lump Sum	Generator Pad, Complete
92	Sq. Ft.	Misc. Concrete Pads
1,800	Sq. Yds.	Aggregate Base, 22A, 8"
5	Each	3' Catch Basin
108	Lin. Ft.	12" R.C.P. (C-76, C1 III) Stm. Swr.
57	Lin. Ft.	10" PVC (SDR-35) Stm. Swr.
1	Lump Sum	Soil Erosion and Sedimentation Control
1	Lump Sum	Cleanup and Restoration
1	Lump Sum	Seeding, Fertilizing, and Mulching

STRUCTURAL

1	Lump Sum	Concrete Repairs
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14	Each	H-Piles, Complete
1	Lump Sum	Box Culvert, Complete
1	Lump Sum	Trash Rack Concrete Structure, Complete
50	Cu. Yds.	Sub Grade Undercutting (As-Needed)
1	Lump Sum	Service Platform and Catwalk, Complete (Includes Fall Restraint System & Handrails)
1	Lump Sum	Sheet Pile and Cap
3	Each	Removeable Beam/Access Hatch
1	Lump Sum	Removable Handrail Systems, Complete
1	Lump Sum	Grating System, Complete

ELECTRICAL

1	Lump Sum	Electrical and Controls, Complete
1	Lump Sum	Site Lighting, Complete

ARCHITECTUAL AND BUILDING IMPROVEMENTS

1	Lump Sum	Pump Station and Control Building, Complete
1	Lump Sum	Roof Access Ladder System, Complete
1	Lump Sum	Misc. Building Improvements
1	Lump Sum	Roof System, Complete
1	Lump Sum	Barrel Vault Skylight System, Complete
1	Lump Sum	Gutters and Downspouts
1	Lump Sum	Painting and Finishing

MECHANICAL

1	Lump Sum	HVAC System, Complete
3	Each	Axial Flow Pump, - Install Only
3	Each	Mixing Pumps - Install Only
1	Lump Sum	Trash Rack - Install Only

MISCELLANEOUS

1	Lump Sum	Mobilization
1	Lump Sum	Traffic Control
40	Cu. Yds.	Wet Well Cleaning

OPEN CHANNEL CONSTRUCTION

1,000	Lin. Ft.	Channel Restoration
1,928	Lin. Ft.	Channel Restoration
2,868	Lin. Ft.	Channel Cleanout - 10' Bottom
7,616	Lin. Ft.	Channel Cleanout - 8' Bottom
8,136	Lin. Ft.	Channel Cleanout - 6' Bottom
9,369	Lin. Ft.	Channel Cleanout - 4' Bottom
20,495	Lin. Ft.	Spoil Leveling - One Side
340	Lin. Ft.	Spoil Leveling (Both Sides)
7,154	Lin. Ft.	Spoil Hauling
1	Lump Sum	Site Clearing

CROSSINGS

No. 1 Station 6+94 - Racer Properties LLC - Bituminous Road

1	Lump Sum	No Work
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No. 2 Station 10+60 - Racer Properties LLC - Native Drive

1	Lump Sum	Remove Existing Crossing
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No. 3 Station 30+82 - General Motors LLC - Native Drive

1 Lump Sum Remove Existing Crossing

No. 4 Station 34+41 - I-75 - Bituminous Road

1 Lump Sum No Work

No. 5 Station 66+50 - Lake State Railway - Railroad

1 Lump Sum No Work

No. 6 Station 84+23 - Consumers Energy Company - Native Drive

57 Lin. Ft. 128" x 83" CMPA (Aluminized)

No. 7 Station 97+73 - Consumers Energy Company - Concrete Bridge

1 Lump Sum Remove Existing Crossing

No. 8 Station 110+58 - Hack Road - Gravel Road

1 Lump Sum Cleanout Existing Crossing

No. 9 Station 141+19 - Commerce Centre Drive - Bituminous Road

1 Lump Sum Cleanout Existing Crossing

No. 10 Station 151+65 - Consumers Energy Company - Gravel Drive

1 Lump Sum Cleanout Existing Crossing

No. 11 Station 163+10 - M-81 - Bituminous Road

1 Lump Sum Cleanout Existing Crossing

1 Lump Sum Crossing Concrete Repairs

No. 12 Station 190+63 - Huron and Eastern Railroad - Railroad

1 Lump Sum No Work

No. 13 Station 216+14 - Wadsworth Ave - Bituminous Road

48 Lin. Ft. 10' Span x 5' Rise Concrete Box Culvert

1 Lump Sum Precast Concrete Headwalls and Footers

32 Cu. Yds. Cast-in-Place Conc. Wing Walls and Aprons

100 Sq. Yds. Plain Miscellaneous Rip Rap

150 Cu. Yds. Subgrade Undercutting and Backfilling

1 Lump Sum Traffic Control

No. 14 Station 245+71 - Janes Ave - Bituminous Road

1 Lump Sum Cleanout Existing Crossing

No. 15 Station 259+63 - Buena Vista Auto Salvage LLC - Gravel Drive

56 Lin. Ft. 103" x 71" CMPA (Aluminized)

No. 16 Station 272+97 - MDOT State Highway Dept. - Gravel

60 Lin. Ft. 103" x 71" CMPA (Aluminized)

No. 17 Station 297+93 - M-46 - Bituminous Road

1 Lump Sum No Work

No. 18 Station 302+49 - Nexteer Automotive - Native Drive

60 Lin. Ft. 95" x 67" CMPA (Aluminized)

No. 19 Station 309+47 -Nexteer Automotive - Gravel Drive

56 Lin. Ft. 95" x 67" CMPA (Aluminized)

No. 20 Station 318+47 - Nexteer Automotive - Native Drive

1 Lump Sum Cleanout Existing Crossing

No. 21 Station 318+97 - Huron and Eastern Railway - Railroad

1 Lump Sum Cleanout Existing Crossing

No. 22 Station 319+50 - Nexteer Automotive - Native Drive

1 Lump Sum Cleanout Existing Crossing

No. 23 Station 320+18 - Nexteer Automotive - Gravel Drive

1 Lump Sum Cleanout Existing Crossing

No. 24 Station 331+45 - Nexteer Automotive - Native Drive

1 Lump Sum Cleanout Existing Crossing

No. 25 Station 342+72 - Nexteer Automotive - Bituminous Drive

1 Lump Sum Cleanout Existing Crossing

No. 26 Station 349+14 - Nexteer Automotive - Native Drive

1 Lump Sum Cleanout Existing Crossing

No. 27 Station 362+31 - Nexteer Automotive - Native Drive

1 Lump Sum Cleanout Existing Crossing

MAINTENANCE LANE CULVERTS

240	Lin. Ft.	15" HP Storm Maint. Lane Culvert
40	Lin. Ft.	18" HP Storm Maint. Lane Culvert
200	Lin. Ft.	24" HP Storm Maint. Lane Culvert
40	Lin. Ft.	30" HP Storm Maint. Lane Culvert
40	Lin. Ft.	36" HP Storm Maint. Lane Culvert
40	Lin. Ft.	48" HP Storm Maint. Lane Culvert

SOIL EROSION AND SEDIMENT CONTROL

900	Sq. Yds.	Plain Miscellaneous Riprap
400	Lin. Ft.	Plain Riprap Spillway
350	Lin. Ft.	Grass Spillway
1,200	Lin. Ft.	Plain Riprap Toe of Slope
8	Each	15" Surface Outlet Tube - 35'
1	Each	24" Surface Outlet Tube - 35'
7	Each	30" and Larger Tile Outlet Repair
6	Each	15" to 24" Tile Outlet Repair
5	Each	10" and 12" Tile Outlet Repair
14	Each	6" to 8" Tile Outlet Repair
132	Each	4" & Smaller Tile Outlet Repair
200	Each	Plain Riprap Splash Pad
1	Each	36" Flap Gate / Connect to HP Storm
2	Each	24" Flap Gate / Connect to HP Storm
1	Each	24" Flap Gate / Connect to CMP
1	Lump Sum	Seeding, Fertilizing, and Mulching
1	Lump Sum	Cleanup and Restoration

MISCELLANEOUS ITEMS

1 Lump Sum Traffic Control

ALTERNATE BID ITEMS

No. 5 Station 66+50 - Lake State Railway - Railroad

60	Lin. Ft.	136" x 87" ERCP (C-507, HE IV)
150	Cu. Yds.	Subgrade Undercutting and Backfilling
270	Sq. Yds.	Plain Misc. Riprap
1	Lump Sum	Expedited Construction Schedule

No. 12 Station 190+63 - Huron and Eastern Railroad - Gravel Drive

50	Lin. Ft.	10' Span x 5' Rise Concrete Box Culvert
1	Lump Sum	Precast Concrete Headwalls and End Treatments

130	Cu. Yds.	Subgrade Undercutting and Backfilling
140	Sq. Yds.	Plain Misc. Riprap
1	Lump Sum	Railroad Track Removal and Restoration

This Notice of Letting, the plans, specifications and bid proposal shall be considered a part of the Contract. The Contract will be let in accordance with the Contract Documents now on file at Spicer Group, 230 S. Washington Ave., Saginaw, MI (Nick Czerwinski, 989-529-0256) and available to interested parties. Bids will be made and received in accordance with these documents. Bidding Documents, including plans and specifications, may be examined at the following locations on **Tuesday, January 19th, 2021**:

Saginaw County Public Works Commissioner: Digital documents on website at no charge
<http://www.saginawcounty.com/PublicWorks/Current-Projects.aspx>

Spicer Group, Inc.: Copies obtained upon payment of a \$100.00 – per Division non-refundable deposit at Spicer Group, Inc., 230 S. Washington Ave., Saginaw, MI 48607 (Angie McCullen, 989-385-4334).

A security deposit drawn payable to the **Gage Drain Drainage District** in the form of a cashier's check, money order, certified check or bidders bond shall be submitted with any bids. No cash will be permitted. The security deposits of all unsuccessful bidders shall be returned after the Contract is awarded.

This project will require Davis Bacon prevailing wage requirements to be followed by the selected contractor on Division I only.

A **mandatory pre-bid conference** will be held at **10:00 a.m.** on the **21st day of January, 2021**, at the office of Spicer Group, Inc., 230 S. Washington Avenue, Saginaw, Michigan 48607. It is a requirement that any prospective General Contractor bidding attend this meeting. Representatives of the Drainage District and Spicer Group, Inc. will be present to discuss the project. Attendance is required for sealed bids to be accepted. Spicer Group, Inc. will transmit to all prospective bidders of record an Addendum as Spicer Group, Inc. considers necessary in response to questions arising at the conference. Oral statements may not be relied upon and will not be legally effective.

The Contract will be awarded to the lowest responsive and responsible bidder for each Division giving adequate security for the performance of the work and meeting all conditions represented in the Instructions to Bidders. The Contract completion date and the terms of payment will be announced at the time and place of letting. If no satisfactory bids are received, we reserve the right to reject any and all bids and to adjourn to a time and location as we shall announce.

DAY OF REVIEW OF DRAINAGE DISTRICT BOUNDARIES

DATE: March 2, 2021

TIME: 9:00 a.m. to 5:00 p.m.

LOCATION: Saginaw County Public Works Commissioner's Office
111 S. Michigan Avenue
Saginaw, MI 48602

QUESTIONS: (989) 790-5258

The Saginaw County Public Works Commissioner will hold a Day of Review of Drainage District Boundaries on the above date, time and location. The Day of Review is an opportunity to review the Gage Drain Drainage District boundaries.

A general description of the lands by section number proposed to be added or deleted from the Drainage Districts as recommended by a licensed professional engineer or surveyor for this Drain is as follows:

Drain Name	Municipalities	Portions of Sections Added	Portions of Sections Removed
Gage Drain	Bridgeport Twp.	4	-
	Buena Vista Twp.	4, 5, 8, 9, 16, 17, 20, 21, 28, 29, 32, 33	4, 5, 9, 16, 21, 28, 33
	Zilwaukee Twp.	33	-
	City of Saginaw	5, 8, 17, 20, 29	-

The Public Works Commissioner, engineers and/or other staff members will be available to assist individuals throughout the day and make revisions where necessary. There is no need to schedule an appointment for a specific time on the Day of Review.

Persons with disabilities needing accommodations for effective participation in the Day of Review should contact the Public Works Commissioner's Office at the number noted above (voice) or through the Michigan Relay Center at 7-1-1 (TDD) at least 24 hours in advance of the Day of Review to request mobility, visual, hearing or other assistance.

You may appeal the Public Works Commissioner's decision to revise the district boundary to the Saginaw County Circuit Court within ten (10) days.

DAY OF REVIEW OF APPORTIONMENTS

DATE: March 16, 2021

TIME: 9:00 a.m. to 5:00 p.m.

LOCATION: Saginaw County Public Works Commissioner's Office
111 S. Michigan Avenue
Saginaw, MI 48602

QUESTIONS: (989) 790-5258

The Saginaw County Public Works Commissioner will hold a Day of Review of Apportionments on the above date, time and location.

The Day of Review is an opportunity to review the tentative apportionment of benefit for each parcel and municipality within the Drainage District.

The Public Works Commissioner, engineers and/or other staff members will be available to assist individuals throughout the day, and make revisions where necessary. There is no need to schedule an appointment for a specific time on the Day of Review. The computation of costs for the Drain will also be available at the Day of Review. Drain assessments are collected in the same manner as property taxes and will appear on your winter tax bill. If drain assessments are being collected for more than one (1) year, you may pay the assessment in full with any interest to date at any time and avoid further interest charges.

Persons with disabilities needing accommodations for effective participation in the Day of Review should contact the Public Works Commissioner's Office at the number noted above (voice) or through the Michigan Relay Center at 7-1-1 (TDD) at least 24 hours in advance of the Day of Review to request mobility, visual, hearing or other assistance.

You may appeal the Public Works Commissioner's determination of apportionments to the Saginaw County Probate Court within ten (10) days.

The following is a condensed description of the land constituting the Gage Drain Drainage District. The description of area that is served by the Gage Drain consists of lands situated in Fractional Section 4 of Bridgeport Township, T.11N.-R.05E., and Sections 4, 5, 8, 9, 16, 17, 20, 21, 28, 29, 32 and 33 of Buena Vista Township, T.12N.-R.05E., and Section 33 of Zilwaukee Township, T.13N.-R.05E., and Sections 5, 8, 17, 20 and 29 of City of Saginaw, T.12N.-R.05E., Saginaw County, Michigan.

Bridgeport Township, T.11N.-R.05E., Saginaw County, Michigan.

In Fractional Section 4 – The North $\frac{1}{2}$ of the Northeast $\frac{1}{4}$ and Southwest $\frac{1}{4}$ of Northeast $\frac{1}{4}$ and Northeast $\frac{1}{4}$ of the Northwest $\frac{1}{4}$ of the Fractional Section.

Buena Vista Township, T.12N.-R.05E., Saginaw, Michigan.

In Section 4 – The West $\frac{1}{2}$ of Northeast $\frac{1}{4}$ and West $\frac{1}{2}$ of Southeast $\frac{1}{4}$ and Northeast $\frac{1}{4}$ of Northwest $\frac{1}{4}$ and South $\frac{1}{2}$ of Northwest $\frac{1}{4}$ and entire Southwest $\frac{1}{4}$ of the Section.

In Section 5 – The South $\frac{1}{2}$ of Northeast $\frac{1}{4}$ and Southeast $\frac{1}{4}$ of Northwest $\frac{1}{4}$ and Northeast $\frac{1}{4}$ of Southwest $\frac{1}{4}$ and entire Southeast $\frac{1}{4}$ of the Section.

In Section 8 – The entire Northeast $\frac{1}{4}$ and entire Southeast $\frac{1}{4}$ of the Section.

In Section 9 – The entire Northwest $\frac{1}{4}$ and entire Southwest $\frac{1}{4}$ and West $\frac{1}{2}$ of Northeast $\frac{1}{4}$ and West $\frac{1}{2}$ of Southeast $\frac{1}{4}$ of the Section.

In Section 16 – The entire Northwest $\frac{1}{4}$ and entire Southwest $\frac{1}{4}$ and entire Northeast $\frac{1}{4}$ and West $\frac{1}{2}$ of Southeast $\frac{1}{4}$ of the Section.

In Section 17 – The entire Northeast $\frac{1}{4}$ and Southeast $\frac{1}{4}$ of the Section.

In Section 20 – The entire Northeast $\frac{1}{4}$ and entire Southeast $\frac{1}{4}$ and East $\frac{1}{2}$ of Northwest $\frac{1}{4}$ and East $\frac{1}{2}$ of Southwest $\frac{1}{4}$ of the Section.

In Section 21 – The entire Northwest $\frac{1}{4}$ and entire Southwest $\frac{1}{4}$ and entire Southeast $\frac{1}{4}$ and West $\frac{1}{2}$ of Northeast $\frac{1}{4}$ and Southeast $\frac{1}{4}$ of Northeast $\frac{1}{4}$ of the Section.

In Section 28 – The entire Northwest $\frac{1}{4}$ and entire Southwest $\frac{1}{4}$ and entire Southeast $\frac{1}{4}$ and West $\frac{1}{2}$ of Northeast $\frac{1}{4}$ and Northeast $\frac{1}{4}$ of Northeast $\frac{1}{4}$ of the Section.

In Section 29 – The entire Northeast $\frac{1}{4}$ and entire Southeast $\frac{1}{4}$ and East $\frac{1}{2}$ of Northwest $\frac{1}{4}$ and Northeast $\frac{1}{4}$ of Southwest $\frac{1}{4}$ of the Section.

In Section 32 – The entire Northeast $\frac{1}{4}$ and East $\frac{1}{2}$ of the Northwest $\frac{1}{4}$ and East $\frac{1}{2}$ of the Southwest $\frac{1}{4}$ of the Section.

In Section 33 – The entire Section.

Zilwaukee Township, T.13N.-R.05E., Saginaw, Michigan.

In Section 33 – The Southwest $\frac{1}{4}$ of the Southeast $\frac{1}{4}$ of the Section.

City of Saginaw, T.12N.-R.05E., Saginaw, Michigan.

In Section 5 – The West $\frac{1}{2}$ of Southeast $\frac{1}{4}$ and East $\frac{1}{2}$ of Southwest $\frac{1}{4}$ of the Section.

In Section 8 – The Northeast $\frac{1}{4}$ of Northwest $\frac{1}{4}$ and Northwest $\frac{1}{4}$ of Northeast $\frac{1}{4}$ and East $\frac{1}{2}$ of the Southwest $\frac{1}{4}$ of the Section.

In Section 17 – The Southwest $\frac{1}{4}$ of the Northeast $\frac{1}{4}$ of the Section.

In Section 20 – The entire Northwest $\frac{1}{4}$ and East $\frac{1}{2}$ of Southwest $\frac{1}{4}$ of the Section.

In Section 29 – The East $\frac{1}{2}$ of Northwest $\frac{1}{4}$ and Northeast $\frac{1}{4}$ of Southwest $\frac{1}{4}$ of the Section.

The following public corporations will be assessed at large to pay part of the cost of the Drain:

Saginaw County
Bridgeport Township
Buena Vista Township
Zilwaukee Township
City of Saginaw

Dated: _____

Brian J. Wendling
Saginaw County Public Works Commissioner

INSTRUCTIONS TO BIDDERS

ARTICLE 1 – DEFINED TERMS

- 1.01 Terms used in these Instructions to Bidders have the meanings indicated in the General Conditions and Supplementary Conditions. Additional terms used in these Instructions to Bidders have the meanings indicated below:
- A. *Issuing Office* – The office from which the Bidding Documents are to be issued.

ARTICLE 2 – COPIES OF BIDDING DOCUMENTS

- 2.01 Complete sets of the Bidding Documents may be obtained from the Issuing Office in the number and format stated in the advertisement or invitation to bid.
- 2.02 Complete sets of Bidding Documents shall be used in preparing Bids; neither Owner nor Engineer assumes any responsibility for errors or misinterpretations resulting from the use of incomplete sets of Bidding Documents.
- 2.03 Owner and Engineer, in making copies of Bidding Documents available on the above terms, do so only for the purpose of obtaining Bids for the Work and do not authorize or confer a license for any other use.

ARTICLE 3 – QUALIFICATIONS OF BIDDERS

- 3.01 To demonstrate Bidder's qualifications to perform the Work, after submitting its Bid and within 3 days of Owner's request, Bidder shall submit written evidence establishing its qualifications such as financial data, previous experience, and present commitments.
- 3.02 A Bidder's failure to submit required qualification information within the times indicated may disqualify Bidder from receiving an award of the Contract.
- 3.03 No requirement in this Article 3 to submit information will prejudice the right of Owner to seek additional pertinent information regarding Bidder's qualifications.
- 3.04 Bidder is advised to carefully review those portions of the Bid Form requiring Bidder's representations and certifications.

ARTICLE 4 – SITE AND OTHER AREAS; EXISTING SITE CONDITIONS; EXAMINATION OF SITE; OWNER'S SAFETY PROGRAM; OTHER WORK AT THE SITE

- 4.01 *Site and Other Areas*
- A. The Site is identified in the Bidding Documents. By definition, the Site includes rights-of-way, easements, and other lands furnished by Owner for the use of the Contractor. Any additional lands required for temporary construction facilities, construction equipment, or storage of materials and equipment, and any access needed for such additional lands, are to be obtained and paid for by Contractor.
- 4.02 *Existing Site Conditions*
- A. Subsurface and Physical Conditions; Hazardous Environmental Conditions
1. The Supplementary Conditions identify:
- a. those reports known to Owner of explorations and tests of subsurface conditions at or adjacent to the Site.

- b. those drawings known to Owner of physical conditions relating to existing surface or subsurface structures at the Site (except Underground Facilities).
 - c. reports and drawings known to Owner relating to Hazardous Environmental Conditions that have been identified at or adjacent to the Site.
 - d. Technical Data contained in such reports and drawings.
- 2. Owner will make copies of reports and drawings referenced above available to any Bidder on request. These reports and drawings are not part of the Contract Documents, but the Technical Data contained therein upon whose accuracy Bidder is entitled to rely, as provided in the General Conditions, has been identified and established in the Supplementary Conditions. Bidder is responsible for any interpretation or conclusion Bidder draws from any Technical Data or any other data, interpretations, opinions, or information contained in such reports or shown or indicated in such drawings.
- 3. If the Supplementary Conditions do not identify Technical Data, the default definition of Technical Data set forth in Article 1 of the General Conditions will apply.
- B. Underground Facilities: Information and data shown or indicated in the Bidding Documents with respect to existing Underground Facilities at or contiguous to the Site are set forth in the Contract Documents and are based upon information and data furnished to Owner and Engineer by owners of such Underground Facilities, including Owner, or others.
- C. Adequacy of Data: Provisions concerning responsibilities for the adequacy of data furnished to prospective Bidders with respect to subsurface conditions, other physical conditions, and Underground Facilities, and possible changes in the Bidding Documents due to differing or unanticipated subsurface or physical conditions appear in Paragraphs 5.03, 5.04, and 5.05 of the General Conditions. Provisions concerning responsibilities for the adequacy of data furnished to prospective Bidders with respect to a Hazardous Environmental Condition at the Site, if any, and possible changes in the Contract Documents due to any Hazardous Environmental Condition uncovered or revealed at the Site which was not shown or indicated in the Drawings or Specifications or identified in the Contract Documents to be within the scope of the Work, appear in Paragraph 5.06 of the General Conditions.

4.03 *Site Visit and Testing by Bidders*

- A. Bidder shall conduct the required Site visit during normal working hours, and shall not disturb any ongoing operations at the Site.
- B. On request, and to the extent Owner has control over the Site, and schedule permitting, the Owner will provide Bidder access to the Site to conduct such additional examinations, investigations, explorations, tests, and studies as Bidder deems necessary for preparing and submitting a successful Bid. Owner will not have any obligation to grant such access if doing so is not practical because of existing operations, security or safety concerns, or restraints on Owner's authority regarding the Site.
- C. Bidder shall comply with all applicable Laws and Regulations regarding excavation and location of utilities, obtain all permits, and comply with all terms and conditions established by Owner or by property owners or other entities controlling the Site with respect to schedule, access, existing operations, security, liability insurance, and applicable safety programs.
- D. Bidder shall fill all holes and clean up and restore the Site to its former condition upon completion of such explorations, investigations, tests, and studies.

4.04 *Owner's Safety Program*

- A. Site visits and work at the Site may be governed by an Owner safety program. As the General Conditions indicate, if an Owner safety program exists, it will be noted in the Supplementary Conditions.

4.05 *Other Work at the Site*

- A. Reference is made to Article 8 of the Supplementary Conditions for the identification of the general nature of other work of which Owner is aware (if any) that is to be performed at the Site by Owner or others (such as utilities and other prime contractors) and relates to the Work contemplated by these Bidding Documents. If Owner is party to a written contract for such other work, then on request, Owner will provide to each Bidder access to examine such contracts (other than portions thereof related to price and other confidential matters), if any.

ARTICLE 5 – BIDDER’S REPRESENTATIONS

5.01 It is the responsibility of each Bidder before submitting a Bid to:

- A. examine and carefully study the Bidding Documents, and any data and reference items identified in the Bidding Documents;
- B. visit the Site, conduct a thorough, alert visual examination of the Site and adjacent areas, and become familiar with and satisfy itself as to the general, local, and Site conditions that may affect cost, progress, and performance of the Work;
- C. become familiar with and satisfy itself as to all Laws and Regulations that may affect cost, progress, and performance of the Work;
- D. carefully study all: (1) reports of explorations and tests of subsurface conditions at or adjacent to the Site and all drawings of physical conditions relating to existing surface or subsurface structures at the Site that have been identified in the Supplementary Conditions, especially with respect to Technical Data in such reports and drawings, and (2) reports and drawings relating to Hazardous Environmental Conditions, if any, at or adjacent to the Site that have been identified in the Supplementary Conditions, especially with respect to Technical Data in such reports and drawings;
- E. consider the information known to Bidder itself; information commonly known to contractors doing business in the locality of the Site; information and observations obtained from visits to the Site; the Bidding Documents; and the Site-related reports and drawings identified in the Bidding Documents, with respect to the effect of such information, observations, and documents on (1) the cost, progress, and performance of the Work; (2) the means, methods, techniques, sequences, and procedures of construction to be employed by Bidder; and (3) Bidder’s safety precautions and programs;
- F. agree, based on the information and observations referred to in the preceding paragraph, that at the time of submitting its Bid no further examinations, investigations, explorations, tests, studies, or data are necessary for the determination of its Bid for performance of the Work at the price bid and within the times required, and in accordance with the other terms and conditions of the Bidding Documents;
- G. become aware of the general nature of the work to be performed by Owner and others at the Site that relates to the Work as indicated in the Bidding Documents;
- H. promptly give Engineer written notice of all conflicts, errors, ambiguities, or discrepancies that Bidder discovers in the Bidding Documents and confirm that the written resolution thereof by Engineer is acceptable to Bidder;
- I. determine that the Bidding Documents are generally sufficient to indicate and convey understanding of all terms and conditions for the performance and furnishing of the Work; and
- J. agree that the submission of a Bid will constitute an incontrovertible representation by Bidder that Bidder has complied with every requirement of this Article, that without exception the Bid and all prices in the Bid are premised upon performing and furnishing the Work required by the Bidding Documents.

ARTICLE 6 – PRE-BID CONFERENCE

- 6.01 A **mandatory pre-bid conference** will be held at the time and location stated in the invitation or advertisement to bid. Representatives of Owner and Engineer will be present to discuss the Project. Bidders are encouraged to attend and participate in the conference. Engineer will transmit to all prospective Bidders of record such Addenda as Engineer considers necessary in response to questions arising at the conference. Oral statements may not be relied upon and will not be binding or legally effective.

ARTICLE 7 – INTERPRETATIONS AND ADDENDA

- 7.01 All questions about the meaning or intent of the Bidding Documents are to be submitted to Engineer in writing. Interpretations or clarifications considered necessary by Engineer in response to such questions will be issued by Addenda delivered to all parties recorded as having received the Bidding Documents. Questions received less than seven days prior to the date for opening of Bids may not be answered. Only questions answered by Addenda will be binding. Oral and other interpretations or clarifications will be without legal effect.
- 7.02 Addenda may be issued to clarify, correct, supplement, or change the Bidding Documents.
- 7.03 All Addenda will be distributed on the Owner's website:
<http://www.saginawcounty.com/PublicWorks/Current-Projects.aspx>
It is the Contractor's responsibility to check the website regularly during the bidding process.

ARTICLE 8 – BID SECURITY

- 8.01 A Bid must be accompanied by Bid security made payable to Gage Drain Drainage District in an amount of 5 percent of Bidder's maximum Bid price (determined by adding the base bid and all alternates) and in the form of a certified check, bank money order, or a Bid bond (on the form included in the Bidding Documents) issued by a surety meeting the requirements of Paragraphs 6.01 and 6.02 of the General Conditions.
- 8.02 The Bid security of the apparent Successful Bidder will be retained until Owner awards the contract to such Bidder, and such Bidder has executed the Contract Documents, furnished the required contract security, and met the other conditions of the Notice of Award, whereupon the Bid security will be released. If the Successful Bidder fails to execute and deliver the Contract Documents and furnish the required contract security within 15 days after the Notice of Award, Owner may consider Bidder to be in default, annul the Notice of Award, and the Bid security of that Bidder will be forfeited. Such forfeiture shall be Owner's exclusive remedy if Bidder defaults.
- 8.03 The Bid security of other Bidders that Owner believes to have a reasonable chance of receiving the award may be retained by Owner until the earlier of seven days after the Effective Date of the Contract or 61 days after the Bid opening, whereupon Bid security furnished by such Bidders will be released.
- 8.04 Bid security of other Bidders that Owner believes do not have a reasonable chance of receiving the award will be released within seven days after the Bid opening.

ARTICLE 9 – CONTRACT TIMES

- 9.01 The number of days within which, or the dates by which the Work is to be substantially completed and ready for final payment are set forth in the Agreement.

ARTICLE 10 – LIQUIDATED DAMAGES

- 10.01 Provisions for liquidated damages, if any, for failure to timely attain a Milestone, Substantial Completion, or completion of the Work in readiness for final payment, are set forth in the Agreement.

ARTICLE 11 – SUBSTITUTE AND “OR-EQUAL” ITEMS

- 11.01 The Contract for the Work, as awarded, will be on the basis of materials and equipment specified or described in the Bidding Documents without consideration during the bidding and Contract award process of possible substitute or “or-equal” items. In cases in which the Contract allows the Contractor to request that Engineer authorize the use of a substitute or “or-equal” item of material or equipment, application for such acceptance may not be made to and will not be considered by Engineer until after the Effective Date of the Contract.
- 11.02 All prices that Bidder sets forth in its Bid shall be based on the presumption that the Contractor will furnish the materials and equipment specified or described in the Bidding Documents, as supplemented by Addenda. Any assumptions regarding the possibility of post-Bid approvals of “or-equal” or substitution requests are made at Bidder’s sole risk.

ARTICLE 12 – SUBCONTRACTORS, SUPPLIERS, AND OTHERS

- 12.01 A Bidder shall be prepared to retain specific Subcontractors, Suppliers, or other individuals or entities for the performance of the Work if required by the Bidding Documents (most commonly in the Specifications) to do so. If a prospective Bidder objects to retaining any such Subcontractor, Supplier, or other individual or entity, and the concern is not relieved by an Addendum, then the prospective Bidder should refrain from submitting a Bid.
- 12.02 Subsequent to the submittal of the Bid, Owner may not require the Successful Bidder or Contractor to retain any Subcontractor, Supplier, or other individual or entity against which Contractor has reasonable objection.
- 12.03 The apparent Successful Bidder, and any other Bidder so requested, shall within five days after Bid opening, submit to Owner a list of the Subcontractors or Suppliers proposed for the substantial portions of the Work.
- If requested by Owner, such list shall be accompanied by an experience statement with pertinent information regarding similar projects and other evidence of qualification for each such Subcontractor, Supplier, or other individual or entity. If Owner or Engineer, after due investigation, has reasonable objection to any proposed Subcontractor, Supplier, individual, or entity, Owner may, before the Notice of Award is given, request apparent Successful Bidder to submit an acceptable substitute, in which case apparent Successful Bidder shall submit a substitute, Bidder’s Bid price will be increased (or decreased) by the difference in cost occasioned by such substitution, and Owner may consider such price adjustment in evaluating Bids and making the Contract award.
- 12.04 If apparent Successful Bidder declines to make any such substitution, Owner may award the Contract to the next lowest Bidder that proposes to use acceptable Subcontractors, Suppliers, or other individuals or entities. Declining to make requested substitutions will constitute grounds for forfeiture of the Bid security of any Bidder. Any Subcontractor, Supplier, individual, or entity so listed and against which Owner or Engineer makes no written objection prior to the giving of the Notice of Award will be deemed acceptable to Owner and Engineer subject to subsequent revocation of such acceptance as provided in Paragraph 7.06 of the General Conditions.

ARTICLE 13 – PREPARATION OF BID

- 13.01 The Bid Form is included with the Bidding Documents.
- A. All blanks on the Bid Form shall be completed in ink and the Bid Form signed in ink. Erasures or alterations shall be initialed in ink by the person signing the Bid Form. A Bid price shall be indicated for each section, Bid item, alternate, adjustment unit price item, and unit price item listed therein.
 - B. If the Bid Form expressly indicates that submitting pricing on a specific alternate item is optional, and Bidder elects to not furnish pricing for such optional alternate item, then Bidder may enter the words “No Bid” or “Not Applicable.”
- 13.02 A Bid by a corporation shall be executed in the corporate name by a corporate officer (whose title must appear under the signature), accompanied by evidence of authority to sign. The corporate address and state of incorporation shall be shown.
- 13.03 A Bid by a limited liability company shall be executed in the name of the firm by a member or other authorized person and accompanied by evidence of authority to sign. The state of formation of the firm and the official address of the firm shall be shown.
- 13.04 A Bid by an individual shall show the Bidder’s name and official address.
- 13.05 A Bid by a joint venture shall be executed by an authorized representative of each joint venturer in the manner indicated on the Bid Form. The official address of the joint venture shall be shown.
- 13.06 All names shall be printed in ink below the signatures.
- 13.07 The Bid shall contain an acknowledgment of receipt of all Addenda, the numbers of which shall be filled in on the Bid Form.
- 13.08 Postal and e-mail addresses and telephone number for communications regarding the Bid shall be shown.
- 13.09 The Bid shall contain evidence of Bidder’s authority and qualification to do business in the state where the Project is located, or Bidder shall covenant in writing to obtain such authority and qualification prior to award of the Contract and attach such covenant to the Bid. Bidder’s state contractor license number, if any, shall also be shown on the Bid Form.

ARTICLE 14 – BASIS OF BID

14.01 *Lump Sum*

- A. Bidders shall submit a Bid on a lump sum basis as set forth in the Bid Form.

14.01 Base Bid with Alternates

- A. Bidders shall submit a Bid on a lump sum basis for the base Bid and include a separate price for each alternate described in the Bidding Documents and as provided for in the Bid Form. The price for each alternate will be the amount added to or deleted from the base Bid if Owner selects the alternate.
- B. In the comparison of Bids, alternates will be applied in the same order of priority as listed in the Bid Form.

14.02 *Unit Price*

- A. Bidders shall submit a Bid on a unit price basis for each item of Work listed in the unit price section of the Bid Form.
- B. The “Bid Price” (sometimes referred to as the extended price) for each unit price Bid item will be the product of the “Estimated Quantity” (which Owner or its representative has set forth in the Bid Form) for the item and the corresponding “Bid Unit Price” offered by the

Bidder. The total of all unit price Bid items will be the sum of these “Bid Prices”; such total will be used by Owner for Bid comparison purposes. The final quantities and Contract Price will be determined in accordance with Paragraph 13.03 of the General Conditions.

- C. Discrepancies between the multiplication of units of Work and unit prices will be resolved in favor of the unit prices. Discrepancies between the indicated sum of any column of figures and the correct sum thereof will be resolved in favor of the correct sum.

14.03 Allowances

- A. For cash allowances the Bid price shall include such amounts as the Bidder deems proper for Contractor's overhead, costs, profit, and other expenses on account of cash allowances, if any, named in the Contract Documents, in accordance with Paragraph 13.02.B of the General Conditions.

ARTICLE 15 – SUBMITTAL OF BID

- 15.01 With each copy of the Bidding Documents, a Bidder is furnished one Affidavit of Compliance – Iran Economic Sanctions Act (C210) This form must be signed, notarized and included with the submitted bid package.
- 15.02 A Bid shall be received no later than the date and time prescribed and at the place indicated in the advertisement or invitation to bid and shall be enclosed in a plainly marked package with the Project title (and, if applicable, the designated portion of the Project for which the Bid is submitted), the name and address of Bidder, and shall be accompanied by the Bid security and other required documents. If a Bid is sent by mail or other delivery system, the sealed envelope containing the Bid shall be enclosed in a separate package plainly marked on the outside with the notation “BID ENCLOSED.” A mailed Bid shall be addressed to **Spicer Group, Inc., 230 S. Washington Avenue, Saginaw, MI 48607, Attn: Nick Czerwinski.**
- 15.03 Bids received after the date and time prescribed for the opening of bids, or not submitted at the correct location or in the designated manner, will not be accepted and will be returned to the Bidder unopened.

ARTICLE 16 – MODIFICATION AND WITHDRAWAL OF BID

- 16.01 A Bid may be withdrawn by an appropriate document duly executed in the same manner that a Bid must be executed and delivered to the place where Bids are to be submitted prior to the date and time for the opening of Bids. Upon receipt of such notice, the unopened Bid will be returned to the Bidder.
- 16.02 If a Bidder wishes to modify its Bid prior to Bid opening, Bidder must withdraw its initial Bid in the manner specified in Paragraph 16.01 and submit a new Bid prior to the date and time for the opening of Bids.
- 16.03 If within 24 hours after Bids are opened any Bidder files a duly signed written notice with Owner and promptly thereafter demonstrates to the reasonable satisfaction of Owner that there was a material and substantial mistake in the preparation of its Bid, that Bidder may withdraw its Bid, and the Bid security will be returned. Thereafter, if the Work is rebid, that Bidder will be disqualified from further bidding on the Work.

ARTICLE 17 – OPENING OF BIDS

- 17.01 Bids will be opened at the time and place indicated in the advertisement or invitation to bid and, unless obviously non-responsive, read aloud publicly. An abstract of the amounts of the base Bids and major alternates, if any, will be made available to Bidders after the opening of Bids.

ARTICLE 18 – BIDS TO REMAIN SUBJECT TO ACCEPTANCE

- 18.01 All Bids will remain subject to acceptance for the period of time stated in the Bid Form, but Owner may, in its sole discretion, release any Bid and return the Bid security prior to the end of this period.

ARTICLE 19 – EVALUATION OF BIDS AND AWARD OF CONTRACT

- 19.01 Owner reserves the right to reject any or all Bids, including without limitation, nonconforming, nonresponsive, unbalanced, or conditional Bids. Owner will reject the Bid of any Bidder that Owner finds, after reasonable inquiry and evaluation, to not be responsible. If Bidder purports to add terms or conditions to its Bid, takes exception to any provision of the Bidding Documents, or attempts to alter the contents of the Contract Documents for purposes of the Bid, then the Owner will reject the Bid as nonresponsive; provided that Owner also reserves the right to waive all minor informalities not involving price, time, or changes in the Work.
- 19.02 If Owner awards the contract for the Work, such award shall be to the responsible Bidder submitting the lowest responsive Bid.
- 19.03 Evaluation of Bids
- A. In evaluating Bids, Owner will consider whether or not the Bids comply with the prescribed requirements, and such alternates, unit prices, and other data, as may be requested in the Bid Form or prior to the Notice of Award.
 - B. For the determination of the apparent low Bidder when unit price bids are submitted, Bids will be compared on the basis of the total of the products of the estimated quantity of each item and unit price Bid for that item, together with any lump sum items.
- 19.04 In evaluating whether a Bidder is responsible, Owner will consider the qualifications of the Bidder and may consider the qualifications and experience of Subcontractors and Suppliers proposed for those portions of the Work for which the identity of Subcontractors and Suppliers must be submitted as provided in the Bidding Documents.
- 19.05 Owner may conduct such investigations as Owner deems necessary to establish the responsibility, qualifications, and financial ability of Bidders and any proposed Subcontractors or Suppliers.

ARTICLE 20 – BONDS AND INSURANCE

- 20.01 Article 6 of the General Conditions, as may be modified by the Supplementary Conditions, sets forth Owner's requirements as to performance and payment bonds and insurance. When the Successful Bidder delivers the Agreement (executed by Successful Bidder) to Owner, it shall be accompanied by required bonds and insurance documentation.

ARTICLE 21 – SIGNING OF AGREEMENT

- 21.01 When Owner issues a Notice of Award to the Successful Bidder, it shall be accompanied by the unexecuted counterparts of the Agreement along with the other Contract Documents as identified in the Agreement. Within 15 days thereafter, Successful Bidder shall execute and deliver the required number of counterparts of the Agreement (and any bonds and insurance documentation required to be delivered by the Contract Documents) to Owner. Within ten days thereafter, Owner shall deliver one fully executed counterpart of the Agreement to Successful Bidder, together with printed and electronic copies of the Contract Documents as stated in Paragraph 2.02 of the General Conditions.

AFFIDAVIT OF COMPLIANCE-IRAN ECONOMIC SANCTIONS ACT
MICHIGAN PUBLIC ACT 517 OF 2012

The undersigned, as owner or authorized officer of the below named CONTRACTOR, pursuant to the compliance certification requirement by the State of Michigan, and as referenced by OWNER in the BIDDING DOCUMENTS, hereby certifies, represents and warrants that the CONTRACTOR (including its Officers, Directors and Employees) is not an "Iran linked business" as defined by the Iran Economic Sanctions Act, Michigan Public Act 517 of 2012 (THE ACT). And, that in the event CONTRACTOR is awarded a contract as a result of the aforementioned BIDDING DOCUMENTS, the Contractor will not become an "Iran linked business" at any time during the course of performing the work or any services under the contract.

The CONTRACTOR further acknowledges that any person who is found to have submitted a false certification is responsible for a civil penalty of not more than \$250,000.00 or 2 times the amount of the contract or proposed contract for which the false certification was made, whichever is greater. The cost of the OWNER'S investigation and reasonable attorney fees may also be added in addition to the fine. Moreover, any person who submitted a false certification shall be ineligible to bid on any other of the OWNER'S projects for three (3) years from the date that it is determined that the person has submitted the false certification.

CONTRACTOR:

Name of Contractor

By: _____

Its: _____

Date: _____

STATE OF _____ }

ss.

COUNTY OF _____ }

This instrument was acknowledged before me on the _____ day of _____, _____
by _____.

, Notary Public

_____ County, State of _____

My Commission expires: _____

Acting in the County of: _____

**BID FORM
FOR CONSTRUCTION CONTRACTS**

ARTICLE 1 – BID RECIPIENT

1.01 This Bid is submitted to:

Saginaw County Public Works Commissioner

1.02 The undersigned Bidder proposes and agrees, if this Bid is accepted, to enter into an Agreement with Owner in the form included in the Bidding Documents to perform all Work as specified or indicated in the Bidding Documents for the prices and within the times indicated in this Bid and in accordance with the other terms and conditions of the Bidding Documents.

ARTICLE 2 – BIDDER’S ACKNOWLEDGEMENTS

2.01 Bidder accepts all of the terms and conditions of the Instructions to Bidders, including without limitation those dealing with the disposition of Bid security. This Bid will remain subject to acceptance for 120 days after the Bid opening, or for such longer period of time that Bidder may agree to in writing upon request of Owner.

ARTICLE 3 – BIDDER’S REPRESENTATIONS

3.01 In submitting this Bid, Bidder represents that:

- A. Bidder has examined and carefully studied the Bidding Documents, and any data and reference items identified in the Bidding Documents, and hereby acknowledges receipt of the following Addenda:

<u>Addendum No.</u>	<u>Addendum, Date</u>
_____	_____
_____	_____
_____	_____
_____	_____

If no addenda have been issued, insert “N/A”. Bidder shall submit signed copies of the Addendum Acknowledgment receipt form issued with each addendum with the complete bid form.

- B. Bidder has visited the Site, conducted a thorough, alert visual examination of the Site and adjacent areas, and become familiar with and satisfied itself as to the general, local, and Site conditions that may affect cost, progress, and performance of the Work.
- C. Bidder is familiar with and has satisfied itself as to all Laws and Regulations that may affect cost, progress, and performance of the Work.
- D. Bidder has carefully studied all: (1) reports of explorations and tests of subsurface conditions at or adjacent to the Site and all drawings of physical conditions relating to existing surface or subsurface structures at the Site that have been identified in the Supplementary

Conditions, especially with respect to Technical Data in such reports and drawings, and (2) reports and drawings relating to Hazardous Environmental Conditions, if any, at or adjacent to the Site that have been identified in the Supplementary Conditions, especially with respect to Technical Data in such reports and drawings.

- E. Bidder has considered the information known to Bidder itself; information commonly known to contractors doing business in the locality of the Site; information and observations obtained from visits to the Site; the Bidding Documents; and any Site-related reports and drawings identified in the Bidding Documents, with respect to the effect of such information, observations, and documents on (1) the cost, progress, and performance of the Work; (2) the means, methods, techniques, sequences, and procedures of construction to be employed by Bidder; and (3) Bidder's safety precautions and programs.
- F. Bidder agrees, based on the information and observations referred to in the preceding paragraph, that no further examinations, investigations, explorations, tests, studies, or data are necessary for the determination of this Bid for performance of the Work at the price bid and within the times required, and in accordance with the other terms and conditions of the Bidding Documents.
- G. Bidder is aware of the general nature of work to be performed by Owner and others at the Site that relates to the Work as indicated in the Bidding Documents.
- H. Bidder has given Engineer written notice of all conflicts, errors, ambiguities, or discrepancies that Bidder has discovered in the Bidding Documents, and confirms that the written resolution thereof by Engineer is acceptable to Bidder.
- I. The Bidding Documents are generally sufficient to indicate and convey understanding of all terms and conditions for the performance and furnishing of the Work.
- J. The submission of this Bid constitutes an incontrovertible representation by Bidder that Bidder has complied with every requirement of this Article, and that without exception the Bid and all prices in the Bid are premised upon performing and furnishing the Work required by the Bidding Documents.

ARTICLE 4 – BIDDER'S CERTIFICATION

4.01 Bidder certifies that:

- A. This Bid is genuine and not made in the interest of or on behalf of any undisclosed individual or entity and is not submitted in conformity with any collusive agreement or rules of any group, association, organization, or corporation;
- B. Bidder has not directly or indirectly induced or solicited any other Bidder to submit a false or sham Bid;
- C. Bidder has not solicited or induced any individual or entity to refrain from bidding; and
- D. Bidder has not engaged in corrupt, fraudulent, collusive, or coercive practices in competing for the Contract. For the purposes of this Paragraph 4.01.D:
 - 1. "corrupt practice" means the offering, giving, receiving, or soliciting of anything of value likely to influence the action of a public official in the bidding process;
 - 2. "fraudulent practice" means an intentional misrepresentation of facts made (a) to influence the bidding process to the detriment of Owner, (b) to establish bid prices at artificial non-competitive levels, or (c) to deprive Owner of the benefits of free and open competition;

3. “collusive practice” means a scheme or arrangement between two or more Bidders, with or without the knowledge of Owner, a purpose of which is to establish bid prices at artificial, non-competitive levels; and
4. “coercive practice” means harming or threatening to harm, directly or indirectly, persons or their property to influence their participation in the bidding process or affect the execution of the Contract.

ARTICLE 5 – BASIS OF BID

- 5.01 Bidder will complete the Work in accordance with the Contract Documents for the following price(s):

UNIT PRICE BID – SEE ATTACHED BID FORM

Bidder acknowledges that (1) each Bid Unit Price includes an amount considered by Bidder to be adequate to cover Contractor’s overhead and profit for each separately identified item, and (2) estimated quantities are not guaranteed, and are solely for the purpose of comparison of Bids, and final payment for all unit price Bid items will be based on actual quantities, determined as provided in the Contract Documents.

ARTICLE 6 – TIME OF COMPLETION

- 6.01 Bidder agrees that the Work will be substantially complete on or before September 30, 2022, and will be completed and ready for final payment in accordance with Paragraph 15.06 of the General Conditions on or before October 29, 2022.
- 6.02 Bidder accepts the provisions of the Agreement as to liquidated damages.

ARTICLE 7 – ATTACHMENTS TO THIS BID

- 7.01 The following documents are submitted with and made a condition of this Bid:
- A. Required Bid security;
 - B. Affidavit of Compliance – Iran Economic Sanctions Act;
 - C. List of Subcontractors to be used on project

ARTICLE 8 – DEFINED TERMS

- 8.01 The terms used in this Bid with initial capital letters have the meanings stated in the Instructions to Bidders, the General Conditions, and the Supplementary Conditions.

ARTICLE 9 – INSPECTION DAYS

- 9.01 In addition, BIDDER accepts:
- A. That the OWNER will provide, through the PROFESSIONAL, reference points for construction and the CONTRACTOR will be responsible for laying out (staking) the work sufficient for construction purposes in accordance with applicable parts of paragraph 4.03 of the General Conditions and the Supplementary Conditions.
 - B. All inspection on this project will be performed by the PROFESSIONAL. The Contractor shall state in the proposal the number of inspection days required for the completion of this project.
A required minimum number of Inspection has been shown in the proposal.

The Contractor is to bid the Additional Inspection if in his opinion the Inspection amount is not adequate, in which case the Contractor should write in the blank the total number additional inspection days he feels it will take to complete this project.

The total inspection day's fee bid will be part of the total contract price and will be considered to determine the low bidder on the project.

An inspection day shall be an **8-hour** day, Monday thru and including Friday and not a holiday day when an inspector or resident project representative is required to observe the following type of work.

1. Laying pipe and appurtenances.
2. Backfilling trenches.
3. Exploratory Excavation/Utility location.
4. Making a road crossing and repairing a road crossing.
5. Installing pumps.
6. Installing trash rack.
7. Installing mixers.
8. Pouring concrete.
9. Equipment startups.
10. Installing piles, box culverts, sheeting.

This is not intended to be an all inclusive list, but rather a mere sample.

The amount bid for inspection days shall not change through the course of the project unless by Change Order to the Contract for additional work and shall be prepared by the PROFESSIONAL.

Each progress payment shall include a section where the Contractor is paid the number of inspection days used up to the bid amount unless additional days have been added. The progress payment shall also have a section where the actual number of inspection days used shall be deducted from the Contractor's progress payment.

If the project is completed at the Inspection (Minimum Estimated by the Engineer) amount or under, the Inspection (Minimum Days Estimated by Engineer) amount shall be deducted from the Contract **and the remainder will be credited to the Contractor.**

If the project is completed at the Additional Inspection (Extra Days Estimated by Contractor) amount or under, the amount actually used, shall be deducted from the contract **and the remainder will be credited to the Contractor.**

The person doing the inspection and observation shall be known as the Resident Project Representative (RPR) whose limitations of authority and responsibilities are generally described in paragraph 9.13 of the General Conditions.

The CONTRACTOR shall be responsible for coordinating with the PROFESSIONAL the starting and stopping times of each workday. Any work performed by the CONTRACTOR without the Resident Project Representative will not be paid or shall be exposed, uncovered and witnessed that it was properly installed before recommendation for payment will be made.

Hours worked in excess of the **8** hour-day, a **40** hour work week; hours on Saturday, Sunday, or hours on a Holiday shall be charged at 1 ½ times **\$125.00** per hour.

Show-up time for the Resident Project Representative will be charge at a minimum of two hours per day.

- C. The inspector's daily report (IDR) shall reflect the exact hours to be charged to the Contractor for that particular day. The contractor shall receive copies of the weeks IDR the following Monday morning.

ARTICLE 10 – BIDDER COMMUNICATIONS

10.01 Communications concerning this Bid shall be addressed to:

Nicholas D. Czerwinski, P.E., Project Manager, 230 S. Washington, Saginaw, MI 48607-1286, Phone; (989) 529-0256; nickc@spicergroup.com.

ARTICLE 11 – BID SUBMITTAL

BIDDER: *[Indicate correct name of bidding entity]*

By:

[Signature]

[Printed name]

(If Bidder is a corporation, a limited liability company, a partnership, or a joint venture, attach evidence of authority to sign.)

Attest:

[Signature]

[Printed name]

Title:

Submittal Date:

Address for giving notices:

Telephone Number:

Fax Number:

Contact Name and e-mail address:

Bidder's License No.:

(where applicable)

NOTE TO USER: *Use in those states or other jurisdictions where applicable or required.*

**GAGE DRAIN
PUMP STATION - DIVISION I
BID FORM**

Item No.	Estimated Quantity	Unit	Description	Unit Price	Total
<u>SITEWORK</u>					
1.	1	Lump Sum	Site Clearing	Lump Sum	\$ _____
2.	1	Lump Sum	Temporary Dewatering and Cofferdams	Lump Sum	\$ _____
3.	1	Lump Sum	Demolition (Includes Hauling of Salvagable Equipment)	Lump Sum	\$ _____
4.	1	Lump Sum	Sitework and Grading	Lump Sum	\$ _____
5.	250	Sq. Yds.	Heavy Riprap Bank Protection	\$ _____	\$ _____
6.	1	Lump Sum	Chain Link Fence - 8' Tall (Complete Including Gates)	Lump Sum	\$ _____
7.	1	Lump Sum	Generator Pad, Complete	Lump Sum	\$ _____
8.	92	Sq. Ft.	Misc. Concrete Pads	\$ _____	\$ _____
9.	1,700	Sq. Yds.	Aggregate Base, 22A, 8"	\$ _____	\$ _____
10.	5	Each	3' Catch Basin	\$ _____	\$ _____
11.	108	Lin. Ft.	12" R.C.P. (C-76, CI III) Stm. Swr.	\$ _____	\$ _____
12.	57	Lin. Ft.	10" PVC (SDR-35) Stm. Swr.	\$ _____	\$ _____
13.	1	Lump Sum	Soil Erosion and Sedimentation Control	Lump Sum	\$ _____
14.	1	Lump Sum	Cleanup and Restoration	Lump Sum	\$ _____
15.	1	Lump Sum	Seeding, Fertilizing, and Mulching	Lump Sum	\$ _____
<u>STRUCTURAL</u>					
16.	1	Lump Sum	Concrete Repairs	Lump Sum	\$ _____
17.	14	Each	H-Piles, Complete	\$ _____	\$ _____
18.	1	Lump Sum	Box Culvert, Complete (Includes all connections, footers, pre-cast components, and Cast-in-Place Concrete over the box)	Lump Sum	\$ _____
19.	1	Lump Sum	Trash Rack Concrete Structure, Complete (Includes Vertical Walls in Collection Area)	Lump Sum	\$ _____
20.	50	Cu. Yds.	Sub Grade Undercutting (As-Needed)	\$ _____	\$ _____
21.	1	Lump Sum	Service Platform and Catwalk, Complete (Includes Fall Restraint System & Handrails)	Lump Sum	\$ _____

22.	1	Lump Sum	Sheet Pile and Cap	Lump Sum	\$ _____
23.	3	Each	Removeable Beam/Access Hatch	\$ _____	\$ _____
24.	1	Lump Sum	Removable Handrail Systems, Complete (Includes Wet Well, Discharge Basin/Walkway, Trashrack, & Sheeting)	Lump Sum	\$ _____
25.	1	Lump Sum	Grating System, Complete (Wet Well and Discharge Walkways)	Lump Sum	\$ _____

ELECTRICAL

26.	1	Lump Sum	Electrical and Controls, Complete	Lump Sum	\$ _____
27.	1	Lump Sum	Site Lighting, Complete	Lump Sum	\$ _____

ARCHITECTUAL AND BUILDING IMPROVEMENTS

28.	1	Lump Sum	Pump Station and Control Building, Complete (Includes All Foundations, Slabs, Etc.)	Lump Sum	\$ _____
29.	1	Lump Sum	Roof Access Ladder System, Complete	Lump Sum	\$ _____
30.	1	Lump Sum	Misc. Building Improvements	Lump Sum	\$ _____
31.	1	Lump Sum	Roof System, Complete	Lump Sum	\$ _____
32.	1	Lump Sum	Barrel Vault Skylight System, Complete	Lump Sum	\$ _____
33.	1	Lump Sum	Gutters and Downspouts	Lump Sum	\$ _____
34.	1	Lump Sum	Painting and Finishing	Lump Sum	\$ _____

MECHANICAL

35.	1	Lump Sum	HVAC System, Complete	Lump Sum	\$ _____
36.	3	Each	Axial Flow Pump, - Install Only (Includes All Accessories Needed for Install)	\$ _____	\$ _____
37.	3	Each	Mixing Pumps - Install Only (Includes All Accessories Needed for Install)	\$ _____	\$ _____
38.	1	Lump Sum	Trash Rack - Install Only (Includes All Accessories Needed for Install)	Lump Sum	\$ _____

MISCELLANEOUS

39.	1	Lump Sum	Mobilization	Lump Sum	\$ _____
40.	15	Days	Inspection Days (Minimum)	\$1,000.00	\$15,000.00
41.	_____	Days	Inspection Days (Additional)	\$1,000.00	\$ _____
42.	1	Lump Sum	Traffic Control	Lump Sum	\$ _____
43.	40	Cu. Yds.	Wet Well Cleaning	\$ _____	\$ _____

TOTAL BID AMOUNT----- \$ _____

ALTERNATE BID ITEMS

44.	5	Each	36" Stainless Steel Flap Gates	\$ _____	\$ _____
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NOTE: Headings in bid form are for organizational purposes during bidding and construction only. Headings imply no division of work amongst trades/sub-contractors. Prime contractor holds sole responsibility for making sure all work shown on plans is included in the provided line items above.

NOTICE OF AWARD

Date of Issuance:

Owner: Saginaw County Public Works
Commissioner

Owner's Contract No.:

Engineer: Spicer Group, Inc.

Engineer's Project No.: 122901SG2015

Project: Gage Drain – Pump Station –
Division I

Contract Name: Gage Drain – Pump Station –
Division I

Bidder:

Bidder's
Address:

TO BIDDER:

You are notified that Owner has accepted your Bid dated [_____] for the above Contract, and that you are the Successful Bidder and are awarded a Contract for:

[describe Work, alternates, or sections of Work awarded]

The Contract Price of the awarded Contract is: \$ _____ *[note if subject to unit prices, or cost-plus]*

Four (4) unexecuted counterparts of the Agreement accompany this Notice of Award, and one copy of the Contract Documents accompanies this Notice of Award, or has been transmitted or made available to Bidder electronically. *[revise if multiple copies accompany the Notice of Award]*

☐ a set of the Drawings will be delivered separately from the other Contract Documents.

You must comply with the following conditions precedent within 15 days of the date of receipt of this Notice of Award:

1. Deliver to Owner three (3) counterparts of the Agreement, fully executed by Bidder.
2. Deliver with the executed Agreement(s) the Contract security *[e.g., performance and payment bonds]* and insurance documentation as specified in the Instructions to Bidders and General Conditions, Articles 2 and 6.
3. Other conditions precedent (if any):

Failure to comply with these conditions within the time specified will entitle Owner to consider you in default, annul this Notice of Award, and declare your Bid security forfeited.

Within ten days after you comply with the above conditions, Owner will return to you one fully executed counterpart of the Agreement, together with any additional copies of the Contract Documents as indicated in Paragraph 2.02 of the General Conditions.

Owner:

Authorized Signature

By:

Title:

Copy: Engineer

AGREEMENT

THIS AGREEMENT is by and
between

Saginaw County Public Works Commissioner (“Owner”) and
 (“Contractor”).

Owner and Contractor hereby agree as follows:

ARTICLE 1 – WORK

1.01 Contractor shall complete all Work as specified or indicated in the Contract Documents. The Work is generally described as follows: Gage Drain – Pump Station – Division I

ARTICLE 2 – THE PROJECT

2.01 The Project, of which the Work under the Contract Documents is a part, is generally described as follows: Gage Drain – Pump Station – Division I

ARTICLE 3 – ENGINEER

3.01 The Project has been designed by Spicer Group, Inc.

3.02 The Owner has retained Spicer Group, Inc. (“Engineer”) to act as Owner’s representative, assume all duties and responsibilities, and have the rights and authority assigned to Engineer in the Contract Documents in connection with the completion of the Work in accordance with the Contract Documents.

ARTICLE 4 – CONTRACT TIMES

4.01 *Time of the Essence*

A. All time limits for Milestones, if any, Substantial Completion, and completion and readiness for final payment as stated in the Contract Documents are of the essence of the Contract.

4.02 *Contract Times: Dates*

A. The Work will be substantially completed on or before September 30, 2022, and completed and ready for final payment in accordance with Paragraph 15.06 of the General Conditions on or before October 29, 2022.

4.03 Liquidated Damages

A. Contractor and Owner recognize that time is of the essence as stated in Paragraph 4.01 above and that Owner will suffer financial and other losses if the Work is not completed and Milestones not achieved within the times specified in Paragraph 4.02 above, plus any extensions thereof allowed in accordance with the Contract. The parties also recognize the delays, expense, and difficulties involved in proving in a legal or arbitration proceeding the actual loss suffered by Owner if the Work is not completed on time. Accordingly, instead of requiring any such proof, Owner and Contractor agree that as liquidated damages for delay (but not as a penalty):

1. Substantial Completion: Contractor shall pay Owner \$500 for each day that expires after the time (as duly adjusted pursuant to the Contract) specified in Paragraph 4.02.A above for Substantial Completion until the Work is substantially complete.
2. Completion of Remaining Work: After Substantial Completion, if Contractor shall neglect, refuse, or fail to complete the remaining Work within the Contract Time (as duly adjusted pursuant to the Contract) for completion and readiness for final payment, Contractor shall pay Owner \$500 for each day that expires after such time until the Work is completed and ready for final payment.
3. Liquidated damages for failing to timely attain Substantial Completion and final completion are not additive and will not be imposed concurrently.

4.04 *Special Damages*

- A. In addition to the amount provided for liquidated damages, Contractor shall reimburse Owner (1) for any fines or penalties imposed on Owner as a direct result of the Contractor's failure to attain Substantial Completion according to the Contract Times, and (2) for the actual costs reasonably incurred by Owner for engineering, construction observation, inspection, and administrative services needed after the time specified in Paragraph 4.02 for Substantial Completion (as duly adjusted pursuant to the Contract), until the Work is substantially complete.
- B. After Contractor achieves Substantial Completion, if Contractor shall neglect, refuse, or fail to complete the remaining Work within the Contract Times, Contractor shall reimburse Owner for the actual costs reasonably incurred by Owner for engineering, construction observation, inspection, and administrative services needed after the time specified in Paragraph 4.02 for Work to be completed and ready for final payment (as duly adjusted pursuant to the Contract), until the Work is completed and ready for final payment.

ARTICLE 5 – CONTRACT PRICE

- 5.01 Owner shall pay Contractor for completion of the Work in accordance with the Contract Documents the amounts that follow, subject to adjustment under the Contract:
- A. For all Work, at the prices stated in Contractor's Bid, attached hereto as an exhibit (see Exhibit A).

ARTICLE 6 – PAYMENT PROCEDURES

6.01 *Submittal and Processing of Payments*

- A. Contractor shall submit Applications for Payment in accordance with Article 15 of the General Conditions. Applications for Payment will be processed by Engineer as provided in the General Conditions.

6.02 *Progress Payments; Retainage*

- A. Owner shall make progress payments on account of the Contract Price on the basis of Contractor's Applications for Payment on or about the 28th day of each month during performance of the Work as provided in Paragraph 6.02.A.1 below, provided that such Applications for Payment have been submitted in a timely manner and otherwise meet the requirements of the Contract. All such payments will be measured by the Schedule of Values established as provided in the General Conditions (and in the case of Unit Price Work based on the number of units completed) or, in the event there is no Schedule of Values, as provided elsewhere in the Contract.
 1. Prior to Substantial Completion, progress payments will be made in an amount equal to the percentage indicated below but, in each case, less the aggregate of payments

previously made and less such amounts as Owner may withhold, including but not limited to liquidated damages, in accordance with the Contract

- a. 90 percent of Work completed (with the balance being retainage). If the Work has been 50 percent completed as determined by Engineer, and if the character and progress of the Work have been satisfactory to Owner and Engineer, then as long as the character and progress of the Work remain satisfactory to Owner and Engineer, there will be no additional retainage; and
- B. Upon Substantial Completion, Owner shall pay an amount sufficient to increase total payments to Contractor to 100 percent of the Work completed, less such amounts set off by Owner pursuant to Paragraph 15.01.E of the General Conditions, and less 100 percent of Engineer's estimate of the value of Work to be completed or corrected as shown on the punch list of items to be completed or corrected prior to final payment.

6.03 Final Payment

- A. Upon final completion and acceptance of the Work in accordance with Paragraph 15.06 of the General Conditions, Owner shall pay the remainder of the Contract Price as recommended by Engineer as provided in said Paragraph 15.06.

ARTICLE 7 – INTEREST

7.01 All amounts not paid when due shall bear interest at the rate of 0 percent per annum.

ARTICLE 8 – CONTRACTOR'S REPRESENTATIONS

- 8.01 In order to induce Owner to enter into this Contract, Contractor makes the following representations:
- A. Contractor has examined and carefully studied the Contract Documents, and any data and reference items identified in the Contract Documents.
 - B. Contractor has visited the Site, conducted a thorough, alert visual examination of the Site and adjacent areas, and become familiar with and is satisfied as to the general, local, and Site conditions that may affect cost, progress, and performance of the Work.
 - C. Contractor is familiar with and is satisfied as to all Laws and Regulations that may affect cost, progress, and performance of the Work.
 - D. Contractor has carefully studied all: (1) reports of explorations and tests of subsurface conditions at or adjacent to the Site and all drawings of physical conditions relating to existing surface or subsurface structures at the Site that have been identified in the Supplementary Conditions, especially with respect to Technical Data in such reports and drawings, and (2) reports and drawings relating to Hazardous Environmental Conditions, if any, at or adjacent to the Site that have been identified in the Supplementary Conditions, especially with respect to Technical Data in such reports and drawings.
 - E. Contractor has considered the information known to Contractor itself; information commonly known to contractors doing business in the locality of the Site; information and observations obtained from visits to the Site; the Contract Documents; and the Site-related reports and drawings identified in the Contract Documents, with respect to the effect of such information, observations, and documents on (1) the cost, progress, and performance of the Work; (2) the means, methods, techniques, sequences, and procedures of construction to be employed by Contractor; and (3) Contractor's safety precautions and programs.
 - F. Based on the information and observations referred to in the preceding paragraph, Contractor agrees that no further examinations, investigations, explorations, tests, studies, or data are

necessary for the performance of the Work at the Contract Price, within the Contract Times, and in accordance with the other terms and conditions of the Contract.

- G. Contractor is aware of the general nature of work to be performed by Owner and others at the Site that relates to the Work as indicated in the Contract Documents.
- H. Contractor has given Engineer written notice of all conflicts, errors, ambiguities, or discrepancies that Contractor has discovered in the Contract Documents, and the written resolution thereof by Engineer is acceptable to Contractor.
- I. The Contract Documents are generally sufficient to indicate and convey understanding of all terms and conditions for performance and furnishing of the Work.
- J. Contractor's entry into this Contract constitutes an incontrovertible representation by Contractor that without exception all prices in the Agreement are premised upon performing and furnishing the Work required by the Contract Documents.

ARTICLE 9 – CONTRACT DOCUMENTS

9.01 *Contents*

- A. The Contract Documents consist of the following:
 - 1. This Agreement (pages 1 to 7, inclusive).
 - 2. Performance bond (pages 1 to 3, inclusive).
 - 3. Payment bond (pages 1 to 4, inclusive).
 - 4. General Conditions (pages 1 to 65, inclusive).
 - 5. Supplementary Conditions (pages 1 to 6, inclusive).
 - 6. Specifications as listed in the table of contents of the Project Manual.
 - 7. The Drawings are listed on the document title page.
 - 8. Addenda, inclusive.
 - 9. Exhibits to this Agreement (enumerated as follows):
 - a. Contractor's Bid, inclusive.
 - 10. The following which may be delivered or issued on or after the Effective Date of the Contract and are not attached hereto:
 - a. Notice to Proceed.
 - b. Work Change Directives.
 - c. Change Orders.
 - d. Field Orders.
- B. The documents listed in Paragraph 9.01.A are attached to this Agreement (except as expressly noted otherwise above).
- C. There are no Contract Documents other than those listed above in this Article 9.
- D. The Contract Documents may only be amended, modified, or supplemented as provided in the General Conditions.

ARTICLE 10 – MISCELLANEOUS

10.01 *Terms*

- A. Terms used in this Agreement will have the meanings stated in the General Conditions and the Supplementary Conditions.

10.02 *Assignment of Contract*

- A. Unless expressly agreed to elsewhere in the Contract, no assignment by a party hereto of any rights under or interests in the Contract will be binding on another party hereto without the written consent of the party sought to be bound; and, specifically but without limitation, money that may become due and money that is due may not be assigned without such consent (except to the extent that the effect of this restriction may be limited by law), and unless specifically stated to the contrary in any written consent to an assignment, no assignment will release or discharge the assignor from any duty or responsibility under the Contract Documents.

10.03 *Successors and Assigns*

- A. Owner and Contractor each binds itself, its successors, assigns, and legal representatives to the other party hereto, its successors, assigns, and legal representatives in respect to all covenants, agreements, and obligations contained in the Contract Documents.

10.04 *Severability*

- A. Any provision or part of the Contract Documents held to be void or unenforceable under any Law or Regulation shall be deemed stricken, and all remaining provisions shall continue to be valid and binding upon Owner and Contractor, who agree that the Contract Documents shall be reformed to replace such stricken provision or part thereof with a valid and enforceable provision that comes as close as possible to expressing the intention of the stricken provision.

10.05 *Contractor's Certifications*

- A. Contractor certifies that it has not engaged in corrupt, fraudulent, collusive, or coercive practices in competing for or in executing the Contract. For the purposes of this Paragraph 10.05:
 - 1. “corrupt practice” means the offering, giving, receiving, or soliciting of any thing of value likely to influence the action of a public official in the bidding process or in the Contract execution;
 - 2. “fraudulent practice” means an intentional misrepresentation of facts made (a) to influence the bidding process or the execution of the Contract to the detriment of Owner, (b) to establish Bid or Contract prices at artificial non-competitive levels, or (c) to deprive Owner of the benefits of free and open competition;
 - 3. “collusive practice” means a scheme or arrangement between two or more Bidders, with or without the knowledge of Owner, a purpose of which is to establish Bid prices at artificial, non-competitive levels; and
 - 4. “coercive practice” means harming or threatening to harm, directly or indirectly, persons or their property to influence their participation in the bidding process or affect the execution of the Contract.

10.06 *Other Provisions*

- A. Owner stipulates that if the General Conditions that are made a part of this Contract are based on EJCDC® C-700, Standard General Conditions for the Construction Contract, published by the Engineers Joint Contract Documents Committee®, and if Owner is the

party that has furnished said General Conditions, then Owner has plainly shown all modifications to the standard wording of such published document to the Contractor, through a process such as highlighting or “track changes” (redline/strikeout), or in the Supplementary Conditions.

B. Equal Opportunity

Contractor shall not discriminate against an employee or applicant for employment with respect to hire, tenure, terms, conditions, or privileges of employment, or a matter directly or indirectly related to employment, because of race, color, religion, national origin, age, sex, height, weight, marital status, or because of a handicap that is unrelated to the person’s ability to perform the duties of a particular job or position.

C. Prevailing Wage

Contractor will comply with prevailing wage requirements as set forth in the Bidding Documents, including all Subcontractors completing work on the project. Contractor will make payrolls available for all of their employees, and their Subcontractor’s employees as requested by the Owner or Engineer.

IN WITNESS WHEREOF, Owner and Contractor have signed this Agreement.

This Agreement will be effective on (which is the Effective Date of the Contract).

OWNER:

CONTRACTOR:

Saginaw County Public Works Commissioner

By: _____

By: _____

Title: _____

Title: _____

Attest: _____

Attest: _____

Title: _____

Title: _____

Address for giving notices:

Address for giving notices:

111 S. Michigan Avenue

Saginaw, MI 48602

NOTICE TO PROCEED

Owner:	Saginaw County Public Works Commissioner	Owner's Contract No.:	
Contractor:		Contractor's Project No.:	
Engineer:	Spicer Group, Inc.	Engineer's Project No.:	122901SG2015
Project:	Gage Drain – Pump Station – Division I	Contract Name:	Gage Drain – Pump Station – Division I
		Effective Date of Contract:	

TO CONTRACTOR:

Owner hereby notifies Contractor that the Contract Times under the above Contract will commence to run on [REDACTED], 20[REDACTED]. *[see Paragraph 4.01 of the General Conditions]*

On that date, Contractor shall start performing its obligations under the Contract Documents. No Work shall be done at the Site prior to such date. In accordance with the Agreement, the date of Substantial Completion is September 30, 2022, and the date of readiness for final payment is October 29, 2022.

Before starting any Work at the Site, Contractor must comply with the following:

[Note any access limitations, security procedures, or other restrictions]

Owner:

Authorized Signature

By:

Title:

Date Issued:

Copy: Engineer

PERFORMANCE BOND

CONTRACTOR *(name and address)*:

SURETY *(name and address of principal place of business)*:

OWNER *(name and address)*:

Saginaw County Public Works Commissioner
111 S. Michigan Avenue
Saginaw, MI 48602

CONSTRUCTION CONTRACT

Effective Date of the Agreement:

Amount:

Description *(name and location)*: Gage Drain – Pump Station – Division I, Saginaw County, MI

BOND

Bond Number:

Date *(not earlier than the Effective Date of the Agreement of the Construction Contract)*:

Amount:

Modifications to this Bond Form: ☐ None ☐ See Paragraph 16

Surety and Contractor, intending to be legally bound hereby, subject to the terms set forth below, do each cause this Performance Bond to be duly executed by an authorized officer, agent, or representative.

CONTRACTOR AS PRINCIPAL

SURETY

Contractor's Name and Corporate Seal

Surety's Name and Corporate Seal

By: _____
Signature

By: _____
Signature *(attach power of attorney)*

Print Name

Print Name

Title

Title

Attest: _____
Signature

Attest: _____
Signature

Title

Title

Notes: (1) Provide supplemental execution by any additional parties, such as joint venturers. (2) Any singular reference to Contractor, Surety, Owner, or other party shall be considered plural where applicable.

1. The Contractor and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors, and assigns to the Owner for the performance of the Construction Contract, which is incorporated herein by reference.

2. If the Contractor performs the Construction Contract, the Surety and the Contractor shall have no obligation under this Bond, except when applicable to participate in a conference as provided in Paragraph 3.

3. If there is no Owner Default under the Construction Contract, the Surety's obligation under this Bond shall arise after:

3.1 The Owner first provides notice to the Contractor and the Surety that the Owner is considering declaring a Contractor Default. Such notice shall indicate whether the Owner is requesting a conference among the Owner, Contractor, and Surety to discuss the Contractor's performance. If the Owner does not request a conference, the Surety may, within five (5) business days after receipt of the Owner's notice, request such a conference. If the Surety timely requests a conference, the Owner shall attend. Unless the Owner agrees otherwise, any conference requested under this Paragraph 3.1 shall be held within ten (10) business days of the Surety's receipt of the Owner's notice. If the Owner, the Contractor, and the Surety agree, the Contractor shall be allowed a reasonable time to perform the Construction Contract, but such an agreement shall not waive the Owner's right, if any, subsequently to declare a Contractor Default;

3.2 The Owner declares a Contractor Default, terminates the Construction Contract and notifies the Surety; and

3.3 The Owner has agreed to pay the Balance of the Contract Price in accordance with the terms of the Construction Contract to the Surety or to a contractor selected to perform the Construction Contract.

4. Failure on the part of the Owner to comply with the notice requirement in Paragraph 3.1 shall not constitute a failure to comply with a condition precedent to the Surety's obligations, or release the Surety from its obligations, except to the extent the Surety demonstrates actual prejudice.

5. When the Owner has satisfied the conditions of Paragraph 3, the Surety shall promptly and at the Surety's expense take one of the following actions:

5.1 Arrange for the Contractor, with the consent of the Owner, to perform and complete the Construction Contract;

5.2 Undertake to perform and complete the Construction Contract itself, through its agents or independent contractors;

5.3 Obtain bids or negotiated proposals from qualified contractors acceptable to the Owner for a contract for performance and completion of the Construction Contract, arrange for a contract to be prepared for execution by the Owner and a contractor selected with the Owners concurrence, to be secured with performance and payment bonds executed by a qualified surety equivalent to the bonds issued on the Construction Contract, and pay to the Owner the amount of damages as described in Paragraph 7 in excess of the Balance of the Contract Price incurred by the Owner as a result of the Contractor Default; or

5.4 Waive its right to perform and complete, arrange for completion, or obtain a new contractor, and with reasonable promptness under the circumstances:

5.4.1 After investigation, determine the amount for which it may be liable to the Owner and, as soon as practicable after the amount is determined, make payment to the Owner; or

5.4.2 Deny liability in whole or in part and notify the Owner, citing the reasons for denial.

6. If the Surety does not proceed as provided in Paragraph 5 with reasonable promptness, the Surety shall be deemed to be in default on this Bond seven days after receipt of an additional written notice from the Owner to the Surety demanding that the Surety perform its obligations under this Bond, and the Owner shall be entitled to enforce any remedy available to the Owner. If the Surety proceeds as provided in Paragraph 5.4, and the Owner refuses the payment or the Surety has denied liability, in whole or in part, without further notice the Owner shall be entitled to enforce any remedy available to the Owner.

7. If the Surety elects to act under Paragraph 5.1, 5.2, or 5.3, then the responsibilities of the Surety to the Owner shall not be greater than those of the Contractor under the Construction Contract, and the responsibilities of the Owner to the Surety shall not be greater than those of the Owner under the Construction Contract. Subject to the commitment by the Owner to pay the Balance of the Contract Price, the Surety is obligated, without duplication for:

7.1 the responsibilities of the Contractor for correction of defective work and completion of the Construction Contract;

7.2 additional legal, design professional, and delay costs resulting from the Contractor's Default, and resulting from the actions or failure to act of the Surety under Paragraph 5; and

7.3 liquidated damages, or if no liquidated damages are specified in the Construction Contract, actual damages caused by delayed performance or non-performance of the Contractor.

8. If the Surety elects to act under Paragraph 5.1, 5.3, or 5.4, the Surety's liability is limited to the amount of this Bond.

9. The Surety shall not be liable to the Owner or others for obligations of the Contractor that are unrelated to the Construction Contract, and the Balance of the Contract Price shall not be reduced or set off on account of any such unrelated obligations. No right of action shall accrue on this Bond to any person or entity other than the Owner or its heirs, executors, administrators, successors, and assigns.

10. The Surety hereby waives notice of any change, including changes of time, to the Construction Contract or to related subcontracts, purchase orders, and other obligations.

11. Any proceeding, legal or equitable, under this Bond may be instituted in any court of competent jurisdiction in the location in which the work or part of the work is located and shall be instituted within two years after a declaration of Contractor Default or within two years after the Contractor ceased working or within two years after the Surety refuses or fails to perform its obligations under this Bond, whichever occurs first. If the provisions of this paragraph are void or prohibited by law, the minimum periods of limitations available to sureties as a defense in the jurisdiction of the suit shall be applicable.

12. Notice to the Surety, the Owner, or the Contractor shall be mailed or delivered to the address shown on the page on which their signature appears.

13. When this Bond has been furnished to comply with a statutory or other legal requirement in the location where the construction was to be performed, any provision in this Bond conflicting with said statutory or legal requirement shall be deemed deleted herefrom and provisions conforming to such statutory or other legal requirement shall be deemed

incorporated herein. When so furnished, the intent is that this Bond shall be construed as a statutory bond and not as a common law bond.

14. Definitions

14.1 Balance of the Contract Price: The total amount payable by the Owner to the Contractor under the Construction Contract after all proper adjustments have been made including allowance for the Contractor for any amounts received or to be received by the Owner in settlement of insurance or other claims for damages to which the Contractor is entitled, reduced by all valid and proper payments made to or on behalf of the Contractor under the Construction Contract.

14.2 Construction Contract: The agreement between the Owner and Contractor identified on the cover page, including all Contract Documents and changes made to the agreement and the Contract Documents.

14.3 Contractor Default: Failure of the Contractor, which has not been remedied or waived, to perform or otherwise to comply with a material term of the Construction Contract.

14.4 Owner Default: Failure of the Owner, which has not been remedied or waived, to pay the Contractor as required under the Construction Contract or to perform and complete or comply with the other material terms of the Construction Contract.

14.5 Contract Documents: All the documents that comprise the agreement between the Owner and Contractor.

15. If this Bond is issued for an agreement between a contractor and subcontractor, the term Contractor in this Bond shall be deemed to be Subcontractor and the term Owner shall be deemed to be Contractor.

16. Modifications to this Bond are as follows:

PAYMENT BOND

CONTRACTOR (*name and address*):

SURETY (*name and address of principal place of business*):

OWNER (*name and address*):

Saginaw County Public Works Commissioner
111 S. Michigan Avenue
Saginaw, MI 48602

CONSTRUCTION CONTRACT

Effective Date of the Agreement:

Amount:

Description (*name and location*): Gage Drain – Pump Station – Division I, Saginaw County, MI

BOND

Bond Number:

Date (*not earlier than the Effective Date of the Agreement of the Construction Contract*):

Amount:

Modifications to this Bond Form: ☐ None ☐ See Paragraph 18

Surety and Contractor, intending to be legally bound hereby, subject to the terms set forth below, do each cause this Payment Bond to be duly executed by an authorized officer, agent, or representative.

CONTRACTOR AS PRINCIPAL

SURETY

(seal)

Contractor's Name and Corporate Seal

(seal)

Surety's Name and Corporate Seal

By: _____

Signature

By: _____

Signature (*attach power of attorney*)

Print Name

Print Name

Title

Title

Attest: _____

Signature

Attest: _____

Signature

Title

Title

Notes: (1) Provide supplemental execution by any additional parties, such as joint venturers. (2) Any singular reference to Contractor, Surety, Owner, or other party shall be considered plural where applicable.

Gage Drain – Pump Station – Division I
Saginaw County Public Works Commissioner

Payment Bond
C-615 - 1

Claim to the Surety (at the address described in Paragraph 13).

1. The Contractor and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors, and assigns to the Owner to pay for labor, materials, and equipment furnished for use in the performance of the Construction Contract, which is incorporated herein by reference, subject to the following terms.
2. If the Contractor promptly makes payment of all sums due to Claimants, and defends, indemnifies, and holds harmless the Owner from claims, demands, liens, or suits by any person or entity seeking payment for labor, materials, or equipment furnished for use in the performance of the Construction Contract, then the Surety and the Contractor shall have no obligation under this Bond.
3. If there is no Owner Default under the Construction Contract, the Surety's obligation to the Owner under this Bond shall arise after the Owner has promptly notified the Contractor and the Surety (at the address described in Paragraph 13) of claims, demands, liens, or suits against the Owner or the Owner's property by any person or entity seeking payment for labor, materials, or equipment furnished for use in the performance of the Construction Contract, and tendered defense of such claims, demands, liens, or suits to the Contractor and the Surety.
4. When the Owner has satisfied the conditions in Paragraph 3, the Surety shall promptly and at the Surety's expense defend, indemnify, and hold harmless the Owner against a duly tendered claim, demand, lien, or suit.
5. The Surety's obligations to a Claimant under this Bond shall arise after the following:
 - 5.1 Claimants who do not have a direct contract with the Contractor,
 - 5.1.1 have furnished a written notice of non-payment to the Contractor, stating with substantial accuracy the amount claimed and the name of the party to whom the materials were, or equipment was, furnished or supplied or for whom the labor was done or performed, within ninety (90) days after having last performed labor or last furnished materials or equipment included in the Claim; and
 - 5.1.2 have sent a Claim to the Surety (at the address described in Paragraph 13).
 - 5.2 Claimants who are employed by or have a direct contract with the Contractor have sent a
6. If a notice of non-payment required by Paragraph 5.1.1 is given by the Owner to the Contractor, that is sufficient to satisfy a Claimant's obligation to furnish a written notice of non-payment under Paragraph 5.1.1.
7. When a Claimant has satisfied the conditions of Paragraph 5.1 or 5.2, whichever is applicable, the Surety shall promptly and at the Surety's expense take the following actions:
 - 7.1 Send an answer to the Claimant, with a copy to the Owner, within sixty (60) days after receipt of the Claim, stating the amounts that are undisputed and the basis for challenging any amounts that are disputed; and
 - 7.2 Pay or arrange for payment of any undisputed amounts.
 - 7.3 The Surety's failure to discharge its obligations under Paragraph 7.1 or 7.2 shall not be deemed to constitute a waiver of defenses the Surety or Contractor may have or acquire as to a Claim, except as to undisputed amounts for which the Surety and Claimant have reached agreement. If, however, the Surety fails to discharge its obligations under Paragraph 7.1 or 7.2, the Surety shall indemnify the Claimant for the reasonable attorney's fees the Claimant incurs thereafter to recover any sums found to be due and owing to the Claimant.
8. The Surety's total obligation shall not exceed the amount of this Bond, plus the amount of reasonable attorney's fees provided under Paragraph 7.3, and the amount of this Bond shall be credited for any payments made in good faith by the Surety.
9. Amounts owed by the Owner to the Contractor under the Construction Contract shall be used for the performance of the Construction Contract and to satisfy claims, if any, under any construction performance bond. By the Contractor furnishing and the Owner accepting this Bond, they agree that all funds earned by the Contractor in the performance of the Construction Contract are dedicated to satisfy obligations of the Contractor and Surety under this Bond, subject to the Owner's priority to use the funds for the completion of the work.
10. The Surety shall not be liable to the Owner, Claimants, or others for obligations of the Contractor that are unrelated to the Construction Contract. The Owner shall not be liable for the payment of any costs or expenses of any Claimant under this Bond,

and shall have under this Bond no obligation to make payments to or give notice on behalf of Claimants, or otherwise have any obligations to Claimants under this Bond.

11. The Surety hereby waives notice of any change, including changes of time, to the Construction Contract or to related subcontracts, purchase orders, and other obligations.
12. No suit or action shall be commenced by a Claimant under this Bond other than in a court of competent jurisdiction in the state in which the project that is the subject of the Construction Contract is located or after the expiration of one year from the date (1) on which the Claimant sent a Claim to the Surety pursuant to Paragraph 5.1.2 or 5.2, or (2) on which the last labor or service was performed by anyone or the last materials or equipment were furnished by anyone under the Construction Contract, whichever of (1) or (2) first occurs. If the provisions of this paragraph are void or prohibited by law, the minimum period of limitation available to sureties as a defense in the jurisdiction of the suit shall be applicable.
13. Notice and Claims to the Surety, the Owner, or the Contractor shall be mailed or delivered to the address shown on the page on which their signature appears. Actual receipt of notice or Claims, however accomplished, shall be sufficient compliance as of the date received.
14. When this Bond has been furnished to comply with a statutory or other legal requirement in the location where the construction was to be performed, any provision in this Bond conflicting with said statutory or legal requirement shall be deemed deleted herefrom and provisions conforming to such statutory or other legal requirement shall be deemed incorporated herein. When so furnished, the intent is that this Bond shall be construed as a statutory bond and not as a common law bond.
15. Upon requests by any person or entity appearing to be a potential beneficiary of this Bond, the Contractor and Owner shall promptly furnish a copy of this Bond or shall permit a copy to be made.

16. Definitions

16.1 **Claim:** A written statement by the Claimant including at a minimum:

1. The name of the Claimant;
2. The name of the person for whom the labor was done, or materials or equipment furnished;
3. A copy of the agreement or purchase order pursuant to which labor, materials,

or equipment was furnished for use in the performance of the Construction Contract;

4. A brief description of the labor, materials, or equipment furnished;
5. The date on which the Claimant last performed labor or last furnished materials or equipment for use in the performance of the Construction Contract;
6. The total amount earned by the Claimant for labor, materials, or equipment furnished as of the date of the Claim;
7. The total amount of previous payments received by the Claimant; and
8. The total amount due and unpaid to the Claimant for labor, materials, or equipment furnished as of the date of the Claim.

16.2 **Claimant:** An individual or entity having a direct contract with the Contractor or with a subcontractor of the Contractor to furnish labor, materials, or equipment for use in the performance of the Construction Contract. The term Claimant also includes any individual or entity that has rightfully asserted a claim under an applicable mechanic's lien or similar statute against the real property upon which the Project is located. The intent of this Bond shall be to include without limitation in the terms of "labor, materials, or equipment" that part of the water, gas, power, light, heat, oil, gasoline, telephone service, or rental equipment used in the Construction Contract, architectural and engineering services required for performance of the work of the Contractor and the Contractor's subcontractors, and all other items for which a mechanic's lien may be asserted in the jurisdiction where the labor, materials, or equipment were furnished.

16.3 **Construction Contract:** The agreement between the Owner and Contractor identified on the cover page, including all Contract Documents and all changes made to the agreement and the Contract Documents.

16.4 **Owner Default:** Failure of the Owner, which has not been remedied or waived, to pay the Contractor as required under the Construction Contract or to perform and complete or comply with the other material terms of the Construction Contract.

16.5 **Contract Documents:** All the documents that comprise the agreement between the Owner and Contractor.

17. If this Bond is issued for an agreement between a contractor and subcontractor, the term Contractor in

this Bond shall be deemed to be Subcontractor and
the term Owner shall be deemed to be Contractor.

18. Modifications to this Bond are as follows:

Contractor's Application for Payment No.

	Application Period:	Application Date:
To (Owner): Saginaw County Public Works Commissioner	From (Contractor):	Via (Engineer): Spicer Group, Inc.
Project: Gage Drain - Pump Station - Division I	Contract:	
Owner's Contract No.:	Contractor's Project No.:	Engineer's Project No.: 122901SG2015

Application For Payment

Change Order Summary

Approved Change Orders	Number	Additions	Deductions	
				1. ORIGINAL CONTRACT PRICE..... \$ _____
				2. Net change by Change Orders..... \$ _____
				3. Current Contract Price (Line 1 ± 2)..... \$ _____
				4. TOTAL COMPLETED AND STORED TO DATE
				(Column F total on Progress Estimates)..... \$ _____
				5. RETAINAGE:
				a. X _____ Work Completed..... \$ _____
				b. X _____ Stored Material..... \$ _____
				c. Total Retainage (Line 5.a + Line 5.b)..... \$ _____
				6. AMOUNT ELIGIBLE TO DATE (Line 4 - Line 5.c)..... \$ _____
				7. LESS PREVIOUS PAYMENTS (Line 6 from prior Application)..... \$ _____
				8. AMOUNT DUE THIS APPLICATION..... \$ _____
				9. BALANCE TO FINISH, PLUS RETAINAGE
				(Column G total on Progress Estimates + Line 5.c above)..... \$ _____
TOTALS				
NET CHANGE BY CHANGE ORDERS				

Contractor's Certification

The undersigned Contractor certifies, to the best of its knowledge, the following:

(1) All previous progress payments received from Owner on account of Work done under the Contract have been applied on account to discharge Contractor's legitimate obligations incurred in connection with the Work covered by prior Applications for Payment;

(2) Title to all Work, materials and equipment incorporated in said Work, or otherwise listed in or covered by this Application for Payment, will pass to Owner at time of payment free and clear of all Liens, security interests, and encumbrances (except such as are covered by a bond acceptable to Owner indemnifying Owner against any such Liens, security interest, or encumbrances); and

(3) All the Work covered by this Application for Payment is in accordance with the Contract Documents and is not defective.

Contractor Signature

By:	Date:
-----	-------

Payment of: \$ _____
(Line 8 or other - attach explanation of the other amount)

is recommended by: _____
(Engineer) (Date)

Payment of: \$ _____
(Line 8 or other - attach explanation of the other amount)

is approved by: _____
(Owner) (Date)

Approved by: _____
Funding or Financing Entity (if applicable) (Date)

CERTIFICATE OF SUBSTANTIAL COMPLETION

Owner: Saginaw County Public Works Commissioner	Owner's Contract No.:
Contractor:	Contractor's Project No.:
Engineer: Spicer Group, Inc.	Engineer's Project No.: 122901SG2015
Project: Gage Drain – Pump Station – Division I	Contract Name: Gage Drain – Pump Station – Division I

This [preliminary] [final] Certificate of Substantial Completion applies to:

☐ All Work ☐ The following specified portions of the Work:

Date of Substantial Completion

The Work to which this Certificate applies has been inspected by authorized representatives of Owner, Contractor, and Engineer, and found to be substantially complete. The Date of Substantial Completion of the Work or portion thereof designated above is hereby established, subject to the provisions of the Contract pertaining to Substantial Completion. The date of Substantial Completion in the final Certificate of Substantial Completion marks the commencement of the contractual correction period and applicable warranties required by the Contract.

A punch list of items to be completed or corrected is attached to this Certificate. This list may not be all-inclusive, and the failure to include any items on such list does not alter the responsibility of the Contractor to complete all Work in accordance with the Contract.

The responsibilities between Owner and Contractor for security, operation, safety, maintenance, heat, utilities, insurance, and warranties upon Owner's use or occupancy of the Work shall be as provided in the Contract, except as amended as follows: *[Note: Amendments of contractual responsibilities recorded in this Certificate should be the product of mutual agreement of Owner and Contractor; see Paragraph 15.03.D of the General Conditions.]*

Amendments to Owner's responsibilities: ☐ None
☐ As follows

Amendments to Contractor's responsibilities: ☐ None
☐ As follows:

The following documents are attached to and made a part of this Certificate: *[punch list; others]*

This Certificate does not constitute an acceptance of Work not in accordance with the Contract Documents, nor is it a release of Contractor's obligation to complete the Work in accordance with the Contract.

EXECUTED BY ENGINEER:	RECEIVED:	RECEIVED:
By: _____ (Authorized signature)	By: _____ Owner (Authorized Signature)	By: _____ Contractor (Authorized Signature)
Title: _____	Title: _____	Title: _____
Date: _____	Date: _____	Date: _____

**STANDARD GENERAL CONDITIONS OF THE
CONSTRUCTION CONTRACT**

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ARTICLE 1 – DEFINITIONS AND TERMINOLOGY

1.01 *Defined Terms*

- A. Wherever used in the Bidding Requirements or Contract Documents, a term printed with initial capital letters, including the term's singular and plural forms, will have the meaning indicated in the definitions below. In addition to terms specifically defined, terms with initial capital letters in the Contract Documents include references to identified articles and paragraphs, and the titles of other documents or forms.
1. *Addenda*—Written or graphic instruments issued prior to the opening of Bids which clarify, correct, or change the Bidding Requirements or the proposed Contract Documents.
 2. *Agreement*—The written instrument, executed by Owner and Contractor, that sets forth the Contract Price and Contract Times, identifies the parties and the Engineer, and designates the specific items that are Contract Documents.
 3. *Application for Payment*—The form acceptable to Engineer which is to be used by Contractor during the course of the Work in requesting progress or final payments and which is to be accompanied by such supporting documentation as is required by the Contract Documents.
 4. *Bid*—The offer of a Bidder submitted on the prescribed form setting forth the prices for the Work to be performed.
 5. *Bidder*—An individual or entity that submits a Bid to Owner.
 6. *Bidding Documents*—The Bidding Requirements, the proposed Contract Documents, and all Addenda.
 7. *Bidding Requirements*—The advertisement or invitation to bid, Instructions to Bidders, Bid Bond or other Bid security, if any, the Bid Form, and the Bid with any attachments.
 8. *Change Order*—A document which is signed by Contractor and Owner and authorizes an addition, deletion, or revision in the Work or an adjustment in the Contract Price or the Contract Times, or other revision to the Contract, issued on or after the Effective Date of the Contract.
 9. *Change Proposal*—A written request by Contractor, duly submitted in compliance with the procedural requirements set forth herein, seeking an adjustment in Contract Price or Contract Times, or both; contesting an initial decision by Engineer concerning the requirements of the Contract Documents or the acceptability of Work under the Contract Documents; challenging a set-off against payments due; or seeking other relief with respect to the terms of the Contract.
 10. *Claim*—(a) A demand or assertion by Owner directly to Contractor, duly submitted in compliance with the procedural requirements set forth herein: seeking an adjustment of Contract Price or Contract Times, or both; contesting an initial decision by Engineer concerning the requirements of the Contract Documents or the acceptability of Work under the Contract Documents; contesting Engineer's decision regarding a Change Proposal; seeking resolution of a contractual issue that Engineer has declined to address; or seeking other relief with respect to the terms of the Contract; or (b) a demand or assertion by Contractor directly to Owner, duly submitted in compliance with the procedural requirements set forth herein, contesting Engineer's decision regarding a Change Proposal; or seeking resolution of a contractual issue that Engineer has declined to address. A demand for money or services by a third party is not a Claim.

11. *Constituent of Concern*—Asbestos, petroleum, radioactive materials, polychlorinated biphenyls (PCBs), hazardous waste, and any substance, product, waste, or other material of any nature whatsoever that is or becomes listed, regulated, or addressed pursuant to (a) the Comprehensive Environmental Response, Compensation and Liability Act, 42 U.S.C. §§9601 et seq. (“CERCLA”); (b) the Hazardous Materials Transportation Act, 49 U.S.C. §§5501 et seq.; (c) the Resource Conservation and Recovery Act, 42 U.S.C. §§6901 et seq. (“RCRA”); (d) the Toxic Substances Control Act, 15 U.S.C. §§2601 et seq.; (e) the Clean Water Act, 33 U.S.C. §§1251 et seq.; (f) the Clean Air Act, 42 U.S.C. §§7401 et seq.; or (g) any other federal, state, or local statute, law, rule, regulation, ordinance, resolution, code, order, or decree regulating, relating to, or imposing liability or standards of conduct concerning, any hazardous, toxic, or dangerous waste, substance, or material.
12. *Contract*—The entire and integrated written contract between the Owner and Contractor concerning the Work.
13. *Contract Documents*—Those items so designated in the Agreement, and which together comprise the Contract.
14. *Contract Price*—The money that Owner has agreed to pay Contractor for completion of the Work in accordance with the Contract Documents. .
15. *Contract Times*—The number of days or the dates by which Contractor shall: (a) achieve Milestones, if any; (b) achieve Substantial Completion; and (c) complete the Work.
16. *Contractor*—The individual or entity with which Owner has contracted for performance of the Work.
17. *Cost of the Work*—See Paragraph 13.01 for definition.
18. *Drawings*—The part of the Contract that graphically shows the scope, extent, and character of the Work to be performed by Contractor.
19. *Effective Date of the Contract*—The date, indicated in the Agreement, on which the Contract becomes effective.
20. *Engineer*—The individual or entity named as such in the Agreement.
21. *Field Order*—A written order issued by Engineer which requires minor changes in the Work but does not change the Contract Price or the Contract Times.
22. *Hazardous Environmental Condition*—The presence at the Site of Constituents of Concern in such quantities or circumstances that may present a danger to persons or property exposed thereto. The presence at the Site of materials that are necessary for the execution of the Work, or that are to be incorporated in the Work, and that are controlled and contained pursuant to industry practices, Laws and Regulations, and the requirements of the Contract, does not establish a Hazardous Environmental Condition.
23. *Laws and Regulations; Laws or Regulations*—Any and all applicable laws, statutes, rules, regulations, ordinances, codes, and orders of any and all governmental bodies, agencies, authorities, and courts having jurisdiction.
24. *Liens*—Charges, security interests, or encumbrances upon Contract-related funds, real property, or personal property.
25. *Milestone*—A principal event in the performance of the Work that the Contract requires Contractor to achieve by an intermediate completion date or by a time prior to Substantial Completion of all the Work.

26. *Notice of Award*—The written notice by Owner to a Bidder of Owner's acceptance of the Bid.
27. *Notice to Proceed*—A written notice by Owner to Contractor fixing the date on which the Contract Times will commence to run and on which Contractor shall start to perform the Work.
28. *Owner*—The individual or entity with which Contractor has contracted regarding the Work, and which has agreed to pay Contractor for the performance of the Work, pursuant to the terms of the Contract.
29. *Progress Schedule*—A schedule, prepared and maintained by Contractor, describing the sequence and duration of the activities comprising the Contractor's plan to accomplish the Work within the Contract Times.
30. *Project*—The total undertaking to be accomplished for Owner by engineers, contractors, and others, including planning, study, design, construction, testing, commissioning, and start-up, and of which the Work to be performed under the Contract Documents is a part.
31. *Project Manual*—The written documents prepared for, or made available for, procuring and constructing the Work, including but not limited to the Bidding Documents or other construction procurement documents, geotechnical and existing conditions information, the Agreement, bond forms, General Conditions, Supplementary Conditions, and Specifications. The contents of the Project Manual may be bound in one or more volumes.
32. *Resident Project Representative*—The authorized representative of Engineer assigned to assist Engineer at the Site. As used herein, the term Resident Project Representative or "RPR" includes any assistants or field staff of Resident Project Representative.
33. *Samples*—Physical examples of materials, equipment, or workmanship that are representative of some portion of the Work and that establish the standards by which such portion of the Work will be judged.
34. *Schedule of Submittals*—A schedule, prepared and maintained by Contractor, of required submittals and the time requirements for Engineer's review of the submittals and the performance of related construction activities.
35. *Schedule of Values*—A schedule, prepared and maintained by Contractor, allocating portions of the Contract Price to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.
36. *Shop Drawings*—All drawings, diagrams, illustrations, schedules, and other data or information that are specifically prepared or assembled by or for Contractor and submitted by Contractor to illustrate some portion of the Work. Shop Drawings, whether approved or not, are not Drawings and are not Contract Documents.
37. *Site*—Lands or areas indicated in the Contract Documents as being furnished by Owner upon which the Work is to be performed, including rights-of-way and easements, and such other lands furnished by Owner which are designated for the use of Contractor.
38. *Specifications*—The part of the Contract that consists of written requirements for materials, equipment, systems, standards, and workmanship as applied to the Work, and certain administrative requirements and procedural matters applicable to the Work.
39. *Subcontractor*—An individual or entity having a direct contract with Contractor or with any other Subcontractor for the performance of a part of the Work.
40. *Substantial Completion*—The time at which the Work (or a specified part thereof) has progressed to the point where, in the opinion of Engineer, the Work (or a specified part

thereof) is sufficiently complete, in accordance with the Contract Documents, so that the Work (or a specified part thereof) can be utilized for the purposes for which it is intended. The terms “substantially complete” and “substantially completed” as applied to all or part of the Work refer to Substantial Completion thereof.

41. *Successful Bidder*—The Bidder whose Bid the Owner accepts, and to which the Owner makes an award of contract, subject to stated conditions.
42. *Supplementary Conditions*—The part of the Contract that amends or supplements these General Conditions.
43. *Supplier*—A manufacturer, fabricator, supplier, distributor, materialman, or vendor having a direct contract with Contractor or with any Subcontractor to furnish materials or equipment to be incorporated in the Work by Contractor or a Subcontractor.
44. *Technical Data*—Those items expressly identified as Technical Data in the Supplementary Conditions, with respect to either (a) subsurface conditions at the Site, or physical conditions relating to existing surface or subsurface structures at the Site (except Underground Facilities) or (b) Hazardous Environmental Conditions at the Site. If no such express identifications of Technical Data have been made with respect to conditions at the Site, then the data contained in boring logs, recorded measurements of subsurface water levels, laboratory test results, and other factual, objective information regarding conditions at the Site that are set forth in any geotechnical or environmental report prepared for the Project and made available to Contractor are hereby defined as Technical Data with respect to conditions at the Site under Paragraphs 5.03, 5.04, and 5.06.
45. *Underground Facilities*—All underground pipelines, conduits, ducts, cables, wires, manholes, vaults, tanks, tunnels, or other such facilities or attachments, and any encasements containing such facilities, including but not limited to those that convey electricity, gases, steam, liquid petroleum products, telephone or other communications, fiber optic transmissions, cable television, water, wastewater, storm water, other liquids or chemicals, or traffic or other control systems.
46. *Unit Price Work*—Work to be paid for on the basis of unit prices.
47. *Work*—The entire construction or the various separately identifiable parts thereof required to be provided under the Contract Documents. Work includes and is the result of performing or providing all labor, services, and documentation necessary to produce such construction; furnishing, installing, and incorporating all materials and equipment into such construction; and may include related services such as testing, start-up, and commissioning, all as required by the Contract Documents.
48. *Work Change Directive*—A written directive to Contractor issued on or after the Effective Date of the Contract, signed by Owner and recommended by Engineer, ordering an addition, deletion, or revision in the Work.

1.02 Terminology

- A. The words and terms discussed in the following paragraphs are not defined but, when used in the Bidding Requirements or Contract Documents, have the indicated meaning.
- B. *Intent of Certain Terms or Adjectives*:
 1. The Contract Documents include the terms “as allowed,” “as approved,” “as ordered,” “as directed” or terms of like effect or import to authorize an exercise of professional judgment by Engineer. In addition, the adjectives “reasonable,” “suitable,” “acceptable,” “proper,” “satisfactory,” or adjectives of like effect or import are used to describe an action or determination of Engineer as to the Work. It is intended that such exercise of professional judgment, action, or determination will be solely to evaluate, in

general, the Work for compliance with the information in the Contract Documents and with the design concept of the Project as a functioning whole as shown or indicated in the Contract Documents (unless there is a specific statement indicating otherwise). The use of any such term or adjective is not intended to and shall not be effective to assign to Engineer any duty or authority to supervise or direct the performance of the Work, or any duty or authority to undertake responsibility contrary to the provisions of Article 10 or any other provision of the Contract Documents.

C. *Day:*

1. The word “day” means a calendar day of 24 hours measured from midnight to the next midnight.

D. *Defective:*

1. The word “defective,” when modifying the word “Work,” refers to Work that is unsatisfactory, faulty, or deficient in that it:
 - a. does not conform to the Contract Documents; or
 - b. does not meet the requirements of any applicable inspection, reference standard, test, or approval referred to in the Contract Documents; or
 - c. has been damaged prior to Engineer’s recommendation of final payment (unless responsibility for the protection thereof has been assumed by Owner at Substantial Completion in accordance with Paragraph 15.03 or 15.04).

E. *Furnish, Install, Perform, Provide:*

1. The word “furnish,” when used in connection with services, materials, or equipment, shall mean to supply and deliver said services, materials, or equipment to the Site (or some other specified location) ready for use or installation and in usable or operable condition.
2. The word “install,” when used in connection with services, materials, or equipment, shall mean to put into use or place in final position said services, materials, or equipment complete and ready for intended use.
3. The words “perform” or “provide,” when used in connection with services, materials, or equipment, shall mean to furnish and install said services, materials, or equipment complete and ready for intended use.
4. If the Contract Documents establish an obligation of Contractor with respect to specific services, materials, or equipment, but do not expressly use any of the four words “furnish,” “install,” “perform,” or “provide,” then Contractor shall furnish and install said services, materials, or equipment complete and ready for intended use.

- F. Unless stated otherwise in the Contract Documents, words or phrases that have a well-known technical or construction industry or trade meaning are used in the Contract Documents in accordance with such recognized meaning.

ARTICLE 2 – PRELIMINARY MATTERS

2.01 *Delivery of Bonds and Evidence of Insurance*

- A. *Bonds:* When Contractor delivers the executed counterparts of the Agreement to Owner, Contractor shall also deliver to Owner such bonds as Contractor may be required to furnish.
- B. *Evidence of Contractor’s Insurance:* When Contractor delivers the executed counterparts of the Agreement to Owner, Contractor shall also deliver to Owner, with copies to each named insured and additional insured (as identified in the Supplementary Conditions or elsewhere

in the Contract), the certificates and other evidence of insurance required to be provided by Contractor in accordance with Article 6.

- C. *Evidence of Owner's Insurance:* After receipt of the executed counterparts of the Agreement and all required bonds and insurance documentation, Owner shall promptly deliver to Contractor, with copies to each named insured and additional insured (as identified in the Supplementary Conditions or otherwise), the certificates and other evidence of insurance required to be provided by Owner under Article 6.

2.02 *Copies of Documents*

- A. Owner shall furnish to Contractor four printed copies of the Contract (including one fully executed counterpart of the Agreement), and one copy in electronic portable document format (PDF). Additional printed copies will be furnished upon request at the cost of reproduction.
- B. Owner shall maintain and safeguard at least one original printed record version of the Contract, including Drawings and Specifications signed and sealed by Engineer and other design professionals. Owner shall make such original printed record version of the Contract available to Contractor for review. Owner may delegate the responsibilities under this provision to Engineer.

2.03 *Before Starting Construction*

- A. *Preliminary Schedules:* Within 10 days after the Effective Date of the Contract (or as otherwise specifically required by the Contract Documents), Contractor shall submit to Engineer for timely review:
 - 1. a preliminary Progress Schedule indicating the times (numbers of days or dates) for starting and completing the various stages of the Work, including any Milestones specified in the Contract;
 - 2. a preliminary Schedule of Submittals; and
 - 3. a preliminary Schedule of Values for all of the Work which includes quantities and prices of items which when added together equal the Contract Price and subdivides the Work into component parts in sufficient detail to serve as the basis for progress payments during performance of the Work. Such prices will include an appropriate amount of overhead and profit applicable to each item of Work.

2.04 *Preconstruction Conference; Designation of Authorized Representatives*

- A. Before any Work at the Site is started, a conference attended by Owner, Contractor, Engineer, and others as appropriate will be held to establish a working understanding among the parties as to the Work and to discuss the schedules referred to in Paragraph 2.03.A, procedures for handling Shop Drawings, Samples, and other submittals, processing Applications for Payment, electronic or digital transmittals, and maintaining required records.
- B. At this conference Owner and Contractor each shall designate, in writing, a specific individual to act as its authorized representative with respect to the services and responsibilities under the Contract. Such individuals shall have the authority to transmit and receive information, render decisions relative to the Contract, and otherwise act on behalf of each respective party.

2.05 *Initial Acceptance of Schedules*

- A. At least 10 days before submission of the first Application for Payment a conference, attended by Contractor, Engineer, and others as appropriate, will be held to review for acceptability to Engineer as provided below the schedules submitted in accordance with Paragraph 2.03.A. Contractor shall have an additional 10 days to make corrections and

adjustments and to complete and resubmit the schedules. No progress payment shall be made to Contractor until acceptable schedules are submitted to Engineer.

1. The Progress Schedule will be acceptable to Engineer if it provides an orderly progression of the Work to completion within the Contract Times. Such acceptance will not impose on Engineer responsibility for the Progress Schedule, for sequencing, scheduling, or progress of the Work, nor interfere with or relieve Contractor from Contractor's full responsibility therefor.
2. Contractor's Schedule of Submittals will be acceptable to Engineer if it provides a workable arrangement for reviewing and processing the required submittals.
3. Contractor's Schedule of Values will be acceptable to Engineer as to form and substance if it provides a reasonable allocation of the Contract Price to the component parts of the Work.

2.06 *Electronic Transmittals*

- A. Except as otherwise stated elsewhere in the Contract, the Owner, Engineer, and Contractor may transmit, and shall accept, Project-related correspondence, text, data, documents, drawings, information, and graphics, including but not limited to Shop Drawings and other submittals, in electronic media or digital format, either directly, or through access to a secure Project website.
- B. If the Contract does not establish protocols for electronic or digital transmittals, then Owner, Engineer, and Contractor shall jointly develop such protocols.
- C. When transmitting items in electronic media or digital format, the transmitting party makes no representations as to long term compatibility, usability, or readability of the items resulting from the recipient's use of software application packages, operating systems, or computer hardware differing from those used in the drafting or transmittal of the items, or from those established in applicable transmittal protocols.

ARTICLE 3 – DOCUMENTS: INTENT, REQUIREMENTS, REUSE

3.01 *Intent*

- A. The Contract Documents are complementary; what is required by one is as binding as if required by all.
- B. It is the intent of the Contract Documents to describe a functionally complete project (or part thereof) to be constructed in accordance with the Contract Documents.
- C. Unless otherwise stated in the Contract Documents, if there is a discrepancy between the electronic or digital versions of the Contract Documents (including any printed copies derived from such electronic or digital versions) and the printed record version, the printed record version shall govern.
- D. The Contract supersedes prior negotiations, representations, and agreements, whether written or oral.
- E. Engineer will issue clarifications and interpretations of the Contract Documents as provided herein.

3.02 *Reference Standards*

- A. Standards Specifications, Codes, Laws and Regulations
 1. Reference in the Contract Documents to standard specifications, manuals, reference standards, or codes of any technical society, organization, or association, or to Laws or Regulations, whether such reference be specific or by implication, shall mean the

standard specification, manual, reference standard, code, or Laws or Regulations in effect at the time of opening of Bids (or on the Effective Date of the Contract if there were no Bids), except as may be otherwise specifically stated in the Contract Documents.

2. No provision of any such standard specification, manual, reference standard, or code, or any instruction of a Supplier, shall be effective to change the duties or responsibilities of Owner, Contractor, or Engineer, or any of their subcontractors, consultants, agents, or employees, from those set forth in the part of the Contract Documents prepared by or for Engineer. No such provision or instruction shall be effective to assign to Owner, Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors, any duty or authority to supervise or direct the performance of the Work or any duty or authority to undertake responsibility inconsistent with the provisions of the part of the Contract Documents prepared by or for Engineer.

3.03 *Reporting and Resolving Discrepancies*

A. *Reporting Discrepancies:*

1. *Contractor's Verification of Figures and Field Measurements:* Before undertaking each part of the Work, Contractor shall carefully study the Contract Documents, and check and verify pertinent figures and dimensions therein, particularly with respect to applicable field measurements. Contractor shall promptly report in writing to Engineer any conflict, error, ambiguity, or discrepancy that Contractor discovers, or has actual knowledge of, and shall not proceed with any Work affected thereby until the conflict, error, ambiguity, or discrepancy is resolved, by a clarification or interpretation by Engineer, or by an amendment or supplement to the Contract Documents issued pursuant to Paragraph 11.01.
2. *Contractor's Review of Contract Documents:* If, before or during the performance of the Work, Contractor discovers any conflict, error, ambiguity, or discrepancy within the Contract Documents, or between the Contract Documents and (a) any applicable Law or Regulation, (b) actual field conditions, (c) any standard specification, manual, reference standard, or code, or (d) any instruction of any Supplier, then Contractor shall promptly report it to Engineer in writing. Contractor shall not proceed with the Work affected thereby (except in an emergency as required by Paragraph 7.15) until the conflict, error, ambiguity, or discrepancy is resolved, by a clarification or interpretation by Engineer, or by an amendment or supplement to the Contract Documents issued pursuant to Paragraph 11.01.
3. Contractor shall not be liable to Owner or Engineer for failure to report any conflict, error, ambiguity, or discrepancy in the Contract Documents unless Contractor had actual knowledge thereof.

B. *Resolving Discrepancies:*

1. Except as may be otherwise specifically stated in the Contract Documents, the provisions of the part of the Contract Documents prepared by or for Engineer shall take precedence in resolving any conflict, error, ambiguity, or discrepancy between such provisions of the Contract Documents and:
 - a. the provisions of any standard specification, manual, reference standard, or code, or the instruction of any Supplier (whether or not specifically incorporated by reference as a Contract Document); or
 - b. the provisions of any Laws or Regulations applicable to the performance of the Work (unless such an interpretation of the provisions of the Contract Documents would result in violation of such Law or Regulation).

3.04 *Requirements of the Contract Documents*

- A. During the performance of the Work and until final payment, Contractor and Owner shall submit to the Engineer all matters in question concerning the requirements of the Contract Documents (sometimes referred to as requests for information or interpretation—RFIs), or relating to the acceptability of the Work under the Contract Documents, as soon as possible after such matters arise. Engineer will be the initial interpreter of the requirements of the Contract Documents, and judge of the acceptability of the Work thereunder.
- B. Engineer will, with reasonable promptness, render a written clarification, interpretation, or decision on the issue submitted, or initiate an amendment or supplement to the Contract Documents. Engineer's written clarification, interpretation, or decision will be final and binding on Contractor, unless it appeals by submitting a Change Proposal, and on Owner, unless it appeals by filing a Claim.
- C. If a submitted matter in question concerns terms and conditions of the Contract Documents that do not involve (1) the performance or acceptability of the Work under the Contract Documents, (2) the design (as set forth in the Drawings, Specifications, or otherwise), or (3) other engineering or technical matters, then Engineer will promptly give written notice to Owner and Contractor that Engineer is unable to provide a decision or interpretation. If Owner and Contractor are unable to agree on resolution of such a matter in question, either party may pursue resolution as provided in Article 12.

3.05 *Reuse of Documents*

- A. Contractor and its Subcontractors and Suppliers shall not:
 - 1. have or acquire any title to or ownership rights in any of the Drawings, Specifications, or other documents (or copies of any thereof) prepared by or bearing the seal of Engineer or its consultants, including electronic media editions, or reuse any such Drawings, Specifications, other documents, or copies thereof on extensions of the Project or any other project without written consent of Owner and Engineer and specific written verification or adaptation by Engineer; or
 - 2. have or acquire any title or ownership rights in any other Contract Documents, reuse any such Contract Documents for any purpose without Owner's express written consent, or violate any copyrights pertaining to such Contract Documents.
- B. The prohibitions of this Paragraph 3.05 will survive final payment, or termination of the Contract. Nothing herein shall preclude Contractor from retaining copies of the Contract Documents for record purposes.

ARTICLE 4 – COMMENCEMENT AND PROGRESS OF THE WORK

4.01 *Commencement of Contract Times; Notice to Proceed*

- A. The Contract Times will commence to run on the thirtieth day after the Effective Date of the Contract or, if a Notice to Proceed is given, on the day indicated in the Notice to Proceed. A Notice to Proceed may be given at any time within 30 days after the Effective Date of the Contract. In no event will the Contract Times commence to run later than the sixtieth day after the day of Bid opening or the thirtieth day after the Effective Date of the Contract, whichever date is earlier.

4.02 *Starting the Work*

- A. Contractor shall start to perform the Work on the date when the Contract Times commence to run. No Work shall be done at the Site prior to such date.

4.03 *Reference Points*

- A. Owner shall provide engineering surveys to establish reference points for construction which in Engineer's judgment are necessary to enable Contractor to proceed with the Work. Contractor shall be responsible for laying out the Work, shall protect and preserve the established reference points and property monuments, and shall make no changes or relocations without the prior written approval of Owner. Contractor shall report to Engineer whenever any reference point or property monument is lost or destroyed or requires relocation because of necessary changes in grades or locations, and shall be responsible for the accurate replacement or relocation of such reference points or property monuments by professionally qualified personnel.

4.04 *Progress Schedule*

- A. Contractor shall adhere to the Progress Schedule established in accordance with Paragraph 2.05 as it may be adjusted from time to time as provided below.
 - 1. Contractor shall submit to Engineer for acceptance (to the extent indicated in Paragraph 2.05) proposed adjustments in the Progress Schedule that will not result in changing the Contract Times.
 - 2. Proposed adjustments in the Progress Schedule that will change the Contract Times shall be submitted in accordance with the requirements of Article 11.
- B. Contractor shall carry on the Work and adhere to the Progress Schedule during all disputes or disagreements with Owner. No Work shall be delayed or postponed pending resolution of any disputes or disagreements, or during any appeal process, except as permitted by Paragraph 16.04, or as Owner and Contractor may otherwise agree in writing.

4.05 *Delays in Contractor's Progress*

- A. If Owner, Engineer, or anyone for whom Owner is responsible, delays, disrupts, or interferes with the performance or progress of the Work, then Contractor shall be entitled to an equitable adjustment in the Contract Times and Contract Price. Contractor's entitlement to an adjustment of the Contract Times is conditioned on such adjustment being essential to Contractor's ability to complete the Work within the Contract Times.
- B. Contractor shall not be entitled to an adjustment in Contract Price or Contract Times for delay, disruption, or interference caused by or within the control of Contractor. Delay, disruption, and interference attributable to and within the control of a Subcontractor or Supplier shall be deemed to be within the control of Contractor.
- C. If Contractor's performance or progress is delayed, disrupted, or interfered with by unanticipated causes not the fault of and beyond the control of Owner, Contractor, and those for which they are responsible, then Contractor shall be entitled to an equitable adjustment in Contract Times. Contractor's entitlement to an adjustment of the Contract Times is conditioned on such adjustment being essential to Contractor's ability to complete the Work within the Contract Times. Such an adjustment shall be Contractor's sole and exclusive remedy for the delays, disruption, and interference described in this paragraph. Causes of delay, disruption, or interference that may give rise to an adjustment in Contract Times under this paragraph include but are not limited to the following:
 - 1. severe and unavoidable natural catastrophes such as fires, floods, epidemics, and earthquakes;
 - 2. abnormal weather conditions;
 - 3. acts or failures to act of utility owners (other than those performing other work at or adjacent to the Site by arrangement with the Owner, as contemplated in Article 8); and
 - 4. acts of war or terrorism.

- D. Delays, disruption, and interference to the performance or progress of the Work resulting from the existence of a differing subsurface or physical condition, an Underground Facility that was not shown or indicated by the Contract Documents, or not shown or indicated with reasonable accuracy, and those resulting from Hazardous Environmental Conditions, are governed by Article 5.
- E. Paragraph 8.03 governs delays, disruption, and interference to the performance or progress of the Work resulting from the performance of certain other work at or adjacent to the Site.
- F. Contractor shall not be entitled to an adjustment in Contract Price or Contract Times for any delay, disruption, or interference if such delay is concurrent with a delay, disruption, or interference caused by or within the control of Contractor.
- G. Contractor must submit any Change Proposal seeking an adjustment in Contract Price or Contract Times under this paragraph within 30 days of the commencement of the delaying, disrupting, or interfering event.

ARTICLE 5 – AVAILABILITY OF LANDS; SUBSURFACE AND PHYSICAL CONDITIONS; HAZARDOUS ENVIRONMENTAL CONDITIONS

5.01 *Availability of Lands*

- A. Owner shall furnish the Site. Owner shall notify Contractor of any encumbrances or restrictions not of general application but specifically related to use of the Site with which Contractor must comply in performing the Work.
- B. Upon reasonable written request, Owner shall furnish Contractor with a current statement of record legal title and legal description of the lands upon which permanent improvements are to be made and Owner's interest therein as necessary for giving notice of or filing a mechanic's or construction lien against such lands in accordance with applicable Laws and Regulations.
- C. Contractor shall provide for all additional lands and access thereto that may be required for temporary construction facilities or storage of materials and equipment.

5.02 *Use of Site and Other Areas*

- A. *Limitation on Use of Site and Other Areas:*
 - 1. Contractor shall confine construction equipment, temporary construction facilities, the storage of materials and equipment, and the operations of workers to the Site, adjacent areas that Contractor has arranged to use through construction easements or otherwise, and other adjacent areas permitted by Laws and Regulations, and shall not unreasonably encumber the Site and such other adjacent areas with construction equipment or other materials or equipment. Contractor shall assume full responsibility for (a) damage to the Site; (b) damage to any such other adjacent areas used for Contractor's operations; (c) damage to any other adjacent land or areas; and (d) for injuries and losses sustained by the owners or occupants of any such land or areas; provided that such damage or injuries result from the performance of the Work or from other actions or conduct of the Contractor or those for which Contractor is responsible.
 - 2. If a damage or injury claim is made by the owner or occupant of any such land or area because of the performance of the Work, or because of other actions or conduct of the Contractor or those for which Contractor is responsible, Contractor shall (a) take immediate corrective or remedial action as required by Paragraph 7.12, or otherwise; (b) promptly attempt to settle the claim as to all parties through negotiations with such owner or occupant, or otherwise resolve the claim by arbitration or other dispute resolution proceeding, or at law; and (c) to the fullest extent permitted by Laws and Regulations, indemnify and hold harmless Owner and Engineer, and the officers,

directors, members, partners, employees, agents, consultants and subcontractors of each and any of them from and against any such claim, and against all costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to any claim or action, legal or equitable, brought by any such owner or occupant against Owner, Engineer, or any other party indemnified hereunder to the extent caused directly or indirectly, in whole or in part by, or based upon, Contractor's performance of the Work, or because of other actions or conduct of the Contractor or those for which Contractor is responsible.

- B. *Removal of Debris During Performance of the Work:* During the progress of the Work the Contractor shall keep the Site and other adjacent areas free from accumulations of waste materials, rubbish, and other debris. Removal and disposal of such waste materials, rubbish, and other debris shall conform to applicable Laws and Regulations.
- C. *Cleaning:* Prior to Substantial Completion of the Work Contractor shall clean the Site and the Work and make it ready for utilization by Owner. At the completion of the Work Contractor shall remove from the Site and adjacent areas all tools, appliances, construction equipment and machinery, and surplus materials and shall restore to original condition all property not designated for alteration by the Contract Documents.
- D. *Loading of Structures:* Contractor shall not load nor permit any part of any structure to be loaded in any manner that will endanger the structure, nor shall Contractor subject any part of the Work or adjacent structures or land to stresses or pressures that will endanger them.

5.03 *Subsurface and Physical Conditions*

- A. *Reports and Drawings:* The Supplementary Conditions identify:
 - 1. those reports known to Owner of explorations and tests of subsurface conditions at or adjacent to the Site;
 - 2. those drawings known to Owner of physical conditions relating to existing surface or subsurface structures at the Site (except Underground Facilities); and
 - 3. Technical Data contained in such reports and drawings.
- B. *Reliance by Contractor on Technical Data Authorized:* Contractor may rely upon the accuracy of the Technical Data expressly identified in the Supplementary Conditions with respect to such reports and drawings, but such reports and drawings are not Contract Documents. If no such express identification has been made, then Contractor may rely upon the accuracy of the Technical Data (as defined in Article 1) contained in any geotechnical or environmental report prepared for the Project and made available to Contractor. Except for such reliance on Technical Data, Contractor may not rely upon or make any claim against Owner or Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors, with respect to:
 - 1. the completeness of such reports and drawings for Contractor's purposes, including, but not limited to, any aspects of the means, methods, techniques, sequences, and procedures of construction to be employed by Contractor, and safety precautions and programs incident thereto; or
 - 2. other data, interpretations, opinions, and information contained in such reports or shown or indicated in such drawings; or
 - 3. any Contractor interpretation of or conclusion drawn from any Technical Data or any such other data, interpretations, opinions, or information.

5.04 *Differing Subsurface or Physical Conditions*

- A. *Notice by Contractor:* If Contractor believes that any subsurface or physical condition that is uncovered or revealed at the Site either:
1. is of such a nature as to establish that any Technical Data on which Contractor is entitled to rely as provided in Paragraph 5.03 is materially inaccurate; or
 2. is of such a nature as to require a change in the Drawings or Specifications; or
 3. differs materially from that shown or indicated in the Contract Documents; or
 4. is of an unusual nature, and differs materially from conditions ordinarily encountered and generally recognized as inherent in work of the character provided for in the Contract Documents;

then Contractor shall, promptly after becoming aware thereof and before further disturbing the subsurface or physical conditions or performing any Work in connection therewith (except in an emergency as required by Paragraph 7.15), notify Owner and Engineer in writing about such condition. Contractor shall not further disturb such condition or perform any Work in connection therewith (except with respect to an emergency) until receipt of a written statement permitting Contractor to do so.

- B. *Engineer's Review:* After receipt of written notice as required by the preceding paragraph, Engineer will promptly review the subsurface or physical condition in question; determine the necessity of Owner's obtaining additional exploration or tests with respect to the condition; conclude whether the condition falls within any one or more of the differing site condition categories in Paragraph 5.04.A above; obtain any pertinent cost or schedule information from Contractor; prepare recommendations to Owner regarding the Contractor's resumption of Work in connection with the subsurface or physical condition in question and the need for any change in the Drawings or Specifications; and advise Owner in writing of Engineer's findings, conclusions, and recommendations.
- C. *Owner's Statement to Contractor Regarding Site Condition:* After receipt of Engineer's written findings, conclusions, and recommendations, Owner shall issue a written statement to Contractor (with a copy to Engineer) regarding the subsurface or physical condition in question, addressing the resumption of Work in connection with such condition, indicating whether any change in the Drawings or Specifications will be made, and adopting or rejecting Engineer's written findings, conclusions, and recommendations, in whole or in part.
- D. *Possible Price and Times Adjustments:*
1. Contractor shall be entitled to an equitable adjustment in Contract Price or Contract Times, or both, to the extent that the existence of a differing subsurface or physical condition, or any related delay, disruption, or interference, causes an increase or decrease in Contractor's cost of, or time required for, performance of the Work; subject, however, to the following:
 - a. such condition must fall within any one or more of the categories described in Paragraph 5.04.A;
 - b. with respect to Work that is paid for on a unit price basis, any adjustment in Contract Price will be subject to the provisions of Paragraph 13.03; and,
 - c. Contractor's entitlement to an adjustment of the Contract Times is conditioned on such adjustment being essential to Contractor's ability to complete the Work within the Contract Times.

2. Contractor shall not be entitled to any adjustment in the Contract Price or Contract Times with respect to a subsurface or physical condition if:
 - a. Contractor knew of the existence of such condition at the time Contractor made a commitment to Owner with respect to Contract Price and Contract Times by the submission of a Bid or becoming bound under a negotiated contract, or otherwise; or
 - b. the existence of such condition reasonably could have been discovered or revealed as a result of any examination, investigation, exploration, test, or study of the Site and contiguous areas expressly required by the Bidding Requirements or Contract Documents to be conducted by or for Contractor prior to Contractor's making such commitment; or
 - c. Contractor failed to give the written notice as required by Paragraph 5.04.A.
3. If Owner and Contractor agree regarding Contractor's entitlement to and the amount or extent of any adjustment in the Contract Price or Contract Times, or both, then any such adjustment shall be set forth in a Change Order.
4. Contractor may submit a Change Proposal regarding its entitlement to or the amount or extent of any adjustment in the Contract Price or Contract Times, or both, no later than 30 days after Owner's issuance of the Owner's written statement to Contractor regarding the subsurface or physical condition in question.

5.05 *Underground Facilities*

- A. *Contractor's Responsibilities:* The information and data shown or indicated in the Contract Documents with respect to existing Underground Facilities at or adjacent to the Site is based on information and data furnished to Owner or Engineer by the owners of such Underground Facilities, including Owner, or by others. Unless it is otherwise expressly provided in the Supplementary Conditions:
 1. Owner and Engineer do not warrant or guarantee the accuracy or completeness of any such information or data provided by others; and
 2. the cost of all of the following will be included in the Contract Price, and Contractor shall have full responsibility for:
 - a. reviewing and checking all information and data regarding existing Underground Facilities at the Site;
 - b. locating all Underground Facilities shown or indicated in the Contract Documents as being at the Site;
 - c. coordination of the Work with the owners (including Owner) of such Underground Facilities, during construction; and
 - d. the safety and protection of all existing Underground Facilities at the Site, and repairing any damage thereto resulting from the Work.
- B. *Notice by Contractor:* If Contractor believes that an Underground Facility that is uncovered or revealed at the Site was not shown or indicated in the Contract Documents, or was not shown or indicated with reasonable accuracy, then Contractor shall, promptly after becoming aware thereof and before further disturbing conditions affected thereby or performing any Work in connection therewith (except in an emergency as required by Paragraph 7.15), identify the owner of such Underground Facility and give written notice to that owner and to Owner and Engineer.
- C. *Engineer's Review:* Engineer will promptly review the Underground Facility and conclude whether such Underground Facility was not shown or indicated in the Contract Documents,

or was not shown or indicated with reasonable accuracy; obtain any pertinent cost or schedule information from Contractor; prepare recommendations to Owner regarding the Contractor's resumption of Work in connection with the Underground Facility in question; determine the extent, if any, to which a change is required in the Drawings or Specifications to reflect and document the consequences of the existence or location of the Underground Facility; and advise Owner in writing of Engineer's findings, conclusions, and recommendations. During such time, Contractor shall be responsible for the safety and protection of such Underground Facility.

D. *Owner's Statement to Contractor Regarding Underground Facility:* After receipt of Engineer's written findings, conclusions, and recommendations, Owner shall issue a written statement to Contractor (with a copy to Engineer) regarding the Underground Facility in question, addressing the resumption of Work in connection with such Underground Facility, indicating whether any change in the Drawings or Specifications will be made, and adopting or rejecting Engineer's written findings, conclusions, and recommendations in whole or in part.

E. *Possible Price and Times Adjustments:*

1. Contractor shall be entitled to an equitable adjustment in the Contract Price or Contract Times, or both, to the extent that any existing Underground Facility at the Site that was not shown or indicated in the Contract Documents, or was not shown or indicated with reasonable accuracy, or any related delay, disruption, or interference, causes an increase or decrease in Contractor's cost of, or time required for, performance of the Work; subject, however, to the following:
 - a. Contractor did not know of and could not reasonably have been expected to be aware of or to have anticipated the existence or actual location of the Underground Facility in question;
 - b. With respect to Work that is paid for on a unit price basis, any adjustment in Contract Price will be subject to the provisions of Paragraph 13.03;
 - c. Contractor's entitlement to an adjustment of the Contract Times is conditioned on such adjustment being essential to Contractor's ability to complete the Work within the Contract Times; and
 - d. Contractor gave the notice required in Paragraph 5.05.B.
2. If Owner and Contractor agree regarding Contractor's entitlement to and the amount or extent of any adjustment in the Contract Price or Contract Times, or both, then any such adjustment shall be set forth in a Change Order.
3. Contractor may submit a Change Proposal regarding its entitlement to or the amount or extent of any adjustment in the Contract Price or Contract Times, or both, no later than 30 days after Owner's issuance of the Owner's written statement to Contractor regarding the Underground Facility in question.

5.06 *Hazardous Environmental Conditions at Site*

A. *Reports and Drawings:* The Supplementary Conditions identify:

1. those reports and drawings known to Owner relating to Hazardous Environmental Conditions that have been identified at or adjacent to the Site; and
2. Technical Data contained in such reports and drawings.

B. *Reliance by Contractor on Technical Data Authorized:* Contractor may rely upon the accuracy of the Technical Data expressly identified in the Supplementary Conditions with respect to such reports and drawings, but such reports and drawings are not Contract Documents. If no such express identification has been made, then Contractor may rely on the

accuracy of the Technical Data (as defined in Article 1) contained in any geotechnical or environmental report prepared for the Project and made available to Contractor. Except for such reliance on Technical Data, Contractor may not rely upon or make any claim against Owner or Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors with respect to:

1. the completeness of such reports and drawings for Contractor's purposes, including, but not limited to, any aspects of the means, methods, techniques, sequences and procedures of construction to be employed by Contractor and safety precautions and programs incident thereto; or
 2. other data, interpretations, opinions and information contained in such reports or shown or indicated in such drawings; or
 3. any Contractor interpretation of or conclusion drawn from any Technical Data or any such other data, interpretations, opinions or information.
- C. Contractor shall not be responsible for removing or remediating any Hazardous Environmental Condition encountered, uncovered, or revealed at the Site unless such removal or remediation is expressly identified in the Contract Documents to be within the scope of the Work.
- D. Contractor shall be responsible for controlling, containing, and duly removing all Constituents of Concern brought to the Site by Contractor, Subcontractors, Suppliers, or anyone else for whom Contractor is responsible, and for any associated costs; and for the costs of removing and remediating any Hazardous Environmental Condition created by the presence of any such Constituents of Concern.
- E. If Contractor encounters, uncovers, or reveals a Hazardous Environmental Condition whose removal or remediation is not expressly identified in the Contract Documents as being within the scope of the Work, or if Contractor or anyone for whom Contractor is responsible creates a Hazardous Environmental Condition, then Contractor shall immediately: (1) secure or otherwise isolate such condition; (2) stop all Work in connection with such condition and in any area affected thereby (except in an emergency as required by Paragraph 7.15); and (3) notify Owner and Engineer (and promptly thereafter confirm such notice in writing). Owner shall promptly consult with Engineer concerning the necessity for Owner to retain a qualified expert to evaluate such condition or take corrective action, if any. Promptly after consulting with Engineer, Owner shall take such actions as are necessary to permit Owner to timely obtain required permits and provide Contractor the written notice required by Paragraph 5.06.F. If Contractor or anyone for whom Contractor is responsible created the Hazardous Environmental Condition in question, then Owner may remove and remediate the Hazardous Environmental Condition, and impose a set-off against payments to account for the associated costs.
- F. Contractor shall not resume Work in connection with such Hazardous Environmental Condition or in any affected area until after Owner has obtained any required permits related thereto, and delivered written notice to Contractor either (1) specifying that such condition and any affected area is or has been rendered safe for the resumption of Work, or (2) specifying any special conditions under which such Work may be resumed safely.
- G. If Owner and Contractor cannot agree as to entitlement to or on the amount or extent, if any, of any adjustment in Contract Price or Contract Times, or both, as a result of such Work stoppage or such special conditions under which Work is agreed to be resumed by Contractor, then within 30 days of Owner's written notice regarding the resumption of Work, Contractor may submit a Change Proposal, or Owner may impose a set-off.
- H. If after receipt of such written notice Contractor does not agree to resume such Work based on a reasonable belief it is unsafe, or does not agree to resume such Work under such special

conditions, then Owner may order the portion of the Work that is in the area affected by such condition to be deleted from the Work, following the contractual change procedures in Article 11. Owner may have such deleted portion of the Work performed by Owner's own forces or others in accordance with Article 8.

- I. To the fullest extent permitted by Laws and Regulations, Owner shall indemnify and hold harmless Contractor, Subcontractors, and Engineer, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to a Hazardous Environmental Condition, provided that such Hazardous Environmental Condition (1) was not shown or indicated in the Drawings, Specifications, or other Contract Documents, identified as Technical Data entitled to limited reliance pursuant to Paragraph 5.06.B, or identified in the Contract Documents to be included within the scope of the Work, and (2) was not created by Contractor or by anyone for whom Contractor is responsible. Nothing in this Paragraph 5.06.H shall obligate Owner to indemnify any individual or entity from and against the consequences of that individual's or entity's own negligence.
- J. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to the failure to control, contain, or remove a Constituent of Concern brought to the Site by Contractor or by anyone for whom Contractor is responsible, or to a Hazardous Environmental Condition created by Contractor or by anyone for whom Contractor is responsible. Nothing in this Paragraph 5.06.J shall obligate Contractor to indemnify any individual or entity from and against the consequences of that individual's or entity's own negligence.
- K. The provisions of Paragraphs 5.03, 5.04, and 5.05 do not apply to the presence of Constituents of Concern or to a Hazardous Environmental Condition uncovered or revealed at the Site.

ARTICLE 6 – BONDS AND INSURANCE

6.01 *Performance, Payment, and Other Bonds*

- A. Contractor shall furnish a performance bond and a payment bond, each in an amount at least equal to the Contract Price, as security for the faithful performance and payment of all of Contractor's obligations under the Contract. These bonds shall remain in effect until one year after the date when final payment becomes due or until completion of the correction period specified in Paragraph 15.08, whichever is later, except as provided otherwise by Laws or Regulations, the Supplementary Conditions, or other specific provisions of the Contract. Contractor shall also furnish such other bonds as are required by the Supplementary Conditions or other specific provisions of the Contract.
- B. All bonds shall be in the form prescribed by the Contract except as provided otherwise by Laws or Regulations, and shall be executed by such sureties as are named in "Companies Holding Certificates of Authority as Acceptable Sureties on Federal Bonds and as Acceptable Reinsuring Companies" as published in Circular 570 (as amended and supplemented) by the Financial Management Service, Surety Bond Branch, U.S. Department of the Treasury. A bond signed by an agent or attorney-in-fact must be accompanied by a certified copy of that individual's authority to bind the surety. The evidence of authority

shall show that it is effective on the date the agent or attorney-in-fact signed the accompanying bond.

- C. Contractor shall obtain the required bonds from surety companies that are duly licensed or authorized in the jurisdiction in which the Project is located to issue bonds in the required amounts.
- D. If the surety on a bond furnished by Contractor is declared bankrupt or becomes insolvent, or its right to do business is terminated in any state or jurisdiction where any part of the Project is located, or the surety ceases to meet the requirements above, then Contractor shall promptly notify Owner and Engineer and shall, within 20 days after the event giving rise to such notification, provide another bond and surety, both of which shall comply with the bond and surety requirements above.
- E. If Contractor has failed to obtain a required bond, Owner may exclude the Contractor from the Site and exercise Owner's termination rights under Article 16.
- F. Upon request, Owner shall provide a copy of the payment bond to any Subcontractor, Supplier, or other person or entity claiming to have furnished labor or materials used in the performance of the Work.

6.02 *Insurance—General Provisions*

- A. Owner and Contractor shall obtain and maintain insurance as required in this Article and in the Supplementary Conditions.
- B. All insurance required by the Contract to be purchased and maintained by Owner or Contractor shall be obtained from insurance companies that are duly licensed or authorized, in the state or jurisdiction in which the Project is located, to issue insurance policies for the required limits and coverages. Unless a different standard is indicated in the Supplementary Conditions, all companies that provide insurance policies required under this Contract shall have an A.M. Best rating of A-VII or better.
- C. Contractor shall deliver to Owner, with copies to each named insured and additional insured (as identified in this Article, in the Supplementary Conditions, or elsewhere in the Contract), certificates of insurance establishing that Contractor has obtained and is maintaining the policies, coverages, and endorsements required by the Contract. Upon request by Owner or any other insured, Contractor shall also furnish other evidence of such required insurance, including but not limited to copies of policies and endorsements, and documentation of applicable self-insured retentions and deductibles. Contractor may block out (redact) any confidential premium or pricing information contained in any policy or endorsement furnished under this provision.
- D. Owner shall deliver to Contractor, with copies to each named insured and additional insured (as identified in this Article, the Supplementary Conditions, or elsewhere in the Contract), certificates of insurance establishing that Owner has obtained and is maintaining the policies, coverages, and endorsements required of Owner by the Contract (if any). Upon request by Contractor or any other insured, Owner shall also provide other evidence of such required insurance (if any), including but not limited to copies of policies and endorsements, and documentation of applicable self-insured retentions and deductibles. Owner may block out (redact) any confidential premium or pricing information contained in any policy or endorsement furnished under this provision.
- E. Failure of Owner or Contractor to demand such certificates or other evidence of the other party's full compliance with these insurance requirements, or failure of Owner or Contractor to identify a deficiency in compliance from the evidence provided, shall not be construed as a waiver of the other party's obligation to obtain and maintain such insurance.

- F. If either party does not purchase or maintain all of the insurance required of such party by the Contract, such party shall notify the other party in writing of such failure to purchase prior to the start of the Work, or of such failure to maintain prior to any change in the required coverage.
- G. If Contractor has failed to obtain and maintain required insurance, Owner may exclude the Contractor from the Site, impose an appropriate set-off against payment, and exercise Owner's termination rights under Article 16.
- H. Without prejudice to any other right or remedy, if a party has failed to obtain required insurance, the other party may elect to obtain equivalent insurance to protect such other party's interests at the expense of the party who was required to provide such coverage, and the Contract Price shall be adjusted accordingly.
- I. Owner does not represent that insurance coverage and limits established in this Contract necessarily will be adequate to protect Contractor or Contractor's interests.
- J. The insurance and insurance limits required herein shall not be deemed as a limitation on Contractor's liability under the indemnities granted to Owner and other individuals and entities in the Contract.

6.03 *Contractor's Insurance*

- A. *Workers' Compensation:* Contractor shall purchase and maintain workers' compensation and employer's liability insurance for:
 - 1. claims under workers' compensation, disability benefits, and other similar employee benefit acts.
 - 2. United States Longshoreman and Harbor Workers' Compensation Act and Jones Act coverage (if applicable).
 - 3. claims for damages because of bodily injury, occupational sickness or disease, or death of Contractor's employees (by stop-gap endorsement in monopolist worker's compensation states).
 - 4. Foreign voluntary worker compensation (if applicable).
- B. *Commercial General Liability—Claims Covered:* Contractor shall purchase and maintain commercial general liability insurance, covering all operations by or on behalf of Contractor, on an occurrence basis, against:
 - 1. claims for damages because of bodily injury, sickness or disease, or death of any person other than Contractor's employees.
 - 2. claims for damages insured by reasonably available personal injury liability coverage.
 - 3. claims for damages, other than to the Work itself, because of injury to or destruction of tangible property wherever located, including loss of use resulting therefrom.
- C. *Commercial General Liability—Form and Content:* Contractor's commercial liability policy shall be written on a 1996 (or later) ISO commercial general liability form (occurrence form) and include the following coverages and endorsements:
 - 1. Products and completed operations coverage:
 - a. Such insurance shall be maintained for three years after final payment.
 - b. Contractor shall furnish Owner and each other additional insured (as identified in the Supplementary Conditions or elsewhere in the Contract) evidence of continuation of such insurance at final payment and three years thereafter.

2. Blanket contractual liability coverage, to the extent permitted by law, including but not limited to coverage of Contractor's contractual indemnity obligations in Paragraph 7.18.
 3. Broad form property damage coverage.
 4. Severability of interest.
 5. Underground, explosion, and collapse coverage.
 6. Personal injury coverage.
 7. Additional insured endorsements that include both ongoing operations and products and completed operations coverage through ISO Endorsements CG 20 10 10 01 and CG 20 37 10 01 (together); or CG 20 10 07 04 and CG 20 37 07 04 (together); or their equivalent.
 8. For design professional additional insureds, ISO Endorsement CG 20 32 07 04, "Additional Insured—Engineers, Architects or Surveyors Not Engaged by the Named Insured" or its equivalent.
- D. *Automobile liability*: Contractor shall purchase and maintain automobile liability insurance against claims for damages because of bodily injury or death of any person or property damage arising out of the ownership, maintenance, or use of any motor vehicle. The automobile liability policy shall be written on an occurrence basis.
- E. *Umbrella or excess liability*: Contractor shall purchase and maintain umbrella or excess liability insurance written over the underlying employer's liability, commercial general liability, and automobile liability insurance described in the paragraphs above. Subject to industry-standard exclusions, the coverage afforded shall follow form as to each and every one of the underlying policies.
- F. *Contractor's pollution liability insurance*: Contractor shall purchase and maintain a policy covering third-party injury and property damage claims, including clean-up costs, as a result of pollution conditions arising from Contractor's operations and completed operations. This insurance shall be maintained for no less than three years after final completion.
- G. *Additional insureds*: The Contractor's commercial general liability, automobile liability, umbrella or excess, and pollution liability policies shall include and list as additional insureds Owner and Engineer, and any individuals or entities identified in the Supplementary Conditions; include coverage for the respective officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of all such additional insureds; and the insurance afforded to these additional insureds shall provide primary coverage for all claims covered thereby (including as applicable those arising from both ongoing and completed operations) on a non-contributory basis. Contractor shall obtain all necessary endorsements to support these requirements.
- H. *Contractor's professional liability insurance*: If Contractor will provide or furnish professional services under this Contract, through a delegation of professional design services or otherwise, then Contractor shall be responsible for purchasing and maintaining applicable professional liability insurance. This insurance shall provide protection against claims arising out of performance of professional design or related services, and caused by a negligent error, omission, or act for which the insured party is legally liable. It shall be maintained throughout the duration of the Contract and for a minimum of two years after Substantial Completion. If such professional design services are performed by a Subcontractor, and not by Contractor itself, then the requirements of this paragraph may be satisfied through the purchasing and maintenance of such insurance by such Subcontractor.
- I. *General provisions*: The policies of insurance required by this Paragraph 6.03 shall:
1. include at least the specific coverages provided in this Article.

2. be written for not less than the limits of liability provided in this Article and in the Supplementary Conditions, or required by Laws or Regulations, whichever is greater.
 3. contain a provision or endorsement that the coverage afforded will not be canceled, materially changed, or renewal refused until at least 10 days prior written notice has been given to Contractor. Within three days of receipt of any such written notice, Contractor shall provide a copy of the notice to Owner, Engineer, and each other insured under the policy.
 4. remain in effect at least until final payment (and longer if expressly required in this Article) and at all times thereafter when Contractor may be correcting, removing, or replacing defective Work as a warranty or correction obligation, or otherwise, or returning to the Site to conduct other tasks arising from the Contract Documents.
 5. be appropriate for the Work being performed and provide protection from claims that may arise out of or result from Contractor's performance of the Work and Contractor's other obligations under the Contract Documents, whether it is to be performed by Contractor, any Subcontractor or Supplier, or by anyone directly or indirectly employed by any of them to perform any of the Work, or by anyone for whose acts any of them may be liable.
- J. The coverage requirements for specific policies of insurance must be met by such policies, and not by reference to excess or umbrella insurance provided in other policies.

6.04 *Owner's Liability Insurance*

- A. In addition to the insurance required to be provided by Contractor under Paragraph 6.03, Owner, at Owner's option, may purchase and maintain at Owner's expense Owner's own liability insurance as will protect Owner against claims which may arise from operations under the Contract Documents.
- B. Owner's liability policies, if any, operate separately and independently from policies required to be provided by Contractor, and Contractor cannot rely upon Owner's liability policies for any of Contractor's obligations to the Owner, Engineer, or third parties.

6.05 *Property Insurance*

- A. *Builder's Risk:* Unless otherwise provided in the Supplementary Conditions, Contractor shall purchase and maintain builder's risk insurance upon the Work on a completed value basis, in the amount of the full insurable replacement cost thereof (subject to such deductible amounts as may be provided in the Supplementary Conditions or required by Laws and Regulations). This insurance shall:
 1. include the Owner and Contractor as named insureds, and all Subcontractors, and any individuals or entities required by the Supplementary Conditions to be insured under such builder's risk policy, as insureds or named insureds. For purposes of the remainder of this Paragraph 6.05, Paragraphs 6.06 and 6.07, and any corresponding Supplementary Conditions, the parties required to be insured shall collectively be referred to as "insureds."
 2. be written on a builder's risk "all risk" policy form that shall at least include insurance for physical loss or damage to the Work, temporary buildings, falsework, and materials and equipment in transit, and shall insure against at least the following perils or causes of loss: fire; lightning; windstorm; riot; civil commotion; terrorism; vehicle impact; aircraft; smoke; theft; vandalism and malicious mischief; mechanical breakdown, boiler explosion, and artificially generated electric current; earthquake; volcanic activity, and other earth movement; flood; collapse; explosion; debris removal; demolition occasioned by enforcement of Laws and Regulations; water damage (other than that caused by flood); and such other perils or causes of loss as may be specifically required

by the Supplementary Conditions. If insurance against mechanical breakdown, boiler explosion, and artificially generated electric current; earthquake; volcanic activity, and other earth movement; or flood, are not commercially available under builder's risk policies, by endorsement or otherwise, such insurance may be provided through other insurance policies acceptable to Owner and Contractor.

3. cover, as insured property, at least the following: (a) the Work and all materials, supplies, machinery, apparatus, equipment, fixtures, and other property of a similar nature that are to be incorporated into or used in the preparation, fabrication, construction, erection, or completion of the Work, including Owner-furnished or assigned property; (b) spare parts inventory required within the scope of the Contract; and (c) temporary works which are not intended to form part of the permanent constructed Work but which are intended to provide working access to the Site, or to the Work under construction, or which are intended to provide temporary support for the Work under construction, including scaffolding, form work, fences, shoring, falsework, and temporary structures.
 4. cover expenses incurred in the repair or replacement of any insured property (including but not limited to fees and charges of engineers and architects).
 5. extend to cover damage or loss to insured property while in temporary storage at the Site or in a storage location outside the Site (but not including property stored at the premises of a manufacturer or Supplier).
 6. extend to cover damage or loss to insured property while in transit.
 7. allow for partial occupation or use of the Work by Owner, such that those portions of the Work that are not yet occupied or used by Owner shall remain covered by the builder's risk insurance.
 8. allow for the waiver of the insurer's subrogation rights, as set forth below.
 9. provide primary coverage for all losses and damages caused by the perils or causes of loss covered.
 10. not include a co-insurance clause.
 11. include an exception for ensuing losses from physical damage or loss with respect to any defective workmanship, design, or materials exclusions.
 12. include performance/hot testing and start-up.
 13. be maintained in effect, subject to the provisions herein regarding Substantial Completion and partial occupancy or use of the Work by Owner, until the Work is complete.
- B. *Notice of Cancellation or Change:* All the policies of insurance (and the certificates or other evidence thereof) required to be purchased and maintained in accordance with this Paragraph 6.05 will contain a provision or endorsement that the coverage afforded will not be canceled or materially changed or renewal refused until at least 10 days prior written notice has been given to the purchasing policyholder. Within three days of receipt of any such written notice, the purchasing policyholder shall provide a copy of the notice to each other insured.
- C. *Deductibles:* The purchaser of any required builder's risk or property insurance shall pay for costs not covered because of the application of a policy deductible.
- D. *Partial Occupancy or Use by Owner:* If Owner will occupy or use a portion or portions of the Work prior to Substantial Completion of all the Work as provided in Paragraph 15.04, then Owner (directly, if it is the purchaser of the builder's risk policy, or through Contractor) will provide notice of such occupancy or use to the builder's risk insurer. The builder's risk insurance shall not be canceled or permitted to lapse on account of any such partial use or

occupancy; rather, those portions of the Work that are occupied or used by Owner may come off the builder's risk policy, while those portions of the Work not yet occupied or used by Owner shall remain covered by the builder's risk insurance.

- E. *Additional Insurance*: If Contractor elects to obtain other special insurance to be included in or supplement the builder's risk or property insurance policies provided under this Paragraph 6.05, it may do so at Contractor's expense.
- F. *Insurance of Other Property*: If the express insurance provisions of the Contract do not require or address the insurance of a property item or interest, such as tools, construction equipment, or other personal property owned by Contractor, a Subcontractor, or an employee of Contractor or a Subcontractor, then the entity or individual owning such property item will be responsible for deciding whether to insure it, and if so in what amount.

6.06 *Waiver of Rights*

- A. All policies purchased in accordance with Paragraph 6.05, expressly including the builder's risk policy, shall contain provisions to the effect that in the event of payment of any loss or damage the insurers will have no rights of recovery against any insureds thereunder, or against Engineer or its consultants, or their officers, directors, members, partners, employees, agents, consultants, or subcontractors. Owner and Contractor waive all rights against each other and the respective officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, for all losses and damages caused by, arising out of, or resulting from any of the perils or causes of loss covered by such policies and any other property insurance applicable to the Work; and, in addition, waive all such rights against Engineer, its consultants, all Subcontractors, all individuals or entities identified in the Supplementary Conditions as insureds, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, under such policies for losses and damages so caused. None of the above waivers shall extend to the rights that any party making such waiver may have to the proceeds of insurance held by Owner or Contractor as trustee or fiduciary, or otherwise payable under any policy so issued.
- B. Owner waives all rights against Contractor, Subcontractors, and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them, for:
 - 1. loss due to business interruption, loss of use, or other consequential loss extending beyond direct physical loss or damage to Owner's property or the Work caused by, arising out of, or resulting from fire or other perils whether or not insured by Owner; and
 - 2. loss or damage to the completed Project or part thereof caused by, arising out of, or resulting from fire or other insured peril or cause of loss covered by any property insurance maintained on the completed Project or part thereof by Owner during partial occupancy or use pursuant to Paragraph 15.04, after Substantial Completion pursuant to Paragraph 15.03, or after final payment pursuant to Paragraph 15.06.
- C. Any insurance policy maintained by Owner covering any loss, damage or consequential loss referred to in Paragraph 6.06.B shall contain provisions to the effect that in the event of payment of any such loss, damage, or consequential loss, the insurers will have no rights of recovery against Contractor, Subcontractors, or Engineer, or the officers, directors, members, partners, employees, agents, consultants, or subcontractors of each and any of them.
- D. Contractor shall be responsible for assuring that the agreement under which a Subcontractor performs a portion of the Work contains provisions whereby the Subcontractor waives all rights against Owner, Contractor, all individuals or entities identified in the Supplementary

Conditions as insureds, the Engineer and its consultants, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, for all losses and damages caused by, arising out of, relating to, or resulting from any of the perils or causes of loss covered by builder's risk insurance and any other property insurance applicable to the Work.

6.07 *Receipt and Application of Property Insurance Proceeds*

- A. Any insured loss under the builder's risk and other policies of insurance required by Paragraph 6.05 will be adjusted and settled with the named insured that purchased the policy. Such named insured shall act as fiduciary for the other insureds, and give notice to such other insureds that adjustment and settlement of a claim is in progress. Any other insured may state its position regarding a claim for insured loss in writing within 15 days after notice of such claim.
- B. Proceeds for such insured losses may be made payable by the insurer either jointly to multiple insureds, or to the named insured that purchased the policy in its own right and as fiduciary for other insureds, subject to the requirements of any applicable mortgage clause. A named insured receiving insurance proceeds under the builder's risk and other policies of insurance required by Paragraph 6.05 shall distribute such proceeds in accordance with such agreement as the parties in interest may reach, or as otherwise required under the dispute resolution provisions of this Contract or applicable Laws and Regulations.
- C. If no other special agreement is reached, the damaged Work shall be repaired or replaced, the money so received applied on account thereof, and the Work and the cost thereof covered by Change Order, if needed.

ARTICLE 7 – CONTRACTOR'S RESPONSIBILITIES

7.01 *Supervision and Superintendence*

- A. Contractor shall supervise, inspect, and direct the Work competently and efficiently, devoting such attention thereto and applying such skills and expertise as may be necessary to perform the Work in accordance with the Contract Documents. Contractor shall be solely responsible for the means, methods, techniques, sequences, and procedures of construction.
- B. At all times during the progress of the Work, Contractor shall assign a competent resident superintendent who shall not be replaced without written notice to Owner and Engineer except under extraordinary circumstances.

7.02 *Labor; Working Hours*

- A. Contractor shall provide competent, suitably qualified personnel to survey and lay out the Work and perform construction as required by the Contract Documents. Contractor shall at all times maintain good discipline and order at the Site.
- B. Except as otherwise required for the safety or protection of persons or the Work or property at the Site or adjacent thereto, and except as otherwise stated in the Contract Documents, all Work at the Site shall be performed during regular working hours, Monday through Friday. Contractor will not perform Work on a Saturday, Sunday, or any legal holiday. Contractor may perform Work outside regular working hours or on Saturdays, Sundays, or legal holidays only with Owner's written consent, which will not be unreasonably withheld.

7.03 *Services, Materials, and Equipment*

- A. Unless otherwise specified in the Contract Documents, Contractor shall provide and assume full responsibility for all services, materials, equipment, labor, transportation, construction equipment and machinery, tools, appliances, fuel, power, light, heat, telephone, water, sanitary facilities, temporary facilities, and all other facilities and incidentals necessary for

the performance, testing, start up, and completion of the Work, whether or not such items are specifically called for in the Contract Documents.

- B. All materials and equipment incorporated into the Work shall be of good quality and new, except as otherwise provided in the Contract Documents. All special warranties and guarantees required by the Specifications shall expressly run to the benefit of Owner. If required by Engineer, Contractor shall furnish satisfactory evidence (including reports of required tests) as to the source, kind, and quality of materials and equipment.
- C. All materials and equipment shall be stored, applied, installed, connected, erected, protected, used, cleaned, and conditioned in accordance with instructions of the applicable Supplier, except as otherwise may be provided in the Contract Documents.

7.04 “Or Equals”

- A. Whenever an item of material or equipment is specified or described in the Contract Documents by using the name of a proprietary item or the name of a particular Supplier, the Contract Price has been based upon Contractor furnishing such item as specified. The specification or description of such an item is intended to establish the type, function, appearance, and quality required. Unless the specification or description contains or is followed by words reading that no like, equivalent, or “or equal” item is permitted, Contractor may request that Engineer authorize the use of other items of material or equipment, or items from other proposed suppliers under the circumstances described below.
 - 1. If Engineer in its sole discretion determines that an item of material or equipment proposed by Contractor is functionally equal to that named and sufficiently similar so that no change in related Work will be required, Engineer shall deem it an “or equal” item. For the purposes of this paragraph, a proposed item of material or equipment will be considered functionally equal to an item so named if:
 - a. in the exercise of reasonable judgment Engineer determines that:
 - 1) it is at least equal in materials of construction, quality, durability, appearance, strength, and design characteristics;
 - 2) it will reliably perform at least equally well the function and achieve the results imposed by the design concept of the completed Project as a functioning whole;
 - 3) it has a proven record of performance and availability of responsive service; and
 - 4) it is not objectionable to Owner.
 - b. Contractor certifies that, if approved and incorporated into the Work:
 - 1) there will be no increase in cost to the Owner or increase in Contract Times; and
 - 2) it will conform substantially to the detailed requirements of the item named in the Contract Documents.
- B. *Contractor’s Expense:* Contractor shall provide all data in support of any proposed “or equal” item at Contractor’s expense.
- C. *Engineer’s Evaluation and Determination:* Engineer will be allowed a reasonable time to evaluate each “or-equal” request. Engineer may require Contractor to furnish additional data about the proposed “or-equal” item. Engineer will be the sole judge of acceptability. No “or-equal” item will be ordered, furnished, installed, or utilized until Engineer’s review is complete and Engineer determines that the proposed item is an “or-equal”, which will be

evidenced by an approved Shop Drawing or other written communication. Engineer will advise Contractor in writing of any negative determination.

- D. *Effect of Engineer's Determination:* Neither approval nor denial of an "or-equal" request shall result in any change in Contract Price. The Engineer's denial of an "or-equal" request shall be final and binding, and may not be reversed through an appeal under any provision of the Contract Documents.
- E. *Treatment as a Substitution Request:* If Engineer determines that an item of material or equipment proposed by Contractor does not qualify as an "or-equal" item, Contractor may request that Engineer consider the proposed item as a substitute pursuant to Paragraph 7.05.

7.05 *Substitutes*

- A. Unless the specification or description of an item of material or equipment required to be furnished under the Contract Documents contains or is followed by words reading that no substitution is permitted, Contractor may request that Engineer authorize the use of other items of material or equipment under the circumstances described below. To the extent possible such requests shall be made before commencement of related construction at the Site.
 - 1. Contractor shall submit sufficient information as provided below to allow Engineer to determine if the item of material or equipment proposed is functionally equivalent to that named and an acceptable substitute therefor. Engineer will not accept requests for review of proposed substitute items of material or equipment from anyone other than Contractor.
 - 2. The requirements for review by Engineer will be as set forth in Paragraph 7.05.B, as supplemented by the Specifications, and as Engineer may decide is appropriate under the circumstances.
 - 3. Contractor shall make written application to Engineer for review of a proposed substitute item of material or equipment that Contractor seeks to furnish or use. The application:
 - a. shall certify that the proposed substitute item will:
 - 1) perform adequately the functions and achieve the results called for by the general design,
 - 2) be similar in substance to that specified, and
 - 3) be suited to the same use as that specified.
 - b. will state:
 - 1) the extent, if any, to which the use of the proposed substitute item will necessitate a change in Contract Times,
 - 2) whether use of the proposed substitute item in the Work will require a change in any of the Contract Documents (or in the provisions of any other direct contract with Owner for other work on the Project) to adapt the design to the proposed substitute item, and
 - 3) whether incorporation or use of the proposed substitute item in connection with the Work is subject to payment of any license fee or royalty.
 - c. will identify:
 - 1) all variations of the proposed substitute item from that specified, and
 - 2) available engineering, sales, maintenance, repair, and replacement services.

- d. shall contain an itemized estimate of all costs or credits that will result directly or indirectly from use of such substitute item, including but not limited to changes in Contract Price, shared savings, costs of redesign, and claims of other contractors affected by any resulting change.
- B. *Engineer's Evaluation and Determination:* Engineer will be allowed a reasonable time to evaluate each substitute request, and to obtain comments and direction from Owner. Engineer may require Contractor to furnish additional data about the proposed substitute item. Engineer will be the sole judge of acceptability. No substitute will be ordered, furnished, installed, or utilized until Engineer's review is complete and Engineer determines that the proposed item is an acceptable substitute. Engineer's determination will be evidenced by a Field Order or a proposed Change Order accounting for the substitution itself and all related impacts, including changes in Contract Price or Contract Times. Engineer will advise Contractor in writing of any negative determination.
- C. *Special Guarantee:* Owner may require Contractor to furnish at Contractor's expense a special performance guarantee or other surety with respect to any substitute.
- D. *Reimbursement of Engineer's Cost:* Engineer will record Engineer's costs in evaluating a substitute proposed or submitted by Contractor. Whether or not Engineer approves a substitute so proposed or submitted by Contractor, Contractor shall reimburse Owner for the reasonable charges of Engineer for evaluating each such proposed substitute. Contractor shall also reimburse Owner for the reasonable charges of Engineer for making changes in the Contract Documents (or in the provisions of any other direct contract with Owner) resulting from the acceptance of each proposed substitute.
- E. *Contractor's Expense:* Contractor shall provide all data in support of any proposed substitute at Contractor's expense.
- F. *Effect of Engineer's Determination:* If Engineer approves the substitution request, Contractor shall execute the proposed Change Order and proceed with the substitution. The Engineer's denial of a substitution request shall be final and binding, and may not be reversed through an appeal under any provision of the Contract Documents. Contractor may challenge the scope of reimbursement costs imposed under Paragraph 7.05.D, by timely submittal of a Change Proposal.

7.06 *Concerning Subcontractors, Suppliers, and Others*

- A. Contractor may retain Subcontractors and Suppliers for the performance of parts of the Work. Such Subcontractors and Suppliers must be acceptable to Owner.
- B. Contractor shall retain specific Subcontractors, Suppliers, or other individuals or entities for the performance of designated parts of the Work if required by the Contract to do so.
- C. Subsequent to the submittal of Contractor's Bid or final negotiation of the terms of the Contract, Owner may not require Contractor to retain any Subcontractor, Supplier, or other individual or entity to furnish or perform any of the Work against which Contractor has reasonable objection.
- D. Prior to entry into any binding subcontract or purchase order, Contractor shall submit to Owner the identity of the proposed Subcontractor or Supplier (unless Owner has already deemed such proposed Subcontractor or Supplier acceptable, during the bidding process or otherwise). Such proposed Subcontractor or Supplier shall be deemed acceptable to Owner unless Owner raises a substantive, reasonable objection within five days.
- E. Owner may require the replacement of any Subcontractor, Supplier, or other individual or entity retained by Contractor to perform any part of the Work. Owner also may require Contractor to retain specific replacements; provided, however, that Owner may not require a replacement to which Contractor has a reasonable objection. If Contractor has submitted the

identity of certain Subcontractors, Suppliers, or other individuals or entities for acceptance by Owner, and Owner has accepted it (either in writing or by failing to make written objection thereto), then Owner may subsequently revoke the acceptance of any such Subcontractor, Supplier, or other individual or entity so identified solely on the basis of substantive, reasonable objection after due investigation. Contractor shall submit an acceptable replacement for the rejected Subcontractor, Supplier, or other individual or entity.

- F. If Owner requires the replacement of any Subcontractor, Supplier, or other individual or entity retained by Contractor to perform any part of the Work, then Contractor shall be entitled to an adjustment in Contract Price or Contract Times, or both, with respect to the replacement; and Contractor shall initiate a Change Proposal for such adjustment within 30 days of Owner's requirement of replacement.
- G. No acceptance by Owner of any such Subcontractor, Supplier, or other individual or entity, whether initially or as a replacement, shall constitute a waiver of the right of Owner to the completion of the Work in accordance with the Contract Documents.
- H. On a monthly basis Contractor shall submit to Engineer a complete list of all Subcontractors and Suppliers having a direct contract with Contractor, and of all other Subcontractors and Suppliers known to Contractor at the time of submittal.
- I. Contractor shall be fully responsible to Owner and Engineer for all acts and omissions of the Subcontractors, Suppliers, and other individuals or entities performing or furnishing any of the Work just as Contractor is responsible for Contractor's own acts and omissions.
- J. Contractor shall be solely responsible for scheduling and coordinating the work of Subcontractors, Suppliers, and all other individuals or entities performing or furnishing any of the Work.
- K. Contractor shall restrict all Subcontractors, Suppliers, and such other individuals or entities performing or furnishing any of the Work from communicating with Engineer or Owner, except through Contractor or in case of an emergency, or as otherwise expressly allowed herein.
- L. The divisions and sections of the Specifications and the identifications of any Drawings shall not control Contractor in dividing the Work among Subcontractors or Suppliers or delineating the Work to be performed by any specific trade.
- M. All Work performed for Contractor by a Subcontractor or Supplier shall be pursuant to an appropriate contractual agreement that specifically binds the Subcontractor or Supplier to the applicable terms and conditions of the Contract Documents for the benefit of Owner and Engineer.
- N. Owner may furnish to any Subcontractor or Supplier, to the extent practicable, information about amounts paid to Contractor on account of Work performed for Contractor by the particular Subcontractor or Supplier.
- O. Nothing in the Contract Documents:
 - 1. shall create for the benefit of any such Subcontractor, Supplier, or other individual or entity any contractual relationship between Owner or Engineer and any such Subcontractor, Supplier, or other individual or entity; nor
 - 2. shall create any obligation on the part of Owner or Engineer to pay or to see to the payment of any money due any such Subcontractor, Supplier, or other individual or entity except as may otherwise be required by Laws and Regulations.

7.07 Patent Fees and Royalties

- A. Contractor shall pay all license fees and royalties and assume all costs incident to the use in the performance of the Work or the incorporation in the Work of any invention, design,

process, product, or device which is the subject of patent rights or copyrights held by others. If a particular invention, design, process, product, or device is specified in the Contract Documents for use in the performance of the Work and if, to the actual knowledge of Owner or Engineer, its use is subject to patent rights or copyrights calling for the payment of any license fee or royalty to others, the existence of such rights shall be disclosed by Owner in the Contract Documents.

- B. To the fullest extent permitted by Laws and Regulations, Owner shall indemnify and hold harmless Contractor, and its officers, directors, members, partners, employees, agents, consultants, and subcontractors from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals, and all court or arbitration or other dispute resolution costs) arising out of or relating to any infringement of patent rights or copyrights incident to the use in the performance of the Work or resulting from the incorporation in the Work of any invention, design, process, product, or device specified in the Contract Documents, but not identified as being subject to payment of any license fee or royalty to others required by patent rights or copyrights.
- C. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to any infringement of patent rights or copyrights incident to the use in the performance of the Work or resulting from the incorporation in the Work of any invention, design, process, product, or device not specified in the Contract Documents.

7.08 *Permits*

- A. Unless otherwise provided in the Contract Documents, Contractor shall obtain and pay for all construction permits and licenses. Owner shall assist Contractor, when necessary, in obtaining such permits and licenses. Contractor shall pay all governmental charges and inspection fees necessary for the prosecution of the Work which are applicable at the time of the submission of Contractor's Bid (or when Contractor became bound under a negotiated contract). Owner shall pay all charges of utility owners for connections for providing permanent service to the Work

7.09 *Taxes*

- A. Contractor shall pay all sales, consumer, use, and other similar taxes required to be paid by Contractor in accordance with the Laws and Regulations of the place of the Project which are applicable during the performance of the Work.

7.10 *Laws and Regulations*

- A. Contractor shall give all notices required by and shall comply with all Laws and Regulations applicable to the performance of the Work. Except where otherwise expressly required by applicable Laws and Regulations, neither Owner nor Engineer shall be responsible for monitoring Contractor's compliance with any Laws or Regulations.
- B. If Contractor performs any Work or takes any other action knowing or having reason to know that it is contrary to Laws or Regulations, Contractor shall bear all resulting costs and losses, and shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such

Work or other action. It shall not be Contractor's responsibility to make certain that the Work described in the Contract Documents is in accordance with Laws and Regulations, but this shall not relieve Contractor of Contractor's obligations under Paragraph 3.03.

- C. Owner or Contractor may give notice to the other party of any changes after the submission of Contractor's Bid (or after the date when Contractor became bound under a negotiated contract) in Laws or Regulations having an effect on the cost or time of performance of the Work, including but not limited to changes in Laws or Regulations having an effect on procuring permits and on sales, use, value-added, consumption, and other similar taxes. If Owner and Contractor are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in Contract Price or Contract Times resulting from such changes, then within 30 days of such notice Contractor may submit a Change Proposal, or Owner may initiate a Claim.

7.11 *Record Documents*

- A. Contractor shall maintain in a safe place at the Site one printed record copy of all Drawings, Specifications, Addenda, Change Orders, Work Change Directives, Field Orders, written interpretations and clarifications, and approved Shop Drawings. Contractor shall keep such record documents in good order and annotate them to show changes made during construction. These record documents, together with all approved Samples, will be available to Engineer for reference. Upon completion of the Work, Contractor shall deliver these record documents to Engineer.

7.12 *Safety and Protection*

- A. Contractor shall be solely responsible for initiating, maintaining, and supervising all safety precautions and programs in connection with the Work. Such responsibility does not relieve Subcontractors of their responsibility for the safety of persons or property in the performance of their work, nor for compliance with applicable safety Laws and Regulations. Contractor shall take all necessary precautions for the safety of, and shall provide the necessary protection to prevent damage, injury, or loss to:
 - 1. all persons on the Site or who may be affected by the Work;
 - 2. all the Work and materials and equipment to be incorporated therein, whether in storage on or off the Site; and
 - 3. other property at the Site or adjacent thereto, including trees, shrubs, lawns, walks, pavements, roadways, structures, other work in progress, utilities, and Underground Facilities not designated for removal, relocation, or replacement in the course of construction.
- B. Contractor shall comply with all applicable Laws and Regulations relating to the safety of persons or property, or to the protection of persons or property from damage, injury, or loss; and shall erect and maintain all necessary safeguards for such safety and protection. Contractor shall notify Owner; the owners of adjacent property, Underground Facilities, and other utilities; and other contractors and utility owners performing work at or adjacent to the Site, when prosecution of the Work may affect them, and shall cooperate with them in the protection, removal, relocation, and replacement of their property or work in progress.
- C. Contractor shall comply with the applicable requirements of Owner's safety programs, if any. The Supplementary Conditions identify any Owner's safety programs that are applicable to the Work.
- D. Contractor shall inform Owner and Engineer of the specific requirements of Contractor's safety program with which Owner's and Engineer's employees and representatives must comply while at the Site.

- E. All damage, injury, or loss to any property referred to in Paragraph 7.12.A.2 or 7.12.A.3 caused, directly or indirectly, in whole or in part, by Contractor, any Subcontractor, Supplier, or any other individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable, shall be remedied by Contractor at its expense (except damage or loss attributable to the fault of Drawings or Specifications or to the acts or omissions of Owner or Engineer or anyone employed by any of them, or anyone for whose acts any of them may be liable, and not attributable, directly or indirectly, in whole or in part, to the fault or negligence of Contractor or any Subcontractor, Supplier, or other individual or entity directly or indirectly employed by any of them).
- F. Contractor's duties and responsibilities for safety and protection shall continue until such time as all the Work is completed and Engineer has issued a notice to Owner and Contractor in accordance with Paragraph 15.06.B that the Work is acceptable (except as otherwise expressly provided in connection with Substantial Completion).
- G. Contractor's duties and responsibilities for safety and protection shall resume whenever Contractor or any Subcontractor or Supplier returns to the Site to fulfill warranty or correction obligations, or to conduct other tasks arising from the Contract Documents.

7.13 *Safety Representative*

- A. Contractor shall designate a qualified and experienced safety representative at the Site whose duties and responsibilities shall be the prevention of accidents and the maintaining and supervising of safety precautions and programs.

7.14 *Hazard Communication Programs*

- A. Contractor shall be responsible for coordinating any exchange of material safety data sheets or other hazard communication information required to be made available to or exchanged between or among employers at the Site in accordance with Laws or Regulations.

7.15 *Emergencies*

- A. In emergencies affecting the safety or protection of persons or the Work or property at the Site or adjacent thereto, Contractor is obligated to act to prevent threatened damage, injury, or loss. Contractor shall give Engineer prompt written notice if Contractor believes that any significant changes in the Work or variations from the Contract Documents have been caused thereby or are required as a result thereof. If Engineer determines that a change in the Contract Documents is required because of the action taken by Contractor in response to such an emergency, a Work Change Directive or Change Order will be issued.

7.16 *Shop Drawings, Samples, and Other Submittals*

A. *Shop Drawing and Sample Submittal Requirements:*

1. Before submitting a Shop Drawing or Sample, Contractor shall have:
 - a. reviewed and coordinated the Shop Drawing or Sample with other Shop Drawings and Samples and with the requirements of the Work and the Contract Documents;
 - b. determined and verified all field measurements, quantities, dimensions, specified performance and design criteria, installation requirements, materials, catalog numbers, and similar information with respect thereto;
 - c. determined and verified the suitability of all materials and equipment offered with respect to the indicated application, fabrication, shipping, handling, storage, assembly, and installation pertaining to the performance of the Work; and
 - d. determined and verified all information relative to Contractor's responsibilities for means, methods, techniques, sequences, and procedures of construction, and safety precautions and programs incident thereto.

2. Each submittal shall bear a stamp or specific written certification that Contractor has satisfied Contractor's obligations under the Contract Documents with respect to Contractor's review of that submittal, and that Contractor approves the submittal.
 3. With each submittal, Contractor shall give Engineer specific written notice of any variations that the Shop Drawing or Sample may have from the requirements of the Contract Documents. This notice shall be set forth in a written communication separate from the Shop Drawings or Sample submittal; and, in addition, in the case of Shop Drawings by a specific notation made on each Shop Drawing submitted to Engineer for review and approval of each such variation.
- B. *Submittal Procedures for Shop Drawings and Samples:* Contractor shall submit Shop Drawings and Samples to Engineer for review and approval in accordance with the accepted Schedule of Submittals. Each submittal will be identified as Engineer may require.
1. *Shop Drawings:*
 - a. Contractor shall submit the number of copies required in the Specifications.
 - b. Data shown on the Shop Drawings will be complete with respect to quantities, dimensions, specified performance and design criteria, materials, and similar data to show Engineer the services, materials, and equipment Contractor proposes to provide and to enable Engineer to review the information for the limited purposes required by Paragraph 7.16.D.
 2. *Samples:*
 - a. Contractor shall submit the number of Samples required in the Specifications.
 - b. Contractor shall clearly identify each Sample as to material, Supplier, pertinent data such as catalog numbers, the use for which intended and other data as Engineer may require to enable Engineer to review the submittal for the limited purposes required by Paragraph 7.16.D.
 3. Where a Shop Drawing or Sample is required by the Contract Documents or the Schedule of Submittals, any related Work performed prior to Engineer's review and approval of the pertinent submittal will be at the sole expense and responsibility of Contractor.
- C. *Other Submittals:* Contractor shall submit other submittals to Engineer in accordance with the accepted Schedule of Submittals, and pursuant to the applicable terms of the Specifications.
- D. *Engineer's Review:*
1. Engineer will provide timely review of Shop Drawings and Samples in accordance with the Schedule of Submittals acceptable to Engineer. Engineer's review and approval will be only to determine if the items covered by the submittals will, after installation or incorporation in the Work, conform to the information given in the Contract Documents and be compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents.
 2. Engineer's review and approval will not extend to means, methods, techniques, sequences, or procedures of construction or to safety precautions or programs incident thereto.
 3. Engineer's review and approval of a separate item as such will not indicate approval of the assembly in which the item functions.
 4. Engineer's review and approval of a Shop Drawing or Sample shall not relieve Contractor from responsibility for any variation from the requirements of the Contract

Documents unless Contractor has complied with the requirements of Paragraph 7.16.A.3 and Engineer has given written approval of each such variation by specific written notation thereof incorporated in or accompanying the Shop Drawing or Sample. Engineer will document any such approved variation from the requirements of the Contract Documents in a Field Order.

5. Engineer's review and approval of a Shop Drawing or Sample shall not relieve Contractor from responsibility for complying with the requirements of Paragraph 7.16.A and B.
6. Engineer's review and approval of a Shop Drawing or Sample, or of a variation from the requirements of the Contract Documents, shall not, under any circumstances, change the Contract Times or Contract Price, unless such changes are included in a Change Order.
7. Neither Engineer's receipt, review, acceptance or approval of a Shop Drawing, Sample, or other submittal shall result in such item becoming a Contract Document.
8. Contractor shall perform the Work in compliance with the requirements and commitments set forth in approved Shop Drawings and Samples, subject to the provisions of Paragraph 7.16.D.4.

E. *Resubmittal Procedures:*

1. Contractor shall make corrections required by Engineer and shall return the required number of corrected copies of Shop Drawings and submit, as required, new Samples for review and approval. Contractor shall direct specific attention in writing to revisions other than the corrections called for by Engineer on previous submittals.
2. Contractor shall furnish required submittals with sufficient information and accuracy to obtain required approval of an item with no more than three submittals. Engineer will record Engineer's time for reviewing a fourth or subsequent submittal of a Shop Drawings, sample, or other item requiring approval, and Contractor shall be responsible for Engineer's charges to Owner for such time. Owner may impose a set-off against payments due to Contractor to secure reimbursement for such charges.
3. If Contractor requests a change of a previously approved submittal item, Contractor shall be responsible for Engineer's charges to Owner for its review time, and Owner may impose a set-off against payments due to Contractor to secure reimbursement for such charges, unless the need for such change is beyond the control of Contractor.

7.17 *Contractor's General Warranty and Guarantee*

- A. Contractor warrants and guarantees to Owner that all Work will be in accordance with the Contract Documents and will not be defective. Engineer and its officers, directors, members, partners, employees, agents, consultants, and subcontractors shall be entitled to rely on Contractor's warranty and guarantee.
- B. Contractor's warranty and guarantee hereunder excludes defects or damage caused by:
 1. abuse, modification, or improper maintenance or operation by persons other than Contractor, Subcontractors, Suppliers, or any other individual or entity for whom Contractor is responsible; or
 2. normal wear and tear under normal usage.
- C. Contractor's obligation to perform and complete the Work in accordance with the Contract Documents shall be absolute. None of the following will constitute an acceptance of Work that is not in accordance with the Contract Documents or a release of Contractor's obligation to perform the Work in accordance with the Contract Documents:

1. observations by Engineer;
 2. recommendation by Engineer or payment by Owner of any progress or final payment;
 3. the issuance of a certificate of Substantial Completion by Engineer or any payment related thereto by Owner;
 4. use or occupancy of the Work or any part thereof by Owner;
 5. any review and approval of a Shop Drawing or Sample submittal;
 6. the issuance of a notice of acceptability by Engineer;
 7. any inspection, test, or approval by others; or
 8. any correction of defective Work by Owner.
- D. If the Contract requires the Contractor to accept the assignment of a contract entered into by Owner, then the specific warranties, guarantees, and correction obligations contained in the assigned contract shall govern with respect to Contractor's performance obligations to Owner for the Work described in the assigned contract.

7.18 *Indemnification*

- A. To the fullest extent permitted by Laws and Regulations, and in addition to any other obligations of Contractor under the Contract or otherwise, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to the performance of the Work, provided that any such claim, cost, loss, or damage is attributable to bodily injury, sickness, disease, or death, or to injury to or destruction of tangible property (other than the Work itself), including the loss of use resulting therefrom but only to the extent caused by any negligent act or omission of Contractor, any Subcontractor, any Supplier, or any individual or entity directly or indirectly employed by any of them to perform any of the Work or anyone for whose acts any of them may be liable.
- B. In any and all claims against Owner or Engineer or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors by any employee (or the survivor or personal representative of such employee) of Contractor, any Subcontractor, any Supplier, or any individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable, the indemnification obligation under Paragraph 7.18.A shall not be limited in any way by any limitation on the amount or type of damages, compensation, or benefits payable by or for Contractor or any such Subcontractor, Supplier, or other individual or entity under workers' compensation acts, disability benefit acts, or other employee benefit acts.
- C. The indemnification obligations of Contractor under Paragraph 7.18.A shall not extend to the liability of Engineer and Engineer's officers, directors, members, partners, employees, agents, consultants and subcontractors arising out of:
1. the preparation or approval of, or the failure to prepare or approve maps, Drawings, opinions, reports, surveys, Change Orders, designs, or Specifications; or
 2. giving directions or instructions, or failing to give them, if that is the primary cause of the injury or damage.

7.19 *Delegation of Professional Design Services*

- A. Contractor will not be required to provide professional design services unless such services are specifically required by the Contract Documents for a portion of the Work or unless such

services are required to carry out Contractor's responsibilities for construction means, methods, techniques, sequences and procedures. Contractor shall not be required to provide professional services in violation of applicable Laws and Regulations.

- B. If professional design services or certifications by a design professional related to systems, materials, or equipment are specifically required of Contractor by the Contract Documents, Owner and Engineer will specify all performance and design criteria that such services must satisfy. Contractor shall cause such services or certifications to be provided by a properly licensed professional, whose signature and seal shall appear on all drawings, calculations, specifications, certifications, and other submittals prepared by such professional. Shop Drawings and other submittals related to the Work designed or certified by such professional, if prepared by others, shall bear such professional's written approval when submitted to Engineer.
- C. Owner and Engineer shall be entitled to rely upon the adequacy, accuracy, and completeness of the services, certifications, or approvals performed by such design professionals, provided Owner and Engineer have specified to Contractor all performance and design criteria that such services must satisfy.
- D. Pursuant to this paragraph, Engineer's review and approval of design calculations and design drawings will be only for the limited purpose of checking for conformance with performance and design criteria given and the design concept expressed in the Contract Documents. Engineer's review and approval of Shop Drawings and other submittals (except design calculations and design drawings) will be only for the purpose stated in Paragraph 7.16.D.1.
- E. Contractor shall not be responsible for the adequacy of the performance or design criteria specified by Owner or Engineer.

ARTICLE 8 – OTHER WORK AT THE SITE

8.01 *Other Work*

- A. In addition to and apart from the Work under the Contract Documents, the Owner may perform other work at or adjacent to the Site. Such other work may be performed by Owner's employees, or through contracts between the Owner and third parties. Owner may also arrange to have third-party utility owners perform work on their utilities and facilities at or adjacent to the Site.
- B. If Owner performs other work at or adjacent to the Site with Owner's employees, or through contracts for such other work, then Owner shall give Contractor written notice thereof prior to starting any such other work. If Owner has advance information regarding the start of any utility work at or adjacent to the Site, Owner shall provide such information to Contractor.
- C. Contractor shall afford each other contractor that performs such other work, each utility owner performing other work, and Owner, if Owner is performing other work with Owner's employees, proper and safe access to the Site, and provide a reasonable opportunity for the introduction and storage of materials and equipment and the execution of such other work. Contractor shall do all cutting, fitting, and patching of the Work that may be required to properly connect or otherwise make its several parts come together and properly integrate with such other work. Contractor shall not endanger any work of others by cutting, excavating, or otherwise altering such work; provided, however, that Contractor may cut or alter others' work with the written consent of Engineer and the others whose work will be affected.
- D. If the proper execution or results of any part of Contractor's Work depends upon work performed by others under this Article 8, Contractor shall inspect such other work and promptly report to Engineer in writing any delays, defects, or deficiencies in such other work that render it unavailable or unsuitable for the proper execution and results of Contractor's

Work. Contractor's failure to so report will constitute an acceptance of such other work as fit and proper for integration with Contractor's Work except for latent defects and deficiencies in such other work.

8.02 *Coordination*

- A. If Owner intends to contract with others for the performance of other work at or adjacent to the Site, to perform other work at or adjacent to the Site with Owner's employees, or to arrange to have utility owners perform work at or adjacent to the Site, the following will be set forth in the Supplementary Conditions or provided to Contractor prior to the start of any such other work:
 - 1. the identity of the individual or entity that will have authority and responsibility for coordination of the activities among the various contractors;
 - 2. an itemization of the specific matters to be covered by such authority and responsibility; and
 - 3. the extent of such authority and responsibilities.
- B. Unless otherwise provided in the Supplementary Conditions, Owner shall have sole authority and responsibility for such coordination.

8.03 *Legal Relationships*

- A. If, in the course of performing other work at or adjacent to the Site for Owner, the Owner's employees, any other contractor working for Owner, or any utility owner causes damage to the Work or to the property of Contractor or its Subcontractors, or delays, disrupts, interferes with, or increases the scope or cost of the performance of the Work, through actions or inaction, then Contractor shall be entitled to an equitable adjustment in the Contract Price or the Contract Times, or both. Contractor must submit any Change Proposal seeking an equitable adjustment in the Contract Price or the Contract Times under this paragraph within 30 days of the damaging, delaying, disrupting, or interfering event. The entitlement to, and extent of, any such equitable adjustment shall take into account information (if any) regarding such other work that was provided to Contractor in the Contract Documents prior to the submittal of the Bid or the final negotiation of the terms of the Contract. When applicable, any such equitable adjustment in Contract Price shall be conditioned on Contractor assigning to Owner all Contractor's rights against such other contractor or utility owner with respect to the damage, delay, disruption, or interference that is the subject of the adjustment. Contractor's entitlement to an adjustment of the Contract Times is conditioned on such adjustment being essential to Contractor's ability to complete the Work within the Contract Times.
- B. Contractor shall take reasonable and customary measures to avoid damaging, delaying, disrupting, or interfering with the work of Owner, any other contractor, or any utility owner performing other work at or adjacent to the Site. If Contractor fails to take such measures and as a result damages, delays, disrupts, or interferes with the work of any such other contractor or utility owner, then Owner may impose a set-off against payments due to Contractor, and assign to such other contractor or utility owner the Owner's contractual rights against Contractor with respect to the breach of the obligations set forth in this paragraph.
- C. When Owner is performing other work at or adjacent to the Site with Owner's employees, Contractor shall be liable to Owner for damage to such other work, and for the reasonable direct delay, disruption, and interference costs incurred by Owner as a result of Contractor's failure to take reasonable and customary measures with respect to Owner's other work. In response to such damage, delay, disruption, or interference, Owner may impose a set-off against payments due to Contractor.

- D. If Contractor damages, delays, disrupts, or interferes with the work of any other contractor, or any utility owner performing other work at or adjacent to the Site, through Contractor's failure to take reasonable and customary measures to avoid such impacts, or if any claim arising out of Contractor's actions, inactions, or negligence in performance of the Work at or adjacent to the Site is made by any such other contractor or utility owner against Contractor, Owner, or Engineer, then Contractor shall (1) promptly attempt to settle the claim as to all parties through negotiations with such other contractor or utility owner, or otherwise resolve the claim by arbitration or other dispute resolution proceeding or at law, and (2) indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them from and against any such claims, and against all costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such damage, delay, disruption, or interference.

ARTICLE 9 – OWNER'S RESPONSIBILITIES

9.01 *Communications to Contractor*

- A. Except as otherwise provided in these General Conditions, Owner shall issue all communications to Contractor through Engineer.

9.02 *Replacement of Engineer*

- A. Owner may at its discretion appoint an engineer to replace Engineer, provided Contractor makes no reasonable objection to the replacement engineer. The replacement engineer's status under the Contract Documents shall be that of the former Engineer.

9.03 *Furnish Data*

- A. Owner shall promptly furnish the data required of Owner under the Contract Documents.

9.04 *Pay When Due*

- A. Owner shall make payments to Contractor when they are due as provided in the Agreement.

9.05 *Lands and Easements; Reports, Tests, and Drawings*

- A. Owner's duties with respect to providing lands and easements are set forth in Paragraph 5.01.
- B. Owner's duties with respect to providing engineering surveys to establish reference points are set forth in Paragraph 4.03.
- C. Article 5 refers to Owner's identifying and making available to Contractor copies of reports of explorations and tests of conditions at the Site, and drawings of physical conditions relating to existing surface or subsurface structures at the Site.

9.06 *Insurance*

- A. Owner's responsibilities, if any, with respect to purchasing and maintaining liability and property insurance are set forth in Article 6.

9.07 *Change Orders*

- A. Owner's responsibilities with respect to Change Orders are set forth in Article 11.

9.08 *Inspections, Tests, and Approvals*

- A. Owner's responsibility with respect to certain inspections, tests, and approvals is set forth in Paragraph 14.02.B.

9.09 *Limitations on Owner's Responsibilities*

- A. The Owner shall not supervise, direct, or have control or authority over, nor be responsible for, Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work. Owner will not be responsible for Contractor's failure to perform the Work in accordance with the Contract Documents.

9.10 *Undisclosed Hazardous Environmental Condition*

- A. Owner's responsibility in respect to an undisclosed Hazardous Environmental Condition is set forth in Paragraph 5.06.

9.11 *Evidence of Financial Arrangements*

- A. Upon request of Contractor, Owner shall furnish Contractor reasonable evidence that financial arrangements have been made to satisfy Owner's obligations under the Contract Documents (including obligations under proposed changes in the Work).

9.12 *Safety Programs*

- A. While at the Site, Owner's employees and representatives shall comply with the specific applicable requirements of Contractor's safety programs of which Owner has been informed.
- B. Owner shall furnish copies of any applicable Owner safety programs to Contractor.

ARTICLE 10 – ENGINEER'S STATUS DURING CONSTRUCTION

10.01 *Owner's Representative*

- A. Engineer will be Owner's representative during the construction period. The duties and responsibilities and the limitations of authority of Engineer as Owner's representative during construction are set forth in the Contract.

10.02 *Visits to Site*

- A. Engineer will make visits to the Site at intervals appropriate to the various stages of construction as Engineer deems necessary in order to observe as an experienced and qualified design professional the progress that has been made and the quality of the various aspects of Contractor's executed Work. Based on information obtained during such visits and observations, Engineer, for the benefit of Owner, will determine, in general, if the Work is proceeding in accordance with the Contract Documents. Engineer will not be required to make exhaustive or continuous inspections on the Site to check the quality or quantity of the Work. Engineer's efforts will be directed toward providing for Owner a greater degree of confidence that the completed Work will conform generally to the Contract Documents. On the basis of such visits and observations, Engineer will keep Owner informed of the progress of the Work and will endeavor to guard Owner against defective Work.
- B. Engineer's visits and observations are subject to all the limitations on Engineer's authority and responsibility set forth in Paragraph 10.08. Particularly, but without limitation, during or as a result of Engineer's visits or observations of Contractor's Work, Engineer will not supervise, direct, control, or have authority over or be responsible for Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work.

10.03 *Project Representative*

- A. If Owner and Engineer have agreed that Engineer will furnish a Resident Project Representative to represent Engineer at the Site and assist Engineer in observing the progress

and quality of the Work, then the authority and responsibilities of any such Resident Project Representative will be as provided in the Supplementary Conditions, and limitations on the responsibilities thereof will be as provided in Paragraph 10.08. If Owner designates another representative or agent to represent Owner at the Site who is not Engineer's consultant, agent, or employee, the responsibilities and authority and limitations thereon of such other individual or entity will be as provided in the Supplementary Conditions.

10.04 *Rejecting Defective Work*

- A. Engineer has the authority to reject Work in accordance with Article 14.

10.05 *Shop Drawings, Change Orders and Payments*

- A. Engineer's authority, and limitations thereof, as to Shop Drawings and Samples, are set forth in Paragraph 7.16.
- B. Engineer's authority, and limitations thereof, as to design calculations and design drawings submitted in response to a delegation of professional design services, if any, are set forth in Paragraph 7.19.
- C. Engineer's authority as to Change Orders is set forth in Article 11.
- D. Engineer's authority as to Applications for Payment is set forth in Article 15.

10.06 *Determinations for Unit Price Work*

- A. Engineer will determine the actual quantities and classifications of Unit Price Work performed by Contractor as set forth in Paragraph 13.03.

10.07 *Decisions on Requirements of Contract Documents and Acceptability of Work*

- A. Engineer will render decisions regarding the requirements of the Contract Documents, and judge the acceptability of the Work, pursuant to the specific procedures set forth herein for initial interpretations, Change Proposals, and acceptance of the Work. In rendering such decisions and judgments, Engineer will not show partiality to Owner or Contractor, and will not be liable to Owner, Contractor, or others in connection with any proceedings, interpretations, decisions, or judgments conducted or rendered in good faith.

10.08 *Limitations on Engineer's Authority and Responsibilities*

- A. Neither Engineer's authority or responsibility under this Article 10 or under any other provision of the Contract, nor any decision made by Engineer in good faith either to exercise or not exercise such authority or responsibility or the undertaking, exercise, or performance of any authority or responsibility by Engineer, shall create, impose, or give rise to any duty in contract, tort, or otherwise owed by Engineer to Contractor, any Subcontractor, any Supplier, any other individual or entity, or to any surety for or employee or agent of any of them.
- B. Engineer will not supervise, direct, control, or have authority over or be responsible for Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work. Engineer will not be responsible for Contractor's failure to perform the Work in accordance with the Contract Documents.
- C. Engineer will not be responsible for the acts or omissions of Contractor or of any Subcontractor, any Supplier, or of any other individual or entity performing any of the Work.
- D. Engineer's review of the final Application for Payment and accompanying documentation and all maintenance and operating instructions, schedules, guarantees, bonds, certificates of inspection, tests and approvals, and other documentation required to be delivered by Paragraph 15.06.A will only be to determine generally that their content complies with the

requirements of, and in the case of certificates of inspections, tests, and approvals, that the results certified indicate compliance with the Contract Documents.

- E. The limitations upon authority and responsibility set forth in this Paragraph 10.08 shall also apply to the Resident Project Representative, if any.

10.09 *Compliance with Safety Program*

- A. While at the Site, Engineer's employees and representatives will comply with the specific applicable requirements of Owner's and Contractor's safety programs (if any) of which Engineer has been informed.

ARTICLE 11 – AMENDING THE CONTRACT DOCUMENTS; CHANGES IN THE WORK

11.01 *Amending and Supplementing Contract Documents*

- A. The Contract Documents may be amended or supplemented by a Change Order, a Work Change Directive, or a Field Order.
 - 1. *Change Orders:*
 - a. If an amendment or supplement to the Contract Documents includes a change in the Contract Price or the Contract Times, such amendment or supplement must be set forth in a Change Order. A Change Order also may be used to establish amendments and supplements of the Contract Documents that do not affect the Contract Price or Contract Times.
 - b. Owner and Contractor may amend those terms and conditions of the Contract Documents that do not involve (1) the performance or acceptability of the Work, (2) the design (as set forth in the Drawings, Specifications, or otherwise), or (3) other engineering or technical matters, without the recommendation of the Engineer. Such an amendment shall be set forth in a Change Order.
 - 2. *Work Change Directives:* A Work Change Directive will not change the Contract Price or the Contract Times but is evidence that the parties expect that the modification ordered or documented by a Work Change Directive will be incorporated in a subsequently issued Change Order, following negotiations by the parties as to the Work Change Directive's effect, if any, on the Contract Price and Contract Times; or, if negotiations are unsuccessful, by a determination under the terms of the Contract Documents governing adjustments, expressly including Paragraph 11.04 regarding change of Contract Price. Contractor must submit any Change Proposal seeking an adjustment of the Contract Price or the Contract Times, or both, no later than 30 days after the completion of the Work set out in the Work Change Directive. Owner must submit any Claim seeking an adjustment of the Contract Price or the Contract Times, or both, no later than 60 days after issuance of the Work Change Directive.
 - 3. *Field Orders:* Engineer may authorize minor changes in the Work if the changes do not involve an adjustment in the Contract Price or the Contract Times and are compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents. Such changes will be accomplished by a Field Order and will be binding on Owner and also on Contractor, which shall perform the Work involved promptly. If Contractor believes that a Field Order justifies an adjustment in the Contract Price or Contract Times, or both, then before proceeding with the Work at issue, Contractor shall submit a Change Proposal as provided herein.

11.02 *Owner-Authorized Changes in the Work*

- A. Without invalidating the Contract and without notice to any surety, Owner may, at any time or from time to time, order additions, deletions, or revisions in the Work. Such changes shall

be supported by Engineer's recommendation, to the extent the change involves the design (as set forth in the Drawings, Specifications, or otherwise), or other engineering or technical matters. Such changes may be accomplished by a Change Order, if Owner and Contractor have agreed as to the effect, if any, of the changes on Contract Times or Contract Price; or by a Work Change Directive. Upon receipt of any such document, Contractor shall promptly proceed with the Work involved; or, in the case of a deletion in the Work, promptly cease construction activities with respect to such deleted Work. Added or revised Work shall be performed under the applicable conditions of the Contract Documents. Nothing in this paragraph shall obligate Contractor to undertake work that Contractor reasonably concludes cannot be performed in a manner consistent with Contractor's safety obligations under the Contract Documents or Laws and Regulations.

11.03 *Unauthorized Changes in the Work*

- A. Contractor shall not be entitled to an increase in the Contract Price or an extension of the Contract Times with respect to any work performed that is not required by the Contract Documents, as amended, modified, or supplemented, except in the case of an emergency as provided in Paragraph 7.15 or in the case of uncovering Work as provided in Paragraph 14.05.

11.04 *Change of Contract Price*

- A. The Contract Price may only be changed by a Change Order. Any Change Proposal for an adjustment in the Contract Price shall comply with the provisions of Paragraph 11.06. Any Claim for an adjustment of Contract Price shall comply with the provisions of Article 12.
- B. An adjustment in the Contract Price will be determined as follows:
 - 1. where the Work involved is covered by unit prices contained in the Contract Documents, then by application of such unit prices to the quantities of the items involved (subject to the provisions of Paragraph 13.03); or
 - 2. where the Work involved is not covered by unit prices contained in the Contract Documents, then by a mutually agreed lump sum (which may include an allowance for overhead and profit not necessarily in accordance with Paragraph 11.04.C.2); or
 - 3. where the Work involved is not covered by unit prices contained in the Contract Documents and the parties do not reach mutual agreement to a lump sum, then on the basis of the Cost of the Work (determined as provided in Paragraph 13.01) plus a Contractor's fee for overhead and profit (determined as provided in Paragraph 11.04.C).
- C. *Contractor's Fee:* When applicable, the Contractor's fee for overhead and profit shall be determined as follows:
 - 1. a mutually acceptable fixed fee; or
 - 2. if a fixed fee is not agreed upon, then a fee based on the following percentages of the various portions of the Cost of the Work:
 - a. for costs incurred under Paragraphs 13.01.B.1 and 13.01.B.2, the Contractor's fee shall be 15 percent;
 - b. for costs incurred under Paragraph 13.01.B.3, the Contractor's fee shall be five percent;
 - c. where one or more tiers of subcontracts are on the basis of Cost of the Work plus a fee and no fixed fee is agreed upon, the intent of Paragraphs 11.01.C.2.a and 11.01.C.2.b is that the Contractor's fee shall be based on: (1) a fee of 15 percent of the costs incurred under Paragraphs 13.01.A.1 and 13.01.A.2 by the Subcontractor that actually performs the Work, at whatever tier, and (2) with respect to Contractor itself and to any Subcontractors of a tier higher than that of the

Subcontractor that actually performs the Work, a fee of five percent of the amount (fee plus underlying costs incurred) attributable to the next lower tier Subcontractor; provided, however, that for any such subcontracted work the maximum total fee to be paid by Owner shall be no greater than 27 percent of the costs incurred by the Subcontractor that actually performs the work;

- d. no fee shall be payable on the basis of costs itemized under Paragraphs 13.01.B.4, 13.01.B.5, and 13.01.C;
- e. the amount of credit to be allowed by Contractor to Owner for any change which results in a net decrease in cost will be the amount of the actual net decrease in cost plus a deduction in Contractor's fee by an amount equal to five percent of such net decrease; and
- f. when both additions and credits are involved in any one change, the adjustment in Contractor's fee shall be computed on the basis of the net change in accordance with Paragraphs 11.04.C.2.a through 11.04.C.2.e, inclusive.

11.05 *Change of Contract Times*

- A. The Contract Times may only be changed by a Change Order. Any Change Proposal for an adjustment in the Contract Times shall comply with the provisions of Paragraph 11.06. Any Claim for an adjustment in the Contract Times shall comply with the provisions of Article 12.
- B. An adjustment of the Contract Times shall be subject to the limitations set forth in Paragraph 4.05, concerning delays in Contractor's progress.

11.06 *Change Proposals*

- A. Contractor shall submit a Change Proposal to Engineer to request an adjustment in the Contract Times or Contract Price; appeal an initial decision by Engineer concerning the requirements of the Contract Documents or relating to the acceptability of the Work under the Contract Documents; contest a set-off against payment due; or seek other relief under the Contract. The Change Proposal shall specify any proposed change in Contract Times or Contract Price, or both, or other proposed relief, and explain the reason for the proposed change, with citations to any governing or applicable provisions of the Contract Documents.
 - 1. *Procedures:* Contractor shall submit each Change Proposal to Engineer promptly (but in no event later than 30 days) after the start of the event giving rise thereto, or after such initial decision. The Contractor shall submit supporting data, including the proposed change in Contract Price or Contract Time (if any), to the Engineer and Owner within 15 days after the submittal of the Change Proposal. The supporting data shall be accompanied by a written statement that the supporting data are accurate and complete, and that any requested time or price adjustment is the entire adjustment to which Contractor believes it is entitled as a result of said event. Engineer will advise Owner regarding the Change Proposal, and consider any comments or response from Owner regarding the Change Proposal.
 - 2. *Engineer's Action:* Engineer will review each Change Proposal and, within 30 days after receipt of the Contractor's supporting data, either deny the Change Proposal in whole, approve it in whole, or deny it in part and approve it in part. Such actions shall be in writing, with a copy provided to Owner and Contractor. If Engineer does not take action on the Change Proposal within 30 days, then either Owner or Contractor may at any time thereafter submit a letter to the other party indicating that as a result of Engineer's inaction the Change Proposal is deemed denied, thereby commencing the time for appeal of the denial under Article 12.

3. *Binding Decision:* Engineer's decision will be final and binding upon Owner and Contractor, unless Owner or Contractor appeals the decision by filing a Claim under Article 12.
- B. *Resolution of Certain Change Proposals:* If the Change Proposal does not involve the design (as set forth in the Drawings, Specifications, or otherwise), the acceptability of the Work, or other engineering or technical matters, then Engineer will notify the parties that the Engineer is unable to resolve the Change Proposal. For purposes of further resolution of such a Change Proposal, such notice shall be deemed a denial, and Contractor may choose to seek resolution under the terms of Article 12.

11.07 *Execution of Change Orders*

- A. Owner and Contractor shall execute appropriate Change Orders covering:
 1. changes in the Contract Price or Contract Times which are agreed to by the parties, including any undisputed sum or amount of time for Work actually performed in accordance with a Work Change Directive;
 2. changes in Contract Price resulting from an Owner set-off, unless Contractor has duly contested such set-off;
 3. changes in the Work which are: (a) ordered by Owner pursuant to Paragraph 11.02, (b) required because of Owner's acceptance of defective Work under Paragraph 14.04 or Owner's correction of defective Work under Paragraph 14.07, or (c) agreed to by the parties, subject to the need for Engineer's recommendation if the change in the Work involves the design (as set forth in the Drawings, Specifications, or otherwise), or other engineering or technical matters; and
 4. changes in the Contract Price or Contract Times, or other changes, which embody the substance of any final and binding results under Paragraph 11.06, or Article 12.
- B. If Owner or Contractor refuses to execute a Change Order that is required to be executed under the terms of this Paragraph 11.07, it shall be deemed to be of full force and effect, as if fully executed.

11.08 *Notification to Surety*

- A. If the provisions of any bond require notice to be given to a surety of any change affecting the general scope of the Work or the provisions of the Contract Documents (including, but not limited to, Contract Price or Contract Times), the giving of any such notice will be Contractor's responsibility. The amount of each applicable bond will be adjusted to reflect the effect of any such change.

ARTICLE 12 – CLAIMS

12.01 *Claims*

- A. *Claims Process:* The following disputes between Owner and Contractor shall be submitted to the Claims process set forth in this Article:
 1. Appeals by Owner or Contractor of Engineer's decisions regarding Change Proposals;
 2. Owner demands for adjustments in the Contract Price or Contract Times, or other relief under the Contract Documents; and
 3. Disputes that Engineer has been unable to address because they do not involve the design (as set forth in the Drawings, Specifications, or otherwise), the acceptability of the Work, or other engineering or technical matters.

- B. *Submittal of Claim:* The party submitting a Claim shall deliver it directly to the other party to the Contract promptly (but in no event later than 30 days) after the start of the event giving rise thereto; in the case of appeals regarding Change Proposals within 30 days of the decision under appeal. The party submitting the Claim shall also furnish a copy to the Engineer, for its information only. The responsibility to substantiate a Claim shall rest with the party making the Claim. In the case of a Claim by Contractor seeking an increase in the Contract Times or Contract Price, or both, Contractor shall certify that the Claim is made in good faith, that the supporting data are accurate and complete, and that to the best of Contractor's knowledge and belief the amount of time or money requested accurately reflects the full amount to which Contractor is entitled.
- C. *Review and Resolution:* The party receiving a Claim shall review it thoroughly, giving full consideration to its merits. The two parties shall seek to resolve the Claim through the exchange of information and direct negotiations. The parties may extend the time for resolving the Claim by mutual agreement. All actions taken on a Claim shall be stated in writing and submitted to the other party, with a copy to Engineer.
- D. *Mediation:*
1. At any time after initiation of a Claim, Owner and Contractor may mutually agree to mediation of the underlying dispute. The agreement to mediate shall stay the Claim submittal and response process.
 2. If Owner and Contractor agree to mediation, then after 60 days from such agreement, either Owner or Contractor may unilaterally terminate the mediation process, and the Claim submittal and decision process shall resume as of the date of the termination. If the mediation proceeds but is unsuccessful in resolving the dispute, the Claim submittal and decision process shall resume as of the date of the conclusion of the mediation, as determined by the mediator.
 3. Owner and Contractor shall each pay one-half of the mediator's fees and costs.
- E. *Partial Approval:* If the party receiving a Claim approves the Claim in part and denies it in part, such action shall be final and binding unless within 30 days of such action the other party invokes the procedure set forth in Article 17 for final resolution of disputes.
- F. *Denial of Claim:* If efforts to resolve a Claim are not successful, the party receiving the Claim may deny it by giving written notice of denial to the other party. If the receiving party does not take action on the Claim within 90 days, then either Owner or Contractor may at any time thereafter submit a letter to the other party indicating that as a result of the inaction, the Claim is deemed denied, thereby commencing the time for appeal of the denial. A denial of the Claim shall be final and binding unless within 30 days of the denial the other party invokes the procedure set forth in Article 17 for the final resolution of disputes.
- G. *Final and Binding Results:* If the parties reach a mutual agreement regarding a Claim, whether through approval of the Claim, direct negotiations, mediation, or otherwise; or if a Claim is approved in part and denied in part, or denied in full, and such actions become final and binding; then the results of the agreement or action on the Claim shall be incorporated in a Change Order to the extent they affect the Contract, including the Work, the Contract Times, or the Contract Price.

ARTICLE 13 – COST OF THE WORK; ALLOWANCES; UNIT PRICE WORK

13.01 *Cost of the Work*

- A. *Purposes for Determination of Cost of the Work:* The term Cost of the Work means the sum of all costs necessary for the proper performance of the Work at issue, as further defined below. The provisions of this Paragraph 13.01 are used for two distinct purposes:

1. To determine Cost of the Work when Cost of the Work is a component of the Contract Price, under cost-plus-fee, time-and-materials, or other cost-based terms; or
 2. To determine the value of a Change Order, Change Proposal, Claim, set-off, or other adjustment in Contract Price. When the value of any such adjustment is determined on the basis of Cost of the Work, Contractor is entitled only to those additional or incremental costs required because of the change in the Work or because of the event giving rise to the adjustment.
- B. *Costs Included:* Except as otherwise may be agreed to in writing by Owner, costs included in the Cost of the Work shall be in amounts no higher than those prevailing in the locality of the Project, shall not include any of the costs itemized in Paragraph 13.01.C, and shall include only the following items:
1. Payroll costs for employees in the direct employ of Contractor in the performance of the Work under schedules of job classifications agreed upon by Owner and Contractor. Such employees shall include, without limitation, superintendents, foremen, and other personnel employed full time on the Work. Payroll costs for employees not employed full time on the Work shall be apportioned on the basis of their time spent on the Work. Payroll costs shall include, but not be limited to, salaries and wages plus the cost of fringe benefits, which shall include social security contributions, unemployment, excise, and payroll taxes, workers' compensation, health and retirement benefits, bonuses, sick leave, and vacation and holiday pay applicable thereto. The expenses of performing Work outside of regular working hours, on Saturday, Sunday, or legal holidays, shall be included in the above to the extent authorized by Owner.
 2. Cost of all materials and equipment furnished and incorporated in the Work, including costs of transportation and storage thereof, and Suppliers' field services required in connection therewith. All cash discounts shall accrue to Contractor unless Owner deposits funds with Contractor with which to make payments, in which case the cash discounts shall accrue to Owner. All trade discounts, rebates, and refunds and returns from sale of surplus materials and equipment shall accrue to Owner, and Contractor shall make provisions so that they may be obtained.
 3. Payments made by Contractor to Subcontractors for Work performed by Subcontractors. If required by Owner, Contractor shall obtain competitive bids from subcontractors acceptable to Owner and Contractor and shall deliver such bids to Owner, who will then determine, with the advice of Engineer, which bids, if any, will be acceptable. If any subcontract provides that the Subcontractor is to be paid on the basis of Cost of the Work plus a fee, the Subcontractor's Cost of the Work and fee shall be determined in the same manner as Contractor's Cost of the Work and fee as provided in this Paragraph 13.01.
 4. Costs of special consultants (including but not limited to engineers, architects, testing laboratories, surveyors, attorneys, and accountants) employed for services specifically related to the Work.
 5. Supplemental costs including the following:
 - a. The proportion of necessary transportation, travel, and subsistence expenses of Contractor's employees incurred in discharge of duties connected with the Work.
 - b. Cost, including transportation and maintenance, of all materials, supplies, equipment, machinery, appliances, office, and temporary facilities at the Site, and hand tools not owned by the workers, which are consumed in the performance of the Work, and cost, less market value, of such items used but not consumed which remain the property of Contractor.

- c. Rentals of all construction equipment and machinery, and the parts thereof, whether rented from Contractor or others in accordance with rental agreements approved by Owner with the advice of Engineer, and the costs of transportation, loading, unloading, assembly, dismantling, and removal thereof. All such costs shall be in accordance with the terms of said rental agreements. The rental of any such equipment, machinery, or parts shall cease when the use thereof is no longer necessary for the Work.
 - d. Sales, consumer, use, and other similar taxes related to the Work, and for which Contractor is liable, as imposed by Laws and Regulations.
 - e. Deposits lost for causes other than negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, and royalty payments and fees for permits and licenses.
 - f. Losses and damages (and related expenses) caused by damage to the Work, not compensated by insurance or otherwise, sustained by Contractor in connection with the performance of the Work (except losses and damages within the deductible amounts of property insurance established in accordance with Paragraph 6.05), provided such losses and damages have resulted from causes other than the negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable. Such losses shall include settlements made with the written consent and approval of Owner. No such losses, damages, and expenses shall be included in the Cost of the Work for the purpose of determining Contractor's fee.
 - g. The cost of utilities, fuel, and sanitary facilities at the Site.
 - h. Minor expenses such as communication service at the Site, express and courier services, and similar petty cash items in connection with the Work.
 - i. The costs of premiums for all bonds and insurance that Contractor is required by the Contract Documents to purchase and maintain.
- C. *Costs Excluded:* The term Cost of the Work shall not include any of the following items:
- 1. Payroll costs and other compensation of Contractor's officers, executives, principals (of partnerships and sole proprietorships), general managers, safety managers, engineers, architects, estimators, attorneys, auditors, accountants, purchasing and contracting agents, expeditors, timekeepers, clerks, and other personnel employed by Contractor, whether at the Site or in Contractor's principal or branch office for general administration of the Work and not specifically included in the agreed upon schedule of job classifications referred to in Paragraph 13.01.B.1 or specifically covered by Paragraph 13.01.B.4. The payroll costs and other compensation excluded here are to be considered administrative costs covered by the Contractor's fee.
 - 2. Expenses of Contractor's principal and branch offices other than Contractor's office at the Site.
 - 3. Any part of Contractor's capital expenses, including interest on Contractor's capital employed for the Work and charges against Contractor for delinquent payments.
 - 4. Costs due to the negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, including but not limited to, the correction of defective Work, disposal of materials or equipment wrongly supplied, and making good any damage to property.
 - 5. Other overhead or general expense costs of any kind and the costs of any item not specifically and expressly included in Paragraph 13.01.B.

- D. *Contractor's Fee*: When the Work as a whole is performed on the basis of cost-plus, Contractor's fee shall be determined as set forth in the Agreement. When the value of any Work covered by a Change Order, Change Proposal, Claim, set-off, or other adjustment in Contract Price is determined on the basis of Cost of the Work, Contractor's fee shall be determined as set forth in Paragraph 11.04.C.
- E. *Documentation*: Whenever the Cost of the Work for any purpose is to be determined pursuant to this Article 13, Contractor will establish and maintain records thereof in accordance with generally accepted accounting practices and submit in a form acceptable to Engineer an itemized cost breakdown together with supporting data.

13.02 Allowances

- A. It is understood that Contractor has included in the Contract Price all allowances so named in the Contract Documents and shall cause the Work so covered to be performed for such sums and by such persons or entities as may be acceptable to Owner and Engineer.
- B. *Cash Allowances*: Contractor agrees that:
 - 1. the cash allowances include the cost to Contractor (less any applicable trade discounts) of materials and equipment required by the allowances to be delivered at the Site, and all applicable taxes; and
 - 2. Contractor's costs for unloading and handling on the Site, labor, installation, overhead, profit, and other expenses contemplated for the cash allowances have been included in the Contract Price and not in the allowances, and no demand for additional payment on account of any of the foregoing will be valid.
- C. *Contingency Allowance*: Contractor agrees that a contingency allowance, if any, is for the sole use of Owner to cover unanticipated costs.
- D. Prior to final payment, an appropriate Change Order will be issued as recommended by Engineer to reflect actual amounts due Contractor on account of Work covered by allowances, and the Contract Price shall be correspondingly adjusted.

13.03 Unit Price Work

- A. Where the Contract Documents provide that all or part of the Work is to be Unit Price Work, initially the Contract Price will be deemed to include for all Unit Price Work an amount equal to the sum of the unit price for each separately identified item of Unit Price Work times the estimated quantity of each item as indicated in the Agreement.
- B. The estimated quantities of items of Unit Price Work are not guaranteed and are solely for the purpose of comparison of Bids and determining an initial Contract Price. Payments to Contractor for Unit Price Work will be based on actual quantities.
- C. Each unit price will be deemed to include an amount considered by Contractor to be adequate to cover Contractor's overhead and profit for each separately identified item.
- D. Engineer will determine the actual quantities and classifications of Unit Price Work performed by Contractor. Engineer will review with Contractor the Engineer's preliminary determinations on such matters before rendering a written decision thereon (by recommendation of an Application for Payment or otherwise). Engineer's written decision thereon will be final and binding (except as modified by Engineer to reflect changed factual conditions or more accurate data) upon Owner and Contractor, subject to the provisions of the following paragraph.
- E. Within 30 days of Engineer's written decision under the preceding paragraph, Contractor may submit a Change Proposal, or Owner may file a Claim, seeking an adjustment in the Contract Price if:

1. the quantity of any item of Unit Price Work performed by Contractor differs materially and significantly from the estimated quantity of such item indicated in the Agreement;
2. there is no corresponding adjustment with respect to any other item of Work; and
3. Contractor believes that it is entitled to an increase in Contract Price as a result of having incurred additional expense or Owner believes that Owner is entitled to a decrease in Contract Price, and the parties are unable to agree as to the amount of any such increase or decrease.

ARTICLE 14 – TESTS AND INSPECTIONS; CORRECTION, REMOVAL OR ACCEPTANCE OF DEFECTIVE WORK

14.01 *Access to Work*

- A. Owner, Engineer, their consultants and other representatives and personnel of Owner, independent testing laboratories, and authorities having jurisdiction will have access to the Site and the Work at reasonable times for their observation, inspection, and testing. Contractor shall provide them proper and safe conditions for such access and advise them of Contractor's safety procedures and programs so that they may comply therewith as applicable.

14.02 *Tests, Inspections, and Approvals*

- A. Contractor shall give Engineer timely notice of readiness of the Work (or specific parts thereof) for all required inspections and tests, and shall cooperate with inspection and testing personnel to facilitate required inspections and tests.
- B. Owner shall retain and pay for the services of an independent inspector, testing laboratory, or other qualified individual or entity to perform all inspections and tests expressly required by the Contract Documents to be furnished and paid for by Owner, except that costs incurred in connection with tests or inspections of covered Work shall be governed by the provisions of Paragraph 14.05.
- C. If Laws or Regulations of any public body having jurisdiction require any Work (or part thereof) specifically to be inspected, tested, or approved by an employee or other representative of such public body, Contractor shall assume full responsibility for arranging and obtaining such inspections, tests, or approvals, pay all costs in connection therewith, and furnish Engineer the required certificates of inspection or approval.
- D. Contractor shall be responsible for arranging, obtaining, and paying for all inspections and tests required:
 1. by the Contract Documents, unless the Contract Documents expressly allocate responsibility for a specific inspection or test to Owner;
 2. to attain Owner's and Engineer's acceptance of materials or equipment to be incorporated in the Work;
 3. by manufacturers of equipment furnished under the Contract Documents;
 4. for testing, adjusting, and balancing of mechanical, electrical, and other equipment to be incorporated into the Work; and
 5. for acceptance of materials, mix designs, or equipment submitted for approval prior to Contractor's purchase thereof for incorporation in the Work.

Such inspections and tests shall be performed by independent inspectors, testing laboratories, or other qualified individuals or entities acceptable to Owner and Engineer.

- E. If the Contract Documents require the Work (or part thereof) to be approved by Owner, Engineer, or another designated individual or entity, then Contractor shall assume full responsibility for arranging and obtaining such approvals.
- F. If any Work (or the work of others) that is to be inspected, tested, or approved is covered by Contractor without written concurrence of Engineer, Contractor shall, if requested by Engineer, uncover such Work for observation. Such uncovering shall be at Contractor's expense unless Contractor had given Engineer timely notice of Contractor's intention to cover the same and Engineer had not acted with reasonable promptness in response to such notice.

14.03 *Defective Work*

- A. *Contractor's Obligation:* It is Contractor's obligation to assure that the Work is not defective.
- B. *Engineer's Authority:* Engineer has the authority to determine whether Work is defective, and to reject defective Work.
- C. *Notice of Defects:* Prompt notice of all defective Work of which Owner or Engineer has actual knowledge will be given to Contractor.
- D. *Correction, or Removal and Replacement:* Promptly after receipt of written notice of defective Work, Contractor shall correct all such defective Work, whether or not fabricated, installed, or completed, or, if Engineer has rejected the defective Work, remove it from the Project and replace it with Work that is not defective.
- E. *Preservation of Warranties:* When correcting defective Work, Contractor shall take no action that would void or otherwise impair Owner's special warranty and guarantee, if any, on said Work.
- F. *Costs and Damages:* In addition to its correction, removal, and replacement obligations with respect to defective Work, Contractor shall pay all claims, costs, losses, and damages arising out of or relating to defective Work, including but not limited to the cost of the inspection, testing, correction, removal, replacement, or reconstruction of such defective Work, fines levied against Owner by governmental authorities because the Work is defective, and the costs of repair or replacement of work of others resulting from defective Work. Prior to final payment, if Owner and Contractor are unable to agree as to the measure of such claims, costs, losses, and damages resulting from defective Work, then Owner may impose a reasonable set-off against payments due under Article 15.

14.04 *Acceptance of Defective Work*

- A. If, instead of requiring correction or removal and replacement of defective Work, Owner prefers to accept it, Owner may do so (subject, if such acceptance occurs prior to final payment, to Engineer's confirmation that such acceptance is in general accord with the design intent and applicable engineering principles, and will not endanger public safety). Contractor shall pay all claims, costs, losses, and damages attributable to Owner's evaluation of and determination to accept such defective Work (such costs to be approved by Engineer as to reasonableness), and for the diminished value of the Work to the extent not otherwise paid by Contractor. If any such acceptance occurs prior to final payment, the necessary revisions in the Contract Documents with respect to the Work shall be incorporated in a Change Order. If the parties are unable to agree as to the decrease in the Contract Price, reflecting the diminished value of Work so accepted, then Owner may impose a reasonable set-off against payments due under Article 15. If the acceptance of defective Work occurs after final payment, Contractor shall pay an appropriate amount to Owner.

14.05 *Uncovering Work*

- A. Engineer has the authority to require special inspection or testing of the Work, whether or not the Work is fabricated, installed, or completed.
- B. If any Work is covered contrary to the written request of Engineer, then Contractor shall, if requested by Engineer, uncover such Work for Engineer's observation, and then replace the covering, all at Contractor's expense.
- C. If Engineer considers it necessary or advisable that covered Work be observed by Engineer or inspected or tested by others, then Contractor, at Engineer's request, shall uncover, expose, or otherwise make available for observation, inspection, or testing as Engineer may require, that portion of the Work in question, and provide all necessary labor, material, and equipment.
 - 1. If it is found that the uncovered Work is defective, Contractor shall be responsible for all claims, costs, losses, and damages arising out of or relating to such uncovering, exposure, observation, inspection, and testing, and of satisfactory replacement or reconstruction (including but not limited to all costs of repair or replacement of work of others); and pending Contractor's full discharge of this responsibility the Owner shall be entitled to impose a reasonable set-off against payments due under Article 15.
 - 2. If the uncovered Work is not found to be defective, Contractor shall be allowed an increase in the Contract Price or an extension of the Contract Times, or both, directly attributable to such uncovering, exposure, observation, inspection, testing, replacement, and reconstruction. If the parties are unable to agree as to the amount or extent thereof, then Contractor may submit a Change Proposal within 30 days of the determination that the Work is not defective.

14.06 *Owner May Stop the Work*

- A. If the Work is defective, or Contractor fails to supply sufficient skilled workers or suitable materials or equipment, or fails to perform the Work in such a way that the completed Work will conform to the Contract Documents, then Owner may order Contractor to stop the Work, or any portion thereof, until the cause for such order has been eliminated; however, this right of Owner to stop the Work shall not give rise to any duty on the part of Owner to exercise this right for the benefit of Contractor, any Subcontractor, any Supplier, any other individual or entity, or any surety for, or employee or agent of any of them.

14.07 *Owner May Correct Defective Work*

- A. If Contractor fails within a reasonable time after written notice from Engineer to correct defective Work, or to remove and replace rejected Work as required by Engineer, or if Contractor fails to perform the Work in accordance with the Contract Documents, or if Contractor fails to comply with any other provision of the Contract Documents, then Owner may, after seven days written notice to Contractor, correct or remedy any such deficiency.
- B. In exercising the rights and remedies under this Paragraph 14.07, Owner shall proceed expeditiously. In connection with such corrective or remedial action, Owner may exclude Contractor from all or part of the Site, take possession of all or part of the Work and suspend Contractor's services related thereto, and incorporate in the Work all materials and equipment stored at the Site or for which Owner has paid Contractor but which are stored elsewhere. Contractor shall allow Owner, Owner's representatives, agents and employees, Owner's other contractors, and Engineer and Engineer's consultants access to the Site to enable Owner to exercise the rights and remedies under this paragraph.
- C. All claims, costs, losses, and damages incurred or sustained by Owner in exercising the rights and remedies under this Paragraph 14.07 will be charged against Contractor as set-offs against payments due under Article 15. Such claims, costs, losses and damages will include

but not be limited to all costs of repair, or replacement of work of others destroyed or damaged by correction, removal, or replacement of Contractor's defective Work.

- D. Contractor shall not be allowed an extension of the Contract Times because of any delay in the performance of the Work attributable to the exercise by Owner of Owner's rights and remedies under this Paragraph 14.07.

ARTICLE 15 – PAYMENTS TO CONTRACTOR; SET-OFFS; COMPLETION; CORRECTION PERIOD

15.01 *Progress Payments*

- A. *Basis for Progress Payments:* The Schedule of Values established as provided in Article 2 will serve as the basis for progress payments and will be incorporated into a form of Application for Payment acceptable to Engineer. Progress payments on account of Unit Price Work will be based on the number of units completed during the pay period, as determined under the provisions of Paragraph 13.03. Progress payments for cost-based Work will be based on Cost of the Work completed by Contractor during the pay period.
- B. *Applications for Payments:*
 - 1. At least 20 days before the date established in the Agreement for each progress payment (but not more often than once a month), Contractor shall submit to Engineer for review an Application for Payment filled out and signed by Contractor covering the Work completed as of the date of the Application and accompanied by such supporting documentation as is required by the Contract Documents. If payment is requested on the basis of materials and equipment not incorporated in the Work but delivered and suitably stored at the Site or at another location agreed to in writing, the Application for Payment shall also be accompanied by a bill of sale, invoice, or other documentation warranting that Owner has received the materials and equipment free and clear of all Liens, and evidence that the materials and equipment are covered by appropriate property insurance, a warehouse bond, or other arrangements to protect Owner's interest therein, all of which must be satisfactory to Owner.
 - 2. Beginning with the second Application for Payment, each Application shall include an affidavit of Contractor stating that all previous progress payments received on account of the Work have been applied on account to discharge Contractor's legitimate obligations associated with prior Applications for Payment.
 - 3. The amount of retainage with respect to progress payments will be as stipulated in the Agreement.
- C. *Review of Applications:*
 - 1. Engineer will, within 10 days after receipt of each Application for Payment, including each resubmittal, either indicate in writing a recommendation of payment and present the Application to Owner, or return the Application to Contractor indicating in writing Engineer's reasons for refusing to recommend payment. In the latter case, Contractor may make the necessary corrections and resubmit the Application.
 - 2. Engineer's recommendation of any payment requested in an Application for Payment will constitute a representation by Engineer to Owner, based on Engineer's observations of the executed Work as an experienced and qualified design professional, and on Engineer's review of the Application for Payment and the accompanying data and schedules, that to the best of Engineer's knowledge, information and belief:
 - a. the Work has progressed to the point indicated;

- b. the quality of the Work is generally in accordance with the Contract Documents (subject to an evaluation of the Work as a functioning whole prior to or upon Substantial Completion, the results of any subsequent tests called for in the Contract Documents, a final determination of quantities and classifications for Unit Price Work under Paragraph 13.03, and any other qualifications stated in the recommendation); and
 - c. the conditions precedent to Contractor's being entitled to such payment appear to have been fulfilled in so far as it is Engineer's responsibility to observe the Work.
- 3. By recommending any such payment Engineer will not thereby be deemed to have represented that:
 - a. inspections made to check the quality or the quantity of the Work as it has been performed have been exhaustive, extended to every aspect of the Work in progress, or involved detailed inspections of the Work beyond the responsibilities specifically assigned to Engineer in the Contract; or
 - b. there may not be other matters or issues between the parties that might entitle Contractor to be paid additionally by Owner or entitle Owner to withhold payment to Contractor.
- 4. Neither Engineer's review of Contractor's Work for the purposes of recommending payments nor Engineer's recommendation of any payment, including final payment, will impose responsibility on Engineer:
 - a. to supervise, direct, or control the Work, or
 - b. for the means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or
 - c. for Contractor's failure to comply with Laws and Regulations applicable to Contractor's performance of the Work, or
 - d. to make any examination to ascertain how or for what purposes Contractor has used the money paid on account of the Contract Price, or
 - e. to determine that title to any of the Work, materials, or equipment has passed to Owner free and clear of any Liens.
- 5. Engineer may refuse to recommend the whole or any part of any payment if, in Engineer's opinion, it would be incorrect to make the representations to Owner stated in Paragraph 15.01.C.2.
- 6. Engineer will recommend reductions in payment (set-offs) necessary in Engineer's opinion to protect Owner from loss because:
 - a. the Work is defective, requiring correction or replacement;
 - b. the Contract Price has been reduced by Change Orders;
 - c. Owner has been required to correct defective Work in accordance with Paragraph 14.07, or has accepted defective Work pursuant to Paragraph 14.04;
 - d. Owner has been required to remove or remediate a Hazardous Environmental Condition for which Contractor is responsible; or
 - e. Engineer has actual knowledge of the occurrence of any of the events that would constitute a default by Contractor and therefore justify termination for cause under the Contract Documents.

D. *Payment Becomes Due:*

1. Ten days after presentation of the Application for Payment to Owner with Engineer's recommendation, the amount recommended (subject to any Owner set-offs) will become due, and when due will be paid by Owner to Contractor.

E. *Reductions in Payment by Owner:*

1. In addition to any reductions in payment (set-offs) recommended by Engineer, Owner is entitled to impose a set-off against payment based on any of the following:
 - a. claims have been made against Owner on account of Contractor's conduct in the performance or furnishing of the Work, or Owner has incurred costs, losses, or damages on account of Contractor's conduct in the performance or furnishing of the Work, including but not limited to claims, costs, losses, or damages from workplace injuries, adjacent property damage, non-compliance with Laws and Regulations, and patent infringement;
 - b. Contractor has failed to take reasonable and customary measures to avoid damage, delay, disruption, and interference with other work at or adjacent to the Site;
 - c. Contractor has failed to provide and maintain required bonds or insurance;
 - d. Owner has been required to remove or remediate a Hazardous Environmental Condition for which Contractor is responsible;
 - e. Owner has incurred extra charges or engineering costs related to submittal reviews, evaluations of proposed substitutes, tests and inspections, or return visits to manufacturing or assembly facilities;
 - f. the Work is defective, requiring correction or replacement;
 - g. Owner has been required to correct defective Work in accordance with Paragraph 14.07, or has accepted defective Work pursuant to Paragraph 14.04;
 - h. the Contract Price has been reduced by Change Orders;
 - i. an event that would constitute a default by Contractor and therefore justify a termination for cause has occurred;
 - j. liquidated damages have accrued as a result of Contractor's failure to achieve Milestones, Substantial Completion, or final completion of the Work;
 - k. Liens have been filed in connection with the Work, except where Contractor has delivered a specific bond satisfactory to Owner to secure the satisfaction and discharge of such Liens;
 - l. there are other items entitling Owner to a set off against the amount recommended.
2. If Owner imposes any set-off against payment, whether based on its own knowledge or on the written recommendations of Engineer, Owner will give Contractor immediate written notice (with a copy to Engineer) stating the reasons for such action and the specific amount of the reduction, and promptly pay Contractor any amount remaining after deduction of the amount so withheld. Owner shall promptly pay Contractor the amount so withheld, or any adjustment thereto agreed to by Owner and Contractor, if Contractor remedies the reasons for such action. The reduction imposed shall be binding on Contractor unless it duly submits a Change Proposal contesting the reduction.
3. Upon a subsequent determination that Owner's refusal of payment was not justified, the amount wrongfully withheld shall be treated as an amount due as determined by Paragraph 15.01.C.1 and subject to interest as provided in the Agreement.

15.02 *Contractor's Warranty of Title*

- A. Contractor warrants and guarantees that title to all Work, materials, and equipment furnished under the Contract will pass to Owner free and clear of (1) all Liens and other title defects, and (2) all patent, licensing, copyright, or royalty obligations, no later than seven days after the time of payment by Owner.

15.03 *Substantial Completion*

- A. When Contractor considers the entire Work ready for its intended use Contractor shall notify Owner and Engineer in writing that the entire Work is substantially complete and request that Engineer issue a certificate of Substantial Completion. Contractor shall at the same time submit to Owner and Engineer an initial draft of punch list items to be completed or corrected before final payment.
- B. Promptly after Contractor's notification, Owner, Contractor, and Engineer shall make an inspection of the Work to determine the status of completion. If Engineer does not consider the Work substantially complete, Engineer will notify Contractor in writing giving the reasons therefor.
- C. If Engineer considers the Work substantially complete, Engineer will deliver to Owner a preliminary certificate of Substantial Completion which shall fix the date of Substantial Completion. Engineer shall attach to the certificate a punch list of items to be completed or corrected before final payment. Owner shall have seven days after receipt of the preliminary certificate during which to make written objection to Engineer as to any provisions of the certificate or attached punch list. If, after considering the objections to the provisions of the preliminary certificate, Engineer concludes that the Work is not substantially complete, Engineer will, within 14 days after submission of the preliminary certificate to Owner, notify Contractor in writing that the Work is not substantially complete, stating the reasons therefor. If Owner does not object to the provisions of the certificate, or if despite consideration of Owner's objections Engineer concludes that the Work is substantially complete, then Engineer will, within said 14 days, execute and deliver to Owner and Contractor a final certificate of Substantial Completion (with a revised punch list of items to be completed or corrected) reflecting such changes from the preliminary certificate as Engineer believes justified after consideration of any objections from Owner.
- D. At the time of receipt of the preliminary certificate of Substantial Completion, Owner and Contractor will confer regarding Owner's use or occupancy of the Work following Substantial Completion, review the builder's risk insurance policy with respect to the end of the builder's risk coverage, and confirm the transition to coverage of the Work under a permanent property insurance policy held by Owner. Unless Owner and Contractor agree otherwise in writing, Owner shall bear responsibility for security, operation, protection of the Work, property insurance, maintenance, heat, and utilities upon Owner's use or occupancy of the Work.
- E. After Substantial Completion the Contractor shall promptly begin work on the punch list of items to be completed or corrected prior to final payment. In appropriate cases Contractor may submit monthly Applications for Payment for completed punch list items, following the progress payment procedures set forth above.
- F. Owner shall have the right to exclude Contractor from the Site after the date of Substantial Completion subject to allowing Contractor reasonable access to remove its property and complete or correct items on the punch list.

15.04 *Partial Use or Occupancy*

- A. Prior to Substantial Completion of all the Work, Owner may use or occupy any substantially completed part of the Work which has specifically been identified in the Contract Documents, or which Owner, Engineer, and Contractor agree constitutes a separately

functioning and usable part of the Work that can be used by Owner for its intended purpose without significant interference with Contractor's performance of the remainder of the Work, subject to the following conditions:

1. At any time Owner may request in writing that Contractor permit Owner to use or occupy any such part of the Work that Owner believes to be substantially complete. If and when Contractor agrees that such part of the Work is substantially complete, Contractor, Owner, and Engineer will follow the procedures of Paragraph 15.03.A through E for that part of the Work.
2. At any time Contractor may notify Owner and Engineer in writing that Contractor considers any such part of the Work substantially complete and request Engineer to issue a certificate of Substantial Completion for that part of the Work.
3. Within a reasonable time after either such request, Owner, Contractor, and Engineer shall make an inspection of that part of the Work to determine its status of completion. If Engineer does not consider that part of the Work to be substantially complete, Engineer will notify Owner and Contractor in writing giving the reasons therefor. If Engineer considers that part of the Work to be substantially complete, the provisions of Paragraph 15.03 will apply with respect to certification of Substantial Completion of that part of the Work and the division of responsibility in respect thereof and access thereto.
4. No use or occupancy or separate operation of part of the Work may occur prior to compliance with the requirements of Paragraph 6.05 regarding builder's risk or other property insurance.

15.05 *Final Inspection*

- A. Upon written notice from Contractor that the entire Work or an agreed portion thereof is complete, Engineer will promptly make a final inspection with Owner and Contractor and will notify Contractor in writing of all particulars in which this inspection reveals that the Work, or agreed portion thereof, is incomplete or defective. Contractor shall immediately take such measures as are necessary to complete such Work or remedy such deficiencies.

15.06 *Final Payment*

A. *Application for Payment:*

1. After Contractor has, in the opinion of Engineer, satisfactorily completed all corrections identified during the final inspection and has delivered, in accordance with the Contract Documents, all maintenance and operating instructions, schedules, guarantees, bonds, certificates or other evidence of insurance, certificates of inspection, annotated record documents (as provided in Paragraph 7.11), and other documents, Contractor may make application for final payment.
2. The final Application for Payment shall be accompanied (except as previously delivered) by:
 - a. all documentation called for in the Contract Documents;
 - b. consent of the surety, if any, to final payment;
 - c. satisfactory evidence that all title issues have been resolved such that title to all Work, materials, and equipment has passed to Owner free and clear of any Liens or other title defects, or will so pass upon final payment.
 - d. a list of all disputes that Contractor believes are unsettled; and

- e. complete and legally effective releases or waivers (satisfactory to Owner) of all Lien rights arising out of the Work, and of Liens filed in connection with the Work.
 - 3. In lieu of the releases or waivers of Liens specified in Paragraph 15.06.A.2 and as approved by Owner, Contractor may furnish receipts or releases in full and an affidavit of Contractor that: (a) the releases and receipts include all labor, services, material, and equipment for which a Lien could be filed; and (b) all payrolls, material and equipment bills, and other indebtedness connected with the Work for which Owner might in any way be responsible, or which might in any way result in liens or other burdens on Owner's property, have been paid or otherwise satisfied. If any Subcontractor or Supplier fails to furnish such a release or receipt in full, Contractor may furnish a bond or other collateral satisfactory to Owner to indemnify Owner against any Lien, or Owner at its option may issue joint checks payable to Contractor and specified Subcontractors and Suppliers.
- B. *Engineer's Review of Application and Acceptance:*
- 1. If, on the basis of Engineer's observation of the Work during construction and final inspection, and Engineer's review of the final Application for Payment and accompanying documentation as required by the Contract Documents, Engineer is satisfied that the Work has been completed and Contractor's other obligations under the Contract have been fulfilled, Engineer will, within ten days after receipt of the final Application for Payment, indicate in writing Engineer's recommendation of final payment and present the Application for Payment to Owner for payment. Such recommendation shall account for any set-offs against payment that are necessary in Engineer's opinion to protect Owner from loss for the reasons stated above with respect to progress payments. At the same time Engineer will also give written notice to Owner and Contractor that the Work is acceptable, subject to the provisions of Paragraph 15.07. Otherwise, Engineer will return the Application for Payment to Contractor, indicating in writing the reasons for refusing to recommend final payment, in which case Contractor shall make the necessary corrections and resubmit the Application for Payment.
- C. *Completion of Work:* The Work is complete (subject to surviving obligations) when it is ready for final payment as established by the Engineer's written recommendation of final payment.
- D. *Payment Becomes Due:* Thirty days after the presentation to Owner of the final Application for Payment and accompanying documentation, the amount recommended by Engineer (less any further sum Owner is entitled to set off against Engineer's recommendation, including but not limited to set-offs for liquidated damages and set-offs allowed under the provisions above with respect to progress payments) will become due and shall be paid by Owner to Contractor.

15.07 *Waiver of Claims*

- A. The making of final payment will not constitute a waiver by Owner of claims or rights against Contractor. Owner expressly reserves claims and rights arising from unsettled Liens, from defective Work appearing after final inspection pursuant to Paragraph 15.05, from Contractor's failure to comply with the Contract Documents or the terms of any special guarantees specified therein, from outstanding Claims by Owner, or from Contractor's continuing obligations under the Contract Documents.
- B. The acceptance of final payment by Contractor will constitute a waiver by Contractor of all claims and rights against Owner other than those pending matters that have been duly submitted or appealed under the provisions of Article 17.

15.08 *Correction Period*

- A. If within one year after the date of Substantial Completion (or such longer period of time as may be prescribed by the terms of any applicable special guarantee required by the Contract Documents, or by any specific provision of the Contract Documents), any Work is found to be defective, or if the repair of any damages to the Site, adjacent areas that Contractor has arranged to use through construction easements or otherwise, and other adjacent areas used by Contractor as permitted by Laws and Regulations, is found to be defective, then Contractor shall promptly, without cost to Owner and in accordance with Owner's written instructions:
 - 1. correct the defective repairs to the Site or such other adjacent areas;
 - 2. correct such defective Work;
 - 3. if the defective Work has been rejected by Owner, remove it from the Project and replace it with Work that is not defective, and
 - 4. satisfactorily correct or repair or remove and replace any damage to other Work, to the work of others, or to other land or areas resulting therefrom.
- B. If Contractor does not promptly comply with the terms of Owner's written instructions, or in an emergency where delay would cause serious risk of loss or damage, Owner may have the defective Work corrected or repaired or may have the rejected Work removed and replaced. Contractor shall pay all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such correction or repair or such removal and replacement (including but not limited to all costs of repair or replacement of work of others).
- C. In special circumstances where a particular item of equipment is placed in continuous service before Substantial Completion of all the Work, the correction period for that item may start to run from an earlier date if so provided in the Specifications.
- D. Where defective Work (and damage to other Work resulting therefrom) has been corrected or removed and replaced under this paragraph, the correction period hereunder with respect to such Work will be extended for an additional period of one year after such correction or removal and replacement has been satisfactorily completed.
- E. Contractor's obligations under this paragraph are in addition to all other obligations and warranties. The provisions of this paragraph shall not be construed as a substitute for, or a waiver of, the provisions of any applicable statute of limitation or repose.

ARTICLE 16 – SUSPENSION OF WORK AND TERMINATION

16.01 *Owner May Suspend Work*

- A. At any time and without cause, Owner may suspend the Work or any portion thereof for a period of not more than 90 consecutive days by written notice to Contractor and Engineer. Such notice will fix the date on which Work will be resumed. Contractor shall resume the Work on the date so fixed. Contractor shall be entitled to an adjustment in the Contract Price or an extension of the Contract Times, or both, directly attributable to any such suspension. Any Change Proposal seeking such adjustments shall be submitted no later than 30 days after the date fixed for resumption of Work.

16.02 *Owner May Terminate for Cause*

- A. The occurrence of any one or more of the following events will constitute a default by Contractor and justify termination for cause:
 - 1. Contractor's persistent failure to perform the Work in accordance with the Contract Documents (including, but not limited to, failure to supply sufficient skilled workers or suitable materials or equipment or failure to adhere to the Progress Schedule);
 - 2. Failure of Contractor to perform or otherwise to comply with a material term of the Contract Documents;
 - 3. Contractor's disregard of Laws or Regulations of any public body having jurisdiction; or
 - 4. Contractor's repeated disregard of the authority of Owner or Engineer.
- B. If one or more of the events identified in Paragraph 16.02.A occurs, then after giving Contractor (and any surety) ten days written notice that Owner is considering a declaration that Contractor is in default and termination of the contract, Owner may proceed to:
 - 1. declare Contractor to be in default, and give Contractor (and any surety) notice that the Contract is terminated; and
 - 2. enforce the rights available to Owner under any applicable performance bond.
- C. Subject to the terms and operation of any applicable performance bond, if Owner has terminated the Contract for cause, Owner may exclude Contractor from the Site, take possession of the Work, incorporate in the Work all materials and equipment stored at the Site or for which Owner has paid Contractor but which are stored elsewhere, and complete the Work as Owner may deem expedient.
- D. Owner may not proceed with termination of the Contract under Paragraph 16.02.B if Contractor within seven days of receipt of notice of intent to terminate begins to correct its failure to perform and proceeds diligently to cure such failure.
- E. If Owner proceeds as provided in Paragraph 16.02.B, Contractor shall not be entitled to receive any further payment until the Work is completed. If the unpaid balance of the Contract Price exceeds the cost to complete the Work, including all related claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals) sustained by Owner, such excess will be paid to Contractor. If the cost to complete the Work including such related claims, costs, losses, and damages exceeds such unpaid balance, Contractor shall pay the difference to Owner. Such claims, costs, losses, and damages incurred by Owner will be reviewed by Engineer as to their reasonableness and, when so approved by Engineer, incorporated in a Change Order. When exercising any rights or remedies under this paragraph, Owner shall not be required to obtain the lowest price for the Work performed.
- F. Where Contractor's services have been so terminated by Owner, the termination will not affect any rights or remedies of Owner against Contractor then existing or which may thereafter accrue, or any rights or remedies of Owner against Contractor or any surety under any payment bond or performance bond. Any retention or payment of money due Contractor by Owner will not release Contractor from liability.
- G. If and to the extent that Contractor has provided a performance bond under the provisions of Paragraph 6.01.A, the provisions of that bond shall govern over any inconsistent provisions of Paragraphs 16.02.B and 16.02.D.

16.03 *Owner May Terminate For Convenience*

- A. Upon seven days written notice to Contractor and Engineer, Owner may, without cause and without prejudice to any other right or remedy of Owner, terminate the Contract. In such case, Contractor shall be paid for (without duplication of any items):
 - 1. completed and acceptable Work executed in accordance with the Contract Documents prior to the effective date of termination, including fair and reasonable sums for overhead and profit on such Work;
 - 2. expenses sustained prior to the effective date of termination in performing services and furnishing labor, materials, or equipment as required by the Contract Documents in connection with uncompleted Work, plus fair and reasonable sums for overhead and profit on such expenses; and
 - 3. other reasonable expenses directly attributable to termination, including costs incurred to prepare a termination for convenience cost proposal.
- B. Contractor shall not be paid on account of loss of anticipated overhead, profits, or revenue, or other economic loss arising out of or resulting from such termination.

16.04 *Contractor May Stop Work or Terminate*

- A. If, through no act or fault of Contractor, (1) the Work is suspended for more than 90 consecutive days by Owner or under an order of court or other public authority, or (2) Engineer fails to act on any Application for Payment within 30 days after it is submitted, or (3) Owner fails for 30 days to pay Contractor any sum finally determined to be due, then Contractor may, upon seven days written notice to Owner and Engineer, and provided Owner or Engineer do not remedy such suspension or failure within that time, terminate the contract and recover from Owner payment on the same terms as provided in Paragraph 16.03.
- B. In lieu of terminating the Contract and without prejudice to any other right or remedy, if Engineer has failed to act on an Application for Payment within 30 days after it is submitted, or Owner has failed for 30 days to pay Contractor any sum finally determined to be due, Contractor may, seven days after written notice to Owner and Engineer, stop the Work until payment is made of all such amounts due Contractor, including interest thereon. The provisions of this paragraph are not intended to preclude Contractor from submitting a Change Proposal for an adjustment in Contract Price or Contract Times or otherwise for expenses or damage directly attributable to Contractor's stopping the Work as permitted by this paragraph.

ARTICLE 17 – FINAL RESOLUTION OF DISPUTES

17.01 *Methods and Procedures*

- A. *Disputes Subject to Final Resolution:* The following disputed matters are subject to final resolution under the provisions of this Article:
 - 1. A timely appeal of an approval in part and denial in part of a Claim, or of a denial in full; and
 - 2. Disputes between Owner and Contractor concerning the Work or obligations under the Contract Documents, and arising after final payment has been made.
- B. *Final Resolution of Disputes:* For any dispute subject to resolution under this Article, Owner or Contractor may:
 - 1. elect in writing to invoke the dispute resolution process provided for in the Supplementary Conditions; or

2. agree with the other party to submit the dispute to another dispute resolution process; or
3. if no dispute resolution process is provided for in the Supplementary Conditions or mutually agreed to, give written notice to the other party of the intent to submit the dispute to a court of competent jurisdiction.

ARTICLE 18 – MISCELLANEOUS

18.01 *Giving Notice*

- A. Whenever any provision of the Contract Documents requires the giving of written notice, it will be deemed to have been validly given if:
 1. delivered in person, by a commercial courier service or otherwise, to the individual or to a member of the firm or to an officer of the corporation for which it is intended; or
 2. delivered at or sent by registered or certified mail, postage prepaid, to the last business address known to the sender of the notice.

18.02 *Computation of Times*

- A. When any period of time is referred to in the Contract by days, it will be computed to exclude the first and include the last day of such period. If the last day of any such period falls on a Saturday or Sunday or on a day made a legal holiday by the law of the applicable jurisdiction, such day will be omitted from the computation.

18.03 *Cumulative Remedies*

- A. The duties and obligations imposed by these General Conditions and the rights and remedies available hereunder to the parties hereto are in addition to, and are not to be construed in any way as a limitation of, any rights and remedies available to any or all of them which are otherwise imposed or available by Laws or Regulations, by special warranty or guarantee, or by other provisions of the Contract. The provisions of this paragraph will be as effective as if repeated specifically in the Contract Documents in connection with each particular duty, obligation, right, and remedy to which they apply.

18.04 *Limitation of Damages*

- A. With respect to any and all Change Proposals, Claims, disputes subject to final resolution, and other matters at issue, neither Owner nor Engineer, nor any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors, shall be liable to Contractor for any claims, costs, losses, or damages sustained by Contractor on or in connection with any other project or anticipated project.

18.05 *No Waiver*

- A. A party's non-enforcement of any provision shall not constitute a waiver of that provision, nor shall it affect the enforceability of that provision or of the remainder of this Contract.

18.06 *Survival of Obligations*

- A. All representations, indemnifications, warranties, and guarantees made in, required by, or given in accordance with the Contract, as well as all continuing obligations indicated in the Contract, will survive final payment, completion, and acceptance of the Work or termination or completion of the Contract or termination of the services of Contractor.

18.07 *Controlling Law*

- A. This Contract is to be governed by the law of the state in which the Project is located.

18.08 *Headings*

- A. Article and paragraph headings are inserted for convenience only and do not constitute parts of these General Conditions.

Supplementary Conditions

These Supplementary Conditions amend or supplement the Standard General Conditions of the Construction Contract, EJCDC® C-700 (2013 Edition). All provisions that are not so amended or supplemented remain in full force and effect.

The terms used in these Supplementary Conditions have the meanings stated in the General Conditions. Additional terms used in these Supplementary Conditions have the meanings stated below, which are applicable to both the singular and plural thereof.

The address system used in these Supplementary Conditions is the same as the address system used in the General Conditions, with the prefix "SC" added thereto.

ARTICLE 5 – AVAILABILITY OF LANDS; SUBSURFACE AND PHYSICAL CONDITIONS; HAZARDOUS ENVIRONMENTAL CONDITIONS

SC-5.03 *Subsurface and Physical Conditions*

SC-5.03 Delete Paragraphs 5.03.A and 5.03.B in their entirety and insert the following:

- A. All reports of exploration or test of subsurface conditions at or adjacent to the Site, or drawings of physical conditions relating to existing surface or subsurface structures are included in Appendix B.

SC-5.06 Hazardous Environmental Conditions

SC 5.06 Delete Paragraphs 5.06.A and 5.06.B in their entirety and insert the following:

- A. No reports or drawings related to Hazardous Environmental Conditions at the Site are known to Owner.
- B. Not Used.

ARTICLE 6 – BONDS AND INSURANCE

SC-6.03 *Contractor's Liability Insurance*

SC 6.03 Add the following new paragraph immediately after Paragraph 6.03.J:

- K. The limits of liability for the insurance required by Paragraph 6.03 of the General Conditions shall provide coverage for not less than the following amounts or greater where required by Laws and Regulations:

- 1. Workers' Compensation, and related coverages under Paragraphs 6.03.A.1 and A.2 of the General Conditions:

Part One: Compensation	Statutory (In Thousands)
Part Two: Employers' Liability:	
accident	\$ 100
disease	\$ 100
aggregate disease	\$ 500

2. Contractor's Commercial General Liability under Paragraphs 6.03.B and 6.03.C of the General Conditions:

General Aggregate Limit	\$1,000
Products/Completed Operations Aggregate Limit	\$1,000
Personal/Adverse Injury	\$1,000
Each Occurrence Limit	\$1,000

3. Automobile Liability under Paragraph 6.03.D of the General Conditions:

Bodily Injury-Each Occurrence Limit	\$ 500
Property Damage-Each Occurrence Limit	\$ 250

OR

Combined Single Limit	\$1,000
No Fault	Statutory

4. Excess or Umbrella Liability:

Per Occurrence	\$2,000,000
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5. Additional Insureds: In addition to Owner and Engineer, include as additional insureds the following: Saginaw County Public Works Commissioner, Gage Drain Drainage District, Michigan Department of Transportation, Spicer Group, Inc., Saginaw County, Buena Vista Township, Saginaw County Road Commission, the People of the State of Michigan, the State of Michigan, and governmental bodies performing permit activities under a maintenance contract, and all officers, agents, and employees of the above, for claims arising out of, under, or by reason of operations covered by a permit issued to (CONTRACTOR) for the construction of the Gage Drain Pump Station, Saginaw County, Michigan.

6. Owner's and Contractor's Protective Liability

Contractor shall purchase and maintain OWNER'S and Contractor's Protective Liability Insurance which shall:

- (1) Be a separate policy to protect OWNER, ENGINEER, their consultants, agents, employees, and such public corporations in whose jurisdiction the Work is located for their liability for work performed by Contractor or Subcontractors under this contract.
- (2) Name OWNER as the insured.
- (3) Include any specific insurance language requirements for the following named insured.
- (4) Name the following as additional insured which will be held harmless and indemnified: Spicer Group, Inc., and others.

Separate:

Each Occurrence	\$1,000
General Aggregate	\$1,000

In lieu of the Owner's and Contractor's Protective Liability, the Contractor may provide an endorsement to their policy for a per project aggregate coverage with the following limits:

Aggregate Limit	\$1,000
Each Occurrence Limit	\$1,000

(ISO form CG2503 or it's equivalent)

A copy of this endorsement must accompany the Certificate of Insurance, the Certificate will clearly state the additional insured requirement and the policy contains the per project aggregate endorsement.

7. **Additional Insureds: In addition to Owner and Engineer, include as additional insureds the following:** Saginaw County Public Works Commissioner, Gage Drain Drainage District, Michigan Department of Transportation, Spicer Group, Inc., Saginaw County, Buena Vista Township, Saginaw County Road Commission, the People of the State of Michigan, the State of Michigan, and governmental bodies performing permit activities under a maintenance contract, and all officers, agents, and employees of the above, for claims arising out of, under, or by reason of operations covered by a permit issued to (CONTRACTOR) for the construction of the Gage Drain Pump Station, Saginaw County, Michigan.
8. **BUILDERS RISK-INSTALLATION FLOATER**
 - (1) Shall include cost to replace at time of loss, including foundations, footings, and materials on site not yet a part of the permanent structure or project.
9. **Contractor shall obtain all insurance required to perform work in MDOT right-of-way as shown on plans.**

ARTICLE 7 – CONTRACTOR'S RESPONSIBILITIES

SC 7.02 Labor; Working Hours

SC-7.02.B. Add the following new subparagraphs immediately after Paragraph 7.02.B:

1. **Regular working hours will be 7 A.M to 7 P.M.**
2. **Owner's legal holidays shall be defined as U.S. Federal Holidays.**

SC-7.02.B. Amend the first and second sentences of Paragraph 7.02.B to state "...all Work at the Site shall be performed during regular working hours, Monday through Saturday. Contractor will not perform Work on a Sunday or any legal holiday."

SC-7.08 Permits

SC 7.08 Add the following new subparagraphs immediately after Paragraph 7.08.A:

- B. **A Soil Erosion and Sedimentation Control (SESC) Permit is not required since the Owner is an Authorized Public Agency (APA). However, the Contractor will need to construct the project in accordance with SESC measure as described in the bidding plans and specifications.**
- C. **Contractor to coordinate with local Road Commission having jurisdiction to obtain necessary permits.**

ARTICLE 10 – ENGINEER’S STATUS DURING CONSTRUCTION

SC-10.03 Project Representative

SC-10.03 Add the following new paragraphs immediately after Paragraph 10.03.A:

- B. The Resident Project Representative (RPR) will be Engineer's representative at the Site, will act as directed by and under the supervision of Engineer, and will confer with Engineer regarding RPR's actions.**
- 1. General: RPR's dealings in matters pertaining to the Work in general shall be with Engineer and Contractor. RPR's dealings with Subcontractors shall only be through or with the full knowledge and approval of Contractor. RPR shall generally communicate with Owner only with the knowledge of and under the direction of Engineer.**
 - 2. Schedules: Review the progress schedule, schedule of Shop Drawing and Sample submittals, and Schedule of Values prepared by Contractor and consult with Engineer concerning acceptability.**
 - 3. Conferences and Meetings: Attend meetings with Contractor, such as preconstruction conferences, progress meetings, job conferences, and other Project-related meetings, and prepare and circulate copies of minutes thereof.**
 - 4. Liaison:**
 - a. Serve as Engineer’s liaison with Contractor. Working principally through Contractor’s authorized representative or designee, assist in providing information regarding the provisions and intent of the Contract Documents.**
 - b. Assist Engineer in serving as Owner’s liaison with Contractor when Contractor’s operations affect Owner’s on-Site operations.**
 - c. Assist in obtaining from Owner additional details or information, when required for proper execution of the Work.**
 - 5. Interpretation of Contract Documents: Report to Engineer when clarifications and interpretations of the Contract Documents are needed and transmit to Contractor clarifications and interpretations as issued by Engineer.**
 - 6. Shop Drawings and Samples:**
 - a. Record date of receipt of Samples and Contractor-approved Shop Drawings.**
 - b. Receive Samples which are furnished at the Site by Contractor, and notify Engineer of availability of Samples for examination.**
 - c. Advise Engineer and Contractor of the commencement of any portion of the Work requiring a Shop Drawing or Sample submittal for which RPR believes that the submittal has not been approved by Engineer.**
 - 7. Modifications: Consider and evaluate Contractor’s suggestions for modifications in Drawings or Specifications and report such suggestions, together with RPR’s recommendations, if any, to Engineer. Transmit to Contractor in writing decisions as issued by Engineer.**

- 8. Review of Work and Rejection of Defective Work:**
 - a. Conduct on-Site observations of Contractor's work in progress to assist Engineer in determining if the Work is in general proceeding in accordance with the Contract Documents.**
 - b. Report to Engineer whenever RPR believes that any part of Contractor's work in progress is defective, will not produce a completed Project that conforms generally to the Contract Documents, or will imperil the integrity of the design concept of the completed Project as a functioning whole as indicated in the Contract Documents, or has been damaged, or does not meet the requirements of any inspection, test or approval required to be made; and advise Engineer of that part of work in progress that RPR believes should be corrected or rejected or should be uncovered for observation, or requires special testing, inspection or approval.**
- 9. Inspections, Tests, and System Start-ups:**
 - a. Verify that tests, equipment, and systems start-ups and operating and maintenance training are conducted in the presence of appropriate Owner's personnel, and that Contractor maintains adequate records thereof.**
 - b. Observe, record, and report to Engineer appropriate details relative to the test procedures and systems start-ups.**
- 10. Records:**
 - a. Prepare a daily report or keep a diary or log book, recording Contractor's hours on the Site, Subcontractors present at the Site, weather conditions, data relative to questions of Change Orders, Field Orders, Work Change Directives, or changed conditions, Site visitors, deliveries of equipment or materials, daily activities, decisions, observations in general, and specific observations in more detail as in the case of observing test procedures; and send copies to Engineer.**
 - b. Record names, addresses, fax numbers, e-mail addresses, web site locations, and telephone numbers of all Contractors, Subcontractors, and major Suppliers of materials and equipment.**
 - c. Maintain records for use in preparing Project documentation.**
- 11. Reports:**
 - a. Furnish to Engineer periodic reports as required of progress of the Work and of Contractor's compliance with the Progress Schedule and schedule of Shop Drawing and Sample submittals.**
 - b. Draft and recommend to Engineer proposed Change Orders, Work Change Directives, and Field Orders. Obtain backup material from Contractor.**
 - c. Immediately notify Engineer of the occurrence of any Site accidents, emergencies, acts of God endangering the Work, force majeure or delay events, damage to property by fire or other causes, or the discovery of any Constituent of Concern or Hazardous Environmental Condition.**

12. **Payment Requests:** Review applications for payment with Contractor for compliance with the established procedure for their submission and forward with recommendations to Engineer, noting particularly the relationship of the payment requested to the Schedule of Values, Work completed, and materials and equipment delivered at the Site but not incorporated in the Work.
13. **Certificates, Operation and Maintenance Manuals:** During the course of the Work, verify that materials and equipment certificates, operation and maintenance manuals and other data required by the Contract Documents to be assembled and furnished by Contractor are applicable to the items actually installed and in accordance with the Contract Documents, and have these documents delivered to Engineer for review and forwarding to Owner prior to payment for that part of the Work.
14. **Completion:**
 - a. Participate in Engineer's visits to the Site to determine Substantial Completion, assist in the determination of Substantial Completion and the preparation of a punch list of items to be completed or corrected.
 - b. Participate in Engineer's final visit to the Site to determine completion of the Work, in the company of Owner and Contractor, and prepare a final punch list of items to be completed and deficiencies to be remedied.
 - c. Observe whether all items on the final list have been completed or corrected and make recommendations to Engineer concerning acceptance and issuance of the notice of acceptability of the work.

C. The RPR shall not:

1. Authorize any deviation from the Contract Documents or substitution of materials or equipment (including "or-equal" items).
2. Exceed limitations of Engineer's authority as set forth in the Contract Documents.
3. Undertake any of the responsibilities of Contractor, Subcontractors, or Suppliers.
4. Advise on, issue directions relative to, or assume control over any aspect of the means, methods, techniques, sequences or procedures of Contractor's work.
5. Advise on, issue directions regarding, or assume control over security or safety practices, precautions, and programs in connection with the activities or operations of Owner or Contractor.
6. Participate in specialized field or laboratory tests or inspections conducted off-site by others except as specifically authorized by Engineer.
7. Accept Shop Drawing or Sample submittals from anyone other than Contractor.
8. Authorize Owner to occupy the Project in whole or in part.

ARTICLE 19 – DAVIS BACON WAGE RATES

SC-19 Add Article 19 titled Davis Bacon Wage Rates

SC-19.01 Add the following as paragraph 19.01 with title Wage Requirements:

A. Contractor is required to comply with Davis Bacon Wage Requirements on this project. Current Davis Bacon Wage determination is included in the bidding documents.

"General Decision Number: MI20210097 01/01/2021

Superseded General Decision Number: MI20200097

State: Michigan

Construction Type: Building

County: Saginaw County in Michigan.

BUILDING CONSTRUCTION PROJECTS (does not include single family homes or apartments up to and including 4 stories).

Note: Under Executive Order (EO) 13658, an hourly minimum wage of \$10.95 for calendar year 2021 applies to all contracts subject to the Davis-Bacon Act for which the contract is awarded (and any solicitation was issued) on or after January 1, 2015. If this contract is covered by the EO, the contractor must pay all workers in any classification listed on this wage determination at least \$10.95 per hour (or the applicable wage rate listed on this wage determination, if it is higher) for all hours spent performing on the contract in calendar year 2021. If this contract is covered by the EO and a classification considered necessary for performance of work on the contract does not appear on this wage determination, the contractor must pay workers in that classification at least the wage rate determined through the conformance process set forth in 29 CFR 5.5(a)(1)(ii) (or the EO minimum wage rate, if it is higher than the conformed wage rate). The EO minimum wage rate will be adjusted annually. Please note that this EO applies to the above-mentioned types of contracts entered into by the federal government that are subject to the Davis-Bacon Act itself, but it does not apply to contracts subject only to the Davis-Bacon Related Acts, including those set forth at 29 CFR 5.1(a)(2)-(60). Additional information on contractor requirements and worker protections under the EO is available at www.dol.gov/whd/govcontracts.

Modification Number	Publication Date
0	01/01/2021

ASBE0047-002 07/01/2020

	Rates	Fringes
ASBESTOS WORKER/HEAT & FROST INSULATOR.....	\$ 32.52	17.88

BOIL0169-001 03/01/2018

	Rates	Fringes
BOILERMAKER.....	\$ 38.65	26.22

BRMI0009-001 08/01/2020

	Rates	Fringes
BRICKLAYER.....	\$ 30.00	21.24
PLASTERER.....	\$ 27.81	19.84
TILE FINISHER.....	\$ 23.18	15.35
TILE SETTER.....	\$ 29.82	15.35

FOOTNOTE:

Paid Holiday: Fourth of July, if the worker is employed by the contractor in any period of seven working days before said holiday within the current calendar year.

CARP0706-004 06/01/2020

	Rates	Fringes
CARPENTER (Including Acoustical Ceiling Installation & Drywall Hanging; Excluding Form Work)....	\$ 27.61	21.84

CARP1045-003 06/01/2013

	Rates	Fringes
LATHER.....	\$ 24.29	13.66

* ELEC0557-001 06/01/2020

	Rates	Fringes
ELECTRICIAN		
Alarm Installation.....	\$ 20.00	10.00
Excluding Alarm Installation.....	\$ 34.25	23.13

ENGI0324-016 06/01/2020

	Rates	Fringes
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OPERATOR: Power Equipment

GROUP 1.....	\$ 40.38	24.85
GROUP 2.....	\$ 37.08	24.85
GROUP 3.....	\$ 33.63	24.85
GROUP 4.....	\$ 32.72	24.85
GROUP 5.....	\$ 32.72	24.85
GROUP 6.....	\$ 26.86	24.85
GROUP 7.....	\$ 24.38	24.85

FOOTNOTES:

Crane operator with main boom and jib 300' or longer: \$1.50 per hour above the group 1 rate. Crane operator with main boom and jib 400' or longer: \$3.00 per hour above the group 1 rate.

PAID HOLIDAYS: New Year's Day, Memorial Day, Fourth of July, Labor Day, Thanksgiving Day and Christmas Day.

POWER EQUIPMENT OPERATOR CLASSIFICATIONS

GROUP 1: Crane operator with main boom and jib 400', 300', or 220' or longer.

GROUP 2: Crane operator with main boom and jib 140' or longer, tower crane, gantry crane, whirley derrick

GROUP 3: Concrete Pump; Crane; Grader/Blade; Highlift; Hoist; Roller; Scraper; Stiff Leg Derrick; Trencher

GROUP 4: Bobcat/Skid Loader; Broom/Sweeper; Fork Truck (over 20' lift)

GROUP 5: Boom Truck (non-swinging)

GROUP 6: Fork Truck (20' lift and under for masonry work)

GROUP 7: Oiler

IRON0025-019 06/01/2019

	Rates	Fringes
IRONWORKER		
REINFORCING.....	\$ 30.98	27.99
STRUCTURAL.....	\$ 36.77	29.03

LAB00334-010 06/01/2019

	Rates	Fringes
LABORER: Landscape and Irrigation		
GROUP 1.....	\$ 20.75	7.10
GROUP 2.....	\$ 18.75	7.10

CLASSIFICATIONS

GROUP 1: Landscape specialist, including air, gas and diesel equipment operator, lawn sprinkler installer and skidsteer (or equivalent)

GROUP 2: Landscape laborer: small power tool operator, material mover, truck driver and lawn sprinkler installer tender

LAB01098-009 07/01/2019

	Rates	Fringes
LABORER		
Common or General; Grade Checker; Mason Tender - Brick/Cement/Concrete; Pipelayer.....	\$ 20.12	12.90
Sandblaster.....	\$ 21.17	12.90

PAIN1803-002 06/01/2020

	Rates	Fringes
PAINTER: Brush and Spray.....	\$ 24.09	16.24
PAINTER: Drywall Finishing/Taping.....	\$ 25.01	18.33

PLAS0016-012 04/01/2014

	Rates	Fringes
CEMENT MASON/CONCRETE FINISHER...	\$ 25.47	12.38

* PLUM0085-003 05/04/2020

	Rates	Fringes
PIPEFITTER, Includes HVAC Pipe and Unit Installation.....	\$ 38.25	21.07

PLUMBER, Excludes HVAC Pipe and Unit Installation.....	\$ 38.25	21.07
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 ROOF0149-003 06/01/2020

	Rates	Fringes
ROOFER.....	\$ 29.58	18.33

 SFMI0669-001 04/01/2020

	Rates	Fringes
SPRINKLER FITTER (Fire Sprinklers).....	\$ 35.72	23.60

 SHEE0007-009 05/01/2018

	Rates	Fringes
SHEET METAL WORKER (Including HVAC Duct Installation; Excluding HVAC System Installation).....	\$ 26.83	23.78

 SUMI2011-022 02/01/2011

	Rates	Fringes
CARPENTER (Form Work Only).....	\$ 16.50	1.65
FLOOR LAYER: Vinyl Flooring.....	\$ 16.81	3.73
IRONWORKER, ORNAMENTAL.....	\$ 18.48	7.93
OPERATOR: Backhoe/Excavator/Trackhoe.....	\$ 18.31	13.84
OPERATOR: Bulldozer.....	\$ 17.50	8.67
OPERATOR: Tractor.....	\$ 19.10	8.48
OPERATOR: Loader.....	\$ 17.62	0.00
PAINTER: Roller.....	\$ 22.02	6.02
TRUCK DRIVER, Includes Dump and Tandem Truck.....	\$ 12.00	0.00

TRUCK DRIVER: Tractor Haul

Truck.....\$ 13.57 1.18

WELDERS - Receive rate prescribed for craft performing
operation to which welding is incidental.

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Note: Executive Order (EO) 13706, Establishing Paid Sick Leave for Federal Contractors applies to all contracts subject to the Davis-Bacon Act for which the contract is awarded (and any solicitation was issued) on or after January 1, 2017. If this contract is covered by the EO, the contractor must provide employees with 1 hour of paid sick leave for every 30 hours they work, up to 56 hours of paid sick leave each year. Employees must be permitted to use paid sick leave for their own illness, injury or other health-related needs, including preventive care; to assist a family member (or person who is like family to the employee) who is ill, injured, or has other health-related needs, including preventive care; or for reasons resulting from, or to assist a family member (or person who is like family to the employee) who is a victim of, domestic violence, sexual assault, or stalking. Additional information on contractor requirements and worker protections under the EO is available at www.dol.gov/whd/govcontracts.

Unlisted classifications needed for work not included within the scope of the classifications listed may be added after award only as provided in the labor standards contract clauses (29CFR 5.5 (a) (1) (ii)).

The body of each wage determination lists the classification and wage rates that have been found to be prevailing for the cited type(s) of construction in the area covered by the wage determination. The classifications are listed in alphabetical order of ""identifiers"" that indicate whether the particular rate is a union rate (current union negotiated rate for local), a survey rate (weighted average rate) or a union average rate (weighted union average rate).

Union Rate Identifiers

A four letter classification abbreviation identifier enclosed in dotted lines beginning with characters other than ""SU"" or ""UAVG"" denotes that the union classification and rate were prevailing for that classification in the survey. Example:

PLUM0198-005 07/01/2014. PLUM is an abbreviation identifier of the union which prevailed in the survey for this classification, which in this example would be Plumbers. 0198 indicates the local union number or district council number where applicable, i.e., Plumbers Local 0198. The next number, 005 in the example, is an internal number used in processing the wage determination. 07/01/2014 is the effective date of the most current negotiated rate, which in this example is July 1, 2014.

Union prevailing wage rates are updated to reflect all rate changes in the collective bargaining agreement (CBA) governing this classification and rate.

Survey Rate Identifiers

Classifications listed under the "SU" identifier indicate that no one rate prevailed for this classification in the survey and the published rate is derived by computing a weighted average rate based on all the rates reported in the survey for that classification. As this weighted average rate includes all rates reported in the survey, it may include both union and non-union rates. Example: SULA2012-007 5/13/2014. SU indicates the rates are survey rates based on a weighted average calculation of rates and are not majority rates. LA indicates the State of Louisiana. 2012 is the year of survey on which these classifications and rates are based. The next number, 007 in the example, is an internal number used in producing the wage determination. 5/13/2014 indicates the survey completion date for the classifications and rates under that identifier.

Survey wage rates are not updated and remain in effect until a new survey is conducted.

Union Average Rate Identifiers

Classification(s) listed under the UAVG identifier indicate that no single majority rate prevailed for those classifications; however, 100% of the data reported for the classifications was union data. EXAMPLE: UAVG-OH-0010 08/29/2014. UAVG indicates that the rate is a weighted union average rate. OH indicates the state. The next number, 0010 in the example, is an internal number used in producing the wage determination. 08/29/2014 indicates the survey completion date for the classifications and rates under that identifier.

A UAVG rate will be updated once a year, usually in January of each year, to reflect a weighted average of the current negotiated/CBA rate of the union locals from which the rate is based.

WAGE DETERMINATION APPEALS PROCESS

1.) Has there been an initial decision in the matter? This can be:

- * an existing published wage determination
- * a survey underlying a wage determination
- * a Wage and Hour Division letter setting forth a position on a wage determination matter
- * a conformance (additional classification and rate) ruling

On survey related matters, initial contact, including requests for summaries of surveys, should be with the Wage and Hour Regional Office for the area in which the survey was conducted because those Regional Offices have responsibility for the Davis-Bacon survey program. If the response from this initial contact is not satisfactory, then the process described in 2.) and 3.) should be followed.

With regard to any other matter not yet ripe for the formal process described here, initial contact should be with the Branch of Construction Wage Determinations. Write to:

Branch of Construction Wage Determinations
Wage and Hour Division
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

2.) If the answer to the question in 1.) is yes, then an interested party (those affected by the action) can request review and reconsideration from the Wage and Hour Administrator (See 29 CFR Part 1.8 and 29 CFR Part 7). Write to:

Wage and Hour Administrator
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

The request should be accompanied by a full statement of the interested party's position and by any information (wage payment data, project description, area practice material, etc.) that the requestor considers relevant to the issue.

3.) If the decision of the Administrator is not favorable, an

interested party may appeal directly to the Administrative Review Board (formerly the Wage Appeals Board). Write to:

Administrative Review Board
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

4.) All decisions by the Administrative Review Board are final.

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END OF GENERAL DECISION

"

Date of Issuance:	Effective Date:
Owner: Saginaw County Public Works Commissioner	Owner's Contract No.:
Contractor:	Contractor's Project No.:
Engineer: Spicer Group, Inc.	Engineer's Project No.: 122901SG2015
Project: Gage Drain – Pump Station – Division I	Contract Name: Gage Drain – Pump Station – Division I

The Contract is modified as follows upon execution of this Change Order:

Description:

Attachments: *[List documents supporting change]*

CHANGE IN CONTRACT PRICE	CHANGE IN CONTRACT TIMES <i>[note changes in Milestones if applicable]</i>
Original Contract Price: \$ _____	Original Contract Times: Substantial Completion: _____ Ready for Final Payment: _____ days or dates
[Increase] [Decrease] from previously approved Change Orders No. ____ to No. ____: \$ _____	[Increase] [Decrease] from previously approved Change Orders No. ____ to No. ____: Substantial Completion: _____ Ready for Final Payment: _____ days
Contract Price prior to this Change Order: \$ _____	Contract Times prior to this Change Order: Substantial Completion: _____ Ready for Final Payment: _____ days or dates
[Increase] [Decrease] of this Change Order: \$ _____	[Increase] [Decrease] of this Change Order: Substantial Completion: _____ Ready for Final Payment: _____ days or dates
Contract Price incorporating this Change Order: \$ _____	Contract Times with all approved Change Orders: Substantial Completion: _____ Ready for Final Payment: _____ days or dates

RECOMMENDED:	ACCEPTED:	ACCEPTED:
By: _____ Engineer (if required)	By: _____ Owner (Authorized Signature)	By: _____ Contractor (Authorized Signature)
Title: _____	Title: _____	Title: _____
Date: _____	Date: _____	Date: _____

Approved by Funding Agency (if applicable)

By: _____ Date: _____
Title: _____

LANDOWNER AGREEMENT FORM

Project Name: Gage Drain – Pump Station – Division I

Date: _____

Landowner's Name: _____

Parcel No. _____

I am the owner of property at the address listed above. I hereby give permission to the Contractor; and employees, agents, and vendors of the Saginaw County Public Works Commissioner to enter my property for the following purpose:

This activity will take place on the following location:

My property can be utilized as described above until the following date:

CONTRACTOR

LANDOWNER

By: _____
(Authorized Signature)

By: _____
(Authorized Signature)

Date: _____

Date: _____

*Renters cannot authorize.

COORDINATION CLAUSE AND PROJECT SCHEDULING

Contractor Coordination

The Gage Drain project is being bid in two (2) divisions. Contractors for separate divisions will be required to work together and coordinate schedules when working near other contractors. As noted on Division I plans, Consumers Energy will have a contractor on the pump station site to install the backup generator once the Division I contractor has the provisions in place to accommodate the generator. In addition, the railroad companies involved in the project may be performing work to their crossings if the alternate bid items on Division II are not included with this project. The contractors on the Gage Drain will be required to coordinate project schedules with all contractors and entities completing work on the project.

No claims for extra compensation or adjustment in contract unit prices will be allowed on account of delay or failure of other contractors to complete work scheduled.

Contractor is required to coordinate with US postal service to ensure uninterrupted mail delivery and provide temporary mailboxes where required. Contractor is required to coordinate with trash pickup service and provide temporary means of maintaining trash pickup as required. Contractor is required to coordinate road shutdowns with Saginaw County Road Commission, emergency services, and school busing as required. Contractor is required to coordinate with landowners prior to driveway or road shutdown and provide access to driveways outside of working hours, if needed. Contractor is required to coordinate project schedule to accommodate utility relocations as needed.

Division II contractor is being required to coordinate all work in the state game area with DNR personnel responsible for managing the area (Barry Sova).

Division II contract includes work within a secured area on Nexteer property. Contractor will be required to coordinate access and schedule with Nexteer prior to commencing work.

Project Scheduling

In addition to the other scheduling constraints on project contract times, the following time constraints will be enforced on this project:

- Division I contractor shall have conduits and generator pad constructed/installed and ready for Consumers Energy to set the generator by November 1, 2021
- Division II contractor to schedule work on the state game area in accordance with the dates listed on the construction notes included on the plans.
- If alternate bid items for railroad crossings are included in the contract, the railroad crossings shall be shutdown for seven (7) days or less. This includes having the rails restored and having the tracks open to traffic. If the "Expedited Construction Schedule" alternate bid item for the Lakestate Railroad is included in the contract, the maximum allowable track shutdown time will be reduced to three (3) days, two of which shall be Saturday and Sunday.

SECTION 01 10 00

SUMMARY

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Contract description.
 - 2. Work by Owner or other Work at the Site.
 - 3. Owner-furnished products.
 - 4. Work sequence.
 - 5. Permits.
 - 6. Specification conventions.

1.2 CONTRACT DESCRIPTION

- A. Work of the Project includes:
 - 1. Site upgrades to existing pump station.
 - 2. Installation of new pumps and trash rack.
 - 3. Electrical and HVAC upgrades.
 - 4. Building construction and improvements.
 - 5. Structural rehabilitation.
- B. Perform Work of Contract under stipulated sum Contract with Owner according to Conditions of Contract.

1.3 WORK BY OWNER OR OTHERS

- A. Generator placement and delivery to site.

1.4 OWNER-FURNISHED PRODUCTS

- A. None.

1.5 WORK SEQUENCE

- A. Coordinate construction schedule and operations with Owner and Engineer.
- B. Include in construction schedule and work sequence the items listed under Section 7.02.B of the Supplementary Conditions.
- C. Work sequence on mechanical demolitions and installations shall follow sequence shown on plans.

1.6 PERMITS

- A. Necessary permits for construction of Work including the following:
 - 1. Contractor will coordinate with the local Road Commission and acquire a permit for construction activities within the County Road right-of-way.

1.7 SPECIFICATION CONVENTIONS

- A. These Specifications are written in imperative mood and streamlined form. This imperative language is directed to Contractor unless specifically noted otherwise. The words "shall be" are included by inference where a colon (:) is used within sentences or phrases.

PART 2 - PRODUCTS - Not Used

PART 3 - EXECUTION - Not Used

END OF SECTION

SECTION 01 20 00

PRICE AND PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Cash allowances.
- B. Testing and inspection allowances.
- C. Application for Payment.
- D. Change procedures.
- E. Defect assessment.
- F. Unit prices.
- G. Alternates.

1.2 CASH ALLOWANCES

- A. Costs Included in Cash Allowances: Cost of product to Contractor or Subcontractor, less applicable trade discounts; delivery to Site and applicable taxes unless stated otherwise in Allowance Schedule.
- B. Costs Not Included in Cash Allowances but Included in Contract Sum/Price: Product handling at Site including unloading, uncrating, and storage; protection of products from elements and from damage; and labor for installation and finishing unless stated otherwise in Allowance Schedule.
- C. Engineer Responsibilities:
 - 1. Consult with Contractor for consideration and selection of products.
 - 2. Select products in consultation with Owner and transmit decision to Contractor.
 - 3. Prepare Change Order.
- D. Contractor Responsibilities:
 - 1. Assist Engineer in selection of products.
 - 2. Obtain proposals from suppliers and offer recommendations.
 - 3. Upon notification of selection by Engineer, execute purchase agreement with designated supplier.
 - 4. Arrange for and process Shop Drawings, Product Data, and Samples. Arrange for delivery.
 - 5. Promptly inspect products upon delivery for completeness, damage, and defects. Submit claims for transportation damage.
- E. Differences in costs will be adjusted by Change Order.

F. Allowance Schedule:

1. None.

1.3 APPLICATION FOR PAYMENT

- A. Submit electronic file of each Application for Payment to Engineer.
- B. Format shall follow that of the Bid Form. Installed quantity, description of Work, unit price, installed price, retainage, payment amount, and date must be included.
- C. Submit updated construction schedule with each Application for Payment.
- D. Payment shall be in accordance with Public Act 524 – as outlined in the agreement.
- E. Submit submittals with transmittal letter as specified in Section 01 33 00 - Submittal Procedures.
- F. Submit waivers requested by Owner.
- G. Substantiating Data: When Engineer requires substantiating information, submit data justifying dollar amounts in question.

1.4 CHANGE PROCEDURES

- A. Submittals: Submit name of individual who is authorized to receive change documents and is responsible for informing others in Contractor's employ or Subcontractors of changes to the Work.
- B. Carefully study and compare Contract Documents before proceeding with fabrication and installation of Work. Promptly advise Engineer of any error, inconsistency, omission, or apparent discrepancy.
- C. Requests for Interpretation (RFI) and Clarifications: Allot time in construction scheduling for liaison with Engineer; establish procedures for handling queries and clarifications.
 1. Use Contractor form for requesting interpretations.
 2. Engineer may respond with a direct answer on the Request for Interpretation form, C-942 - Field Order.
- D. Engineer will advise of minor changes in the Work not involving adjustment to Contract Sum/Price or Contract Time by issuing supplemental instructions on C-940.
- E. Engineer may issue Proposal Request including a detailed description of proposed change with supplementary or revised Drawings and Specifications, a change in Contract Time for executing the change with stipulation of overtime work required and with the period of time during which the requested price will be considered valid. Contractor will prepare and submit estimate within 14 days.

- F. Contractor may propose changes by submitting a request for change to Engineer, describing proposed change and its full effect on the Work. Include a statement describing reason for the change and the effect on Contract Sum/Price and Contract Time with full documentation and a statement describing effect on the Work by separate or other Contractors.
- G. Stipulated Sum/Price Change Order: Based on and Contractor's estimated price quotation or Contractor's request for Change Order as approved by Engineer.
- H. Unit Price Change Order: For Contract unit prices and quantities, the Change Order will be executed on a fixed unit price basis. For unit costs or quantities of units of that which are not predetermined, execute Work under Work Directive Change. Changes in Contract Sum/Price or Contract Time will be computed as specified for Force Account Change Order.
- I. Work Directive Change: Engineer may issue directive, on C-940 - Work Change Directive signed by Owner, instructing Contractor to proceed with change in the Work, for subsequent inclusion in a Change Order. Document will describe changes in the Work and designate method of determining any change in Contract Sum/Price or Contract Time. Promptly execute change.
- J. Time and Material Change Order: Submit itemized account and supporting data after completion of change, within time limits indicated in Conditions of the Contract. Engineer will determine change allowable in Contract Sum/Price and Contract Time as provided in Contract Documents.
- K. Maintain detailed records of Work done on time and material basis. Provide full information required for evaluation of proposed changes and to substantiate costs for changes in the Work.
- L. Document each quotation for change in Project Cost or Time with sufficient data to allow evaluation of quotation.
- M. Change Order Forms: C-941 - Change Order.
- N. Execution of Change Orders: Engineer will issue Change Orders for signatures of parties as provided in Conditions of the Contract.
- O. Correlation of Contractor Submittals:
 - 1. Promptly revise Schedule of Values and Application for Payment forms to record each authorized Change Order as separate line item and adjust Contract Sum/Price.
 - 2. Promptly revise Progress Schedules to reflect change in Contract Time, revise sub schedules to adjust times for other items of Work affected by the change, and resubmit.
 - 3. Promptly enter changes in Record Documents.

1.5 DEFECT ASSESSMENT

- A. Replace the Work, or portions of the Work, not conforming to specified requirements.
- B. If, in the opinion of Engineer, it is not practical to remove and replace the Work, Engineer will direct appropriate remedy or adjust payment.
- C. The defective Work may remain, but unit sum/price will be adjusted to new sum/price at discretion of Owner.

- D. Defective Work will be partially repaired according to instructions of Engineer, and unit sum/price will be adjusted to new sum/price at discretion of Owner.
- E. Individual Specification Sections may modify these options or may identify specific formula or percentage sum/price reduction.
- F. Authority of Engineer to assess defects and identify payment adjustments is final.
- G. Nonpayment for Rejected Products: Payment will not be made for rejected products for any of the following reasons:
 - 1. Products wasted or disposed of in a manner that is not acceptable.
 - 2. Products determined as unacceptable before or after placement.
 - 3. Products not completely unloaded from transporting vehicle.
 - 4. Products placed beyond lines and levels of the required Work.
 - 5. Products remaining on hand after completion of the Work.
 - 6. Loading, hauling, and disposing of rejected products.

1.6 UNIT PRICES

- A. Authority: Measurement methods are delineated in individual Specification Sections.
- B. Measurement methods delineated in individual Specification Sections complement criteria of this Section. In event of conflict, requirements of individual Specification Section govern.
- C. Take measurements and compute quantities. Engineer will verify measurements and quantities.
- D. Unit Quantities: Quantities and measurements indicated on Bid Form are for Contract purposes only. Quantities and measurements supplied or placed in the Work shall determine payment.
 - 1. When actual Work requires more or fewer quantities than those quantities indicated, provide required quantities at contracted unit sum/prices.
- E. Payment Includes: Full compensation for required labor, products, tools, equipment, plant and facilities, transportation, services and incidentals; erection, application, or installation of item of the Work; overhead and profit.
- F. Final payment for Work governed by unit prices will be made on basis of actual measurements and quantities accepted by Engineer multiplied by unit sum/price for Work incorporated in or made necessary by the Work.
- G. Measurement of Quantities:
 - 1. Weigh Scales: Inspected, tested, and certified by applicable State weights and measures department within past year.
 - 2. Platform Scales: Of sufficient size and capacity to accommodate conveying vehicle.
 - 3. Metering Devices: Inspected, tested, and certified by applicable State department within past year.
 - 4. Measurement by Weight: Concrete reinforcing steel, rolled or formed steel, or other metal shapes will be measured by handbook weights. Welded assemblies will be measured by handbook or scale weight.

5. Measurement by Volume: Measured by cubic dimension using mean length, width, and height or thickness.
6. Measurement by Area: Measured by square dimension using mean length and width or radius.
7. Linear Measurement: Measured by linear dimension, at item centerline or mean chord.
8. Stipulated Sum/Price Measurement: Items measured by weight, volume, area, or linear means or combination, as appropriate, as completed item or unit of the Work.

1.7 ALTERNATES

- A. Alternates quoted on Bid Forms will be reviewed and accepted or rejected at Owner's option. Accepted Alternates will be identified in Owner-Contractor Agreement. The Owner-Contractor Agreement may identify certain Alternates to remain an Owner option for a stipulated period of time.
- B. Coordinate related Work and modify surrounding Work. Description for each Alternate is recognized to be abbreviated but requires that each change shall be complete for scope of Work affected.
 1. Coordinate related requirements among Specification Sections as required.
 2. Include as part of each Alternate: Miscellaneous devices, appurtenances, and similar items incidental to or necessary for complete installation.
 3. Coordinate Alternate with adjacent Work and modify or adjust as necessary to ensure integration.

PART 2 - PRODUCTS - Not Used

PART 3 - EXECUTION - Not Used

END OF SECTION

SECTION 01 25 00

SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Quality assurance.
- B. Product options.
- C. Product substitution procedures.

1.2 QUALITY ASSURANCE

- A. Contract is based on products and standards established in Contract Documents without consideration of proposed substitutions.
- B. Products specified define standard of quality, type, function, dimension, appearance, and performance required.
- C. Substitution Proposals: Permitted for specified products except where specified otherwise. Do not substitute products unless substitution has been accepted and approved in writing by Owner.

1.3 PRODUCT OPTIONS

- A. See Section 01 60 00 - Product Requirements.

1.4 PRODUCT SUBSTITUTION PROCEDURES

- A. Engineer will consider requests for substitutions only within **15** days after date of Owner-Contractor Agreement.
- B. Substitutions may be considered when a product becomes unavailable through no fault of Contractor.
- C. Document each request with complete data, substantiating compliance of proposed substitution with Contract Documents, including:
 - 1. Manufacturer's name and address, product, trade name, model, or catalog number, performance and test data, and reference standards.
 - 2. Itemized point-by-point comparison of proposed substitution with specified product, listing variations in quality, performance, and other pertinent characteristics.
 - 3. Reference to Article and Paragraph numbers in Specification Section.
 - 4. Cost data comparing proposed substitution with specified product and amount of net change to Contract Sum.
 - 5. Changes required in other Work.
 - 6. Availability of maintenance service and source of replacement parts as applicable.

7. Certified test data to show compliance with performance characteristics specified.
8. Samples when applicable or requested.
9. Other information as necessary to assist Engineer's evaluation.

D. A request constitutes a representation that Contractor:

1. Has investigated proposed product and determined that it meets or exceeds quality level of specified product.
2. Will provide same warranty for substitution as for specified product.
3. Will coordinate installation and make changes to other Work that may be required for the Work to be complete with no additional cost to Owner.
4. Waives claims for additional costs or time extension that may subsequently become apparent.
5. Will coordinate installation of the accepted substitute, making such changes as may be required for the Work to be complete in all respects.
6. Will reimburse Owner for review or redesign services associated with reapproval by authorities having jurisdiction.

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 Contract Documents.

F. Substitution Submittal Procedure:

1. Submit requests for substitutions.
2. Submit three copies of Request for Substitution for consideration. Limit each request to one proposed substitution.
3. Submit Shop Drawings, Product Data, and certified test results attesting to proposed product equivalence. Burden of proof is on proposer.
4. 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 01 30 00

ADMINISTRATIVE REQUIREMENTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Coordination and Project conditions.
- B. Field Engineering
- C. Cutting and Patching
- D. Preconstruction meeting.
- E. Site mobilization meeting.
- F. Progress meetings.
- G. Preinstallation meetings.
- H. Closeout meeting.
- I. Alteration procedures.

1.2 COORDINATION AND PROJECT CONDITIONS

- A. Coordinate scheduling, submittals, and Work of various Sections of Bidding Documents to ensure efficient and orderly sequence of installation of interdependent construction elements, with provisions for accommodating items installed later.
- B. Verify that utility requirements and characteristics of operating equipment are compatible with building utilities. Coordinate Work of various Sections having interdependent responsibilities for installing, connecting to, and placing operating equipment in service.
- C. Coordination Meetings: In addition to other meetings specified in this Section, hold coordination meetings with personnel and Subcontractors to ensure coordination of Work.
- D. Coordinate completion and clean-up of Work of separate Sections in preparation for Substantial Completion and for portions of Work designated for Owner's partial occupancy.
- E. After Owner's occupancy of premises, coordinate access to Site for correction of defective Work and Work not complying with Contract Documents, to minimize disruption of Owner's activities.

1.3 FIELD ENGINEERING

- A. Contractor to locate and protect survey control and reference points, land monuments, and property corner.
- B. Control datum for survey is that established by Owner provided survey shown on Drawings.
- C. Engineer will provide construction staking. Call the Engineer to request staking at least 3 working days in advance of the time needed for the work.
- D. Construction stakes removed or damaged by Contractor shall be replaced at Contractor's expense.
- E. When finished surfaces are cut so that a smoother transition and new work is not possible, terminate existing surface along a straight line at a natural line of division and make recommendation to Engineer.
- F. Where a change of plane of 1/4 inch or more occurs, submit recommendation for providing a smooth transition for Engineer review and request instructions from Engineer.
- G. Patch or replace portions of existing surfaces which are damaged, lifted, discolored, or showing other imperfections.
- H. Finish surfaces as specified in individual product sections.
- I. Where there are changes in open drain cross sections, excavate a 20-foot smooth transition between sections.

1.4 CUTTING AND PATCHING

- A. Employ skilled and experienced installer to perform cutting and patching.
- B. Submit written request in advance of cutting or altering elements which affects:
 - 1. Structural integrity of element.
 - 2. Integrity of weather-exposed or moisture-resistant elements.
 - 3. Efficiency, maintenance, or safety of element.
 - 4. Visual quantities of sight-exposed elements.
 - 5. Work of Owner or separate contractor.
- C. Execute cutting, fitting, and patching including excavation and fill, to complete Work, and to:
 - 1. Fit the several parts together, to integrate with other Work.
 - 2. Uncover Work to install or correct ill-timed Work.
 - 3. Remove and replace defective and non-conforming Work.
 - 4. Remove samples of installed Work for testing.
- D. Execute work by methods which will avoid damage to other Work and provide proper surfaces to receive patching and finishing.
- E. Cut rigid materials using masonry saw or core drill.

- F. Restore Work with new products in accordance with requirements of Contract Documents.
- G. Fit Work tight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.
- H. Refinish surfaces to match adjacent finishes. For continuous surfaces, refinish to nearest intersection; for an assembly, refinish entire unit.
- I. Identify any hazardous substance or condition exposed during the Work to the Engineer for decision or remedy.

1.5 PRECONSTRUCTION MEETING

- A. Engineer will schedule and preside over meeting after Notice of Award.
- B. Attendance Required: Engineer, Owner, appropriate governmental agency representatives, applicable public and private utility companies and Contractor.
- C. Minimum Agenda:
 - 1. Execution of Owner-Contractor Agreement.
 - 2. Submission of executed bonds and insurance certificates.
 - 3. Distribution of Contract Documents.
 - 4. Submission of list of Subcontractors, list of products, schedule of values, and Progress Schedule.
 - 5. Designation of personnel representing parties in Contract, along with contact phone number and Engineer.
 - 6. Communication procedures.
 - 7. Procedures and processing of requests for interpretations, field decisions field orders, submittals, substitutions, Applications for Payments, proposal request, Change Orders, and Contract closeout procedures.
 - 8. Scheduling.
 - 9. Critical Work sequencing.
 - 10. Scheduling activities.
 - 11. Utility Representatives comments and requirements.
- D. Engineer will record minutes and distribute copies to participants after meeting.

1.6 PROGRESS MEETINGS

- A. Schedule and administer meetings throughout progress of the Work.
- B. Engineer will make arrangements for meetings, prepare agenda with copies for participants, and preside over meetings.
- C. Attendance Required: Job superintendent, major Subcontractors, Contractors and suppliers, and Engineer, Owner, as appropriate to agenda topics for each meeting.
- D. Minimum Agenda:
 - 1. Review minutes of previous meetings.
 - 2. Review of Work progress.

3. Field observations, problems, and decisions.
4. Identification of problems impeding planned progress.
5. Review of submittal schedule and status of submittals.
6. Review of off-Site fabrication and delivery schedules.
7. Maintenance of Progress Schedule.
8. Corrective measures to regain projected schedules.
9. Planned progress during succeeding work period.
10. Coordination of projected progress.
11. Maintenance of quality and work standards.
12. Effect of proposed changes on Progress Schedule and coordination.
13. Other business relating to Work.

- E. Contractor: Record minutes and distribute copies to participants within two days after meeting, with two copies each to Engineer, Owner, and those affected by decisions made.

1.7 PREINSTALLATION MEETINGS

- A. When required in individual Specification Sections, convene preinstallation meetings at Project Site before starting Work of specific Section.
- B. Require attendance of parties directly affecting, or affected by, Work of specific Section.
- C. Notify Engineer four days in advance of meeting date.
- D. Prepare agenda and preside over meeting:
1. Review conditions of installation, preparation, and installation procedures.
 2. Review coordination with related Work.
- E. Record minutes and distribute copies to participants within two days after meeting, with two copies each to Engineer, Owner, and those affected by decisions made.

1.8 CLOSEOUT MEETING

- A. Schedule Project closeout meeting with sufficient time to prepare for requesting Substantial Completion. Preside over meeting and be responsible for minutes.
- B. Attendance Required: Contractor, Subcontractors, Engineer, Owner, and others appropriate to agenda.
- C. Notify Engineer four days in advance of meeting date.
- D. Minimum Agenda:
1. Start-up of facilities and systems.
 2. Operations and maintenance manuals.
 3. Testing, adjusting, and balancing.
 4. System demonstration and observation.
 5. Operation and maintenance instructions for Owner's personnel.
 6. Temporary indoor-air-quality plan and procedures.
 7. Contractor's inspection of Work.

8. Contractor's preparation of an initial "punch list."
9. Procedure to request Engineer inspection to determine date of Substantial Completion.
10. Completion time for correcting deficiencies.
11. Inspections by authorities having jurisdiction.
12. Certificate of Occupancy and transfer of insurance responsibilities.
13. Partial release of retainage.
14. Final cleaning.
15. Preparation for final inspection.
16. Closeout Submittals:
 - a. Project record documents.
 - b. Operating and maintenance documents.
 - c. Operating and maintenance materials.
 - d. Affidavits.
17. Final Application for Payment.
18. Contractor's demobilization of Site.
19. Maintenance.

- E. Record minutes and distribute copies to participants within two days after meeting, with two copies each to Engineer, Owner, and those affected by decisions made.

PART 2 - PRODUCTS - Not Used

PART 3 - EXECUTION

3.1 ALTERATION PROCEDURES

- A. Entire facility will be occupied for normal operations during progress of construction. Cooperate with Owner in scheduling operations to minimize conflict and to permit continuous usage.
 1. Perform Work not to interfere with operations of occupied areas.
 2. Keep utility and service outages to a minimum and perform only after written approval of Owner.
 3. Clean Owner-occupied areas daily. Clean spillage, overspray, and heavy collection of dust in Owner-occupied areas immediately.
- B. Materials: As specified in product Sections; match existing products with new and salvaged products for patching and extending Work.
- C. Employ skilled and experienced installer to perform alteration and renovation Work.
- D. Cut, move, or remove items as necessary for access to alterations and renovation Work. Replace and restore at completion. Comply with Section 01 70 00 - Execution and Closeout Requirements
- E. Remove unsuitable material not marked for salvage, including rotted wood, corroded metals, and deteriorated masonry and concrete. Replace materials as specified for finished Work.
- F. Remove debris and abandoned items from area and from concealed spaces.

- G. Prepare surface and remove surface finishes to permit installation of new Work and finishes.
- H. Close openings in exterior surfaces to protect existing Work from weather and extremes of temperature and humidity.
- I. Remove, cut, and patch Work to minimize damage and to permit restoring products and finishes to original or specified condition.
- J. Refinish existing visible surfaces to remain in renovated rooms and spaces, to specified or new condition for each material, with neat transition to adjacent finishes.
- K. Where new Work abuts or aligns with existing Work, provide smooth and even transition. Patch Work to match existing adjacent Work in texture and appearance.
- L. When finished surfaces are cut so that smooth transition with new Work is not possible, terminate existing surface along straight line at natural line of division and submit recommendation to Engineer for review.
- M. Where change of plane of 1/4 inch or more occurs, submit recommendation for providing smooth transition to Engineer for review.
- N. Trim existing doors to clear new floor finish. Refinish trim to original or specified condition.
- O. Patch or replace portions of existing surfaces that are damaged, lifted, discolored, or showing other imperfections.
- P. Finish surfaces as specified in individual product Sections.

END OF SECTION

SECTION 01 33 00
SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Definitions.
- B. Submittal procedures.
- C. Construction progress schedules.
- D. Proposed product list.
- E. Product data.
- F. Use of electronic CAD files of Project Drawings.
- G. Shop Drawings.
- H. Samples.
- I. Other submittals.
- J. Design data.
- K. Test reports.
- L. Certificates.
- M. Manufacturer's instructions.
- N. Manufacturer's field reports.
- O. Erection Drawings.
- P. Contractor review.
- Q. Engineer review.

1.2 DEFINITIONS

- A. Action Submittals: Written and graphic information and physical samples that require Engineer's responsive action.

- B. Informational Submittals: Written and graphic information and physical Samples that do not require Engineer's responsive action. Submittals may be rejected for not complying with requirements.

1.3 SUBMITTAL PROCEDURES

- A. Transmit each submittal with Engineer-accepted form.
- B. Sequentially number transmittal forms. Mark revised submittals with original number and sequential alphabetic suffix.
- C. Identify: Project, Contractor, Subcontractor and supplier, pertinent Drawing and detail number, and Specification Section number appropriate to submittal.
- D. Apply Contractor's stamp, signed or initialed, certifying that review, approval, verification of products required, field dimensions, adjacent construction Work, and coordination of information is according to requirements of the Work and Contract Documents.
- E. Schedule submittals to expedite Project, and deliver to Engineer. Coordinate submission of related items.
- F. For each submittal for review, allow 15 days excluding delivery time to and from Contractor.
- G. Identify variations in Contract Documents and product or system limitations that may be detrimental to successful performance of completed Work.
- H. Allow space on submittals for Contractor and Engineer review stamps.
- I. When revised for resubmission, identify changes made since previous submission.
- J. Distribute copies of reviewed submittals as appropriate. Instruct parties to promptly report inability to comply with requirements.
- K. Submittals not requested will not be recognized nor processed.
- L. Incomplete Submittals: Engineer will not review. Complete submittals for each item are required. Delays resulting from incomplete submittals are not the responsibility of Engineer.

1.4 CONSTRUCTION PROGRESS SCHEDULES

- A. Comply with Section 01 32 16 - Construction Progress Schedule

1.5 PROPOSED PRODUCT LIST

- A. Within 15 days after date of Owner-Contractor Agreement, submit list of major products proposed for use, with name of manufacturer, trade name, and model number of each product.
- B. For products specified only by reference standards, indicate manufacturer, trade name, model or catalog designation, and reference standards.

1.6 PRODUCT DATA

- A. Product Data: Action Submittal: Submit to Engineer for review for assessing conformance with information given and design concept expressed in Contract Documents.
- B. Submit number of copies Contractor requires, plus three copies Engineer will retain.
- C. Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturers' standard data to provide information specific to this Project.
- D. Indicate product utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.
- E. After review, produce copies and distribute according to "Submittal Procedures" Article and for record documents described in Section 01 70 00 - Execution and Closeout Requirements.

1.7 ELECTRONIC CAD FILES OF PROJECT DRAWINGS

- A. Electronic CAD Files of Project Drawings: May only be used to expedite production of Shop Drawings for the Project. Use for other Projects or purposes is not allowed.
- B. Electronic CAD Files of Project Drawings: Distributed only under the following conditions:
 - 1. Use of files is solely at receiver's risk. Engineer does not warrant accuracy of files. Receiving files in electronic form does not relieve receiver of responsibilities for measurements, dimensions, and quantities set forth in Contract Documents. In the event of ambiguity, discrepancy, or conflict between information on electronic media and that in Contract Documents, notify Engineer of discrepancy and use information in hard-copy Drawings and Specifications.
 - 2. CAD files do not necessarily represent the latest Contract Documents, existing conditions, and as-built conditions. Receiver is responsible for determining and complying with these conditions and for incorporating addenda and modifications.
 - 3. User is responsible for removing information not normally provided on Shop Drawings and removing references to Contract Documents. Shop Drawings submitted with information associated with other trades or with references to Contract Documents will not be reviewed and will be immediately returned.
 - 4. Receiver shall not hold Engineer responsible for data or file clean-up required to make files usable, nor for error or malfunction in translation, interpretation, or use of this electronic information.
 - 5. Receiver shall understand that even though Engineer has computer virus scanning software to detect presence of computer viruses, there is no guarantee that computer viruses are not present in files or in electronic media.
 - 6. Receiver shall not hold Engineer responsible for such viruses or their consequences, and shall hold Engineer harmless against costs, losses, or damage caused by presence of computer virus in files or media.

1.8 SHOP DRAWINGS

- A. Shop Drawings: Action Submittal: Submit to Engineer for assessing conformance with information given and design concept expressed in Contract Documents.

- B. Indicate special utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.
- C. When required by individual Specification Sections, provide Shop Drawings signed and sealed by a professional Engineer responsible for designing components shown on Shop Drawings.
 - 1. Include signed and sealed calculations to support design.
 - 2. Submit Shop Drawings and calculations in form suitable for submission to and approval by authorities having jurisdiction.
 - 3. Make revisions and provide additional information when required by authorities having jurisdiction.
- D. Submit number of opaque reproductions Contractor requires, plus two copies Engineer will retain.
- E. After review, produce copies and distribute according to "Submittal Procedures" Article and for record documents described in Section 01 70 00 - Execution and Closeout Requirements.

1.9 SAMPLES

- A. Samples: Action Submittal: Submit to Engineer for assessing conformance with information given and design concept expressed in Contract Documents.
- B. Samples for Selection as Specified in Product Sections:
 - 1. Submit to Engineer for aesthetic, color, and finish selection.
 - 2. Submit Samples of finishes, textures, and patterns for Engineer selection.
- C. Submit Samples to illustrate functional and aesthetic characteristics of products, with integral parts and attachment devices. Coordinate Sample submittals for interfacing work.
- D. Include identification on each Sample, with full Project information.
- E. Submit number of Samples specified in individual Specification Sections; Engineer will retain one Sample.
- F. Reviewed Samples that may be used in the Work are indicated in individual Specification Sections.
- G. Samples will not be used for testing purposes unless specifically stated in Specification Section.
- H. After review, produce copies and distribute according to "Submittal Procedures" Article and for record documents described in Section 01 70 00 - Execution and Closeout Requirements.

1.10 OTHER SUBMITTALS

- A. Closeout Submittals: Comply with Section 01 70 00 - Execution and Closeout Requirements.
- B. Informational Submittal: Submit data for Engineer's knowledge as Contract administrator or for Owner.

- C. Submit information for assessing conformance with information given and design concept expressed in Contract Documents.

1.11 TEST REPORTS

- A. Informational Submittal: Submit reports for Engineer's knowledge as Contract administrator or for Owner.
- B. Submit test reports for information for assessing conformance with information given and design concept expressed in Contract Documents.

1.12 CERTIFICATES

- A. Informational Submittal: Submit certification by manufacturer, installation/application Subcontractor, or Contractor to Engineer, in quantities specified for Product Data.
- B. Indicate material or product conforms to or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.
- C. Certificates may be recent or previous test results on material or product but must be acceptable to Engineer.

1.13 MANUFACTURER'S INSTRUCTIONS

- A. Informational Submittal: Submit manufacturer's installation instructions for Engineer's knowledge as Contract administrator or for Owner.
- B. Submit printed instructions for delivery, storage, assembly, installation, startup, adjusting, and finishing, to Engineer in quantities specified for Product Data.
- C. Indicate special procedures, perimeter conditions requiring special attention, and special environmental criteria required for application or installation.

1.14 MANUFACTURER'S FIELD REPORTS

- A. Informational Submittal: Submit reports for Engineer's knowledge as Contract administrator or for Owner.
- B. Submit report in duplicate within 5 days of observation to Engineer for information.
- C. Submit reports for information for assessing conformance with information given and design concept expressed in Contract Documents.

1.15 ERECTION DRAWINGS

- A. Informational Submittal: Submit Drawings for Engineer's knowledge as Contract administrator or for Owner.

- B. Submit Drawings for information assessing conformance with information given and design concept expressed in Contract Documents.
- C. Data indicating inappropriate or unacceptable Work may be subject to action by Engineer or Owner.

1.16 CONTRACTOR REVIEW

- A. Review for compliance with Contract Documents and approve submittals before transmitting to Engineer.
- B. Contractor: Responsible for:
 - 1. Determination and verification of materials including manufacturer's catalog numbers.
 - 2. Determination and verification of field measurements and field construction criteria.
 - 3. Checking and coordinating information in submittal with requirements of Work and of Contract Documents.
 - 4. Determination of accuracy and completeness of dimensions and quantities.
 - 5. Confirmation and coordination of dimensions and field conditions at Site.
 - 6. Construction means, techniques, sequences, and procedures.
 - 7. Safety precautions.
 - 8. Coordination and performance of Work of all trades.
- C. Stamp, sign or initial, and date each submittal to certify compliance with requirements of Contract Documents.
- D. Do not fabricate products or begin Work for which submittals are required until approved submittals have been received from Engineer.

1.17 ENGINEER REVIEW

- A. Do not make "mass submittals" to Engineer. "Mass submittals" are defined as six or more submittals or items in one day or 15 or more submittals or items in one week. If "mass submittals" are received, Engineer's review time stated above will be extended as necessary to perform proper review. Engineer will review "mass submittals" based on priority determined by Engineer after consultation with Owner and Contractor.
- B. Informational submittals and other similar data are for Engineer's information, do not require Engineer's responsive action, and will not be reviewed or returned with comment.
- C. Submittals made by Contractor that are not required by Contract Documents may be returned without action.
- D. Submittal approval does not authorize changes to Contract requirements unless accompanied by Change Order.

PART 2 - PRODUCTS - Not Used

PART 3 - EXECUTION - Not Used

END OF SECTION

SECTION 01 40 00
QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Quality control.
- B. Tolerances.
- C. References.
- D. Labeling.
- E. Mockup requirements.
- F. Testing and inspection services.
- G. Manufacturers' field services.

1.2 QUALITY CONTROL

- A. Monitor quality control over suppliers, manufacturers, products, services, Site conditions, and workmanship, to produce Work of specified quality.
- B. Comply with specified standards as the minimum quality for the Work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.
- C. Perform Work using persons qualified to produce required and specified quality.
- D. Products, materials, and equipment may be subject to inspection by Engineer and Owner at place of manufacture or fabrication. Such inspections shall not relieve Contractor of complying with requirements of Contract Documents.
- E. Supervise performance of Work in such manner and by such means to ensure that Work, whether completed or in progress, will not be subjected to harmful, dangerous, damaging, or otherwise deleterious exposure during construction period.

1.3 TOLERANCES

- A. Monitor fabrication and installation tolerance control of products to produce acceptable Work. Do not permit tolerances to accumulate.

- B. Comply with manufacturers' recommended tolerances and tolerance requirements in reference standards. When such tolerances conflict with Contract Documents, request clarification from Engineer before proceeding.
- C. Adjust products to appropriate dimensions; position before securing products in place.

1.4 REFERENCES

- A. For products or workmanship specified by association, trade, or other consensus standards, comply with requirements of standard except when more rigid requirements are specified or are required by applicable codes.
- B. Conform to reference standard by date of issue current as of date of Contract Documents except where specific date is established by code.
- C. Obtain copies of standards and maintain on Site when required by product Specification Sections.
- D. When requirements of indicated reference standards conflict with Contract Documents, request clarification from Engineer before proceeding.
- E. Neither contractual relationships, duties, or responsibilities of parties in Contract nor those of Engineer shall be altered from Contract Documents by mention or inference in reference documents.

1.5 LABELING

- A. Attach label from agency approved by authorities having jurisdiction for products, assemblies, and systems required to be labeled by applicable code.
- B. Label Information: Include manufacturer's or fabricator's identification, approved agency identification, and the following information, as applicable, on each label:
 - 1. Model number.
 - 2. Serial number.
 - 3. Performance characteristics.
- C. Manufacturer's Nameplates, Trademarks, Logos, and Other Identifying Marks on Products: Not allowed on surfaces exposed to view in public areas, interior or exterior.

1.6 MOCK-UP REQUIREMENTS

- A. Tests will be performed under provisions identified in this Section and identified in individual product Specification Sections.
- B. Assemble and erect specified or indicated items with specified or indicated attachment and anchorage devices, flashings, seals, and finishes.
- C. Accepted mockups shall be comparison standard for remaining Work.

- D. Where mockup has been accepted by Engineer and is specified in product Specification Sections to be removed, remove mockup and clear area when directed to do so by Engineer.

1.7 TESTING AND INSPECTION SERVICES

- A. Owner will employ Engineer to perform testing and inspection.
- B. Engineer will perform tests, inspections, and other services specified in individual Specification Sections and as required by Engineer, Owner, or authorities having jurisdiction.
 - 1. Laboratory: Authorized to operate in State of Michigan.
 - 2. Laboratory Staff: Maintain full-time specialist on staff to review services.
 - 3. Testing Equipment: Calibrated at reasonable intervals with devices of an accuracy traceable to National Bureau of Standards or accepted values of natural physical constants.
- C. Testing, inspections, and source quality control may occur on or off Project Site. Perform off-Site testing as required by Engineer or Owner.
- D. Reports shall be submitted to Engineer, Contractor, and authorities having jurisdiction indicating observations and results of tests and compliance or noncompliance with Contract Documents.
 - 1. Submit final report indicating correction of Work previously reported as noncompliant.
- E. Cooperate with Engineer; furnish samples of materials, design mix, equipment, tools, storage, safe access, and assistance by incidental labor as requested.
 - 1. Notify Engineer 48 hours before expected time for operations requiring services.
 - 2. Make arrangements with Engineer and pay for additional Samples and tests required for Contractor's use.
- F. Employment of testing agency or laboratory shall not relieve Contractor of obligation to perform Work according to requirements of Contract Documents.
- G. Retesting or re-inspection required because of nonconformance with specified or indicated requirements shall be performed by Engineer.
- H. Agency Responsibilities:
 - 1. Test Samples of mixes submitted by Contractor.
 - 2. Provide qualified personnel at Site. Cooperate with Engineer and Contractor in performance of services.
 - 3. Perform indicated sampling and testing of products according to specified standards.
 - 4. Ascertain compliance of materials and mixes with requirements of Contract Documents.
 - 5. Promptly notify Engineer and Contractor of observed irregularities or nonconformance of Work or products.
 - 6. Perform additional tests required by Engineer.
 - 7. Attend preconstruction meetings and progress meetings.
- I. Agency Reports: After each test, promptly submit two copies of report to Engineer, Contractor, and authorities having jurisdiction. When requested by Engineer, provide interpretation of test results. Include the following:

1. Date issued.
2. Project title and number.
3. Name of inspector.
4. Date and time of sampling or inspection.
5. Identification of product and Specification Section.
6. Location in Project.
7. Type of inspection or test.
8. Date of test.
9. Results of tests.
10. Conformance with Contract Documents.

J. Limits on Testing Authority:

1. Agency or laboratory may not release, revoke, alter, or enlarge on requirements of Contract Documents.
2. Agency or laboratory may not approve or accept any portion of the Work.
3. Agency or laboratory may not assume duties of Contractor.
4. Agency or laboratory has no authority to stop the Work.

1.8 MANUFACTURER'S FIELD SERVICES

- A. 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, startup of equipment, testing, adjusting, and balancing of equipment commissioning as applicable, and to initiate instructions when necessary.
- B. Submit qualifications of observer to Engineer 30 days in advance of required observations. Observer is subject to approval of Engineer and Owner.
- C. Report observations and Site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturer's written instructions.
- D. Refer to Section 01 33 00 - Submittal Procedures, "Manufacturer's Field Reports" Article.

PART 2 - PRODUCTS - Not Used

PART 3 - EXECUTION - Not Used

END OF SECTION

SECTION 01 50 00

TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Temporary Utilities:
 - 1. Temporary electricity.
 - 2. Temporary lighting for construction purposes.
 - 3. Temporary heating.
 - 4. Temporary cooling.
 - 5. Temporary ventilation.
 - 6. Communication services.
 - 7. Temporary water service.
 - 8. Temporary sanitary facilities.
- B. Construction Facilities:
 - 1. Field offices and sheds.
 - 2. Vehicular access.
 - 3. Parking.
 - 4. Progress cleaning and waste removal.
 - 5. Project identification.
 - 6. Traffic regulation.
 - 7. Fire-prevention facilities.
- C. Temporary Controls:
 - 1. Barriers.
 - 2. Enclosures and fencing.
 - 3. Security.
 - 4. Water control.
 - 5. Dust control.
 - 6. Erosion and sediment control.
 - 7. Noise control.
 - 8. Pest and rodent control.
 - 9. Pollution control.
- D. Removal of utilities, facilities, and controls.

1.2 UNIT PRICE - MEASUREMENT AND PAYMENT

- A. Temporary Dewatering and Cofferdams:
 - 1. Basis of Measurement: At the lump sum bid price as stated in the proposal.
 - 2. Basis of Payment: Includes all labor, equipment, and material to perform any damming and/or water control needed to perform the work shown on the plans.

- B. Mobilization:
 - 1. Basis of Measurement: At the lump sum bid price as stated in the proposal.
 - 2. Basis of Payment: Includes all cost to mobilize to site and provide any temporary facilities needed to complete the project.

1.3 REFERENCES

- A. ASTM International:
 - 1. ASTM E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
 - 2. ASTM E 90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
 - 3. ASTM E 119 - Standard Test Methods for Fire Tests of Building Construction and Materials.

1.4 TEMPORARY ELECTRICITY

- A. Provide and pay for power service required from utility source as needed for construction operation.
- B. Complement existing power service capacity and characteristics as required for construction operations.
- C. Provide power outlets with branch wiring and distribution boxes located as required for construction operations. Provide suitable, flexible power cords as required for portable construction tools and equipment.
- D. Provide main service disconnect and overcurrent protection at convenient location.
- E. Permanent convenience receptacles may be used during construction.
- F. Provide distribution equipment, wiring, and outlets for single-phase branch circuits for power and lighting.

1.5 TEMPORARY LIGHTING FOR CONSTRUCTION PURPOSES

- A. Provide and maintain lighting for construction operations.
- B. Provide branch wiring from power source to distribution boxes with lighting conductors, pigtails, lamps, and the like, for specified lighting levels.
- C. Maintain lighting and provide routine repairs.
- D. Permanent building lighting may be used during construction.

1.6 TEMPORARY HEATING

- A. Provide and pay for heating devices and heat as needed to maintain specified conditions for construction operations.

- B. Before operating permanent equipment for temporary heating purposes, verify installation is approved for operation, equipment is lubricated, and filters are in place. Provide and pay for operation, maintenance, and regular replacement of filters and worn or consumed parts. Replace filters at Substantial Completion.

1.7 TEMPORARY COOLING

- A. Provide and pay for cooling devices and cooling as needed to maintain specified conditions for construction operations.
- B. Before operating permanent equipment for temporary cooling purposes, verify installation is approved for operation, equipment is lubricated, and filters are in place. Provide and pay for operation, maintenance, and regular replacement of filters and worn or consumed parts. Replace filters at Substantial Completion.

1.8 TEMPORARY VENTILATION

- A. Ventilate enclosed areas to achieve curing of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors, or gases.

1.9 TEMPORARY WATER SERVICE

- A. Provide and pay for suitable quality water service as needed to maintain specified conditions for construction operations.

1.10 TEMPORARY SANITARY FACILITIES

- A. Provide and maintain required facilities and enclosures. Existing facility use is not permitted. Provide facilities at time of Project mobilization.

1.11 VEHICULAR ACCESS

- A. Construct temporary all-weather access roads from public thoroughfares to serve construction area, of width and load-bearing capacity to accommodate unimpeded traffic for construction purposes.
- B. Construct temporary bridges and culverts to span low areas and allow unimpeded drainage.
- C. Extend and relocate vehicular access as Work progress requires and provide detours as necessary for unimpeded traffic flow.
- D. Locate as approved by Engineer or as approved by Owner.
- E. Provide unimpeded access for emergency vehicles. Maintain 10 foot-wide driveways with turning space between and around combustible materials.
- F. Provide and maintain access to fire hydrants and control valves and keep free of obstructions.
- G. Provide means of removing mud from vehicle wheels before entering streets.

H. Use designated existing on-Site roads for construction traffic.

1.12 PARKING

- A. Arrange for, Provide, or Construct temporary surface parking areas to accommodate construction personnel.
- B. Locate as approved by Engineer or as approved by Owner.
- C. If Site space is not adequate, provide additional off-Site parking.
- D. Use of existing on-site streets and driveways used for construction traffic is permitted. Tracked vehicles are not allowed on paved areas.
- E. Use of existing parking facilities used by construction personnel is permitted.
- F. Do not allow heavy vehicles or construction equipment in parking areas.
- G. Permanent Pavements and Parking Facilities:
 - 1. Before Substantial Completion, bases for permanent roads and parking areas may be used for construction traffic.
 - 2. Avoid traffic loading beyond paving design capacity. Tracked vehicles are not allowed.
 - 3. Use of permanent parking structures is permitted.
- H. Maintenance:
 - 1. Maintain traffic and parking areas in sound condition free of excavated material, construction equipment, products, mud, snow, ice, and the like.
 - 2. Maintain existing and permanent paved areas used for construction; promptly repair breaks, potholes, low areas, standing water, and other deficiencies, to maintain paving and drainage in original condition.
- I. Removal, Repair:
 - 1. Remove temporary materials and construction when permanent paving is usable.
 - 2. Remove underground Work and compacted materials to depth of 1 foot; fill and grade Site as indicated.
 - 3. Repair existing and permanent facilities damaged by use, to original condition.
- J. Mud from Site vehicles: Provide means of removing mud from vehicle wheels before entering streets.

1.13 PROGRESS CLEANING AND WASTE REMOVAL

- A. Maintain areas free of waste materials, debris, and rubbish. Maintain Site in clean and orderly condition.
- B. Remove debris and rubbish from pipe chases, plenums, attics, crawl spaces, and other closed or remote spaces, before enclosing spaces.

- C. Broom and vacuum clean interior areas before starting surface finishing, and continue cleaning to eliminate dust.
- D. Collect and remove waste materials, debris, and rubbish from Site periodically and dispose of off-Site.
- E. Open free-fall chutes are not permitted. Terminate closed chutes into appropriate containers with lids.

1.14 TRAFFIC REGULATION

- A. Signs, Signals, and Devices:
 - 1. Post-Mounted and Wall-Mounted Traffic Control and Informational Signs: As approved by authorities having jurisdiction.
 - 2. Traffic Control Signals: As approved by local jurisdictions.
 - 3. Traffic Cones, Drums, Flares, and Lights: As approved by authorities having jurisdiction.
 - 4. Flag Person Equipment: As required by authorities having jurisdiction.
- B. Flag Persons: Provide trained and equipped flag persons to regulate traffic when construction operations or traffic encroach on public traffic lanes.
- C. Flares and Lights: Use flares and lights during hours of low visibility to delineate traffic lanes and to guide traffic.
- D. Haul Routes:
 - 1. Consult with authorities having jurisdiction and establish public thoroughfares to be used for haul routes and Site access.
- E. Traffic Signs and Signals:
 - 1. Provide signs at approaches to Site and on Site, at crossroads, detours, parking areas, and elsewhere as needed to direct construction and affected public traffic.
 - 2. Provide, operate, and maintain traffic control signals to direct and maintain orderly flow of traffic in areas under Contractor's control and areas affected by Contractor's operations.
 - 3. Relocate signs and signals as Work progresses, to maintain effective traffic control.
- F. Removal:
 - 1. Remove equipment and devices when no longer required.
 - 2. Repair damage caused by installation.
 - 3. Remove post settings to depth of 2 feet.

1.15 BARRIERS

- A. Provide barriers to prevent unauthorized entry to construction areas and to protect existing facilities and adjacent properties from damage from construction operations.
- B. Provide barricades required by authorities having jurisdiction for public rights-of-way.
 - 1. Barricade Construction: As indicated on Drawings.
- C. Tree and Plant Protection: Preserve and protect existing trees and plants designated to remain.

1. Protect areas within drip lines from traffic, parking, storage, dumping, chemically injurious materials and liquids, ponding, and continuous running water.
2. Replace trees and plants damaged by construction operations.

D. Protect non-owned vehicular traffic, stored materials, Site, and structures from damage.

1.16 ENCLOSURES AND FENCING

A. Construction: Contractor's option.

B. Exterior Enclosures:

1. Provide temporary weathertight closure of exterior openings to accommodate acceptable working conditions and protection for products, to allow for temporary heating and maintenance of required ambient temperatures identified in individual Specification Sections, and to prevent entry of unauthorized persons. Provide access doors with self-closing hardware and locks.

1.17 SECURITY

A. Entry Control:

1. Restrict entrance of persons and vehicles to Project Site.
2. Allow entrance only to authorized persons with proper identification.
3. Maintain log of workers and visitors and make available to Owner on request.
4. Control entrance of persons and vehicles related to Owner's operations.

B. Restrictions:

1. Do no work on days indicated in Owner-Contractor Agreement.

1.18 WATER CONTROL

A. Grade Site to drain. Maintain excavations free of water. Provide, operate, and maintain necessary pumping equipment.

B. Protect Site from puddles or running water.

1.19 DUST CONTROL

A. Execute Work by methods that minimize raising dust from construction operations.

B. Provide positive means to prevent airborne dust from dispersing into atmosphere.

1.20 EROSION AND SEDIMENT CONTROL

A. Plan and execute construction by methods to control surface drainage from cuts and fills from borrow and waste disposal areas. Prevent erosion and sedimentation.

B. Minimize surface area of bare soil exposed at one time.

- C. Provide temporary measures including berms, dikes, drains, and other devices to prevent water flow.
- D. Construct fill and waste areas by selective placement to avoid erosive surface silts and clays.
- E. Periodically inspect earthwork to detect evidence of erosion and sedimentation. Promptly apply corrective measures.
- F. Comply with sediment and erosion control plan indicated on Drawings.

1.21 NOISE CONTROL

- A. Provide methods, means, and facilities to minimize noise produced by construction operations.

1.22 POLLUTION CONTROL

- A. Provide methods, means, and facilities to prevent contamination of soil, water, and atmosphere from discharge of noxious, toxic substances and pollutants produced by construction operations.
- B. Comply with pollution and environmental control requirements of authorities having jurisdiction.

1.23 REMOVAL OF UTILITIES, FACILITIES, AND CONTROLS

- A. Remove temporary utilities, equipment, facilities, and materials before Final Application for Payment inspection.
- B. Remove underground installations to minimum depth of 2 feet.
- C. Clean and repair damage caused by installation or use of temporary Work.
- D. Restore existing facilities used during construction to original condition. Restore permanent facilities used during construction to specified condition.

PART 2 - PRODUCTS - Not Used

PART 3 - EXECUTION - Not Used

END OF SECTION

SECTION 01 55 26
TRAFFIC CONTROL

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
- B. Traffic Control.
- C. Signs, Signals, and Devices.
- D. Traffic Signs and Signals.
- E. Construction Parking Control.
- F. Regulators.
- G. Lighting Devices.
- H. Haul Routes.
- I. Removal.

1.2 Related Sections:

- A. Section 01 10 00 – Summary.
- B. Section 01 30 00 – Administrative Requirements.
- C. Section 01 50 00 – Temporary Facilities and Controls.

1.3 UNIT PRICE - MEASUREMENT AND PAYMENT

- A. Traffic Control:
 - 1. Basis of Measurement: At the lump sum price bid as stated in the proposal.
 - 2. Basis of Payment: All required traffic control measures and or traffic control devices to meet the requirements of the authority having jurisdiction. Includes all labor, material and equipment necessary to install and maintain traffic control devices.

1.4 TRAFFIC CONTROL

- A. Comply with the rules and regulations of the County, City, Township, Village, or MDOT having jurisdiction over the road.
- B. Provide, install, and maintain traffic control devices.

- C. Control devices shall conform to the Michigan Manual of Uniform Traffic Control Devices Part 6 Construction and Maintenance, Quality Standards for Work Zone Traffic Control Devices published by the American Traffic Safety Services Association (ATSSA) and the MDOT Standard Specifications for Highway Construction.
- D. Maintain through traffic unless written permission to do otherwise is obtained from the authority having jurisdiction over the road.
- E. Provide and maintain detour signs if allowed to close road.

1.5 SIGNS, SIGNALS, AND DEVICES

- A. Traffic Control Signals: As approved by local jurisdictions.
- B. Traffic Cones and Drums, and Lights: As approved by local jurisdictions.
- C. Traffic Regulators (Flagman) Equipment: As approved by local jurisdictions.
- D. Post Mounted and Wall Mounted Traffic Control and Informational Signs: Specified in paragraph 1.4 Traffic Control.
- E. Automatic Traffic Control Signals: As approved by local jurisdictions.

1.6 TRAFFIC SIGNS AND SIGNALS

- A. Install traffic control devices at approaches to Site and on Site, at crossroads, for detours, in parking areas, and elsewhere, as needed to direct construction and affected public traffic.
- B. Install and operate traffic signals to direct and maintain orderly flow of traffic in areas under Contractor's control, and areas affected by Contractor's operations.
- C. Relocate traffic control devices as Work progresses, to maintain effective traffic control.

1.7 CONSTRUCTION PARKING CONTROL

- A. Control vehicular parking to prevent interference with public traffic and parking, access by emergency vehicles, and Landowner's operations.
- B. Monitor parking of construction personnel's vehicles in existing facilities. Maintain vehicular access to and through parking areas.
- C. Prevent parking on or adjacent to access roads or in non-designated areas.
- D. Staging of equipment and storage of materials will not be allowed on business or residential parking areas without written permission from the landowner. See plans for a designated parking area.

1.8 REGULATORS (FLAGMEN)

- A. Provide trained and equipped regulators to move vehicles and pedestrians when construction operations or traffic encroach on public traffic lanes.

1.9 LIGHTING DEVICES

- A. Use lights during hours of low visibility to delineate traffic lanes and to guide traffic.

1.10 HAUL ROUTES

- A. Consult with authority having jurisdiction in establishing public thoroughfares to be used for haul routes and Site access.
- B. Confine construction traffic to designated haul routes.
- C. Provide traffic control devices and/or regulators at critical areas of haul routes to minimize interference with public traffic.

1.11 REMOVAL

- A. Remove equipment and traffic control devices when no longer required.
- B. Repair damage caused by installation.
- C. Remove post settings to a depth of 1 foot.

END OF SECTION

SECTION 01 60 00
PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Products.
- B. Product delivery requirements.
- C. Product storage and handling requirements.
- D. Product options.
- E. Equipment electrical characteristics and components.

1.2 PRODUCTS

- A. At minimum, comply with specified requirements and reference standards.
- B. Specified products define standard of quality, type, function, dimension, appearance, and performance required.
- C. Furnish products of qualified manufacturers that are suitable for intended use. Furnish products of each type by single manufacturer unless specified otherwise. Confirm that manufacturer's production capacity can provide sufficient product, on time, to meet Project requirements.
- D. 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.
- E. Do not use materials and equipment removed from existing premises, except as specifically permitted by the Contract Documents.
- F. Provide interchangeable components of the same manufacturer, for similar components.

1.3 PRODUCT DELIVERY REQUIREMENTS

- A. Comply with delivery requirements in Section 01 74 19 - Construction Waste Management and Disposal.
- B. Transport and handle products according to manufacturer's instructions.
- C. Promptly inspect shipments to ensure products comply with requirements, quantities are correct, and products are undamaged.

- D. Provide equipment and personnel to handle products; use methods to prevent soiling, disfigurement, or damage.

1.4 PRODUCT STORAGE AND HANDLING REQUIREMENTS

- A. Store and protect products according to manufacturer's instructions.
- B. Store products with seals and labels intact and legible.
- C. Store sensitive products in weathertight, climate-controlled enclosures in an environment suitable to product.
- D. For exterior storage of fabricated products, place products on sloped supports aboveground.
- E. Provide off-Site storage and protection when Site does not permit on-Site storage or protection.
- F. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.
- G. Store loose granular materials on solid flat surfaces in well-drained area. Prevent mixing with foreign matter.
- H. Provide equipment and personnel to store products; use methods to prevent soiling, disfigurement, or damage.
- I. Arrange storage of products to permit access for inspection. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.

PART 2 - PRODUCTS

2.1 EQUIPMENT ELECTRICAL CHARACTERISTICS AND COMPONENTS

- A. Wiring Terminations: Furnish terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Include lugs for terminal box.
- B. Cord and Plug: Furnish minimum 6-foot long cord and plug including grounding connector for connection to electric wiring system. Cord of longer length may be specified in individual Specification Sections.

PART 3 - EXECUTION - Not Used

END OF SECTION

SECTION 01 70 00

EXECUTION AND CLOSEOUT REQUIREMENTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Related Sections.
- B. Measurement and Payment.
- C. Closeout Procedures.
- D. Punchlist Procedures.
- E. Cleanup and Restoration.
- F. Adjusting.
- G. Project Record Documents.
- H. Warranties.
- I. Correction period.

1.2 RELATED SECTIONS

- A. Section 01 50 00 – Construction Facilities and Temporary Controls: Progress cleaning
- B. Section 32 91 19 – Landscape Grading
- C. Section 32 92 19 - Seeding

1.3 MEASUREMENT AND PAYMENT

- A. Contract Closeout:
 - 1. Basis of Measurement: Included in other Work items of this Project.
 - 2. Basis of Payment: Includes all associated labor, material and equipment required to implement or perform the following: closeout procedures, punchlist procedures, adjusting, project record documents, warranties and correction period.
- B. Cleanup and Restoration:
 - 1. Basis of Measurement: At the lump sum price bid as stated in the proposal.
 - 2. Basis of Payment: Includes all material, equipment and labor to cleanup and restore the Project to original condition or better as directed by the Engineer.

1.4 CLOSEOUT PROCEDURES

- A. Submit written certification that Contract Documents have been reviewed, Work has been inspected, and that Work is complete in accordance with Contract Documents and ready for Engineer's inspection.
- B. Provide submittals to Engineer that are required by governing or other authorities.
- C. Submit final Application for Payment identifying total adjusted Contract Sum, previous payments, and sum remaining due.

1.5 PUNCHLIST PROCEDURES

- A. Contractor shall notify Engineer when the Work is substantially complete in accordance with Contract Documents.
- B. Owner and Engineer will each appoint one Punchlist Representative who will conduct an inspection of the Work and compile a list of items that are incomplete or do not comply with the requirements of the Contracts Documents. Contractor may accompany the inspection.
- C. Contractor shall acknowledge that subsequent to the initial issuance of the punchlist, more items may be added to the list, which will be deemed amended, but only by the punchlist representatives.
- D. Contractor shall proceed immediately to address the items on the list.
- E. Contractor shall notify Engineer when listed items are completed and corrected.
- F. Contractor shall make arrangements with the Owner and Punchlist Representative for final inspection and acceptance. Should items still be deficient, they will remain on the list until accepted by the Owner and Engineer.
- G. Money will be retained under the Contract to cover items not accepted by the Owner and Engineer.

1.6 CLEANUP AND RESTORATION

- A. Final cleaning shall be completed prior to final payment.
- B. Clean site; sweep paved areas, rake clean landscaped surfaces.
- C. Remove waste and surplus materials, rubbish, and construction facilities from the site.
- D. Repair washouts and seed poorly vegetated areas as directed by the Engineer.
- E. Cleanout excess sediment islands deposited (more than 0.3ft.) in drain during construction as required by Engineer.
- F. Clean site to a sanitary and non-hazardous condition.

- G. Restore roads, driveways, parking areas, lawns, drainage, and other items disturbed during construction to original condition or as required by the documents.
- H. Remove debris from the project site according to section 02110 - Site Clearing.
- I. Remove sediment and debris from catch basins, manholes, sumps, storm sewers, sanitary sewers and sedimentation basins.

1.7 ADJUSTING

- A. Adjust operating Products and equipment to ensure smooth and unhindered operation.

1.8 PROJECT RECORD DOCUMENTS

- A. Maintain on Site one set of the following record documents; record actual revisions to the Work:
 - 1. Contract Drawings.
 - 2. Specifications.
 - 3. Addenda.
 - 4. Change Orders and other Modifications to the Contract.
 - 5. Reviewed shop drawings, product data, and samples.
 - 6. Soil Erosion and Sedimentation Control Plans.
 - 7. Storm water Operators Inspection Log.
- B. Ensure entries are complete and accurate, enabling future reference by Owner.
- C. Store record documents separate from documents used for construction.
- D. Record information concurrent with construction progress, not less than weekly.
- E. Specifications: Legibly mark and record, at each product Section, description of actual products installed, including the following:
 - 1. Manufacturer's name and product model and number.
 - 2. Product substitutions or alternates used.
 - 3. Changes made by Addenda and modifications.
- F. Record Drawings and Shop Drawings: Legibly mark each item to record actual construction as follows:
 - 1. Field changes of dimension and detail.
 - 2. Details not on original Drawings.
- G. Submit marked-up paper copy documents to Engineer before Substantial Completion.
- H. Submit PDF electronic files of marked-up documents to Engineer before Substantial Completion.
- I. Final Payment will not be paid until uniform grass growth is established along the entire project.

1.9 WARRANTIES

- A. Execute and assemble documents from Subcontractors, suppliers, and manufacturers.
- B. Provide Table of Contents and assemble in three D-size ring binder with durable plastic cover.
- C. Submit prior to final Application for Payment.
- D. For items of Work delayed beyond date of Substantial Completion, provide updated submittal within ten days after acceptance, listing date of acceptance as start of warranty period.

1.10 CORRECTION PERIOD

- A. For a period of one year from the date of substantial completion, promptly correct Work or replace materials that are found to be defective.
- B. Seed as needed to establish uniform growth of grass. Final payment will not be issued until uniform growth of grass is established as determined by the APA.
- C. Repair erosion areas as directed by Engineer within one year of substantial completion.

PART 2 - PRODUCTS - Not Used

PART 3 - EXECUTION – Not Used

END OF SECTION

SECTION 02 41 16

STRUCTURE DEMOLITION AND REMOVALS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Demolishing designated items.
 - 2. Demolishing designated foundations.
 - 3. Disconnecting and capping designated utilities.
 - 4. Removing designated items for reuse and Owner's retention.
 - 5. Protecting items designated to remain.
 - 6. Removing demolished materials.
- B. Related Requirements:
 - 1. Section 31 10 00 - Site Clearing.
 - 2. Section 31 23 23 - Fill.

1.2 UNIT PRICES

- A. Demolition:
 - 1. Basis of Measurement: At the lump sum price bid for demolition.
 - 2. Basis of Payment: Includes demolition, loading, removal from site, hauling salvable items to Owners facility. Includes all labor, equipment, and materials to demolish all items shown on plans and properly abandon any items shown on plans.
- B. Wet Well Cleaning:
 - 1. Basis of Measurement: At the unit price bid per cubic yard as stated in the proposal.
 - 2. Basis of Payment: Includes all labor, equipment, and material to clean all debris and solids from the wet well prior to pump. Field measurements will be taken in dewatered wet well to determine removal volume prior to Contractor beginning work.

1.3 SEQUENCING

- A. Section 01 10 00 - Summary: Requirements for sequencing.

1.4 SCHEDULING

- A. Section 01 30 00 - Administrative Requirements: Requirements for scheduling.
- B. Schedule Work to coincide with new construction.
- C. Describe demolition removal procedures and schedule.
- D. Perform Work between the hours of 7 a.m. and 7 p.m. only.

1.5 SUBMITTALS

- A. Permits: Submit copies of permits required by regulatory agencies for demolition and sidewalk and street closings.

1.6 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for submittals.
- B. Project Record Documents: Accurately record actual locations of capped or abandoned utilities, subsurface obstructions.
- C. Operation and Maintenance Data: Submit description of system, inspection data, and parts lists.

1.7 QUALITY ASSURANCE

- A. Perform Work according to local standards and codes.
- B. Conform to applicable codes for demolition of structures, safety of adjacent structures, runoff control and disposal.
- C. Conform to applicable codes for procedures when hazardous or contaminated materials are discovered.
- D. Permits: Obtain required permits from authorities having jurisdiction.
- E. Maintain one copy of each document on-Site.

1.8 QUALIFICATIONS

- A. Construction Firm: Company specializing in performing Work of this Section with minimum 3 years' documented experience.
- B. Licensed Professional: Design shoring, bracing, and underpinning under direct supervision of professional engineer experienced in design of this Work and licensed in State of Michigan.

1.9 EXISTING CONDITIONS

- A. Owner assumes no responsibility for actual condition of items to be demolished.
- B. Notify Architect/Engineer upon discovery of hazardous materials.
- C. Do not sell demolished materials on-Site.
- D. Maintain existing sidewalks to greatest extent possible.

PART 2 - EXECUTION

2.1 EXAMINATION

- A. Examine existing items indicated to be demolished or removed before work begins.
- B. Determine where removals may result in structural deficiency or unplanned building collapse during demolition. Coordinate demolition sequence and procedures to prevent structures from becoming unstable.
- C. Determine where demolition or removal may affect structural integrity or weather resistance of adjacent items indicated to remain.
 - 1. Identify measures required to protect building elements from damage.
 - 2. Identify remedial Work including patching, repairing, bracing, and other Work required to leave buildings indicated to remain in structurally sound, weathertight, and watertight condition.
- D. Existing Structure Documentation
 - 1. Document condition of adjacent structures and building elements indicated to remain.

2.2 PREPARATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation preparation.
- B. Call Miss Dig not less than three working days before performing Work.
 - 1. Request underground utilities to be located and marked within and surrounding construction areas.
- C. Notify affected utility companies before starting Work, and comply with utility's requirements.
- D. Do not close or obstruct roadways, sidewalks, or hydrants without permits.
- E. Erect and maintain temporary barriers and security devices, including warning signs and lights, and similar measures, for protection of the public, Owner and existing improvements indicated to remain.
- F. Protect existing appurtenances and structures indicated to remain.
- G. Prevent movement or settlement of adjacent structures. Provide bracing and shoring.

2.3 DEMOLITION

- A. General:
 - 1. Use of explosives is not permitted.
 - 2. Conduct demolition to minimize interference with adjacent structures.
 - 3. Cease operations immediately when adjacent structures appear to be in danger. Notify Architect/Engineer. Do not resume operations until directed.
 - 4. Conduct operations with minimum interference to public or private accesses to occupied adjacent structures. Maintain continuous egress and access from structures.

5. Obtain written permission from adjacent property owners when demolition equipment will traverse, infringe upon, or limit access to their property.
- B. Remove concrete foundations, building, electrical equipment and trash rack as indicated on drawings.
- C. Remove items to be re-installed or retained in manner to prevent damage; store and protect according to requirements of Section 01 60 00 - Product Requirements.
- D. Rough grade and compact areas affected by demolition to maintain Site grades and contours.
- E. Continuously clean up and remove demolished materials from Site. Do not allow materials to accumulate in building or on-Site.
- F. Do not burn or bury materials on-Site; leave Site in clean condition.

2.4 SCHEDULES

- A. Items to be removed and delivered to Owners storage facility:
 1. Cat-walk system
 2. Pump assemblies
 3. Pump motors
 4. Electrical components deemed by Owner

Contractor is responsible for on-loading, transporting and off-loading at Owners facility at the following location:

Saginaw County Public Works Maintenance Yard

The corner on Niagara Street and Congress Avenue in Saginaw

Pumps are to be loaded onto Owners trailer only. Owner will handle unloading and disposal.

- B. Items to be removed and properly disposed of by Contractor as follows and as indicated on the drawings:
 1. Trash rack assemblies
 2. Pump dresser band couplings
 3. Floor beams
 4. Floor grating
 5. Misc. building items and roof system
 6. Handrail systems
 7. Concrete foundation slab at trash racks
 8. Fence systems
 9. Misc. electrical and control items
 10. Wet well debris
 11. All other components shown or incidental to proposed construction.

END OF SECTION

SECTION 03 10 00

CONCRETE FORMING AND ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Formwork for cast-in-place concrete.
 - 2. Shoring, bracing, and anchorage.
 - 3. Architectural form liners.
 - 4. Form accessories.
 - 5. Form stripping.
- B. Related Requirements:
 - 1. Section 03 20 00 - Concrete Reinforcing.
 - 2. Section 03 30 00 - Cast-in-Place Concrete.
 - 3. Section 03 39 00 - Concrete Curing.

1.2 REFERENCE STANDARDS

- A. American Concrete Institute:
 - 1. ACI 117 - Specification for Tolerances for Concrete Construction and Materials.
 - 2. ACI 301 - Specifications for Structural Concrete.
 - 3. ACI 318 - Building Code Requirements for Structural Concrete.
 - 4. ACI 347 - Guide to Formwork for Concrete.
 - 5. MDOT Standard Specifications for Construction, current edition.
- B. American Forest & Paper Association:
 - 1. AF&PA - National Design Specification (NDS) for Wood Construction.
- C. APA - The Engineered Wood Association:
 - 1. APA/EWA PS 1 - Voluntary Product Standard - Structural Plywood.
- D. ASTM International:
 - 1. ASTM D1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).

1.3 ASTM E96 - Standard Test Methods for Water Vapor Transmission of Materials.

1.4 UNIT PRICE – MEASUREMENT AND PAYMENT

- A. Concrete Forming and Accessories:
 - 1. Basis of Measurement: Included in Work items requiring concrete on this Project.

2. Basis of Payment: Includes all labor, materials, and equipment to erect and remove forms for all concrete and grout Work as shown on the contract documents and as stated in the specifications.

1.5 COORDINATION

- A. Section 01 30 00 - Administrative Requirements: Requirements for coordination.
- B. Coordinate Work of this Section with other Sections of Work in forming and placing openings, slots, reglets, recesses, sleeves, bolts, anchors, other inserts, and components of other Work.

1.6 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Shop Drawings:
 1. Indicate:
 - a. Formwork, shoring, and reshoring.
 - b. Pertinent dimensions, openings, methods of construction, types of connections, materials, joint arrangement and details, ties and shores, location of framing, studding and bracing, and temporary supports.
 - c. Means of leakage prevention for concrete exposed to view in finished construction.
 - d. Sequence and timing of erection and stripping, assumed compressive strength at time of stripping, height of lift, and height of drop during placement.
 - e. Vertical, horizontal, and special loads according to ACI 347, and camber diagrams when applicable.
 - f. Notes to formwork erector showing size and location of conduits and piping embedded in concrete according to ACI 318.
 - g. Procedure and schedule for removal of shores and installation and removal of reshores.
- C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- D. Delegated Design Submittals:
 1. Submit signed and sealed Shop Drawings with design calculations and assumptions for shoring and reshores.
 2. Indicate loads transferred to structure during process of concreting, shoring, and reshoring.
 3. Include structural calculations to support design.
- E. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.
- F. Qualifications Statement:
 1. Submit qualifications for licensed professional.

1.7 QUALITY ASSURANCE

- A. Perform Work according to ACI 347, 301, and 318.
- B. For wood products furnished for Work of this Section, comply with AF&PA.

- C. Perform Work according to MDOT Standard Specifications for Construction, current edition.

1.8 QUALIFICATIONS

- A. Licensed Professional: Professional engineer experienced in design of specified Work and licensed in State of Michigan.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Store materials per manufacturer's recommendations.

PART 2 - PRODUCTS

2.1 PERFORMANCE AND DESIGN CRITERIA

- A. Design, engineer, and construct formwork, shoring, and bracing according to ACI 318 to conform to design and applicable code requirements to achieve concrete shape, line, and dimension as indicated on Drawings.
- B. Vapor Retarder Permeance: Maximum 1 perm when tested according to ASTM E96, water method.

2.2 WOOD FORM MATERIALS

- A. Form Materials: At discretion of Contractor. Solid one side, sound undamaged sheets with clean true edges.

2.3 PREFABRICATED FORMS

- A. Preformed Steel Forms:
 - 1. Description: Matched, tightly fitted, and stiffened to support weight of concrete without deflection detrimental to tolerances and appearance of finished surfaces.
- B. FRP Forms:
 - 1. Matched, tightly fitted, and stiffened to support weight of concrete without deflection detrimental to tolerances and appearance of finished concrete surfaces.
- C. Pan:
 - 1. Material: Steel.
 - 2. Configuration: Size and profile as required.
- D. Tubular Column:
 - 1. Description: Round spirally wound laminated fiber.
 - 2. Surface Treatment: Release agent, non-reusable.
 - 3. Sizes: As indicated on Drawings.
- E. Steel Forms:
 - 1. Description: Sheet steel, suitably reinforced.

- 2. Design: For particular use as indicated on Drawings.
- F. Form Liners: Smooth, durable, grainless, and non-staining hardboard unless otherwise indicated on Drawings.
- G. Framing, Studding, and Bracing: Stud or No. 3 structural light-framing grade.

2.4 FORMWORK ACCESSORIES

- A. Form Ties:
 - 1. Type: Removable.
 - 2. Material: Galvanized.
 - 3. Length: Adjustable.
 - 4. Furnish waterproofing washer.
 - 5. Free of defects capable of leaving holes larger than 1 inch in concrete surface.
- B. Spreaders:
 - 1. Description: Standard, non-corrosive metal-form clamp assembly, of type acting as spreaders and leaving no metal within 1 inch of concrete face.
 - 2. Wire ties, wood spreaders, or through bolts are not permitted.
- C. Form Release Agent:
 - 1. Description: Colorless mineral oil that will not stain concrete or absorb moisture or impair natural bonding or color characteristics of coating intended for use on concrete.
- D. Corners:
 - 1. Type: Chamfer.
 - 2. Size: 1 ½" by 1 ½" inches.
 - 3. Lengths: Maximum possible.
- E. Dovetail Anchor Slot:
 - 1. Material: Galvanized steel.
 - 2. Thickness: 22 gage.
 - 3. Filling: Foam.
 - 4. Fasten slot to concrete formwork according to manufacturer instructions, and insert foam filler to prevent concrete from entering slot during pour.
- F. Flashing Reglets:
 - 1. Material: Galvanized steel.
 - 2. Thickness: 22 gage.
 - 3. Lengths: Maximum possible.
 - 4. Furnish alignment splines for joints.
 - 5. Filling: Foam.
 - 6. Fasten flashing reglet to concrete formwork according to manufacturer instructions, and insert foam to prevent concrete from entering reglet during pour.
- G. Vapor Retarder:
 - 1. Description: Polyethylene sheet.
 - 2. Thickness: 8 mils.

- H. Bituminous Joint Filler: Comply with ASTM D1751.
- I. Nails, Spikes, Lag Bolts, Through Bolts, Anchorages: Size, strength, and character to maintain formwork in place while placing concrete.
- J. Waterstop:
 - 1. Material: PVC.
 - 2. Tensile Strength: Minimum 1,750 psi.
 - 3. Working Temperature Range: Minus 50 to plus 175 degrees F.
 - 4. Width: 4 inches.
 - 5. Lengths: Maximum possible.
 - 6. Profile: Ribbed.
 - 7. Corner Sections: Preformed.
 - 8. Jointing: Heat welded.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation examination.
- B. Verify lines, levels, and centers before proceeding with formwork.
- C. Verify that dimensions agree with Shop Drawings.
- D. If formwork is placed after reinforcement resulting in insufficient concrete cover over reinforcement, request instructions from Engineer before proceeding.

3.2 INSTALLATION

- A. Earth Forms: Are not permitted.
- B. If earth forms are shown on the drawings or specifically approved by the Engineer, they shall be hand trimmed both sides and bottom. Remove loose soil prior to placing concrete.
- C. Formwork:
 - 1. Provide top form for sloped surfaces steeper than 1.5 horizontal to 1 vertical to hold shape of concrete during placement, unless it can be demonstrated that top forms can be omitted.
 - 2. Construct forms to correct shape and dimensions, mortar-tight, braced, and of sufficient strength to maintain shape and position under imposed loads from construction operations.
 - 3. Camber forms where necessary to produce level finished soffits unless indicated otherwise on Drawings.
 - 4. Positioning:
 - a. Carefully verify horizontal and vertical positions of forms.
 - b. Correct misaligned or misplaced forms before placing concrete.
 - 5. Complete wedging and bracing before placing concrete.
 - 6. Erect formwork, shoring, and bracing to achieve design requirements according to ACI 318.

7. Stripping:
 - a. Arrange and assemble formwork to permit dismantling and stripping.
 - b. Do not damage concrete during stripping.
 - c. Permit removal of remaining principal shores.
8. Obtain approval of Engineer before framing openings in structural members not indicated on Drawings.
9. Install fillet and chamfer strips on external corners of beams, joists, and columns.
10. Install void forms according to manufacturer instructions.
11. Do not reuse wood formwork more than 2 times for concrete surfaces to be exposed to view.
12. Do not patch formwork.
13. Leave forms in place for minimum number of days according to ACI 347.

D. Form Removal:

1. Do not remove forms or bracing until concrete has gained sufficient strength to carry its own weight and imposed loads, and removal has been approved by Engineer.
2. Loosen forms carefully; do not wedge pry bars, hammers, or tools against finish concrete surfaces scheduled for exposure to view.
3. Store removed forms in manner that surfaces to be in contact with fresh concrete will not be damaged.
4. Discard damaged forms.
5. Form Release Agent:
 - a. Apply according to manufacturer instructions.
 - b. Apply prior to placement of reinforcing steel, anchoring devices, and embedded items.
 - c. Do not apply form release agent if concrete surfaces are indicated to receive special finishes or applied coverings that may be affected by agent.
 - d. Soak inside surfaces of untreated forms with clean water, and keep surfaces coated prior to placement of concrete.
6. Form Cleaning:
 - a. Clean forms as erection proceeds to remove foreign matter within forms.
 - b. Clean formed cavities of debris prior to placing concrete.
 - c. Flush with water or use compressed air to remove remaining foreign matter.
 - d. Ensure that water and debris drain to exterior through cleanout ports.
 - e. Cold Weather:
 - 1) During cold weather, remove ice and snow from within forms.
 - 2) Do not use de-icing salts.
 - 3) Do not use water to clean out forms, unless formwork and concrete construction proceed within heated enclosure; use compressed air or other dry method to remove foreign matter.
7. Reuse and Coating of Forms:
 - a. Thoroughly clean forms and reapply form coating before each reuse.
 - b. For exposed Work, do not reuse forms with damaged faces or edges.
 - c. Apply form coating to forms according to manufacturer instructions.
 - d. Do not coat forms for concrete indicated to receive "scored finish."
 - e. Apply form coatings before placing reinforcing steel.

E. Forms for Smooth Finish Concrete:

1. Use steel, plywood, or lined-board forms.
2. Use clean and smooth plywood and form liners, uniform in size, and free from surface and edge damage capable of affecting resulting concrete finish.

3. Install form lining with close-fitting square joints between separate sheets without springing into place.
 4. Use full-sized sheets of form liners and plywood wherever possible.
 5. Tape joints to prevent protrusions in concrete.
 6. Apply forming and strip wood forms in a manner to protect corners and edges.
 7. Level and continue horizontal joints.
 8. Keep wood forms wet until stripped.
- F. Architectural Form Liners:
1. Erect architectural side of formwork first.
 2. Attach form liner to forms before installing form ties.
 3. Install form liners square, with joints and pattern aligned.
 4. Seal form liner joints to prevent grout leaks.
 5. Dress joints and edges to match form liner pattern and texture.
- G. Forms for Surfaces to Receive Membrane Waterproofing:
1. Use plywood or steel forms.
 2. After erection of forms, tape form joints to prevent protrusions in concrete.
- H. Framing, Studding, and Bracing:
1. Maximum Spacing of Studs:
 - a. Boards: Maximum 16 inches o.c.
 - b. Plywood: 12 inches o.c.
 2. Size framing, bracing, centering, and supporting members for sufficient strength to maintain shape and position under imposed loads from construction operations.
 3. Construct beam soffits of material minimum 2 inches thick.
 4. Distribute bracing loads over base area on which bracing is erected.
 5. When placed on ground, protect against undermining, settlement, and accidental impact.
- I. Form Anchors and Hangers:
1. Do not use anchors and hangers leaving exposed metal at concrete surface.
 2. Symmetrically arrange hangers supporting forms from structural-steel members to minimize twisting or rotation of member.
 3. Penetration of structural-steel members is not permitted.
- J. Inserts, Embedded Parts, and Openings:
1. Install formed openings for items to be embedded in or passing through concrete Work.
 2. Locate and set in place items required to be cast directly into concrete.
 3. Install accessories straight, level, and plumb, and ensure that items are not disturbed during concrete placement.
 4. Joints:
 - a. Install waterstops continuous without displacing reinforcement.
 - b. Heat-seal joints watertight.
 5. Openings:
 - a. Provide temporary ports or openings in formwork as required to facilitate cleaning and inspection.
 - b. Locate openings at bottom of forms to allow flushing water to drain.

6. Close temporary openings with tight-fitting panels, flush with inside face of forms, and neatly fitted such that joints will not be apparent in exposed concrete surfaces.
- K. Form Ties:
1. Provide sufficient strength and quantity to prevent spreading of forms.
 2. Place ties at least 1 inch away from finished surface of concrete.
 3. Leave inner rods in concrete when forms are stripped.
 4. Space form ties equidistant, symmetrical, and aligned vertically and horizontally unless indicated otherwise on Drawings.
- L. Arrange formwork to allow proper erection sequence and to permit form removal without damage to concrete.
- M. Construction Joints:
1. Install surfaced pouring strip where construction joints intersect on exposed surfaces to provide straight line at joints.
 2. Just prior to subsequent concrete placement, remove strip and tighten forms to conceal shrinkage.
 3. Appearance:
 - a. Show no overlapping of construction joints.
 - b. Construct joints to present same appearance as butted plywood joints.
 4. Arrange joints in continuous line straight, true, and sharp.
- N. Embedded Items:
1. Make provisions for pipes, sleeves, anchors, inserts, reglets, anchor slots, nailers, waterstops, and other features.
 2. Do not embed wood or uncoated aluminum in concrete.
 3. Obtain installation and setting information for embedded items furnished under other Sections.
 4. Securely anchor embedded items in correct location and alignment prior to placing concrete.
 5. Ensure that conduits and pipes, including those made of coated aluminum, meet requirements of ACI 318 regarding size and location limitations.
- O. Openings for Items Passing through Concrete:
1. Frame openings in concrete where indicated on Drawings.
 2. Establish exact locations, sizes, and other conditions required for openings and attachment of Work specified under other Sections.
 3. Coordinate Work to avoid cutting and patching of concrete after placement.
 4. Perform cutting and repairing of concrete required as result of failure to provide required openings.
- P. Screeds:
1. Set screeds and establish levels for tops of and finish on concrete slabs.
 2. Slope slabs to drain where required or as indicated on Drawings.
 3. Before depositing concrete, remove debris from space to be occupied by concrete and thoroughly wet forms; remove freestanding water.

Q. Screed Supports:

1. For concrete over waterproof membranes and vapor retarder membranes, use cradle-, pad-, or base-type screed supports that will not puncture membrane.
2. Staking through membrane is not permitted.

R. Cleanouts and Access Panels:

1. Provide removable cleanout sections or access panels at bottoms of forms to permit inspection and effective cleaning of loose dirt, debris, and waste material.
2. Clean forms and surfaces against which concrete is to be placed.
3. Remove chips, sawdust, and other debris.
4. Thoroughly blow out forms with compressed air just before concrete is placed.

3.3 TOLERANCES

A. Tolerances: Construct formwork to produce completed concrete surfaces within construction tolerances according to ACI 117.

B. Camber:

1. According to ACI 318.

3.4 FIELD QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements: Requirements for inspecting and testing.

B. Inspection:

1. Inspect erected formwork, shoring, and bracing to ensure that Work complies with formwork design and that supports, fastenings, wedges, ties, and items are secure.
2. Notify Engineer after placement of reinforcing steel in forms but prior to placing concrete.
3. Schedule concrete placement to permit formwork inspection before placing concrete.

END OF SECTION

SECTION 03 20 00
CONCRETE REINFORCING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Reinforcing bars.
 - 2. Welded wire fabric.
 - 3. Reinforcement accessories.
- B. Related Requirements:
 - 1. Section 03 10 00 - Concrete Forming and Accessories.
 - 2. Section 03 30 00 - Cast-in-Place Concrete.
 - 3. Section 03 39 00 - Concrete Curing.
 - 4. Section 26 05 26 - Grounding and Bonding for Electrical Systems.

1.2 REFERENCE STANDARDS

- A. American Concrete Institute:
 - 1. ACI 301 - Specifications for Structural Concrete.
 - 2. ACI 318 - Building Code Requirements for Structural Concrete.
 - 3. ACI 530/530.1 - Building Code Requirements and Specification for Masonry Structures.
 - 4. ACI SP-66 - ACI Detailing Manual.
 - 5. MDOT Standard Specifications for Construction, current edition.
- B. American Welding Society:
- C. AWS D1.4 - Structural Welding Code - Reinforcing Steel.
- D. ASTM International:
 - 1. ASTM A184 - Standard Specification for Welded Deformed Steel Bar Mats for Concrete Reinforcement.
 - 2. ASTM A615 - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
 - 3. ASTM A704 - Standard Specification for Welded Steel Plain Bar or Rod Mats for Concrete Reinforcement.
 - 4. ASTM A706 - Standard Specification for Deformed and Plain Low-Alloy Steel Bars for Concrete Reinforcement.
 - 5. ASTM A767 - Standard Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement.
 - 6. ASTM A775 - Standard Specification for Epoxy-Coated Steel Reinforcing Bars.
 - 7. ASTM A884 - Standard Specification for Epoxy-Coated Steel Wire and Welded Wire Reinforcement.

8. ASTM A934 - Standard Specification for Epoxy-Coated Prefabricated Steel Reinforcing Bars.
9. ASTM A996 - Standard Specification for Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement.
10. ASTM A1064 - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete. Concrete Reinforcing Steel Institute:
11. CRSI 10-MSP - Manual of Standard Practice.
12. CRSI 10PLACE - Placing Reinforcing Bars.

1.3 UNIT PRICE – MEASUREMENT AND PAYMENT

- A. Concrete Reinforcing:
 1. Basis of Measurement: Included in work items requiring concrete on this Project.
 2. Basis of Payment: Includes all labor, materials, and equipment for reinforcement of concrete Work as shown on the contract documents and as stated in the specifications.

1.4 COORDINATION

- A. Section 01 30 00 - Administrative Requirements: Requirements for coordination.
- B. Coordinate Work of this Section with placement of formwork, formed openings, and other Work.

1.5 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Shop Drawings:
 1. Indicate bar sizes, spacings, locations, splice locations, lap lengths and quantities of reinforcing steel and welded wire fabric.
 2. Indicate bending and cutting schedules.
 3. Indicate supporting and spacing devices.
- C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- D. Submit certified copies of mill test report of reinforcement materials analysis.
- E. Welder Certificates: Certify welders and welding procedures employed on Work, verifying AWS qualification within previous 12 months.
- F. Qualifications Statement:
 1. Welders: Qualify procedures and personnel according to AWS D1.1.

1.6 QUALITY ASSURANCE

- A. Perform Work according to CRSI 10-MSP.
- B. Prepare Shop Drawings according to ACI SP-66.

- C. Perform Work according to MDOT Standard Specifications for Construction, current edition, and Saginaw County standards.

1.7 QUALIFICATIONS

- A. Welders: AWS qualified within previous 12 months for employed weld types.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- C. Store materials according to manufacturer instructions.
- D. Protection:
 - 1. Protect materials from moisture by storing in clean, dry location remote from construction operations areas.
 - 2. Provide additional protection according to manufacturer instructions.

1.9 EXISTING CONDITIONS

- A. Field Measurements:
 - 1. Verify field measurements prior to fabrication.
 - 2. Indicate field measurements on Shop Drawings.

PART 2 - PRODUCTS

2.1 REINFORCEMENT

- A. Reinforcing Steel:
 - 1. Comply with ASTM A615.
 - 2. Yield Strength: 60 ksi.
 - 3. Billet Bars: Plain.
 - 4. Finish: Uncoated.
- B. Welded Plain Wire Fabric:
 - 1. Comply with ASTM A1064.
 - 2. Configuration: Flat sheets.
 - 3. Finish: Uncoated.

2.2 FABRICATION

- A. Fabricate concrete reinforcement according to CRSI 10-MSP.
- B. Form standard hooks for 180-degree bends, 90-degree bends , stirrups and tie hooks , and seismic hooks as indicated on Drawings.

- C. Form reinforcement bends with minimum diameters according to ACI 318.
- D. Fabricate column reinforcement with offset bends at reinforcement splices.
- E. Form spiral column reinforcement from minimum 3/8-inch-diameter continuous plain bar or wire.
- F. Form ties and stirrups from following:
 - 1. Size bars as indicated on the plans.
- G. Weld reinforcement according to AWS D1.4.
- H. Galvanized and Epoxy-Coated Reinforcement: Clean surfaces, weld, and re-protect welded joint according to CRSI 10PLACE.
- I. Splicing:
 - 1. If not indicated on Drawings, locate reinforcement splices at point of minimum stress.
 - 2. Obtain approval of splice locations from Engineer.

2.3 SHOP FINISHING

- A. Galvanized Finish for Steel Bars:
 - 1. Comply with ASTM A767, Class II.
 - 2. Hot-dip galvanized after fabrication.
- B. Epoxy-Coated Finish for Steel Bars: Comply with ASTM A775.
- C. Epoxy-Coated Finish for Steel Wire: Comply with ASTM A884, Class A.

2.4 ACCESSORY MATERIALS

- A. Tie Wire:
 - 1. Minimum 16 gage, annealed type.
- B. Chairs, Bolsters, Bar Supports, and Spacers:
 - 1. Size and Shape: To strengthen and support reinforcement during concrete placement conditions.
 - 2. Furnish load-bearing pad on bottom to prevent vapor retarder puncture.
- C. Special Chairs, Bolsters, Bar Supports, and Spacers Adjacent to Weather-Exposed Concrete Surfaces:
 - 1. Material: Plastic coated steel.
 - 2. Size and Shape: To meet Project conditions.
- D. Reinforcing Splicing Devices:
 - 1. Type: Mechanical threaded; full tension and compression.
 - 2. Size: To fit joined reinforcing.
- E. Epoxy Coating Patching Material: Type as recommended by coating manufacturer.

2.5 SOURCE QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements: Requirements for testing, inspection, and analysis.
- B. Certificate of Compliance:
 - 1. If fabricator is approved by authorities having jurisdiction, submit certificate of compliance indicating Work performed at fabricator's facility conforms to Contract Documents.
 - 2. Specified shop tests are not required for Work performed by approved fabricator.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Place, support, and secure reinforcement against displacement.
- B. Do not deviate from required position beyond specified tolerance.
- C. Do not weld crossing reinforcement bars for assembly except as permitted by Engineer.
- D. Do not displace or damage vapor retarder.
- E. Accommodate placement of formed openings.
- F. Spacing:
 - 1. Space reinforcement bars with minimum clear spacing according to ACI 318, or as noted on the plans.
 - 2. If bars are indicated in multiple layers, place upper bars directly above lower bars.
- G. Maintain concrete cover around reinforcement according to ACI 318 as follows:

REINFORCEMENT LOCATION		MINIMUM CONCRETE COVER
Footings and Concrete Formed against Earth		3 Inches
Concrete Exposed to Earth or Weather	No. 6 Bars and Larger	2 Inches
	No. 5 Bars and Smaller	2 Inches
Supported Slabs, Walls, and Joists	No. 14 Bars and Larger	2 Inches
	No. 11 Bars and Smaller	2 Inches
Beams and Columns		2 Inches

- H. Splice reinforcing where indicated on Drawings according to manufacturer's instructions.
- I. Bond and ground reinforcement as specified in Section 26 05 26 - Grounding and Bonding for Electrical Systems.

3.2 TOLERANCES

- A. Section 01 40 00 - Quality Requirements: Requirements for tolerances.

- B. Install reinforcement within following tolerances for flexural members, walls, and compression members:

REINFORCEMENT DEPTH	DEPTH TOLERANCE	CONCRETE COVER TOLERANCE
Greater than 8 Inches	Plus or Minus 3/8 Inch	Minus 3/8 Inch
Less than 8 Inches	Plus or Minus 1/2 Inch	Minus 1/2 Inch

- C. Foundation Walls: Install reinforcement within tolerances according to ACI 530/530.1.

3.3 FIELD QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements: Requirements for inspecting and testing.
- B. Perform field inspection and testing according to ACI 318.
- C. Provide unrestricted access to Work and cooperate with appointed inspection and testing firm.
- D. Reinforcement Inspection:
1. Placement Acceptance: Inspect specified and ACI 318 material requirements and specified placement tolerances.
 2. Welding: Inspect welds according to AWS D1.1.
 3. Periodic Placement Inspection: Inspect for correct materials, fabrication, sizes, locations, spacing, concrete cover, and splicing.
 4. Weldability Inspection: Inspect for reinforcement weldability if formed from steel other than ASTM A706.
 5. Continuous Weld Inspection: Inspect reinforcement according to ACI 318.
 6. Periodic Weld Inspection: Inspect other welded connections.

END OF SECTION

SECTION 03 30 00

CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

- A. Comply with ACI 305R when pouring concrete during hot weather.
- B. Comply with ACI 306.1 when pouring concrete during cold weather.
- C. Acquire cement and aggregate from one source for Work.
- D. Perform Work according to State of Michigan MDOT Standard Specifications for Construction, current addition.

PRODUCTS

1.2 PERFORMANCE AND DESIGN CRITERIA

- A. Vapor Retarder Permeance: Maximum 1 perm when tested according to ASTM E96, water method.
- B. MATERIALS Section Includes Cast-in-Place Concrete for Following Items:
 - 1. Vertical walls.
 - 2. Foundation walls.
 - 3. Foundation slabs.
 - 4. Footings.
 - 5. Supported slabs.
 - 6. Slabs on grade.
 - 7. Equipment pads.
 - 8. Light pole base.
- C. Related Requirements:
 - 1. Section 03 10 00 - Concrete Forming and Accessories.
 - 2. Section 03 20 00 - Concrete Reinforcing.
 - 3. Section 03 39 00 - Concrete Curing.

1.3 REFERENCE STANDARDS

- A. American Concrete Institute:
 - 1. ACI 301 - Specifications for Structural Concrete.
 - 2. ACI 305R - Guide to Hot Weather Concreting.
 - 3. ACI 306.1 - Standard Specification for Cold Weather Concreting.
 - 4. ACI 308.1 - Specification for Curing Concrete.
 - 5. ACI 318 - Building Code Requirements for Structural Concrete.
 - 6. MDOT Standard Specifications for Construction, current addition.
- B. ASTM International:
 - 1. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.

2. ASTM C31 - Standard Practice for Making and Curing Concrete Test Specimens in the Field.
3. ASTM C33 - Standard Specification for Concrete Aggregates.
4. ASTM C39 - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
5. ASTM C42 - Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
6. ASTM C94 - Standard Specification for Ready-Mixed Concrete.
7. ASTM C143 - Standard Test Method for Slump of Hydraulic-Cement Concrete.
8. ASTM C150 - Standard Specification for Portland Cement.
9. ASTM C172 - Standard Practice for Sampling Freshly Mixed Concrete.
10. ASTM C173 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method.
11. ASTM C231 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
12. ASTM C260 - Standard Specification for Air-Entraining Admixtures for Concrete.
13. ASTM C330 - Standard Specification for Lightweight Aggregates for Structural Concrete.
14. ASTM C494 - Standard Specification for Chemical Admixtures for Concrete.
15. ASTM C595 - Standard Specification for Blended Hydraulic Cements.
16. ASTM C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.
17. ASTM C685 - Standard Specification for Concrete Made by Volumetric Batching and Continuous Mixing.
18. ASTM C845 - Standard Specification for Expansive Hydraulic Cement.
19. ASTM C989 - Standard Specification for Slag Cement for Use in Concrete and Mortars.
20. ASTM C1017 - Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete.
21. ASTM C1064 - Standard Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete.
22. ASTM C1107 - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink).
23. ASTM C1116 - Standard Specification for Fiber-Reinforced Concrete.
24. ASTM C1157 - Standard Performance Specification for Hydraulic Cement.
25. ASTM C1218 - Standard Test Method for Water-Soluble Chloride in Mortar and Concrete.
26. ASTM C1240 - Standard Specification for Silica Fume Used in Cementitious Mixtures.
27. ASTM D994 - Standard Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type).
28. ASTM D1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
29. ASTM D1752 - Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction.
30. ASTM D6690 - Standard Specification for Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements.
31. ASTM E96 - Standard Test Methods for Water Vapor Transmission of Materials.
32. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials.
33. ASTM E1643 - Standard Practice for Selection, Design, Installation, and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs.
34. ASTM E1745 - Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs.

1.4 UNIT PRICE – MEASUREMENT AND PAYMENT

- A. Cast-In-Place-Concrete:
 - 1. Basis of Measurement: Included in other Work items of this Project unless noted otherwise.
 - 2. Basis of Payment: Includes all labor, materials, and equipment to install concrete, grout, and appurtenances as shown on the contract documents and as stated in the specifications.
- B. Concrete Repairs:
 - 1. Basis of Measurement: At the lump sum price bid as stated in the proposal.
 - 2. Basis of Payment: Includes all labor, equipment, and materials required to make repairs to the existing concrete structures as shown on the plans.
- C. Generator Pad:
 - 1. Basis of Measurement: At the lump sum price bid as stated in the proposal.
 - 2. Basis of Payment: Includes all labor, equipment, and materials to construct the proposed generator pad including stairs complete as shown on the plans. Includes any coordination need with Consumers Energy and their contractor(s).
- D. Pump Station Box Culvert:
 - 1. Basis of Measurement: At the lump sum price bid as stated in the proposal.
 - 2. Basis of Payment: Includes all labor, equipment, and materials to construct the proposed box culvert and foundation. Includes all precast components, footers/pile caps, connection, cast-in-place concrete, concrete pavement, etc. to construct the box culvert portion of the pump station complete as shown on drawings.
- E. Trash Rack Concrete Structure:
 - 1. Basis of Measurement: At the lump sum price bid as stated in the proposal.
 - 2. Basis of Payment: Includes all labor, equipment, and material to construct the concrete structure for the proposed trash rack complete as shown on drawings.
- F. Misc. Concrete Pads:
 - 1. Basis of Measurement: At the unit price bid per square foot as stated in the proposal.
 - 2. Basis of Payment: Includes all labor, equipment, and material to construct concrete pad as shown on plans, complete.

1.5 COORDINATION

- A. Section 01 30 00 - Administrative Requirements: Requirements for coordination.
- B. Coordinate placement of joint devices with erection of concrete formwork and placement of form accessories.

1.6 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit data on joint devices, attachment accessories, admixtures.
- C. Design Data:
 - 1. Submit concrete mix design for each concrete strength.
 - 2. Submit separate mix designs if admixtures are required for following:
 - a. Hot and cold weather concrete Work.
 - b. Air entrained concrete Work.

3. Identify mix ingredients and proportions, including admixtures.
4. Identify chloride content of admixtures and whether or not chlorides were added during manufacture.

D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

E. Manufacturer Instructions: Submit installation procedures and interfacing required with adjacent Work.

F. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

1.7 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for submittals.

B. Project Record Documents: Record actual locations of embedded utilities and components concealed from view in finished construction.

1.8 QUALITY ASSURANCE

A. Perform Work according to ACI 318.

B. Comply with ACI 305R when pouring concrete during hot weather.

C. Comply with ACI 306.1 when pouring concrete during cold weather.

D. Acquire cement and aggregate from one source for Work.

E. Perform Work according to State of Michigan MDOT Standard Specifications for Construction, current addition.

PART 2 - PRODUCTS

2.1 PERFORMANCE AND DESIGN CRITERIA

A. Vapor Retarder Permeance: Maximum 1 perm when tested according to ASTM E96 desiccant method.

2.2 MATERIALS

A. Concrete:

1. Cement:

- a. Comply with ASTM C150, Type I or Type II - Normal.
- b. Type: Portland.

2. Normal Weight Aggregates:

- a. Fine - Comply with ASTM C33 and MDOT 2NS.
- b. Coarse – Comply with ASTM C33 and MDOT 6AA - Aggregate Maximum Size: According to ACI 318.

3. Water:

- a. Comply with ACI 318.
- b. Potable, without deleterious amounts of chloride ions.

B. Admixtures:

1. Furnish materials according to Perform Work according to State of Michigan MDOT Standard Specifications for Construction, current addition.
2. Air Entrainment: Comply with ASTM C260.
3. Chemical:
 - a. Comply with ASTM C494.
 - b. Type A - Water Reducing.
 - c. Type B - Retarding.
 - d. Type C - Accelerating.
 - e. Type D - Water Reducing and Retarding.
 - f. Type E - Water Reducing and Accelerating.
 - g. Type F - Water Reducing, High Range.
 - h. Type G - Water Reducing, High Range, and Retarding.
4. Fly Ash: Comply with ASTM C618, Class F or C.
5. Silica Fume: Comply with ASTM C1240.
6. Slag:
 - a. Description: Ground-granulated blast-furnace slag.
 - b. Comply with ASTM C989.
 - c. Grade 100 or 120.
7. Plasticizing:
 - a. Comply with ASTM C1017.
 - b. Type II, plasticizing and retarding.

C. Joint Devices and Filler:

1. Joint Filler, Type A:
 - a. Description: Asphalt-impregnated fiberboard or felt.
 - b. Comply with ASTM D1751.
 - c. Thickness: 1/4 inch.
 - d. Profile: Tongue-and-groove.
2. Construction Joint Devices:
 - a. Material: Integral extruded plastic.
 - b. Profile: Tongue-and-groove with removable top strip exposing sealant trough and knockout holes spaced at 6 inches o.c.
 - c. Furnish ribbed steel spikes with tongue to fit top screed edge.
3. Expansion and Contraction Joint Devices:
 - a. Comply with ASTM B221.
 - b. Material: Extruded aluminum.
 - c. Filler Strip: Resilient elastomeric with Shore A hardness of 35 to permit plus or minus 25 percent joint movement with full recovery.
 - d. Cover Plate: Extruded aluminum, of longest manufactured length at each location, and flush mounted.
 - e. Color: As selected by Owner.
4. Sealant:
 - a. Comply with ASTM D6690.
 - b. Type: I.

2.3 CONCRETE MIX

- A. Select proportions for normal weight concrete according to ACI 301, Method 1.
- B. Concrete mixtures, general

1. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both.
2. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than Portland cement in concrete as follows:
 - a. Fly Ash: 25%
 - b. Ground Granulated Blast-Furnace Slag: 50%
 - c. Combined Fly Ash and Ground Granulated Blast-Furnace Slag: 50% Portland cement minimum, with fly ash not exceeding 25%
3. Chloride based admixtures are prohibited in all reinforced concrete.
4. Admixtures: Use admixtures according to manufacturer's written instructions.
 - a. Use water-reducing, high-range water-reducing or plasticizing admixture in concrete, as required, for placement and workability.
 - b. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
 - c. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a water-cementitious materials ratio below 0.50.
 - d. Use air-entraining admixture in exterior exposed concrete unless otherwise indicated. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having a total air content with a tolerance of plus or minus 1-1/2 percent within the following limits:
 - 1) Concrete structures and slabs exposed to freezing and thawing, deicer chemicals, or hydraulic pressure: 4.5 percent.
 - 2) Other concrete not exposed to freezing, thawing, or hydraulic pressure, or to receive a surface hardener: 2 to 4 percent.

C. Concrete mixture:

1. Select proportions for normal weight concrete in accordance with ACI 301 Method 2.
2. Select proportions for concrete in accordance with ACI 318 without trial mixtures or field experience when approved by Engineer.
3. Provide concrete to the following criteria:

Concrete Grade: MDOT P1/S2

Material and Property	Measurement
Flexural Strength (7 day)	550 psi
Flexural Strength (28 day)	650 psi
Compressive Strength (7 day)	2,600 psi
Compressive Strength (28 day)	3,500 psi
Cement Type	Type I or II
Cement Content (minimum)	6.0 sacks
Coarse Aggregate Type	6AA
Coarse Aggregate	72 percent by bulk volume (dry,
Fine Aggregate	2NS
Air Content	6.5 percent plus or minus 1.5
Slump	4 inches plus or minus 1 inch

D. Admixtures:

1. Include admixture types and quantities indicated in concrete mix designs only if approved by Engineer.
2. Cold Weather:
 - a. Use accelerating admixtures in cold weather.

- b. Use of admixtures will not relax cold-weather placement requirements.
- 3. Hot Weather: Use set-retarding admixtures.
- 4. For concrete exposed to deicing chemicals, limit fly ash, pozzolans, silica fume, and slag content as required by applicable ACI code.

E. Average Compressive Strength Reduction: Not permitted.

F. Ready-Mixed Concrete: Mix and deliver concrete according to ASTM C685.

G. Site-Mixed Concrete: Mix concrete according to ACI 318.

2.4 ACCESSORIES

A. Bonding Agent:

- 1. ASTM C/1059M, Type II, non-redispersible, acrylic emulsion or styrene butadiene:
- 2. Description: Polymer resin emulsion.

B. Vapor Retarder:

- 1. ASTM E 1745 Class C, not less than 8 mils thick clear polyethylene film; type recommended for below grade application. Furnish joint tape recommended by manufacturer.
- 2. Description: Clear polyethylene film.
- 3. Comply with ASTM E1745, Class C.
- 4. Thickness: 8 mils.
- 5. Type: As recommended for below-grade application.
- 6. Joint Tape: As recommended by manufacturer.

C. Non-shrink Grout:

- 1. Description: Premixed compound consisting of non-metallic aggregate, cement, and water-reducing and plasticizing agents.
- 2. Comply with ASTM C1107.
- 3. Minimum Compressive Strength: 2,400 psi in 48 hours and 7,000 psi in 28 days.

D. Concrete Reinforcing Fibers:

- 1. Description: High-strength industrial-grade fibers specifically engineered for secondary reinforcement of concrete.
- 2. Comply with ASTM C1116.
- 3. Tensile Strength: 130 ksi.
- 4. Toughness: 15 ksi.
- 5. Fiber Length: 3/4 inch.
- 6. Fiber Count: 34 million/lb.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation examination.
- B. Verify requirements for concrete cover over reinforcement.

- C. Verify that anchors, seats, plates, reinforcement, and other items to be cast into concrete are accurately placed, positioned securely, and will not interfere with placing concrete.

3.2 PREPARATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation preparation.
- B. Previously Placed Concrete:
 - 1. Prepare previously placed concrete by cleaning with steel brush and applying bonding agent.
 - 2. Remove laitance, coatings, and unsound materials.
- C. In locations where new concrete is doweled to existing work, drill holes in existing concrete, insert steel dowels, and pack solid with Hilti-HY 200 Injectable Mortar.
- D. Remove debris and ice from formwork, reinforcement, and concrete substrates.
- E. Remove water from areas receiving concrete before concrete is placed.

3.3 INSTALLATION

- A. Placing Concrete:
 - 1. Place concrete according to ACI 318.
 - 2. Notify testing laboratory and Engineer minimum 24 hours prior to commencement of operations.
 - 3. Ensure that reinforcement, inserts, embedded parts, formed expansion and contraction joints are not disturbed during concrete placement.
 - 4. Install vapor retarder under interior slabs on grade according to ASTM E1643.
 - 5. Lap joints minimum 6 inches and seal watertight by taping edges and ends.
 - 6. Repairs:
 - a. Repair vapor retarder damaged during placement of concrete reinforcement.
 - b. Using vapor retarder material, lap over damaged areas minimum 6 inches and seal watertight.
 - 7. Joint Filler:
 - a. Separate slabs on grade from vertical surfaces with joint filler.
 - b. Place joint filler in floor slab pattern placement sequence; set top to required elevations; secure to resist movement by wet concrete.
 - c. Extend joint filler from bottom of slab to within 1/2 inch of finished slab surface.
 - 8. Joint Devices:
 - a. Coordination: Install construction joint devices in coordination with floor slab pattern placement sequence; set top to required elevations; secure to resist movement by wet concrete.
 - b. Install joint device anchors, maintaining correct position to allow joint cover to be flush with floor and wall finish.
 - c. Install joint covers in longest practical length when adjacent construction activity is complete.
 - 9. Deposit concrete at final position, preventing segregation of mix.
 - 10. Place concrete in continuous operation for each panel or section as determined by predetermined joints.
 - 11. Consolidate concrete.
 - 12. Maintain records of concrete placement, including date, location, quantity, air temperature, and test samples taken.

13. Place concrete continuously between predetermined expansion, control, and construction joints.
 14. Do not interrupt successive placement and do not permit cold joints to occur.
 15. Place floor slabs in indicated checkerboard or saw-cut pattern.
 16. Saw-Cut Joints:
 - a. Saw-cut joints within 12 hours after placing.
 - b. Use 3/16-inch-thick blade.
 - c. Cut into 1/4 depth of slab thickness.
 17. Screeding:
 - a. Screed floors and slabs on grade level.
 - b. Surface Flatness: maximum 1/4 inch in 10 feet.
- B. Separate Floor Toppings and Equipment Pads:
1. Prior to placing floor topping, remove deleterious material, roughen substrate concrete surface, and broom and vacuum clean.
 2. Place required dividers and other items to be cast in concrete.
 3. Apply bonding agent to substrate.
- C. Curing and Protection:
1. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.
 2. Protect concrete footings from freezing for minimum of five days.
 3. Maintain concrete with minimal moisture loss at relatively constant temperature for period as necessary for hydration of cement and hardening of concrete.
 4. Cure concrete floor surfaces as specified in Section 03 39 00 - Concrete Curing.

3.4 CONCRETE FINISHING

- A. Formed Surfaces:
1. As a minimum of formed surfaces shall receive a plain finish and rubbed finish.
 2. Plain Finish: Immediately after removal of forms, all fins and loose material shall be removed and all holes, voids, aggregate pockets and depressions shall be cut out to solid concrete. All such defective areas shall be cleaned and wetted thoroughly and immediately be brushed and net cement and filled with Portland Cement grout finished, flush with the adjacent surfaces. Patch work shall be damp cured for a period of 48 hours and, when exposed, it shall be finished to match adjacent surfaces.
 3. Rubbed Finish: All form marks and other such irregularities shall be removed by rubbing the surface with a Carborundum stone and water as soon as practical after from removal.
 4. Bagged Finish: All formed surfaces which are not earth backfilled shall receive a bagged finish. All air and water voids shall be finished flush with the wall surface. The wall shall first be moistened with water. Portland cement grout matching the color of the base concrete shall be worked into the voids using burlap or sponge rubber finishing pads.
- B. Unformed Surface Finishes:
1. Troweled Finish: After a floated finish, provide a smooth surface, free of defects with a steel trowel. Follow the first troweling with a second troweling after the concrete has hardened sufficiently to produce a ringing sound as the trowel is moved over the surface. The finish surface shall be essentially free of trowel marks, uniform in texture and appearance and shall be plane to 1/8" in 10 ft. tolerance.
 2. Broomed Finish: After receiving the floated and troweled finishes, apply a broomed finish with a fiber-bristle brush in a direction transverse to the line of traffic.

3. Floated Finish: Place, consolidate, strike off and level concrete. After the concrete has stiffened sufficiently, floating shall begin using a hard float, power trowel and float shoes or powered disc float. Cut down high spots and fill low spots to 1/4" in 10 ft. tolerance. Float to a uniform sandy texture.
 4. Scratched Finish: After the concrete has been placed consolidated, struck off and leveled to a 1/4" in 2 ft. tolerance, roughen with stiff brushes and rakes before the final set.
- C. Finish concrete floor surface in accordance with ACI 301.
 - D. Provide a troweled finish for base slabs.
 - E. Provide a floated finish for slabs as directed by the Engineer.
 - F. Provide a broom finish for exterior slabs, sidewalks, pavements and where directed by the Engineer.
 - G. Provide a scratched finish where concrete is specified to receive a subsequent concrete tapping.
 - H. In areas with floor drains, maintain floor elevation at walls; pitch surfaces uniformly to drains at one inch per 10 feet unless otherwise indicated on drawings.
 - I. Maximum variation of surface flatness for exposed concrete floors 1/8 inch in 10 feet.

3.5 FIELD QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements: Requirements for inspecting and testing.
- B. Inspection and Testing: Performed by Owner's testing laboratory according to ACI 318 and MDOT Standard Specifications for Construction, current addition.
- C. Provide unrestricted access to Work and cooperate with appointed testing and inspection firm.
- D. Submit proposed mix design of each class of concrete to inspection and testing firm for review prior to commencement of Work.
- E. Concrete Inspections:
 1. Continuous Placement Inspection: Inspect for proper installation procedures.
 2. Periodic Curing Inspection: Inspect for specified curing temperature and procedures.
- F. Strength Test Samples:
 1. Sampling Procedures: Comply with ASTM C172.
 2. Cylinder Molding and Curing Procedures:
 - a. Comply with ASTM C31.
 - b. Cylinder Specimens: Standard cured.
 3. Sample concrete and make one set of three cylinders for every 75 cu. yd. or less of each class of concrete placed each day, and for every 5,000 sq. ft. of surface area for slabs and walls.
 4. If volume of concrete for a class of concrete would provide less than five sets of cylinders, take samples from five randomly selected batches, or from every batch if less than five batches are used.
 5. Make one additional cylinder during cold weather concreting and field cure.

- G. Field Testing:
 - 1. Slump Test Method: Comply with ASTM C143.
 - 2. Air Content Test Method: Comply with ASTM C173.
 - 3. Temperature Test Method: Comply with ASTM C1064.
 - 4. Compressive Strength Concrete:
 - a. Measure slump and temperature for each sample.
 - b. Measure air content in air-entrained concrete for each sample.
- H. Cylinder Compressive Strength Testing:
 - 1. Test Method: Comply with ASTM C39.
 - 2. Test Acceptance: According to ACI 318.
 - 3. Test one cylinder at seven days.
 - 4. Test one cylinder at 28 days.
 - 5. Retain one cylinder for 30 days for testing when requested by Engineer.
 - 6. Dispose of remaining cylinders if testing is not required.
- I. Core Compressive Strength Testing:
 - 1. Sampling and Testing Procedures: Comply with ASTM C42.
 - 2. Test Acceptance: According to ACI 318.
 - 3. Drill three cores for each failed strength test from failed concrete.
- J. Patching:
 - 1. Allow Engineer to inspect concrete surfaces immediately upon removal of forms.
 - 2. Honeycombing or Embodied Debris in Concrete:
 - a. Not acceptable.
 - b. Notify Engineer upon discovery.
 - 3. Patch imperfections as directed by Engineer in accordance with ACI 301.
- K. Defective Concrete:
 - 1. Defective Concrete: Concrete not conforming to required lines, details, dimensions, tolerances or specified requirements.
 - 2. Repair or replacement of defective concrete will be determined by Engineer.
 - 3. Do not patch, fill, touch-up, repair, or replace exposed concrete except upon express direction of Engineer for each individual area.

END OF SECTION

SECTION 03 39 00
CONCRETE CURING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Initial and final curing of horizontal and vertical concrete surfaces.
- B. Related Sections:
 - 1. Section 03 30 00 - Cast-In-Place Concrete.

1.2 REFERENCES

- A. American Concrete Institute:
 - 1. ACI 301 - Specifications for Structural Concrete.
 - 2. ACI 302.1 - Guide for Concrete Floor and Slab Construction.
 - 3. ACI 308.1 - Standard Specification for Curing Concrete.
 - 4. ACI 318 - Building Code Requirements for Structural Concrete.
 - 5. MDOT Standard Specifications for Construction, current edition.
- B. ASTM International:
 - 1. ASTM C171 - Standard Specification for Sheet Materials for Curing Concrete.
 - 2. ASTM C309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
 - 3. ASTM C1315 - Standard Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete.
 - 4. ASTM D2103 - Standard Specification for Polyethylene Film and Sheeting.

1.3 UNIT PRICE – MEASUREMENT AND PAYMENT

- A. Concrete Curing:
 - 1. Basis of Measurement: Included in other Work items of this Project.
 - 2. Basis of Payment: Includes all labor, materials, and equipment to cure concrete as shown on the contract documents and as stated in the specifications.

1.4 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Submittal procedures.
- B. Product Data: Submit data on curing compounds, mats, paper, film, compatibilities, and limitations.

1.5 QUALITY ASSURANCE

- A. Perform Work in accordance with ACI 308.

- B. Perform Work in accordance with MDOT Standard Specifications for Construction, current edition.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.
- B. Deliver curing materials in manufacturer's packaging including application instructions.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Membrane Curing Compound Type A: ASTM C309, Type 1, Class A.
- B. Water: Potable, not detrimental to concrete.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.
- B. Verify substrate surfaces are ready to be cured.

3.2 INSTALLATION - HORIZONTAL SURFACES

- A. Cure concrete in accordance with ACI 308.1 using moisture curing or moisture-retaining-cover curing method.
- B. Spraying: Spray water over slab areas and maintain wet for 7 days.

3.3 INSTALLATION - VERTICAL SURFACES

- A. Cure concrete in accordance with ACI 308.1 using moisture curing or moisture-retaining-cover curing method.
- B. Spraying: Spray water over surfaces and maintain wet for 7 days.

3.4 PROTECTION OF FINISHED WORK

- A. Section 01 70 00 - Execution and Closeout Requirements: Protecting finished Work.
- B. Do not permit traffic over unprotected floor surface.

END OF SECTION

SECTION 04 05 00

MASONRY MORTARING AND GROUTING

1. PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Mortar and grout for masonry.

1.2 RELATED WORK

- A. Section 042000 – Unit Masonry.
- B. Section 054000 – Cold-Formed Metal Framing.

1.3 REFERENCES

- A. ASTM C91 - Masonry Cement.
- B. ASTM C144 - Aggregate for Masonry Mortar.
- C. ASTM C150 - Portland Cement.
- D. ASTM C207 - Hydrated Lime for Masonry Purposes.
- E. ASTM C270 - Mortar for Unit Masonry.
- F. ASTM C387 - Packaged, Dry, Combined Materials, for Mortar and Concrete.
- G. ASTM C404 - Aggregates for Masonry Grout.
- H. ASTM C476 - Grout for Masonry.
- I. ASTM C1019 - Method of Sampling and Testing Grout.
- J. IMIAC - International Masonry Industry All-Weather Council: Recommended Practices and Guide Specifications for Cold Weather Masonry Construction.

1.4 SUBMITTALS

- A. Include design mix, indicate Proportion or Property Method used, required environmental conditions, and admixture limitations.
- B. Submit test reports on grout indicating conformance to ASTM C476.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site, store and protect per manufacturer's recommendations.
- B. Maintain packaged materials clean, dry, and protected against dampness, freezing, and foreign matter.

1.6 ENVIRONMENTAL REQUIREMENTS

- A. Maintain materials and surrounding air temperatures to minimum 50 degrees F (10 degrees C) prior to, during, and 48 hours after completion of masonry work.

1.7 MIX TESTS

- A. Test mortar and grout.
- B. Testing of Mortar Mix: In accordance with ASTM C780.
- C. Test mortar mix for compressive strength 1800 psi.
- D. Testing of Grout Mix: In accordance with ASTM C1019.

2. PART 2 PRODUCTS

2.1 MORTAR

- A. Exterior colored block, brick veneer, and matching colored mortar.
- B. Interior Walls - S mortar standard color block.

2.2 MATERIALS

- A. Portland Cement: ASTM C150, Type II, Gray, color.
- B. Masonry Cement: ASTM C91, Type S.
- C. Mortar Aggregate: ASTM C144, standard masonry type.
- D. Grout Aggregate: ASTM C404.

2.3 GROUT FINE AGGREGATE: Masons sand; 70 percent by volume.

- A. Water: Clean and potable.
- B. Bonding Agent: Portland Cement and 1/10 lime.

2.4 MORTAR COLOR

- A. Exterior Mortar Color: Field and accent colors to be selected by Owner.
- B. Interior Mortar Color: Standard block color.

2.5 ADMIXTURES

- A. Plasticizer: Water reducing type which reduces porosity and absorption to increase bond strength; grout manufacturer's standard.
- B. Water Repellent: Liquid type; Rheopel manufactured by Master Builders Inc., or equal.

2.6 MORTAR MIXES

- A. Mortar for Load Bearing Walls and Partitions: ASTM C270, Type S using the Property Method.
- B. Mortar: ASTM C270, Type S using the Property Method.

2.7 MORTAR MIXING

- A. Thoroughly mix mortar ingredients in quantities needed for immediate use in accordance with ASTM C270.
- B. Add mortar color and admixtures in accordance with manufacturer's instructions. Provide uniformity of mix and coloration.
- C. Do not use anti-freeze compounds to lower the freezing point of mortar.
- D. If water is lost by evaporation, retemper only within two hours of mixing.
- E. Use mortar within two hours after mixing at temperatures of 80 degrees F (26 degrees C), or two-and-one-half hours at temperatures under 50 degrees F (10 degrees C).

2.8 GROUT MIXES

- A. Engineered Masonry: 3000 psi strength at 28 days; 7-8 inches slump; mixed in accordance with ASTM C476 Fine grout.

2.9 GROUT MIXING

- A. Thoroughly mix mortar ingredients in quantities needed for immediate use in accordance with ASTM C476 Fine grout.
- B. Add admixtures in accordance with manufacturer's instructions. Provide uniformity of mix.

3. PART 3 EXECUTION

3.1 EXAMINATION

- A. Request inspection of spaces to be grouted.

3.2 PREPARATION

- A. Apply bonding agent to existing surfaces.
- B. Plug cleanout holes with block masonry units to prevent leakage of grout materials. Brace masonry for wet grout pressure.

3.3 INSTALLATION

- A. Install mortar and grout in accordance with manufacturer's instructions.
- B. Do not displace reinforcement while placing grout.
- C. Remove excess mortar.

END OF SECTION

SECTION 04 20 00

UNIT MASONRY

1. PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Concrete Unit Masonry.
 - 2. Accessories

1.3 RELATED SECTIONS

- A. Section 040500 – Mortar and Grout.
- B. Section 079000 – Caulking and Sealants.

1.4 PERFORMANCE REQUIREMENTS

- A. Provide unit masonry that develops the following installed compressive strengths (f'm) at 28 days.
 - 1. For Concrete Unit Masonry: As follows, based on net area:
 - a. f'm = 1500 psi (10.3 MPa).

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store masonry units on elevated platforms, under cover, and in a dry location to prevent their deterioration or damage due to moisture, temperature changes, contaminants, corrosion, and other causes. If units become wet, do not install until they are in an air-dried condition.
- B. Store cementitious materials on elevated platforms, under cover, and in a dry location.
- C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.
- D. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.6 PROJECT CONDITIONS

- A. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least 3 days after building masonry walls or columns.

- B. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.
1. Protect base of walls from rain-splashed mud and mortar splatter by coverings spread on ground and over wall surface.
- C. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen subgrade or setting beds. Remove and replace unit masonry damaged by frost or freezing conditions. Comply with the following requirements:
1. Cold-Weather Construction: When the ambient temperature is within the limits indicated, use the following procedures:
 - a. 40 to 32 deg F (4 to 0 deg C): Heat mixing water or sand to produce mortar temperatures between 40 and 120 deg F (4 and 49 deg C).
 - b. 32 to 25 deg F (0 to -4 deg C): Heat mixing water and sand to produce mortar temperatures between 40 and 120 deg F (4 and 49 deg C). Heat grout materials to produce grout temperatures between 40 and 120 deg F (4 and 49 deg C). Maintain mortar and grout above freezing until used in masonry.
 - c. 25 to 20 deg F (-4 to -7 deg C): Heat mixing water and sand to produce mortar temperatures between 40 and 120 deg F (4 and 49 deg C). Heat grout materials to produce grout temperatures between 40 and 120 deg F (4 and 49 deg C). Maintain mortar and grout above freezing until used in masonry. Heat masonry units to 40 deg F (4 deg C) if grouting. Use heat on both sides of walls under construction.
 - d. 20 deg F (-7 deg C) and Below: Heat mixing water and sand to produce mortar temperatures between 40 and 120 deg F (4 and 49 deg C). Heat grout materials to produce grout temperatures between 40 and 120 deg F (4 and 49 deg C). Maintain mortar and grout above freezing until used in masonry. Heat masonry units to 40 deg F (4 deg C). Provide enclosures and use heat on both sides of walls under construction to maintain temperatures above 32 deg F (0 deg C) within the enclosures.
 2. Cold-Weather Protection: When the mean daily temperature is within the limits indicated, provide the following protection:
 - a. 40 to 25 deg F (4 to -4 deg C): Cover masonry with a weather-resistant membrane for 48 hours after construction.
 - b. 25 to 20 deg F (-4 to -7 deg C): Cover masonry with insulating blankets or provide enclosure and heat for 48 hours after construction to prevent freezing. Install wind breaks when wind velocity exceeds 15 mi./h (25 km/h).
 - c. 20 deg F (-7 deg C) and Below: Provide enclosure and heat to maintain temperatures above 32 deg F (0 deg C) within the enclosure for 48 hours after construction.
 3. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F (4 deg C) and above and will remain so until masonry has dried out, but not less than 7 days after completion of cleaning.
- D. Hot-Weather Requirements: Protect unit masonry work when temperature and humidity conditions produce excessive evaporation of water from mortar and grout. Provide artificial shade and wind breaks and use cooled materials as required. Do not apply mortar to substrates with temperatures of 100 deg F (38 deg C) and above.

2. PART 2 PRODUCTS

2.1 CONCRETE MASONRY UNITS

- A. Concrete Masonry Units: ASTM C 90 and as follows:
 - 1. Furnish and install split-face concrete masonry units (C.M.U.) per ACI 530 with horizontal ties and mortar or grout filled cavity where indicated. See exterior elevations and sections/details.
 - 2. Unit Compressive Strength: Provide units with minimum average net-area compressive strength indicated below:
 - a. 1900 psi (13.1 MPa).
 - b. Not less than the unit compressive strengths required to produce concrete unit masonry construction of compressive strength indicated.
 - 3. Normal weight units shall be used at concealed and underground conditions.
 - 4. Light-weight units shall be used at conditions exposed to view.
 - 5. Size: Nominal modular size of 4" wide x 16" long x 8" high.
 - 6. Special Units: Provide special units for 90 degree corners, bond beams, lintels, and bullnosed corners.
 - 7. C.M.U. Color:
 - a. Split-Face: Color by owner, mortar to match.
 - b. Single Scored Accent: Color by owner, mortar to match

2.2 REINFORCING STEEL

- A. Steel Reinforcing Bars: Material and grade as follows:
 - 1. Billet steel complying with ASTM A 615 (ASTM A 615M).
 - 2. Epoxy-coated billet steel complying with ASTM A 615 (ASTM A 615M) and ASTM A 775 (ASTM A 775M).
 - a. Grade 60 (Grade 400).
- B. Deformed Reinforcing Wire: ASTM A 496, with ASTM A 153, Class B-2 zinc coating.
- C. Welded-Wire Fabric: ASTM A 185.
- D. Ladder style horizontal reinforcement shall be installed continuous as shown on drawings.

2.3 MISCELLANEOUS ANCHORS

- A. Unit Type Inserts in Concrete: Cast-iron or malleable-iron inserts of type and size indicated.
- B. Anchor Bolts: Steel bolts complying with ASTM A 307, Grade A (ASTM F 568, Property Class 4.6); with ASTM A 563 (ASTM A 563M) hex nuts and, where indicated, flat washers; hot-dip galvanized to comply with ASTM A 153, Class C; of diameter and length indicated and in the following configurations:
 - 1. Headed bolts.
 - 2. Nonheaded bolts, straight.
 - 3. Nonheaded bolts, bent in manner indicated.

2.4 EMBEDDED FLASHING MATERIALS

- A. Asphalt-Coated Copper Flashing: Manufacturer's standard product consisting of sheet copper of weight indicated below, coated with flexible asphalt.
 - 1. Weight: 3 oz./sq. ft. (0.9 kg/sq. m).
 - 2. Weight: 5 oz./sq. ft. (1.5 kg/sq. m).

3. Weight: 7 oz./sq. ft. (2 kg/sq. m).
 4. Application: Use where flashing is fully concealed in masonry.
- B. Solder and Sealants for Sheet-Metal Flashings: As specified in Division 7 Section "Flashing and Sheet Metal."
 - C. Adhesive for Flashings: Of type recommended by manufacturer of flashing material for use indicated.
 - D. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include, but are not limited to, the following:
 - E. Products: Subject to compliance with requirements, provide one of the following:

2.5 ACCESSORIES

- A. Preformed Control Joints (rubber): Provide with corner and tee accessories, cement fused joints.
- B. Joint Filler: Closed cell polyurethane; oversized 50 percent to joint width; self-expanding.
- C. Building Paper: 15# asphalt saturated felt.
- D. Weep Holes: 1" open head joints spaced not greater than 48" on center.

2.6 MASONRY CLEANERS

- A. Job-Mixed Detergent Solution: Solution of 1/2-cup (0.14-L) dry measure tetrasodium polyphosphate and 1/2-cup (0.14-L) dry measure laundry detergent dissolved in 1 gal. (4 L) of water.
- B. Proprietary Acidic Cleaner: Manufacturer's standard-strength, general-purpose cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry surfaces of type indicated below without discoloring or damaging masonry surfaces; expressly approved for intended use by manufacturer of masonry units being cleaned.
 1. For masonry not subject to metallic oxidation stains, use formulation consisting of a concentrated blend of surface-acting acids, chelating, and wetting agents.
 2. For dark-colored masonry not subject to metallic oxidation stains, use formulation consisting of a liquid blend of surface-acting acids and special inhibitors.
 3. For masonry subject to metallic oxidation stains, use formulation consisting of a liquid blend of organic and inorganic acids and special inhibitors.
 4. Available Products: Subject to compliance with requirements, products that may be used to clean unit masonry surfaces include, but are not limited to, the following:
 5. Products: Subject to compliance with requirements, provide one of the following:
 - a. 202 New Masonry Detergent; Diedrich Technologies, Inc.
 - b. 200 Lime Solv; Diedrich Technologies, Inc.
 - c. 202V Vana-Stop; Diedrich Technologies, Inc.
 - d. Sure Klean No. 600 Detergent; ProSoCo, Inc.
 - e. Sure Klean No. 101 Lime Solvent; ProSoCo., Inc.
 - f. Sure Klean Vana Trol; ProSoCo, Inc.

3. PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of unit masonry. Do not proceed with installation until unsatisfactory conditions have been corrected.
 - 1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of unit masonry.
- B. Examine rough-in and built-in construction to verify actual locations of piping connections prior to installation.

3.2 INSTALLATION, GENERAL

- A. Leave openings for equipment to be installed before completion of masonry. After installing equipment, complete masonry to match construction immediately adjacent to the opening.
- B. Cut masonry units with motor-driven saws to provide clean, sharp, unchipped edges. Cut units as required to provide continuous pattern and to fit adjoining construction. Use full-size units without cutting, where possible. Allow units cut with water-cooled saws to dry before placing, unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.
- C. Mix units for exposed unit masonry from several pallets or cubes as they are placed to produce uniform blend of colors and textures.
- D. Colored mortar shall match the colored CMU and begin with the bedding of the course.

3.3 CONSTRUCTION TOLERANCES

- A. Variation from Plumb: For vertical lines and surfaces of columns, walls, and arrises, do not exceed 1/4 inch in 10 feet (6 mm in 3 m), nor 3/8 inch in 20 feet (10 mm in 6 m), nor 1/2 inch in 40 feet (12 mm in 12 m) or more. For external corners, expansion joints, control joints, and other conspicuous lines, do not exceed 1/4 inch in 20 feet (6 mm in 6 m), nor 1/2 inch in 40 feet (12 mm in 12 m) or more. For vertical alignment of head joints, do not exceed plus or minus 1/4 inch in 10 feet (6 mm in 3 m), nor 1/2 inch (12 mm) maximum.
- B. Variation from Level: For bed joints and lines of exposed lintels, sills, parapets, horizontal grooves, and other conspicuous lines, do not exceed 1/4 inch in 20 feet (6 mm in 6 m), nor 1/2 inch in 40 feet (12 mm in 12 m) or more. For top surface of bearing walls, do not exceed 1/8 inch (3 mm) in 10 feet (3 m), nor 1/16 inch (1.5 mm) within width of a single unit.
- C. Variation in Mortar-Joint Thickness: Do not vary from bed-joint thickness indicated by more than plus or minus 1/8 inch (3 mm), with a maximum thickness limited to 1/2 inch (12 mm). Do not vary bed-joint thickness from bed-joint thickness of adjacent course by more than 1/8 inch (3 mm). Do not vary from head-joint thickness indicated by more than plus or minus 1/8 inch (3 mm). Do not vary head-joint thickness from adjacent head-joint thickness by more than 1/8 inch (3 mm). Do not vary from collar-joint thickness indicated by more than minus 1/4 inch (6 mm) or plus 3/8 inch (10 mm).

3. 4 LAYING MASONRY WALLS

- A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint widths and for accurate locating of openings, movement-type joints, returns, and offsets. Avoid the use of less-than-half-size units at corners, jambs, and where possible at other locations.
- B. Lay walls to comply with specified construction tolerances, with courses accurately spaced and coordinated with other construction.

END OF SECTION

SECTION 05 50 00
METAL FABRICATIONS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Shop-fabricated metal items.
 - 2. Ledge and shelf angles.
 - 3. Floor beams, and grating support beams.
 - 4. Ladders and cage.
 - 5. Structural supports for miscellaneous attachments.
 - 6. Catwalk system.
 - 7. Platform at trash rack.
 - 8. Anchor bolts.
- B. Related Requirements:
 - 1. Section 03 30 00 - Cast-In-Place Concrete.
 - 2. Section 05 52 00 - Metal Railings.
 - 3. Section 05 53 00 - Grating.
 - 4. Section 09 90 00 - Painting and Coating.

1.2 UNIT PRICES

- A. Service Platform and Catwalk:
 - 1. Basis of Measurement: At the lump sum price bid as stated in the proposal.
 - 2. Basis of Payment: Includes all labor, equipment, and material required to construct the service platform and catwalk at the trash rack complete as shown on plans. Includes concrete, grating, beams, handrails, end screen, fall resistant systems, hatches, ladders, etc. to complete the work as shown on plans.
- B. Handrail Systems:
 - 1. Basis of Measurement: At the lump sum price bid as stated in the proposal.
 - 2. Basis of Payment: Includes all labor, equipment, and material to construct a new concrete cap on the existing sheet pile wall and install the proposed fixed or removable handrail systems as shown on plans.
- C. Roof Access Ladder System:
 - 1. Basis of Measurement: At the lump sum price bid as stated in the proposal.
 - 2. Basis of Payment: Includes all labor, equipment, and material to fabricate and install the roof access system as shown on plans.
- D. Grating System:
 - 1. Basis of Measurement: At the lump sum price bid as stated in the proposal.

2. Basis of Payment: Includes all labor, equipment, and material to fabricate and install the structural members and grating in the lower level of the pump station and discharge area as shown on plans.
- E. Removable Beam/Access Hatch:
1. Basis of Measurement: At the unit price bid per each as stated in the proposal.
 2. Basis of Payment: Includes all labor, equipment, and material to field measure for dimension and fabricate a replacement removable beam and floor plate on hatch for each pump location as shown on plans.

1.3 REFERENCE STANDARDS

- A. Aluminum Association:
1. AA DAF-45 - Designation System for Aluminum Finishes.
- B. American Architectural Manufacturers Association:
1. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum.
 2. AAMA 2603 - Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels.
 3. AAMA 2604 - Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels.
 4. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels.
- C. American National Standards Institute:
1. ANSI A14.3 - American National Standard (ASC) for Ladders - Fixed - Safety Requirements.
- D. American Welding Society:
1. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination.
 2. AWS D1.1 - Structural Welding Code - Steel.
 3. AWS D1.6 - Structural Welding Code - Stainless Steel.
- E. ASTM International:
1. ASTM A36 - Standard Specification for Carbon Structural Steel.
 2. ASTM A53- Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
 3. ASTM A123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 4. ASTM A153 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 5. ASTM A193 - Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications.
 6. ASTM A240 - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
 7. ASTM A269 - Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
 8. ASTM A276 - Standard Specification for Stainless Steel Bars and Shapes.

9. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength.
10. ASTM A312 - Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes.
11. ASTM A325 - Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
12. ASTM A354 - Standard Specification for Quenched and Tempered Alloy Steel Bolts, Studs, and Other Externally Threaded Fasteners.
13. ASTM A500 - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
14. ASTM A501 - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.
15. ASTM A554 - Standard Specification for Welded Stainless Steel Mechanical Tubing.
16. ASTM A563 - Standard Specification for Carbon and Alloy Steel Nuts.
17. ASTM A572 - Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel.
18. ASTM A653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
19. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
20. ASTM A780 - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
21. ASTM A992 - Standard Specification for Structural Steel Shapes.
22. ASTM B26 - Standard Specification for Aluminum-Alloy Sand Castings.
23. ASTM B85 - Standard Specification for Aluminum-Alloy Die Castings.
24. ASTM B177 - Standard Guide for Engineering Chromium Electroplating.
25. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
26. ASTM B210 - Standard Specification for Aluminum and Aluminum-Alloy Drawn Seamless Tubes.
27. ASTM B211 - Standard Specification for Aluminum and Aluminum-Alloy Rolled or Cold Finished Bar, Rod, and Wire.
28. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
29. ASTM B695 - Standard Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel.
30. ASTM F436 - Standard Specification for Hardened Steel Washers.
31. ASTM F1554 - Standard Specification for Anchor Bolts, Steel, 36, 55, and 105 ksi Yield Strength.

F. Builders Hardware Manufacturers Association (BHMA):

1. ANSI/BHMA A156.20 - American National Standard for Strap and Tee Hinges and Hasps.

G. Green Seal:

1. GC-03- 2nd Edition, January 7, 1997 - Anti-Corrosive Paints.

H. National Ornamental & Miscellaneous Metals Association:

1. NOMMA Guideline 1 - Joint Finishes.

I. SSPC: The Society for Protective Coatings:

1. SSPC - Steel Structures Painting Manual.
2. SSPC Paint 15 - Steel Joist Shop Primer/Metal Building Primer.
3. SSPC Paint 20 - Zinc-Rich Coating (Type I - Inorganic and Type II - Organic).
4. SSPC SP 1 - Solvent Cleaning.
5. SSPC SP 10 - Near-White Blast Cleaning.

1.4 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, elevations, and details where applicable. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.
- C. Welders Certificates: Certify welders employed on the Work, verifying AWS qualification within previous 12 months.
- D. Delegated Design Submittals: Submit signed and sealed Shop Drawings with design calculations and assumptions for trash racks.
- E. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.
- F. Qualifications Statement:
 1. Submit qualifications for licensed professional.

1.5 QUALITY ASSURANCE

- A. Finish joints according to NOMMA Guideline 1.
- B. Perform Work according to AISC standards.
- C. Maintain one copy of each standard affecting the Work of this Section On-Site.

1.6 QUALIFICATIONS

- A. Licensed Professional: Professional engineer experienced in design of specified Work and licensed in State of Michigan.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Inspection: Accept metal fabrications on-Site in labeled shipments. Inspect for damage.
- C. Protect metal fabrications from damage by exposure to weather or by ground contact.

1.8 EXISTING CONDITIONS

- A. Field Measurements: Verify field measurements prior to fabrication. Indicate field measurements on Shop Drawings.

PART 2 - PRODUCTS

- A. Ledge and Shelf Angles Channels and Plates Not Attached to Structural Framing:
 - 1. For support of metal floor grating.
 - 2. Finish: Galvanized (after fabrication).

2.2 FLOOR BEAMS AND GRATING SUPPORT BEAMS

- A. Beams:
 - 1. Steel sections as indicated on Drawings for support of floor grating.
 - 2. Finish: Galvanized (after fabrication).
- B. Grating Support Beams:
 - 1. Steel, wide-flange sections.
 - 2. Shape and Size: As required to support applied loads with maximum deflection of 1/240 of the span.
 - 3. Finish: Galvanized (after fabrication).

2.3 LADDERS AND CAGE

- A. Ladder:
 - 1. ANSI A14.3.
 - 2. Steel-welded construction.
 - 3. Siderails:
 - a. Size: As shown on drawings.
 - b. Spacing: As shown on drawings.
 - 4. Rungs:
 - a. Solid rod slip proof.
 - b. Size: 3/4"-inch diameter.
 - c. Spacing: 12 inches o.c.
 - 5. Mounting:
 - a. Space rungs 7 inches minimum from wall surface.
 - b. Provide steel mounting brackets and attachments.
 - c. Finish: Galvanized (after fabrication).
- B. Ladder Safety Cage:
 - 1. Steel bar sections, minimum 1/4 by 2 inches.
 - 2. Bottom Hoop:
 - a. Size: As shown on plans
 - b. Location: Maximum 74 inches above finished floor or roof.
 - 3. Other Hoops:
 - a. Size: As shown on plans.
 - b. Spacing: Maximum 48 inches o.c.

4. Vertical Bars Spacing: 10 inches o.c.
5. Finish: Match ladder finish.

2.4 CATWALK SYSTEM

- A. Structural members as indicated on drawings.
- B. Handrail: Fabricated removable type as detailed on drawings.
- C. Grating: Size as indicated on drawings.
- D. Finish: Galvanized (after fabrication).
- E. Horizontal Life Line System: Supply equipment as listed on drawings. Install per equipment manufacturers recommendations and per all applicable safety codes.

2.5 PLATFORM AT TRASH RACK

- A. Structural members as indicated on drawings.
- B. Handrail: Fabricated – fixed type as detailed on drawings.
- C. Grating: Size as indicated on drawings.
- D. Finish: Galvanized (after fabrication).

2.6 ANCHOR BOLTS

- A. Description:
 1. Stainless Steel.
 2. Shape: Straight.
 3. Furnish with nut and washer.
 4. Finish: None.
- B. Epoxy Adhesive Anchor System:
 1. Manufacturers:
 - a. HILTI HIT-HY-200 A Injectable Mortar with HDG HAS-R threaded anchor rods.
 - b. Substitutions: Section 01 60 00 - Product Requirements.

2.7 MATERIALS

- A. Steel:
 1. Structural W Shapes: ASTM A992.
 2. Structural Shapes: ASTM A36.
 3. Channels and Angles: ASTM A36.
 4. Steel Plate: ASTM A36.
 5. Hollow Structural Sections: ASTM A500, Grade B.
 6. Steel Pipe:
 - a. ASTM A53, Grade B, Schedule 40

7. Sheet Steel: ASTM A653, Grade 33 Structural Quality.
8. Bolts: ASTM A325; Type 1.
9. Nuts: ASTM A563; heavy-hex type.
10. Washers: ASTM F436; Type 1.
11. Welding Materials: AWS D1.1; type required for materials being welded.

B. Stainless Steel:

1. Tubing: ASTM A269; Type 304.
2. Pipe: ASTM A312, seamless; Type 304.
3. Plate, Sheet, and Strip: ASTM A240; Type 304.
4. Bolts, Nuts, and Washers: ASTM A354.
5. Welding Materials: AWS D1.6; type required for materials being welded.

C. Aluminum:

1. Extruded Aluminum: ASTM B221 Alloy 6063.
2. Sheet Aluminum: ASTM B209 Alloy.
3. Aluminum-Alloy-Drawn Seamless Tubes: ASTM B210 Alloy 6063.
4. Aluminum-Alloy Bars: ASTM B211 Alloy 6063.
5. Bolts, Nuts, and Washers: Stainless steel.
6. Welding Materials: AWS D1.1; type required for materials being welded.

D. Bolts, Nuts, and Washers for Equipment:

1. Carbon Steel:
 - a. Structural Connections: ASTM F3125, Grade A, hot-dip galvanized.
 - b. Anchor Bolts: Stainless Steel.
2. Stainless Steel: Type 316 stainless steel, Class 2; ASTM A193 for bolts; ASTM A194 for nuts.

2.8 FABRICATION

- A. Fit and shop-assemble items in largest practical sections for delivery to Site.
- B. Fabricate items with joints tightly fitted and secured.
- C. Continuously seal joined members by continuous welds.
- D. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small, uniform radius. All holes shall be punched or drilled, flame cutting will not be allowed.
- E. Exposed Mechanical Fastenings: Flush countersunk screws or bolts; unobtrusively located; consistent with design of component, except where specifically noted otherwise.
- F. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.
- G. Fabrication Tolerances:
 1. Squareness: 1/8-inch maximum difference in diagonal measurements.
 2. Maximum Offset between Faces: 1/16 inch.

3. Maximum Misalignment of Adjacent Members: 1/16 inch.
4. Maximum Bow: 1/8 inch in 48 inches.
5. Maximum Deviation from Plane: 1/16 inch in 48 inches.

2.9 FINISHES

- A. Steel:
 1. Prepare surfaces to be primed according to SSPC SP 10.
 2. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.
 3. Do not prime surfaces in direct contact with concrete or where field welding is required.
 4. Prime-paint items with two coats except where galvanizing is specified.
 5. Galvanizing: ASTM A123; hot-dip galvanize after fabrication.
 6. Galvanizing for Fasteners, Connectors, and Anchors:
 - a. Hot-Dip Galvanizing: ASTM A153.
 - b. Mechanical Galvanizing: ASTM B695; Class 50 minimum.
 7. Bolts: Hot-dip galvanized.
 8. Nuts: Hot-dip galvanized.
 9. Washers: Mechanically galvanized.
 10. Shop Primer: SSPC Paint 15, Type 1, red oxide.
 11. Touchup Primer: Match shop primer.
 12. Touchup Primer for Galvanized Surfaces:
 - a. SSPC Paint 20, Type I - Inorganic SSPC Paint 20, Type II - Organic.
 - b. ASTM A780.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements: Requirements for installation examination.
- B. Verify that field conditions are acceptable and are ready to receive Work.

3.2 PREPARATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation preparation.
- B. Clean and strip primed steel items to bare metal where Site welding is required.
- C. Supply steel items required to be cast into concrete with setting templates to appropriate sections.

3.3 INSTALLATION

- A. Install items plumb and level, accurately fitted, and free from distortion or defects.
- B. Make provisions for erection stresses. Install temporary bracing to maintain alignment until permanent bracing and attachments are installed.

- C. Field-weld components indicated on Drawings.
- D. Perform field welding according to AWS D1.1.
- E. Obtain approval of Architect/Engineer prior to Site cutting or making adjustments not scheduled.

3.4 TOLERANCES

- A. Section 01 40 00 - Quality Requirements: Requirements for tolerances.
- B. Maximum Variation from Plumb: 1/4 inch per story or for every 12 feet in height, whichever is greater, non-cumulative.
- C. Maximum Variation from Level: 1/16 inch in 3 feet and 1/4 inch in 10 feet.
- D. Maximum Offset from Alignment: 1/4 inch.
- E. Maximum Out-of-Position: 1/4 inch.

3.5 FIELD QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements: Requirements for inspecting and testing.
- B. Welding: Inspect welds according to AWS D1.1.
- C. Replace damaged or improperly functioning hardware.
- D. After erection, touch up welds, abrasions, and damaged finishes with prime paint or galvanizing repair paint to match shop finishes.
- E. Touch up factory-applied finishes according to manufacturer-recommended procedures.

3.6 ADJUSTING

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for starting and adjusting.
- B. Adjust operating hardware and lubricate as necessary for smooth operation.

END OF SECTION

SECTION 05 52 00

METAL RAILINGS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Steel pipe railings, balusters, and fittings.
 - 2. Handrails.
- B. Related Requirements:
 - 1. Section 03 30 00 - Cast-In-Place Concrete.
 - 2. Section 09 90 00 - Painting and Coating.

1.2 REFERENCE STANDARDS

- A. Aluminum Association:
 - 1. AA ADM 1 - Aluminum Design Manual.
 - 2. AA ASM 35 - Aluminum Sheet Metal Work in Building Construction.
- B. American Architectural Manufacturers Association:
 - 1. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum.
 - 2. AAMA 2603 - Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels.
 - 3. AAMA 2604 - Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels.
 - 4. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels.
- C. ASTM International:
 - 1. ASTM A53 - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
 - 2. ASTM A123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - 3. ASTM A167 - Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
 - 4. ASTM A312 - Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes.
 - 5. ASTM A500 - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
 - 6. ASTM A501 - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.
 - 7. ASTM A513 - Standard Specification for Electric-Resistance-Welded Carbon and Alloy Steel Mechanical Tubing.
 - 8. ASTM A554 - Standard Specification for Welded Stainless Steel Mechanical Tubing.

9. ASTM A743 - Standard Specification for Castings, Iron Chromium, Iron Chromium Nickel, Corrosion Resistant, for General Application.
10. ASTM B177 - Standard Guide for Engineering Chromium Electroplating.
11. ASTM B211 - Standard Specification for Aluminum and Aluminum-Alloy Rolled or Cold Finished Bar, Rod, and Wire.
12. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
13. ASTM B241 - Standard Specification for Aluminum and Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube.
14. ASTM E985 - Standard Specification for Permanent Metal Railing Systems and Rails for Buildings.

D. National Association of Architectural Metal Manufacturers:

1. NAAMM Metal Finishes Manual.

E. National Ornamental & Miscellaneous Metals Association:

1. NOMMA Guideline 1 - Joint Finishes.

F. SSPC: The Society for Protective Coatings:

1. SSPC - Steel Structures Painting Manual.
2. SSPC Paint 20 - Zinc-Rich Coating, Type I - Inorganic and Type II - Organic.

1.3 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Shop Drawings: Indicate profiles, sizes, connection attachments, anchorage, size and type of fasteners, and accessories.
- C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- D. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.
- E. Qualifications Statements:
 1. Submit qualifications for fabricator and erector.
 2. Submit manufacturer's approval of fabricator and erector.

1.4 QUALITY ASSURANCE

- A. Perform Work for structural aluminum according to AA ADM 1 and AA ASM 35.
- B. Perform Work of this Section according to ASTM E985.
- C. Finish joints according to NOMMA Guideline 1.
- D. Perform Work according to OSHA and local building code standards.
- E. Maintain one copy of each standard affecting the Work of this Section On-Site.

1.5 QUALIFICATIONS

- A. Fabricator: Company specializing in fabricating products specified in this Section with minimum three years' documented experience.
- B. Erector: Company specializing in performing Work of this Section with minimum three years' documented experience.

1.6 EXISTING CONDITIONS

- A. Field Measurements: Verify field measurements prior to fabrication. Indicate field measurements on Shop Drawings.

PART 2 - PRODUCTS

2.1 PERFORMANCE AND DESIGN CRITERIA

- A. Design handrail, guardrail, and attachments to resist forces as required by applicable code. Apply loads non-simultaneously to produce maximum stresses.
 - 1. Guard Top Rail and Handrail Concentrated Load: 200 lb. applied at any point in any direction.
 - 2. Guard Top Rail Uniform Load: 50 plf applied in any direction.
 - 3. Intermediate Rails, Panels, and Baluster Concentrated Load: 50 lb. applied to 1 sq. ft. area.

2.2 HANDRAILS AND RAILINGS

- A. Substitutions: Section 01 60 00 - Product Requirements.

2.3 MATERIALS

- A. Steel Railing System:
 - 1. Pipe: ASTM A53, Grade B, Schedule 40.
 - 2. Rails and Posts: 2-inch-diameter steel pipe; welded joints.
 - 3. Posts: 2-inch-diameter steel pipe; welded joints.
 - 4. Fittings: Elbows, T-shapes, wall brackets, escutcheons; cast steel.
 - 5. Mounting: Adjustable brackets and flanges.
 - 6. Exposed Fasteners: Flush countersunk screws or bolts; consistent with design of railing.
 - 7. Splice Connectors: Steel welding collars.
 - 8. Galvanizing: According to ASTM A123; hot-dip galvanized after fabrication.
 - 9. Touchup Primer for Galvanized Surfaces: SSPC Paint 20, Type I - Inorganic, zinc-rich.

2.4 FABRICATION

- A. Fit and shop-assemble components in largest practical sizes for delivery to Site.
- B. Fabricate components with joints tightly fitted and secured. Furnish spigots and sleeves to accommodate Site assembly and installation.

- C. Form simple and compound curves by bending pipe in jigs to produce uniform curvature for each repetitive configuration required; maintain cylindrical cross section of pipe throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of pipe.
- D. Exposed Mechanical Fastenings: Flush countersunk screws or bolts; unobtrusively located; consistent with design of component, except where specifically noted otherwise.
- E. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.
- F. Exterior Components: Continuously seal joined pieces by continuous welds. Drill condensate drainage holes at bottom of members at locations not encouraging water intrusion.
- G. Interior Components: Continuously seal joined pieces by continuous welds.
- H. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.
- I. Accurately form components to suit stairs and landings, to each other and to building structure.
- J. Accommodate expansion and contraction of members and building movement without damage to connections or members.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation examination.
- B. Verify that field conditions are acceptable and are ready to receive Work.
- C. Verify that concealed blocking and reinforcement are installed and correctly located to receive wall-mounted handrails.

3.2 PREPARATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation preparation.
- B. Clean and strip galvanized steel items to bare metal where Site welding is required.
- C. Supply items required to be cast into concrete with setting templates to appropriate Sections.

3.3 INSTALLATION

- A. Install components plumb and level, accurately fitted, free from distortion or defects.

- B. Anchor railings to structure with anchors, as indicated on drawings.
- C. Field-weld anchors as indicated on Drawings. Touch up welds with primer. Grind welds smooth.
- D. Conceal bolts and screws whenever possible.
- E. Installation Standards: Install Work according to OSHA and local building code standards.

3.4 TOLERANCES

- A. Section 01 40 00 - Quality Requirements: Requirements for tolerances.
- B. Maximum Variation from Plumb: 1/4 inch per story, noncumulative.
- C. Maximum Offset from Alignment: 1/4 inch.
- D. Maximum Out-of-Position: 1/4 inch.

END OF SECTION

SECTION 05 53 00

GRATINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Formed floor, platform, and catwalk gratings.

B. Related Requirements:

1. Section 05 50 00 - Metal Fabrications: Miscellaneous metal components as required by this Section.
2. Section 09 90 00 - Painting and Coating: Field-paint finishes.

1.2 REFERENCE STANDARDS

A. ASTM International:

1. ASTM A36 - Standard Specification for Carbon Structural Steel.
2. ASTM A123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
3. ASTM A167 - Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
4. ASTM A653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
5. ASTM A1011 Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength.
6. ASTM B211 - Standard Specification for Aluminum and Aluminum-Alloy Rolled or Cold Finished Bar, Rod, and Wire.
7. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.

B. American Welding Society:

1. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination.
2. AWS D1.1 - Structural Welding Code - Steel.
3. AWS D1.2 - Structural Welding Code - Aluminum.

C. National Association of Architectural Metal Manufacturers:

1. NAAMM AMP 501 - Finishes for Aluminum.
2. NAAMM AMP 503 - Finishes for Stainless Steel.
3. NAAMM MBG 531 - Metal Bar Grating Manual.
4. NAAMM MBG 532 - Heavy-Duty Metal Bar Grating Manual.

- D. SSPC: The Society for Protective Coatings:
 - 1. SSPC Paint 20 - Zinc-Rich Coating, Type I - Inorganic and Type II - Organic.

1.3 COORDINATION

- A. Section 01 30 00 - Administrative Requirements: Requirements for coordination.
- B. Coordinate Work of this Section with placement of frames, tolerances for placed frames, openings, and support beams.

1.4 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit span and deflection tables.
- C. Shop Drawings: Indicate details of gratings, plates, component supports, anchorages, openings, perimeter construction details, and tolerances. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.
- D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- E. Welders' Certificates: Certify welders and welding procedures employed on the Work, verifying AWS qualification within previous 12 months.
- F. Delegated Design Submittals: Submit signed and sealed Shop Drawings with design calculations and assumptions for gratings and plates.
- G. Manufacturer's Instructions: Submit special requirements of openings and perimeter framing.
- H. Qualifications Statement:
 - 1. Submit qualifications for licensed professional.

1.5 QUALITY ASSURANCE

- A. Perform Work according to NAAMM standards.
- B. Maintain one copy of each standard affecting the Work of this Section On-Site.

1.6 QUALIFICATIONS

- A. Welders and Welding Procedures: AWS D.1 qualified within previous 12 months for employed weld types.
- B. Licensed Professional: Professional engineer experienced in design of specified Work and licensed in State of Michigan.

1.7 EXISTING CONDITIONS

- A. Field Measurements: Verify field measurements prior to fabrication. Indicate field measurements on Shop Drawings.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Formed Steel for Welding: ASTM A36 rectangular shape.
- B. Aluminum for Pressure Locking: Alloy 6063T5/T52 extruded aluminum alloy, of rectangular shape.
- C. Crossbars: Alloy 6063T5/T52.
- D. Welding Materials: AWS D1.1, type as required for materials being welded.
- E. Touchup Primer for Galvanized Surfaces: SSPC Paint 20, Type I - Inorganic.

2.2 FABRICATION

- A. Grating Type: NAAMM MBG 531, Steel: welded, aluminum: pressure locked type.
- B. Mechanically clinch, Bolt, Weld, and Rivet joints of intersecting metal sections.
- C. Fabricate support framing for openings.
- D. Top Surface: As noted on plans.
- E. Bearing Bar: As noted on plans.
- F. Crossbar: As noted on plans.
- G. Removable Panels: With recessed finger lift rings.

2.3 FINISHES

- A. Galvanizing: ASTM A123; hot-dip galvanize after fabrication.
- B. Aluminum: Clear anodized, NAAMM, AA-M12C22A41 finish.

2.4 ACCESSORIES

- A. Fasteners and Saddle Clips – Hot dipped galvanized or aluminum.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation examination.
- B. Verify that opening sizes and dimensional tolerances are acceptable.
- C. Verify that supports and anchors are correctly positioned.

3.2 INSTALLATION

- A. Place frames in correct position, plumb and level.
- B. Mechanically cut galvanized finish surfaces. Do not flame cut.
- C. Anchor by bolting through saddle clips.
- D. Secure to prevent movement.

3.3 TOLERANCES

- A. Section 01 40 00 - Quality Requirements: Requirements for tolerances.
- B. Conform to NAAMM MBG 531.

3.4 CLEANING

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for cleaning.
- B. Clean welds and damaged coatings and apply two coats of touchup primer.

END OF SECTION

SECTION 06 10 00

ROUGH CARPENTRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specifications, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Framing with dimension lumber.
 - 2. Framing with engineered wood products.
 - 3. Wood furring, grounds, nailers, and blocking.
 - 4. Sheathing.
 - 5. Utility shelving.

1.3 UNIT PRICE MEASUREMENT AND PAYMENT

- A. Miscellaneous Building Improvements:
 - 1. Basis of Measurement: At the lump sum bid price as stated in the proposal.
 - 2. Basis of Payment: Includes all labor, equipment, and material to perform all miscellaneous building modifications and improvements shown on plans that do not have a dedicated bid item.
- B. Roof System, Complete:
 - 1. Basis of Measurement: At the lump sum bid price as stated in the proposal.
 - 2. Basis of Payment: Includes all labor, equipment, and material to install the roof system complete as shown on plans except for the skylight system.
- C. Barrel Vault Skylight System:
 - 1. Basis of Measurement: At the lump sum bid price as stated in the proposal.
 - 2. Basis of Payment: Includes all labor, equipment, and material to supply and install the proposed skylight system complete as shown on plans.
- D. Pump Station and Control Building:
 - 1. Basis of Measurement: At the lump sum price bid as stated in the proposal.
 - 2. Basis of Payment: Includes all labor, equipment, and material to construct the proposed building as shown on plans, complete. Includes all foundations, slabs, walls, etc.

1.4 DEFINITIONS

- A. Rough Carpentry: Carpentry work not specified in other Sections and not exposed, unless otherwise specified.

- B. Exposed Framing: Dimension lumber not concealed by other construction and indicated to receive a stained or natural finish.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Keep materials under cover and dry. Protect from weather and contact with damp or wet surfaces. Stack lumber, plywood, and other panels. Provide for air circulation within and around stacks and under temporary coverings.
 - 1. For lumber and plywood pressure treated with waterborne chemicals, place spacers between each bundle to provide air circulation.

PART 2 - PRODUCTS

2.1 LUMBER, GENERAL

- A. Lumber Standards: Comply with DOC PS 20, “American Softwood Lumber Standard,” and with applicable grading rules of inspection agencies certified by ALSC’s Board of Review.
- B. Inspection Agencies: Inspection agencies, and the abbreviations used to reference them, include the following:
 - 1. NELMA – Northeastern Lumber Manufacturers Association.
 - 2. NLGA – National Lumber Grades Authority (Canadian).
 - 3. RIS – Redwood Inspection Service.
 - 4. SPIB – Southern Pine Inspection Bureau.
 - 5. WCLIB – West Coast Lumber Inspection Bureau.
 - 6. WWPA – Western Wood Products Association.
- C. Grade Stamps: Provide lumber with each piece factory marked with grade stamp of inspection agency evidencing compliance with grading rule requirements and identifying grading agency, grade, species, moisture content at time of surfacing, and mill.
 - 1. For exposed lumber, furnish piece with grade stamps applied to ends or back of each piece, or omit grade stamps and provide grade-compliance certificates issued by inspection agency.

2.2 DIMENSION LUMBER

- A. General: Provide lumber of grades indicated according to the ALSC National Grading Rule (NGR) provisions of the inspection agency indicated.
- B. Framing Other than Non-Load-Bearing Partitions: Provide framing of the following grade and species:
 - 1. Species and Grade: SPF, HemFir, DougFir, or SYP No. 2 or better.
 - 2. Species and Grade: Any species of machine stress-rated (MSR) dimension lumber with a grade of 1800f-1.6E.

2.3 MISCELLANEOUS LUMBER

- A. General: Provide lumber for support or attachment of other construction, including rooftop equipment curbs and support bases, cant strips, bucks, nailers, blocking, furring, grounds, stripping, and similar members.

- B. Fabricate miscellaneous lumber from dimension lumber of sizes indicated and into shapes shown.
- C. Moisture Content: 19 percent maximum for lumber items not specified to receive wood preservative treatment.
- D. Grade: For dimension lumber sizes, provide No. 3 or Standard grade lumber per ALSC's NGRs of any species. For board-size lumber, provide No. 3 Common grade per NELMA, NLGA, or WWP; No. 2 grade per SPIB; or Standard grade per NLGA, WCLIB or WWP of any species.

2.4 ENGINEERED WOOD PRODUCTS

- A. General: Provide engineered wood products acceptable to authorities having jurisdiction and for which current model code research or evaluation reports exist that evidence compliance with building code in effect for Project.
 - 1. Allowable Design Stresses: Provide engineered wood products with allowable design stresses, as published by manufacturer, that meet or exceed those indicated. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis, and demonstrated by comprehensive testing performed by a qualified independent testing agency.
- B. Laminated-Veneer Lumber: Lumber manufactured by laminating wood veneers in a continuous press using an exterior-type adhesive complying with ASTM D 2559 to produce members with grain of veneers parallel to their lengths and complying with the following requirements:
 - 1. Extreme Fiber Stress in Bending: 2500 psi (17 MPa) for 12-inch nominal- (286-mm actual-) depth members.
 - 2. Modulus of Elasticity: 2,000,000 psi (13 800 MPa).
 - 3. Tension Parallel to Grain: 1850 psi (13 MPa).
 - 4. Compression Parallel to Grain: 2800 psi (19 MPa).
 - 5. Compression Perpendicular to Grain: 400 psi (3 MPa) perpendicular to and 500 psi (3.5 MPa) and parallel to glue line.
 - 6. Horizontal Shear: 285 psi (2 MPa) perpendicular to and 190 psi (1.3 MPa) parallel to glue line.
- C. Parallel-Strand Lumber: Lumber manufactured by laying up wood strands using an exterior-type adhesive complying with ASTM D 2559, and cured under pressure to produce members with grain of strands parallel to their lengths and complying with the following requirements:
 - 1. Extreme Fiber Stress in Bending: 2900 psi (20 MPa) for 12-inch nominal-(286-mm actual-) depth members.
 - 2. Modulus of Elasticity: 2,000,000 psi (13 800 MPa).
 - 3. Tension Parallel to Grain: 2400 psi (16.5 MPa).
 - 4. Compression Parallel to Grain: 2900 psi (20 MPa).
 - 5. Compression Perpendicular to Grain: 400 psi (3 MPa) perpendicular to and 600 psi (4.1 MPa) and parallel to wide face of strands.
 - 6. Horizontal Shear: 210 psi (1.4 MPa) perpendicular to and 290 psi (2 MPa) and parallel to wide face of strands.
- D. Structural Panels (sheathing)
 - 1. APA Rated and labeled plywood meeting DOC PS-1
 - 2. Size: 4'x8' Tongue and groove sheets
 - 3. Span Rating: 48/24
 - 4. Grade: Exterior C-C

2.5 AIR-INFILTRATION BARRIER

- A. Asphalt-saturated organic felt complying with ASTM D 226, Type I (No. 15 asphalt felt), unperforated.
- B. Air retarder complying with ASTM E 1677; made from polyolefins; either cross-laminated films, woven strands, or spunbonded fibers; coated or uncoated; with or without perforations to transmit water vapor but not liquid water; and as follows:
 - 1. Minimum Thickness: 3 mils (0.08 mm).
 - 2. Minimum Water-Vapor Transmission: 10 perms (575 ng/Pa x s x sq. m) when tested according to ASTM E 96, Procedure A.
 - 3. Maximum Flame Spread: 25 per ASTM E 84.
 - 4. Minimum Allowable Exposure Time: 3 months.

2.6 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this Article for material and manufacturer.
 - 1. Where rough carpentry is exposed to weather, in ground contact, or in area of high relative humidity, provide fasteners with a hot-dip zinc coating per ASTM A 153 or of Type 304 stainless steel.
- B. Nails, Wire, Brads, and Staples: FS FF-N-105, ASTM A 153 or 304 stainless steel.
- C. Power-Driven Fasteners: CABO NER-272, ASTM A 153 or 304 stainless steel.
- D. Wood Screws: ASME B18.6.1., ASTM A 153 or 304 stainless steel
- E. Lag Bolts: ASME B18.2.1 (ASME B18.2.3.8M), ASTM A 153 or 304 stainless steel
- F. Bolts: Steel bolts complying with ASTM A 307, Grade A (ASTM F 568, Property Class 4.6); with ASTM A 563 (ASTM A 563M) hex nuts and, where indicated, flat washers, ASTM A 153 or 304 stainless steel.

2.7 FACTORY WOOD TREATMENT

- A. Wood Preservation (Pressure Treatment): AWP U1 using waterborne, SBX preservative.
 - 1. All Dimensional Lumber: Use Category 2 (UC2).
 - 2. All Wood Sheathing: Use Category 2 (UC2).
- B. Moisture Content after Treatment: Kiln dried (KDAT).
 - 1. Lumber: Maximum 19 percent.
 - 2. Structural Panels: Maximum 15 percent.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Discard units of material with defects that impair quality of rough carpentry and that are too small to sue with minimum number of joints or optimum joint arrangement.

- B. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted.
- C. Fit rough carpentry to other construction; scribe and cope as required for accurate fit. Correlate location of furring, nailers, blocking, grounds, and similar supports to allow attachment of other construction.
- D. Apply field treatment complying with AWPA M4 to cut surfaces of preservative-treated lumber and plywood.
- E. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
 - 1. CABO NER-272 for power-driven staples, P-nails, and allied fasteners.
 - 2. Published requirements of metal framing anchor manufacturer.
 - 3. "Recommend Nailing Schedule" of referenced framing standard and with AFPA's "National Design Specifications for Wood Construction".
 - 4. "Table 23-I-Q--Nailing Schedule" of the Uniform Building Code.
 - 5. "Table 2305.2--Fastening Schedule" of the BOCA National Building Code.
 - 6. "Table 1705.1--Fastening Schedule" of the Standard Building Code.
- F. Use common wire nails, unless otherwise indicated. Use finishing nails for finish work. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood; predrill as required.
- G. Use hot-dip galvanized or stainless-steel nails where rough carpentry is exposed to weather, in ground contact, or in area of high relative humidity.
- H. Countersink nail heads on exposed carpentry work and fill holes with wood filler.

3.2 WOOD GROUNDS, NAILERS, BLOCKING, AND SLEEPERS

- A. Install wood grounds, nailers, blocking, and sleepers where shown and where required for screeding or attaching other work. Form to shapes shown and cut as required for true line and level of attached work. Coordinate locations with other work involved.
- B. Attach to substrates to support applied loading. Recess bolts and nuts flush with surfaces, unless otherwise indicated. Build into masonry during installation of masonry work. Where possible, anchor to formwork before concrete placement.
- C. Install permanent grounds for dressed, preservative-treated, key-beveled lumber not less than 1-1/2 inches (38 mm) wide and of thickness required to bring face of ground to exact thickness of finish material. Remove temporary grounds when no longer required.

3.3 WOOD FRAMING, GENERAL

- A. Framing Standard: Comply with AFPA's "Manual for Wood Frame Construction," unless otherwise indicated.
- B. Framing with Engineered Wood Products: Install engineered wood products to comply with manufacturer's written instructions.

- C. Install framing members of size and at spacing indicated.
- D. Do not splice structural members between supports.
- E. Firestop concealed spaces of wood-framed walls and partitions at each floor level and at ceiling line of top story. Where firestopping is not inherent in framing system used, provide closely fitted wood blocks of 2-inch nominal- (38-mm actual-) thickness lumber of same width as framing members.

END OF SECTION

SECTION 07 21 19

FOAMED-IN-PLACE INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including Contractual Conditions and Division 1 Specifications, apply to this Section.

1.2 SUMMARY

- A. Section includes: Water-blown, closed cell, polyurethane spray foam insulation.
- B. Coordinate mechanical ventilation and fresh air supply with Mechanical sections and ASHRAE Guidelines for optimum indoor air quality.

1.3 REFERENCES

- A. American Society for Testing and Materials International (ASTM)
 - 1. ASTM C 518: Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus
 - 2. ASTM C 1338: Standard Test Method for Determining Fungi Resistance of Insulation Materials and Facings
 - 3. ASTM E 84: Test Method for Surface Burning Characteristics of Building Materials
 - 4. ASTM E 96: Standard Test Methods for Water Vapor Transmission of Materials
 - 5. ASTM E 119: Standard Test Methods for Fire Tests of Building Construction and Materials
 - 6. ASTM E 2178: Standard Test Methods for Air Permeance of Building Materials
 - 7. NFPA 285: Standard Fire Test Methods for Evaluation of Fire Propagation Characteristics of Exterior Non Load-Bearing Wall Assemblies Containing Combustible Components

1.4 SUBMITTALS

- A. Product Data for type of insulation product specified.
- B. Product test reports performed by a qualified third-party testing agency evidencing compliance of insulation products with specified requirements including those for thermal resistance, fire-test-response characteristics, water vapor transmission, and other properties, based on comprehensive testing of current products.
- C. Evaluation Report: Evidence of compliance of foam-plastic insulations with International Building Code (IBC), International Residential Code (IRC), International Energy Conservation Code (IECC).
- D. Manufacturer's certificate certifying insulation provided meets or exceeds specified requirements.
- E. Installer's certificate showing the manufacturer's installation certification.

F. Sample warranty

1.5 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Product produced in an ISO 9001 registered factory.
- B. Single Source Responsibility: Single source product from one manufacturer.
- C. Installer Qualifications: Engage manufacturers Licensed Contractor (installer) who has been trained and certified by manufacturer.
- D. Fire-Test-Response Characteristics: Provide materials specified as determined by testing identical products per test method indicated below by a testing and inspecting agency acceptable to authorities having jurisdiction. Identify materials with appropriate markings of applicable testing and inspecting agency.
 - 1. Surface-Burning Characteristics: ASTM E 84
 - 2. Rated Wall Assembly Testing: ASTM E 119 and ASTM 285
- E. Toxicity/Hazardous Materials
 - 1. Provide products that contain no chemical blowing agents.
 - 2. Provide products that are "Low-emitting".
 - 3. Provide products that contain no PBDE's.
 - 4. Provide products that contain no urea-formaldehyde.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Comply with manufacturers written instructions for handling and protection prior to and during installation.
- B. Store both components in a temperature controlled area between 60 and 85 degrees F. Do not allow product to freeze.
- C. Use only those components that are supplied by the Manufacturer.

1.7 PROJECT CONDITIONS

- A. Do not expose to sunlight, except to extent necessary for period of installation and concealment.

1.8 WARRANTY

- A. Manufacturers highest warranty.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Polyurethane Spray Foam Insulation: ICYNENE ProSeal Eco™ (MD-R-210) by Icynene Inc.
- B. Any substitutions must be submitted to Architect prior to bid for approval.

2.2 MATERIALS

- A. General: Provide insulating materials that comply with requirements and with referenced standards.
 - a. Icynene ProSeal LE™ Spray Foam Insulation: Medium-density, closed-cell, conforming to the following material performance:
 - 1) Thermal Resistance (for 1 inch of material) (R-Value/inch @75 deg F): ASTM C 518; 7.1 hr.sq ft.degree F/BTU
 - 2) Air Permeance (for 1 inch of material): ASTM E 2178; less than 0.02 L/s*m² @75 Pa
 - 3) Air Barrier System (for 1 inch of material): ASTM E 2357; less than 0.0106 L/s*m² @75 Pa
 - 4) Water Vapor Transmission (for 1.5 inches of material): ASTM E 96; 0.97 perm
 - 5) Water-Resistive Barrier (for 1 inch of material): ASTM E331 evaluated per ICC-ES AC71; Pass
 - 6) Resistance to Fungal Growth: ASTM C 1338: no growth
 - 7) Flame Spread and Smoke Developed Rating: ASTM E 84
 - a) Flame Spread: 25
 - b) Smoke Development: 300
 - 8) Greenguard Gold Certified

2.3 SOURCE QUALITY CONTROL

- A. Product produced in an ISO 9001 registered factory.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, under which work is to be performed. Do not proceed until unsatisfactory conditions have been corrected.
 - 1. Review placement area to determine final location will not be within 3 inches of any heat source where the temperature will exceed 180 deg F per ASTM C 411 or in accordance with authorities having jurisdiction.

3.2 PREPARATION

- A. Clean substrates and cavities of loose materials capable of interfering with insulation placement.

3.3 APPLICATION

- A. Site mix liquid components supplied by Icynene and installed by Independent Icynene Licensed Dealer.
- B. Apply insulation to substrates in compliance with manufacturer's written instructions.
- C. Apply insulation to produce thickness required for indicated R Value.
- D. Extend insulation in thickness indicated to envelop entire area to be insulated.

- E. Water-Piping Coordination: If water piping is located within insulated exterior walls, coordinate location of piping to ensure that it is placed on warm side of insulation and insulation encapsulates piping.

3.4 REPAIRS

- A. Any repairs must be effected by an Icynene Licensed Contractor.

3.5 PROTECTION

- A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings where insulation is subject to abuse.

END OF SECTION

SECTION 07 54 03

FULLY ADHERED, EPDM ROOFING

PART 1 - GENERAL

1.1 DESCRIPTION

- A. The Gage Pump Station is located in Buena Vista Twp., MI. Nicholas D. Czerwinski, P.E., Project Manager/Coordinator, is the Owner's Representative and may be contacted regarding any questions or for a pre-bid job site inspection, phone (989) 529-0256.
- B. The roof membrane for this building has been selected to provide exceptional protection and puncture resistance for roof top skylight and pump service and maintenance.
- C. The project consists of installing Carlisle's Sure-White (white) FleeceBACK Adhered Roofing System in conjunction with Flexible FAST Adhesive as outlined below:

Apply the FleeceBACK Adhered Roofing System in conjunction with tapered polyisocyanurate insulation over the new treated wood joist and plywood roof deck.

1.2 EXTENT OF WORK

- A. Provide all labor, material, tools, equipment, and supervision necessary to complete the installation of Sure-White FleeceBACK Adhered Roofing System including flashings and insulation as specified herein and as indicated on the drawings in accordance with the manufacturer's most current specifications and details. The roofing contractor shall be fully knowledgeable of all requirements of the contract documents and shall make themselves aware of all job site conditions that will affect their work.
- B. The roofing contractor shall confirm all given information and advise the building owner, prior to bid, of any conflicts that will affect their cost proposal.
- C. Any contractor who intends to submit a bid using a roofing system other than the approved manufacturer must submit for pre-qualification in writing fourteen (14) days prior to the bid date. Any contractor who fails to submit all information as requested will be subject to rejection. Bids stating "as per plans and specs" will be unacceptable.

1.3 SUBMITTALS

- A. Prior to starting work, the roofing contractor must submit the following:
 - 1. Shop drawings showing layout, details of construction and identification of materials.
 - 2. A sample of the manufacturer's Membrane System Warranty.
 - 3. Submit a letter of certification from the manufacturer which certifies the roofing contractor is authorized to install the manufacturer's roofing system and lists foreman who have received training from the manufacturer along with the dates training was received.
 - 4. Certification of the manufacturer's warranty reserve.

- B. Upon completion of the installed work, submit copies of the manufacturer's final inspection to the specifier prior to the issuance of the manufacturer's warranty.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Deliver materials to the job site in the manufacturer's original, unopened containers or wrappings with the manufacturer's name, brand name and installation instructions intact and legible. Deliver in sufficient quantity to permit work to continue without interruption.
- B. Comply with the manufacturer's written instructions for proper material storage:
 - 1. Store FleeceBACK membrane in a dry area. Moisture absorbed by the fleece backing must be removed using a wet-vac system prior to membrane adhesive.
 - 2. Store other materials between 60°F and 80°F in dry areas protected from water and direct sunlight. If exposed to lower temperature, restore to 60°F minimum temperature before using.
 - 3. Store materials containing solvents in dry, well ventilated spaces with proper fire and safety precautions. Keep lids on tight. Use before expiration of their shelf life.
- C. Insulation must be on pallets, off the ground tightly covered with waterproof materials.
- D. Any materials which are found to be damaged shall be removed and replaced at the applicator's expense.

1.5 WORK SEQUENCE

- A. Schedule and execute work to prevent leaks and excessive traffic on completed roof sections. Care should be exercised to provide protection for the interior of the building and to ensure water does not flow beneath or wick into any completed sections of the membrane system.
- B. Do not disrupt activities in occupied spaces.

1.6 USE OF THE PREMISES

- A. Before beginning work, the roofing contractor must secure approval from the building owner's representative for the following:
 - 1. Areas permitted for personnel parking.
 - 2. Access to the site.
 - 3. Areas permitted for storage of materials and debris.
 - 4. Areas permitted for the location of cranes, hoists and chutes for loading and unloading materials to and from the roof.
- B. Interior stairs or elevators may not be used for removing debris or delivering materials, except as authorized by the building superintendent.

1.7 EXISTING CONDITIONS

- A. If discrepancies are discovered between the existing conditions and those noted on the drawings, immediately notify the owner's representative by phone and solicit the manufacturer's approval

prior to commencing with the work. Necessary steps shall be taken to make the building watertight until the discrepancies are resolved.

1.8 TEMPORARY FACILITIES AND CONTROLS

- A. Temporary Utilities:
 - 1. Water, power for construction purposes and lighting are available at the site and will be made available to the roofing contractor.
 - 2. Provide all hoses, valves and connections for water from a source designated by the owner when made available.
 - 3. When available, electrical power should be extended as required from the source. Provide all trailers, connections and fused disconnects.
- B. Temporary, Sanitary Facilities:
 - 1. Sanitary facilities will not be available at the job site. The roofing contractor shall be responsible for the provision and maintenance of portable toilets or their equal.
- C. Building Site:
 - 1. The roofing contractor shall use reasonable care and responsibility to protect the building and site against damages. The contractor shall be responsible for the correction of any damage incurred as a result of the performance of the contract.
 - 2. The roofing contractor shall remove all debris from the job site in a timely and legally acceptable manner so as to not detract from the aesthetics or the functions of the building.
- D. Security:
 - 1. Obey the owner's requirements for personnel identification, inspection and other security measures.

1.9 JOB SITE PROTECTION

- A. The roofing contractor shall adequately protect building, paved areas, service drives, lawn, shrubs, trees, etc. from damage while performing the required work. Provide canvas, boards and sheet metal (properly secured) as necessary for protection and remove protection material at completion. The contractor shall repair or be responsible for costs to repair all property damaged during the roofing application.
- B. During the roofing contractor's performance of the work, the building owner will continue to occupy the existing building. The contractor shall take precautions to prevent the spread of dust and debris, particularly where such material may sift into the building. The roofing contractor shall provide labor and materials to construct, maintain and remove necessary, temporary enclosures to prevent dust or debris in the construction area(s) from entering the remainder of the building.
- C. Do not overload any portion of the building, by either use of or placement of equipment, storage of debris, or storage of materials.
- D. Protect against fire and flame spread. Maintain proper and adequate fire extinguishers.
- E. Take precautions to prevent drains from clogging during the roofing application. Remove debris at the completion of each day's work and clean drains, if required. At completion, test drains to ensure

the system is free running and drains are watertight. Remove strainers and plug drains in areas where work is in progress. Install flags or other telltales on plugs. Remove plugs each night and screen drain.

- F. Store moisture susceptible materials above ground and protect with waterproof coverings.
- G. Remove all traces of piled bulk material and return the job site to its original condition upon completion of the work.

1.10 SAFETY

- A. The roofing contractor shall be responsible for all means and methods as they relate to safety and shall comply with all applicable local, state and federal requirements that are safety related. **Safety shall be the responsibility of the roofing contractor.** All related personnel shall be instructed daily to be mindful of the full time requirement to maintain a safe environment for the facility's occupants including staff, visitors, customers and the occurrence of the general public on or near the site.

1.11 WORKMANSHIP

- A. Applicators installing new roof, flashing and related work shall be factory trained and approved by the manufacturer they are representing.
- B. All work shall be of highest quality and in strict accordance with the manufacturer's published specifications and to the building owner's satisfaction.
- C. There shall be a supervisor on the job site at all times while work is in progress.

1.12 QUALITY ASSURANCE

- A. The Sure-White Membrane Roofing System must achieve a UL Class A.
- B. The specified roofing assembly must have been successfully tested by a qualified testing agency to resist the design uplift pressures calculated according to

ANSI/SPRI WD-1 "Wind Design Standard Practice for Roofing Assemblies" American Society of Civil Engineers (ASCE 7)
International Building Code (IBC)

and after multiplying the results with a safety factor of determined by designing professional.
- C. The membrane must be manufactured by the material supplier. Manufacturer's supplying membrane made by others are not acceptable.
- D. Unless otherwise noted in this specification, the roofing contractor must strictly comply with the manufacturer's current specifications and details.
- E. The roofing system must be installed by an applicator authorized and trained by the manufacturer in compliance with shop drawings as approved by the manufacturer. The roofing applicator shall be

thoroughly experienced and upon request be able to provide evidence of having at least five (5) years successful experience installing single-ply EPDM roofing systems and having installed at least one (1) roofing application or several similar systems of equal or greater size within one year.

- F. Provide adequate number of experienced workmen regularly engaged in this type of work who are skilled in the application techniques of the materials specified. Provide at least one thoroughly trained and an experienced superintendent on the job at all times roofing work is in progress.
- G. There shall be no deviations made from this specification or the approved shop drawings without the prior written approval of the specifier. Any deviation from the manufacturer's installation procedures must be supported by written certification on manufacturer's letterhead and presented for the specifier's consideration.
- H. Upon completion of the installation, the applicator shall arrange for an inspection to be made by a non-sales technical representative of the membrane manufacturer in order to determine whether or not corrective work will be required before the warranty will be issued. Notify the building owner seventy-two (72) hours prior to the manufacturer's final inspection.

1.13 JOB CONDITIONS, CAUTIONS AND WARNINGS

Refer to Carlisle's FleeceBACK Adhered Roofing System specifications for General Job Site Considerations.

- A. Safety Data Sheets (SDS) must be on location at all times during the transportation, storage and application of materials.
- B. **Do not apply Flexible FAST Adhesive** when surface and/or ambient temperatures are **below 25°F**.
- C. The contractor must exercise caution during when spraying adhesive to avoid overspray.

Use a non-atomizing spray tip such as the Graco Spatter Tip and reduce spray pressure to 500 – 800 psi to increase adhesive droplet size and reduce airborne mist. Maintain hand held wind screens on-site for use as necessary. Extruding Flexible FAST Adhesive is also recommended for the elimination of overspray concerns.

- D. When positioning membrane sheets, exercise care to locate all field splices away from low spots and out of drain sumps. All field splices should be shingled to prevent bucking of water.
- E. When loading materials onto the roof, the Carlisle Authorized Roofing Applicator must comply with the requirements of the building owner to prevent overloading and possible disturbance to the building structure.
- F. Proceed with roofing work only when weather conditions are in compliance with the manufacturer's recommended limitations, and when conditions will permit the work to proceed in accordance with the manufacturer's requirements and recommendations.

- G. Proceed with work so new roofing materials are not subject to construction traffic. When necessary, new roof sections shall be protected and inspected upon completion for possible damage.
- H. Provide protection, such as 3/4 inch thick plywood, for all roof areas exposed to traffic during construction. Plywood must be smooth and free of fasteners and splinters.
- I. The surface on which the insulation or roofing membrane is to be applied shall be clean, smooth, dry, and free of projections or contaminants that would prevent proper application of or be incompatible with the new installation, such as fins, sharp edges, foreign materials, oil and grease.
- J. New roofing shall be complete and weather tight at the end of the work day. Care must be taken to avoid wicking water through the fleece by properly sealing exposed edges of the membrane.
- K. Contaminants such as grease, fats and oils shall not be allowed to come in direct contact with the roofing membrane.

1.14 WARRANTY

- A. Provide manufacturer's 20 year Total System Warranty covering both labor and material with no dollar limitation. The maximum wind speed coverage shall be peak gusts of 55 mph measured at 10 meters above ground level. Certification is required with bid submittal indicating the manufacturer has reviewed and agreed to such wind coverage.
- B. Warranty shall also cover leaks caused by accidental punctures:
 - 1. 16 man-hours per year.
 - 2. When Flexible FAST is specified and installed an additional 4 man-hours per year can be included.
- C. Warranty shall also cover leaks caused by hail:
 - 1. Hail up to 24" diameter.
 - 2. When Flexible FAST is specified and installed, an additional 1" diameter hail can be included.
- D. Pro-rated System Warranties shall not be accepted.
- E. Evidence of the manufacturer's warranty reserve shall be included as part of the project submittals for the specifier's approval.

PART 2 - PRODUCTS

2.1 GENERAL

- A. All components of the specified roofing system shall be products of Carlisle SynTec or accepted by Carlisle SynTec as compatible.

- B. Unless otherwise approved by the specifier and accepted by the membrane manufacturer, all products (including adhesives, insulation, fasteners, fastening plates and edgings) must be **manufactured and supplied** by the roofing system manufacturer and covered by the warranty.

2.2 MEMBRANE

- A. Furnish Sure-White (white) FleeceBACK 115-mil membrane. The membrane shall conform to the minimum physical properties of ASTM D4637-96, Type III (Fabric-backed membrane). Membrane sheets are 20' wide and 50' or 100' long and incorporate factory-applied splice tape (FAT) along the length of the membrane.
- B. Dynamic Puncture Resistance (ASTM D5635-04a) of 20 joules.
- C. Static Puncture Resistance (ASTM D120) of 19 lbf.

2.3 INSULATION/UNDERLAYMENT

- A. When applicable, insulation shall be installed in multiple layers and mechanically fastened or secured with Carlisle Flexible FAST Adhesive to the substrate in accordance with manufacturer's published specifications.
- B. Insulation topped with gypsum core cover board such as listed below:
 - 1. **Carlisle Insulbase Polyisocyanurate** – A foam core insulation board covered on both sides with a medium weight fiber-reinforced felt facer meeting ASTM C 1289-06, Type II, Class 1, Grade 2 (20 psi) or Grade 3 (25 psi). The product is available in 4' x 8' standard size with a thickness from 1 to 4 inches. 4' x 4' tapered panels are also available.
 - 2. **Dens Deck Prime** –gypsum core that incorporates glass-mat facings on the top and bottom side. The top surface is pre-primed and provides excellent bond strength for adhered membrane for use as a cover board. Available in 1/4" to 5/8" and 4' x 4' or 4' x 8' size boards.

2.4 FASTENING COMPONENTS

To be used for mechanical attachment of insulation and to provide additional membrane securement:

- A. Fasteners, Plates and Bars:
 - 1. **Pre-Assembled ASAP Fasteners:** A pre-assembled 3" diameter Plastic Plate and # 12 threaded fastener with a #3 drive used for insulation attachment into steel or wood decks. Installed using OMG Fastening Tools. -OR-
 - 2. **InsulFast Fasteners:** A threaded #12 fastener with #3 phillips drive used for insulation attachment into steel or wood decks. -AND-
 - 3. **Insulation Fastening Plates:** a nominal 3 inch diameter plastic or metal plate used for insulation attachment.
 - 4. **HP Term Bar Nail-Ins:** A 1-1/4" long expansion anchor with a zinc plated steel drive pin used for fastening the Carlisle Termination Bar or Seam Fastening Plates to concrete, brick, or block walls.
- B. Insulation Adhesive:

1. **Flexible FAST Adhesive:** An elongating impact resistant two component insulating urethane adhesive used to attach insulation and FleeceBACK membrane. Packaging formats include 50 and 15 gallon drums as well as Dual Tanks, Dual Cartridges and 5 gallon Bag in a Box formats.
 - a. Adhesive to provide 150% elongation in conjunction with fleece backed membrane ASTM D412.
 - b. MDI content of Part A material less than 25%.

2.5 ADHESIVES, CLEANERS AND SEALANTS

- A. **Flexible FAST Adhesive:** An elongating impact resistant two component insulating urethane adhesive used to attach insulation and FleeceBACK membrane. Packaging formats include 50 and 15 gallon drums as well as Dual Cartridges and 5 gallon Bag in a Box formats.
 1. Adhesive to provide 150% elongation in conjunction with fleece backed membrane – ASTM D412.
 2. MDI content of Part A material less than 25%.
- B. **Carlisle Weathered Membrane Cleaner:** A clear, solvent-based cleaner used to loosen and remove dirt and other contaminants from the surface of exposed EPDM membrane (for repairs, etc.) prior to applying EPDM Primer. Weathered Membrane Cleaner can also be used when applying Splicing Cement. Available in 1 and 5-gallon pails.
- C. **Sure-White SecurTAPE:** A 3" or 6" wide by 100' long splice tape used with Sure-White Systems. Complies with the South Coast Air Quality Management District Rule 1168.
- D. **Sure-Seal HP-250 Primer:** A solvent-based primer used to prepare the surface of EPDM membrane for application of Splice Tape or Pressure-Sensitive products. This Primer can also be used in conjunction with EP-95 Splicing Cement in lieu of Splice Cleaner. Available in 1 gallon pails.
- E. **Lap Sealant:** A black, heavy-bodied material used to seal the exposed edges of a membrane splice. A pre- formed Lap Sealant tool is included in each carton of Lap Sealant. Available in tubes.
 1. Sure-Seal Lap Sealant: Black sealant for use with Sure-Seal (black) Roofing Systems.
 2. Sure-White Lap Sealant: White sealant for use with Sure-White (white-on-black) Roofing Systems.
- F. **Water Cut-Off Mastic:** A one-component, low viscosity, self wetting, Butyl blend mastic used as a sealing agent between the EPDM membrane or Elastoform Flashing and applicable substrates. Available in tubes.
- G. **One-Part Pourable Sealer:** Available in black or white, a one-component, moisture curing, elastomeric polyether sealant used for attaching lightning rod bases and ground cable clips to the membrane surface and as a sealant around hard-to-flash penetrations such as clusters of pipes.
- H. **Universal Single-Ply Sealant:** A one-part polyether, non-sagging sealant designed for sealing expansion joints, control joints and counterflashings. Available in white only.
- I. **CCW 702:** A single component, solvent based, high-tack primer used to provide maximum adhesion between Carlisle 725TR Air and Vapor Barrier and an approved substrate. Applied by

spray or long nap roller with a coverage rating ranging from approximately 300 to 350 square feet per gallon on smooth finishes (i.e., concrete) to 75 square feet per gallon on porous surfaces (i.e., Dens-Deck Prime gypsum board). Available in 5-gallon containers.

2.6 METAL EDGING AND MEMBRANE TERMINATIONS

- A. General: All metal edging s shall be tested and meet ANSI/SPRI ES-1 standards and comply with International Building Code.
- B. Coping:
 - 1. **SecurEdge 400:** Coping system is a two-piece assembly that consists of a continuous cleat and a decorative snap-on coping cover. 22-gauge (G90) pre-punched continuous cleat with fasteners spaced at 12" on center, SecurEdge 400 Coping is offered in 10' cleat and coping cover lengths; concealed splice plates and fasteners are included with purchase.
- C. Drip Edge:
 - 1. SecurEdge 400: Two-piece assembly that consists of a continuous base and a decorative Drip Edge cover, and a 22-gauge (G90) pre-punched cleat with fasteners spaced at 12" on center. SecurEdge 400 Drip Edge is available in 10' cleat and cover lengths; concealed splice plates and fasteners are included with purchase.
- D. Termination Bars:
 - 1. The Termination Bar is an extruded aluminum bar that's designed for securing and sealing compression type flashing terminations per Carlisle Specifications. The bar is packaged in 1" x 10' lengths and has pre-punched holes every 6" on center. This bar features a top edge for ease of applying Carlisle's Lap Sealant for EPDM. When installing, make sure that all corners of cut bar are rounded. Install the bar using HP-X Fasteners, or Term-Bar Nail In Fasteners.

2.7 WALKWAYS

- A. Protective surfacing for roof traffic shall be Sure-Seal P.S. Walkway Pads (30" x 30" molded black rubber with factory applied tape) adhered to the FleeceBACK membrane after priming with HP-250 or Low VOC EPDM Primer or concrete pavers loose laid over an approved slip sheet (pavers not recommended for slopes greater than 2" in 12").

2.8 OTHER MATERIALS

- A. Metal Flashing, if required, and miscellaneous items needed to fulfill the project requirements.

PART 3 - EXECUTION

3.1 GENERAL

- A. Comply with the manufacturer's published instructions for the installation of the membrane roofing system including proper substrate preparation, job site considerations and weather restrictions.

- B. Position sheets to accommodate contours of the roof deck and shingle splices to avoid bucking water.

3.2 INSULATION PLACEMENT

- A. Install insulation or membrane underlayment over the substrate with boards butted together. Fill joints or gaps greater than 1/4 inch with Flexible FAST Adhesive. Stagger joints both horizontally and vertically if multiple layers are provided.
- B. Secure insulation to the substrate with Flexible FAST Adhesive or mechanical fasteners in accordance with the manufacturer's specifications.

3.3 MEMBRANE PLACEMENT AND BONDING

- A. Position and unroll successive sheets and align to provide for a minimum 3 inch wide splice. At end laps (along the width of the sheet), membrane shall be butted together and overlaid with 6" wide Sure-Seal Pressure Sensitive Cured Cover Strip or Pressure Sensitive Overlayment Strip.
- B. FleeceBACK Membrane shall be fully adhered to an acceptable substrate with Carlisle Flexible FAST Adhesive. The adhesive is spray applied or extruded to the substrate only and the membrane is rolled into the wet adhesive once it has foamed up and reached string/gel time (approximately 2 minutes). Roll the membrane with a 30" wide, 150 lb weighted segmented steel roller to set the membrane into the adhesive.

Note: Exercise care to prevent overspray onto the membrane. If Flexible FAST Adhesive should contaminate the splice area, immediately (while the adhesive is still in liquid form) clean with Weathered Membrane Cleaner or allow Flexible FAST Adhesive to cure and remove with a paint-type scraper.

- C. Install adjoining membrane sheets in the same manner, overlapping edges approximately 4 inches. Do not apply bonding adhesive to the splice area.

3.4 MEMBRANE SPLICING

- A. General: The FleeceBACK membrane has selvage edges (the fleece-backing is discontinued) and factory-applied splice tape along the length of the sheet for membrane splicing. Selvage edges are not provided along the width of the membrane; adjoining membrane sheets are butted together and overlaid with 6" wide Pressure- Sensitive Cured Cover Strip or Pressure-Sensitive Overlayment Strip. As an option, sheets can be rotated 90 degrees to form a cap sheet to eliminate flashing overlay.
- B. Membrane Splicing with Factory-Applied Splice Tape
 1. Position membrane sheet to allow for required splice overlap. Mark the bottom sheets with an indelible marker approximately 1/4" to 1/2" from the top sheet edge. The pre-marked line on the membrane.
 2. When the membrane is contaminated with dirt, fold the top sheet back and clean the dry splice area (minimum 3" wide) of both membrane sheets by scrubbing with clean natural fiber rags saturated with Sure-Seal Weathered Membrane Cleaner. When using Sure-Seal

(black) PRE-KLEENED membrane, cleaning the splice area is not required unless contaminated with field dirt or other residue.

3. Apply EPDM Primer to splice area and permit to flash off.
4. When adhering Factory Applied Tape (FAT), pull the poly backing from FAT beneath the top sheet and allow the top sheet to fall freely onto the exposed primed surface. Press top sheet on to the bottom sheet using firm even hand pressure across the splice towards the splice edge.
5. For end laps, apply 3" or 6" SecurTAPE to the primed membrane surface in accordance with the manufacturer's specifications. Remove the poly backing and roll the top sheet onto the mating surface.
6. Tape splices must be a minimum of 2-1/2" wide using 3" wide SecurTAPE extending 1/8" minimum to 1/2" maximum beyond the splice edge. Field splices at roof drains must be located outside the drain sump.

Note: For projects where a 90-mil membrane OR 20-year or longer System Warranty is specified, splice enhancements are required. Refer to Carlisle Sure-Seal/Sure-White Roofing System Specification.

7. Immediately roll the splice using positive pressure when using a 2" wide steel roller. Roll across the splice edge, not parallel to it. When FAT is used, Carlisle's Stand-Up Seam Roller can be used to roll parallel to the splice edge.
8. **At all field splice intersections**, apply Lap Sealant along the edge of the membrane splice to cover the exposed SecurTAPE 2" in each direction from the splice intersection. Install Carlisle's Pressure- Sensitive "T" Joint Covers or a 6" wide section (with rounded corners) of Sure-Seal Pressure-Sensitive Flashing over the field splice intersection.

3.5 FLASHING

- A. Wall and curb flashing shall be cured membrane. Continue the deck membrane as wall flashing where practicable.
- B. Follow manufacturer's typical flashing procedures for all wall, curb, and penetration flashing including metal edging/coping and roof drain applications.

3.6 WALKWAYS

- A. Install walkways at all traffic concentration points (such as roof hatches, access doors, rooftop ladders, etc.) and all locations as identified on the specifier's drawing.
- B. Adhere walkways to the membrane in accordance with the manufacturer's specifications.

3.7 DAILY SEAL

- A. On phased roofing, when the completion of flashings and terminations is not achieved by the end of the work day, a daily seal must be performed to temporarily close the membrane to prevent water infiltration.
- B. Use Flexible FAST Adhesive or other similar material in accordance with the manufacturer's requirements.

3.8 CLEAN UP

- A. Perform daily clean up to collect all wrappings, empty containers, paper, and other debris from the project site. Upon completion, all debris must be disposed of in a legally acceptable manner.
- B. Prior to the manufacturer's inspection for warranty, the applicator must perform a pre-inspection to review all work and to verify all flashing has been completed as well as the application of all caulking.

END OF SECTION

SECTION 07 62 00

SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Flashings and counter flashings.
 - 2. Gutters and downspouts.
 - 3. Other fabricated sheet metal items required to keep building weathertight and not specified elsewhere.
- B. Related Requirements:
 - 1. Section 06 10 53 - Miscellaneous Rough Carpentry: Wood blocking and battens for metal roofing substrate profiles.
 - 2. Section 09 90 00 - Painting and Coating: Field painting.

1.2 UNIT PRICE MEASUREMENT AND PAYMENT

- A. Gutters and Downspouts:
 - 1. Basis of Measurement: At the lump sum bid price as stated in the proposal.
 - 2. Basis of Payment: Includes all labor, equipment, and material to fabricate and install the gutter and downspout system as shown on plans complete.

1.3 REFERENCE STANDARDS

- A. Aluminum Association:
 - 1. AA - Designation System for Aluminum Finishes.
- B. American Architectural Manufacturers Association:
 - 1. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum.
 - 2. AAMA 2603 - Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels.
 - 3. AAMA 2604 - Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels.
 - 4. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels.
- C. ASTM International:
 - 1. ASTM A240/A240M - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
 - 2. ASTM A625/A625M - Standard Specification for Tin Mill Products, Black Plate, Single-Reduced.
 - 3. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

4. ASTM A755/A755M - Standard Specification for Steel Sheet, Metallic Coated by the Hot-Dip Process and Prepainted by the Coil-Coating Process for Exterior Exposed Building Products.
5. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
6. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric).
7. ASTM D226/D226M - Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing.
8. ASTM D4586/D4586M - Standard Specification for Asphalt Roof Cement, Asbestos-Free.

D. Federal Specification Unit:

1. FS TT-C-494 - Coating Compound, Bituminous, Solvent Type, Acid Resistant.

E. National Roofing Contractors Association:

1. NRCA - Construction Details Manual.

F. Sheet Metal and Air Conditioning Contractors' National Association:

1. SMACNA - Architectural Sheet Metal Manual.

G. Specialty Steel Industry of North America:

1. SSINA - Standard Practices for Stainless Steel Roofing, Flashing, Copings.

1.4 COORDINATION

- A. Section 01 30 00 - Administrative Requirements: Requirements for coordination.

1.5 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

- B. Product Data: Submit manufacturer information regarding components metal types, finishes, and characteristics.

- C. Shop Drawings: Indicate material profile, jointing pattern, jointing details, fastening methods, flashings, terminations, and installation details.

D. Samples:

1. Submit two samples, illustrating metal finish color.

- E. Fabricator's Certificate: Certify that products meet or exceed specified requirements.

F. Qualifications Statements:

1. Submit qualifications for fabricator and installer.

1.6 QUALITY ASSURANCE

- A. Perform Work according to NRCA standards.

- B. Maintain one copy of each standard affecting Work of this Section on Site.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- C. Storage:
 - 1. Store materials according to manufacturer instructions.
 - 2. Stack material to prevent twisting, bending, and abrasion, and to provide ventilation.
 - 3. Slope metal sheets to ensure drainage.
- D. Protection:
 - 1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
 - 2. Prevent contact with materials that may cause discoloration or staining.
 - 3. Provide additional protection according to manufacturer instructions.

PART 2 - PRODUCTS

2.1 SHEET METAL FLASHING AND TRIM

- A. Manufacturers:
 - 1. Cheney Flashing Company
 - 2. Hohmann & Barnard, Inc
 - 3. Keystone Flashing Company, Inc
 - 4. Metal-Era, Inc.
 - 5. Substitutions: As specified in Section 01 60 00 - Product Requirements.
- B. Performance and Design Criteria:
 - 1. Gutter and Downspout Components: Comply with applicable code for size and method of rainwater discharge.

2.2 MATERIALS

- A. Prefinished Galvanized Steel Sheet:
 - 1. Description:
 - a. Structural steel sheet.
 - b. Type: Thick core.
 - c. Coating: Zinc; G90.
 - 2. Comply with ASTM A755/A755M.
 - 3. Thickness: 0.024 inch.
 - 4. Coating:
 - a. Shop precoated with polyester.
 - b. Color: As selected from manufacturer's standard.
- B. Prefinished Aluminum Sheet:
 - 1. Description: Alloy and temper as required for application and finish.

2. Comply with ASTM B209.
3. Thickness: 0.032 inch.
4. Finish: Mill.
5. Coating:
 - a. Shop precoated with polyester.
 - b. Color: As selected from manufacturer's standard.

2.3 FABRICATION

- A. Form section shapes as indicated on Drawings, accurate in size, square, and free from distortion or defects.
- B. Fabricate cleats of same material as sheet metal, interlocking with sheet.
- C. Form pieces in longest possible lengths.
- D. Hem exposed edges on underside 1/2 inch.
- E. Miter and seam corners.
- F. Forming:
 1. Form material with flat lock seams, except where otherwise indicated.
 2. At moving joints, use sealed, lapped, bayonet-type, or interlocking hooked seams.
- G. Corners:
 1. Fabricate corners from one piece.
- H. Fabricate vertical faces with bottom edge formed outward 1/4 inch and hemmed to form drip.
- I. Gutters: Fabricate to profile and size as indicated on Drawings.
- J. Downspouts: Fabricate to profile and size as indicated on Drawings.
- K. Fabricate accessories in profile and size to suit gutters and downspouts, as follows:
 1. Anchorage Devices: Type as recommended by fabricator.
 2. Gutter Supports: Spikes and ferrules.
 3. Downspout Supports: Straps.
- L. Seal metal joints.

2.4 FINISHES

- A. Class I Color Anodized Finish:
 1. Description:
 - a. Integrally colored anodic coating not less than 0.7 mil thick.
 - b. AA Designation: M12C22A42.
 2. Comply with AAMA 611.

- B. Washcoat: Finish concealed side of metal sheets with washcoat compatible with finish system, as recommended by finish system manufacturer.

2.5 ACCESSORIES

- A. Fasteners: Galvanized steel, with soft neoprene washers.
- B. Slip Sheet: Rosin-sized building paper.
- C. Primer: Zinc molybdate.
- D. Protective Backing Paint: Zinc-molybdate alkyd.
- E. Sealant: Type E butyl as specified in Section 07 90 00 - Joint Protection.
- F. Plastic Cement: Comply with ASTM D4586/D4586M, Type I.
- G. Reglets:
 - 1. Type: Surface mounted.
 - 2. Material: Galvanized steel.
- H. Downspout Boots: Fabricated steel

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation examination.
- B. Verify that roof openings, curbs, pipes, sleeves, ducts, and vents through roof are solidly set, reglets are in place, and nailing strips have been located.
- C. Verify that roofing termination and base flashings are in place, sealed, and secure.

3.2 PREPARATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation preparation.
- B. Install starter strips, edge strips, and cleats before starting installation of sheet metal flashing and trim.
- C. Reglets:
 - 1. Install surface-mounted reglets to lines and levels as indicated on Drawings.
 - 2. Seal top of reglets with sealant.

- D. Paint concealed metal surfaces with protective backing paint to minimum dry film thickness of 15 mils.

3.3 INSTALLATION

- A. Recessed Flashing Reglets:
 - 1. Secure flashings in place using concealed fasteners, using exposed fasteners only where permitted.
 - 2. Apply plastic cement compound between metal flashings and felt flashings.
 - 3. Fit flashings tight in place, and make corners square, surfaces true and straight in planes, and lines accurate to profiles.
 - 4. Seal metal joints watertight.
- B. Gutters:
 - 1. Secure gutters and downspouts in place using concealed fasteners.
 - 2. Slope gutters minimum 1/4 in./ft.
- C. Downspouts:
 - 1. Connect downspouts as shown on plans.
 - 2. Seal connection watertight.
 - 3. Seal metal joints watertight.

3.4 ATTACHMENTS

- A. Through-Wall Flashing in Masonry:
 - 1. Material: Stainless steel, Type 304.
 - 2. Thickness: 0.018 inch.
 - 3. Surface: Smooth.
 - 4. Finish: Number 2B.
- B. Gutters and Downspouts:
 - 1. Material: Aluminum.
 - 2. SMACNA Plate 13.

END OF SECTION

SECTION 09 25 00

GYPSUM DRYWALL

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. This section covers furnishing all labor, materials, tools and equipment required to install all gypsum wallboard, metal corner beads, trims and expansion joints, drywall patches and repairs as well as herein specified and/or as required for a complete job.
- B. Cold Weather Requirements: For the day before through the day after the period of laminating and of finishing of wallboard joints, if outside temperatures will be less than 55°, maintain the temperature within the building within the range of 55° to 70° F. Adequate ventilation shall also be provided to eliminate excessive moisture within the building during this same period.
- C. Delivery of Materials: All materials, as specified, shall be delivered to the job in their original unopened containers or bundles, stored in a place providing protection from damage and exposure to the elements.
- D. Subsurface: Examine and inspect materials to which gypsum board is to be applied. Remedy all defects prior to installation of drywall.

PART 2 - PRODUCTS

1.2 MATERIALS

- A. Trade names of the United States Gypsum Company have been used to establish the desired quality of materials specified herein. Products meeting these specifications will be allowed as manufactured by Georgia-Pacific, Gold Bond Building Products Division, National Gypsum Co., or Owner approved equal.
- B. Gypsum wallboard shall conform to ASTM C36 "Specification for Gypsum Wallboard" with ASTM C-630 Specification added for Water Resistant Wallboard "W/R".
- C. Gypsum Wallboard at Walls, Ceilings: Shall be 5/8" Sheetrock W/R, located as specified herein.
- D. Gypsum Wallboard at Wet Areas: Shall be 5/8" Sheetrock W/R, located as specified herein.
- E. Corner Beads and Metal Trim: Shall be Dur-A-Bead 101 or 200A. Corner reinforcement for adhesive attachment shall be Perf-A-Bead Reinforcement.
- F. Joint Treatment Material: USG "Durabond 90" Joint Compound and USG Ready Mixed Joint Compound All Purpose.

PART 3 - EXECUTION

1.3 APPLICATION

- A. The installation and application of all USG materials shall be in accordance with the latest printed directions or specifications of United States Gypsum and as follows:
- B. Gypsum Wallboard: All ends and edges of Sheetrock Gypsum Wallboard shall occur over fastening members, except when joints are at right angles to framing members as in horizontal application. Ceiling wallboard shall be attached to framing supports utilizing both glue and screw fastening.
- C. Sheetrock Gypsum Wallboard shall be applied to minimize end joints. Boards shall be brought into contact, but shall not be forced into place. Where ends or edges abut, they shall be neatly fitted. End joints shall be staggered. Joints on opposite sides of a partition shall be so arranged as to occur on different studs.
- D. Wallboard shall be attached to framing supports with screws; no nailing will be permitted. Fasteners shall provide a slight depression below the surface of the wallboard without breaking the face paper and fasteners shall not be driven closer than 3/8" from edges and ends of the board. While the fasteners are being driven, the wallboard shall be held in firm contact with the underlying support. Attachment should proceed from the center of the wallboard towards ends and edges.
- E. When necessary to cut ends and edges, scribe, or make cutouts within the field of the wallboard, it shall be done in a workmanlike manner.
- F. Metal corner beads shall be securely attached as per manufacturer's recommendations, to all external corners and in single lengths. Clinch and nail corner beads securely.
- G. Metal trim shall be installed where drywall abuts exposed dissimilar wall material in the manner recommended by the manufacturer.

1.4 JOINT TREATMENT

- A. Unless otherwise indicated, all walls, partitions and ceilings are included. Joints of exterior gypsum wallboard, where not exposed to view, shall not be treated, but shall be installed butted tightly.
- B. Mixing - Durabond "90" joint compound shall be mixed according to the directions on the bag. Caution shall be used to prevent excessive mixing and use of extremely cold water and compound.
- C. All V-grooves formed by abutting wrapped eased edges of Sheetrock SW shall be pre-filled with Durabond "90" joint compound. Application shall be with a flexible 5" or 6" joint finishing knife or an Ames Pre-Fill tool. The V shall be filled flush with the plane of the taper depression and any excess compound beyond the groove shall be wiped clean, leaving a clear depression to receive tape. The pre-fill shall have hardened prior to the next application.

- D. Taping or embedding - USG Ready Mixed Joint Compound - All Purpose, shall be applied with a suitable tool in a thin uniform layer to all joints and angles to be reinforced. Perf-A-Tape reinforcement shall be applied immediately and centered over the joint and seated into the compound. Sufficient compound must remain under the tape to provide proper bond. A skim coat shall immediately follow tape embedment but not to function as a fill or a second coat.
- E. Tape shall be properly folded and embedded in all angles to provide a true angle.
- F. The tape or embedding coat must be thoroughly dry prior to application of the fill coat.
- G. Filling - USG Ready Mixed Compound - All-Purpose, shall be applied over the embedding coat, filling the board taper flush with the surface. On joints with no taper, the fill coat shall cover the tape and feather out at least 4" on either side of the tape. No fill coat is necessary at interior angles.
- H. The fill coat shall be thoroughly dry prior to application of the finish coat.
- I. Finishing - USG Ready Mixed Joint Compound - All Purpose, shall be spread evenly over and extended slightly beyond the fill coat on all joints and feathered to a smooth uniform finish. On tapered joints, the finish coat shall not protrude beyond the plane of the surface.
- J. All taped angles shall receive a finish coat to cover the tape and taping compound, providing a true angle. Where necessary, sanding shall occur between coats and following the final application of compound to provide a smooth surface ready for decoration.
- K. Filling and finishing of fastener depressions - A taping or all-purpose compound must be applied as the first coat to all fastener depressions. This shall be followed by a minimum of 2 additional coats of all-purpose compound, leaving all depressions level with the plane of the surface.

1.5 COMPLETION

- A. Contractor shall correct all poorly installed drywall including, but not limited to, poor seams, "nail pops", poorly executed patches, etc. Final gypsum board condition shall be like new and ready to receive paint.

END OF SECTION

SECTION 09 90 00
PAINTING AND FINISHES

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Surface preparation.
- B. Surface finish schedule.
- C. Color selection schedule.
- D. Applying finishes to existing structures and equipment as specified.

1.2 RELATED WORK

- A. Section 076200 – Sheet Metal Flashing and Trim.
- B. Section 092500 - Gypsum Drywall.

1.3 UNIT PRICE MEASUREMENT AND PAYMENT

- A. Painting and Finishing
 - 1. Basis of Measurement: At the lump sum bid price for painting and finishing.
 - 2. Basis of Payment: Includes all labor, equipment, and material to clean, prep, prime, and finish all existing and proposed structures and equipment as shown on plans.

1.4 REFERENCES

- A. ANSI/ASTM D16 - Definitions of Terms Relating to Paint, Varnish, Laquer, and Related Products.
- B. ASTM D2016 - Test Method for Moisture Content of Wood.
- C. ASTM D4263 - Standard Test Method for indicating moisture in concrete by the plastic sheet method.

1.5 DEFINITIONS

- A. Conform to ANSI/ASTM D16 for interpretation of terms used in this Section.

1.6 QUALITY ASSURANCE

- A. Product Manufacturer: Company specializing in manufacturing quality paint and finish products with three years experience.
- B. Applicator: Company specializing in commercial painting and finishing approved by product manufacturer.

1.7 REGULATORY REQUIREMENTS

- A. Conform to applicable code for flame/fuel/smoke rating requirements for finishes.

1.8 SUBMITTALS

- A. Submit product data under provisions of Section 013300.
- B. Provide product data on all finishing products.
- C. Submit samples and color charts under provisions of Section 013300.
- D. Submit manufacturer's application instructions under provisions of Section 013300.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site under provisions of Section 016000.
- B. Store and protect products under provisions of Section 016000.
- C. Deliver products to site in sealed and labelled containers; inspect to verify acceptance.
- D. Container labelling to include manufacturer's name, type of paint, brand name, brand code, coverage, surface preparation, drying time, cleanup, color designation, and instructions for mixing and reducing.
- E. Store paint materials at minimum ambient temperature of 45 degrees F and a maximum of 90 degrees F, in well ventilated area, unless required otherwise by manufacturer's instructions.
- F. Take precautionary measures to prevent fire hazards and spontaneous combustion.

1.10 ENVIRONMENTAL REQUIREMENTS

- A. Provide continuous ventilation and heating facilities to maintain surface and ambient temperatures above 45 degrees F for 24 hours before, during, and 72 hours after application of finishes, unless required otherwise by manufacturer's instructions.
- B. Do not apply exterior coatings during rain or snow, or when relative humidity is above 50 percent, unless required otherwise by manufacturer's instructions.
- C. Minimum Application Temperatures for Latex Paints: 45 degrees F for interiors; 50 degrees F for exterior; unless required otherwise by manufacturer's instructions.

1.11 EXTRA STOCK

- A. Provide a one gallon container of each color and type to Owner. Quart containers will be acceptable for touchup paint and for small items.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS - PAINT, PRIMERS, BLOCK FILLER, AND FIELD CATALYZED COATINGS

- A. PPG Protective and Marine Coatings
- B. Approved substitutions, request approval no later than 14 days prior to bid date.

2.2 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 or 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.

2.3 FINISHES

- A. Colors to be selected by Owner prior to painting.

PART 3 - EXECUTION

3.1 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. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:
- D. Plaster and Gypsum Wallboard: 12 percent.
- E. Masonry, Concrete, and Concrete Unit Masonry: 12 percent.
- F. Interior Located Wood: 15 percent, measured in accordance with ASTM D2016.
- G. Exterior Located Wood: 15 percent, measured in accordance with ASTM D2016.
- H. Concrete Floors: 14 percent, measured in accordance with ASTM D4263.
- I. Beginning of installation means acceptance of existing surfaces.

3.2 PREPARATION

- A. Remove electrical plates, hardware, light fixture trim, and fittings prior to preparing surfaces or finishing.
- B. Correct minor defects and clean surfaces which affect work of this Section.
- C. Seal marks which may bleed through surface finishes.

- D. Impervious Surfaces: Remove mildew by scrubbing with solution of tri-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.
- E. Concrete Floors: Remove contamination, acid etch, and rinse floors with clear water. Verify required acid-alkali balance is achieved by using a pH pencil or pH range paper, pH should be 11 or less prior to application of coatings.
- F. Copper Surfaces Scheduled for a Paint Finish: Remove contamination by steam, high pressure water, or solvent washing. Apply vinyl etch primer immediately following cleaning.
- G. Gypsum Board Surfaces: Latex fill minor defects. Spot prime defects after repair.
- H. Galvanized Surfaces: Remove surface contamination and oils and wash with solvent. Apply coat of etching primer.
- I. Concrete and Unit Masonry Surfaces Scheduled to Receive Paint Finish: Remove dirt, loose mortar, scale, salt or alkali powder, and other foreign matter. Remove oil and grease with a solution of tri-sodium phosphate; rinse well and allow to dry. Remove stains caused by weathering of corroding metals with a solution of sodium metasilicate after thoroughly wetting with water. Allow to dry.
- J. Uncoated Steel and Iron Surfaces: Remove grease, scale, dirt, and rust. Where heavy coatings of scale are evident, remove by wire brushing or sandblasting; clean by washing with solvent. Apply a treatment of phosphoric acid solution, ensuring weld joints, bolts, and nuts are similarly cleaned. Spot prime paint after repairs.
- K. Shop Primed Steel Surfaces: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces.
- L. Interior Wood Items Scheduled to Receive Finish: Wipe off dust and grit prior to priming. Seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes and cracks after primer has dried; sand between coats.
- M. Exterior Wood Scheduled to Receive Paint Finish: Remove dust, grit, and foreign matter. Seal knots, pitch streaks, and sappy sections. Fill nail holes with tinted exterior caulking compound after prime coat has been applied.
- N. Wood and Metal Doors Scheduled for Painting: Seal top and bottom edges with primer.

3.3 PROTECTION

- A. Protect elements surrounding the work of this Section from damage or disfiguration.
- B. Repair damage to other surfaces caused by work of this Section.
- C. Furnish drop cloths, shields, and protective methods to prevent spray or droppings from disfiguring other surfaces.
- D. Remove empty paint containers from site.

3.4 APPLICATION

- A. Apply products in accordance with manufacturer's instructions.
- B. Do not apply finishes to surfaces that are not dry.
- C. Apply each coat to uniform finish.
- D. Sand lightly between coats to achieve required finish.
- E. Allow applied coat to dry before next coat is applied.
- F. Prime back surfaces of interior and exterior woodwork with primer paint.

3.5 CLEANING

- A. As Work proceeds, promptly remove paint where spilled, splashed, or spattered.
- B. During progress of Work maintain premises free of unnecessary accumulation of tools, equipment, surplus materials, and debris.
- C. Collect cotton waste, cloths, and material which may constitute a fire hazard, place in closed metal containers and remove daily from site.

3.6 GENERAL FINISH SPECIFICATIONS

- A. Pump Station Int/Ext Doors & Frames
 - 1. Primer: Amerlock 2 Surface Tolerant Epoxy @ 4 to 6 mils DFT
 - 2. Finish: Pitthane Ultra Gloss Urethane @ 2 to 3 mils DFT
- B. Interior Masonry Walls, PT-1
 - 1. Primer: Pitt-Glaze HD Block Filler @ 6.0 to 13.0 mils DFT
 - 2. Intermediate: Pitt-Glaze WB 1 Epoxy S/G @ 1.5 to 3.0 mils DFT
 - 3. Finish: Pitt-Gaze WB 1 Epoxy S/G @ 1.5 to 3.0 mils DFT
- C. Interior Dry Wall, PT-2
 - 1. Primer: PPG 17-921 Seal Grip Acrylic Primer Sealer @ 1.2 to 2.0 mils DFT
 - 2. Intermediate: Pitt-Gaze WB 1 Epoxy S/G @ 1.5 to 3.0 mils DFT
 - 3. Finish: Pitt-Gaze WB 1 Epoxy S/G @ 1.5 to 3.0 mils DFT
- D. Interior Plywood
 - 1. Primer: PPG 17-921 Seal Grip Acrylic Primer Sealer @ 1.2 to 2.0 mils DFT
 - 2. Intermediate: Pitt-Gaze WB 1 Epoxy S/G @ 1.5 to 3.0 mils DFT
 - 3. Finish: Pitt-Gaze WB 1 Epoxy S/G @ 1.5 to 3.0 mils DFT
- E. Interior Conduit
 - 1. Primer: PPG 17-921 Seal Grip Acrylic Primer Sealer @ 1.2 to 2.0 mils DFT
 - 2. Intermediate: Pitt-Gaze WB 1 Epoxy S/G @ 1.5 to 3.0 mils DFT
 - 3. Finish: Pitt-Gaze WB 1 Epoxy S/G @ 1.5 to 3.0 mils DFT
- F. Pump Discharge Tubes (below water line prep SSPC SP-10)
 - 1. Primer: Amerlock 2 Surface Tolerant Epoxy @ 4 to 6 mils DFT
 - 2. Finish: Amerlock 2 Surface Tolerant Epoxy @ 4 to 6 mils DFT

G. Interior Floor Beams

1. Primer: Amerlock 2 Surface Tolerant Epoxy @ 4 to 6 mils DFT
2. Finish: Amerlock 2 Surface Tolerant Epoxy @ 4 to 6 mils DFT

3.7 COLOR SCHEDULE

- A. Contractor to provide color samples to Owner for selection of all colors prior to ordering paint material.

END OF SECTION

SECTION 22 22 23.30

VERTICAL AXIAL FLOW PUMP

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Installing and start-up of three (3) vertical axial flow propeller type pumps, furnished by Owner.
- B. Related Sections:
 - 1. Division 03 - Concrete
 - 2. Division 05 - Metals
 - 3. Division 15 – Mechanical, Piping, Gates
 - 4. Division 26 - Electrical

1.2 UNIT PRICE - MEASUREMENT AND PAYMENT

- A. Axial Flow Pumps, Install Only:
 - 1. Basis of Measurement: At the unit price bid as stated in the Proposal.
 - 2. Basis of Payment: Includes all labor, equipment, and coordination required to install the Owner supplied Vertical Axial Flow Pumps as outlined in the plans and specifications. Includes new dresser band couplers, turnbuckles, and any other required accessories for a complete install as shown on plans.

1.3 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data: Indicate compliance with applicable codes.

1.4 REFERENCES

- A. National Electrical Code
- B. ANSI/NFPA
- C. Underwriters Laboratory

1.5 REGULATORY REQUIREMENTS

- A. Conform to NEC standards.
- B. Conform to MIOSHA standards.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Take delivery of, store, protect and handle products under provisions of Section 01 60 00.
- B. Accept equipment on site, along with Owner present, in original factory packaging; inspecting for damage.

PART 2 - PRODUCTS

2.1 SEE APPENDIX A FOR EQUIPMENT CUTSHEETS

2.2 GENERAL

- A. Each pump is vertical axial flow propeller type with 36" diameter horizontal discharge, capable of pumping screened storm water. Oil lubricated design consisting of a bowl assembly, oils reservoir with solenoid valve and fittings, and headshaft assembly for vertical hollow shaft driver.
- B. Pumps Characteristics:
 - 1. Number of Pump(s): 3
 - 2. 150 HP motor
- C. Shop Painting: The pumps are coated on the interior and exterior surfaces with 2 coats tar epoxy with a minimum total DFT of 16 mils. The motor received a manufacturer's standard factory applied paint finish.

2.3 TRAINING

- A. Manufacturer has provided up to 8 hours on site start-up assistance and training by a factory or authorized representative after installation by Contractor. Contractor shall coordinate with Owner and manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Field verify dimensions and provide any necessary piping modifications prior to installation.
- B. Beginning of installation means acceptance of existing conditions.
- C. Prior to pump start-up, thoroughly inspect pump station wet well and all piping for dirt, debris, garbage, splashed material and damage. Clean or repair accordingly.

3.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions.

- B. Install in accordance with the requirements indicated on the Contract drawings and Engineer approved shop drawings. SEE APPENDIX A for preliminary shop drawings.
- C. Contractor to verify alignment and operation of moving parts.
- D. Verify correct propeller rotation.
- E. Replace damaged components.
- F. Coordinate with piping and electrical work.

3.3 FIELD QUALITY CONTROL

- A. In accordance with Section 01 40 00 – Quality Control.

3.4 ADJUSTING

- A. Adjust work under provisions of Section 01 70 00.
- B. Adjust equipment to achieve specified requirements.

3.5 CLEANING

- A. Prior to project acceptance, inspect site for dirt, debris, garbage, splashed material and damage. Clean or repair accordingly. Remove from the job site all tools, surplus materials, scrap and debris.

END OF SECTION

SECTION 22 63 00
NATURAL GAS PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. This Section includes piping, specialties, and accessories for natural gas systems installed across the site and within building and to gas meters.
- B. Consumers Energy (CMS) shall include provide the gas service.
- C. Gas Service: A standard pressure, 7" water column gas meter, less than 250 CFH, is required.
- D. Gas Service Fees and Gas Installation Work Scope (Contractor's Responsibility):
1. The gas service cost including installation of gas service piping, regulator, and gas meter installation will be a reimbursable expense.
 2. The Mechanical Contractor shall be responsible for coordination of all service and meter work, and the installation of all gas service and distribution piping.
 3. The Mechanical Contractor shall provide Consumers Energy (CMS) receipt for fees for all new gas service work and submit receipt to General Contractor for processing and payment
 4. Gas service fees shall be reimbursed by Owner to the General Contractor for distribution and payment to Mechanical Contractor.
 5. The G.C. (and/or subcontracted Painting Contractor) shall be responsible for including all required exterior gas pipe painting (per 2015 International Fuel Gas Code.)

1.2 SUBMITTALS

- A. Product Data: Piping and valves.
- B. Field Quality-Control Submittals: Indicate results of Contractor furnished tests and inspections.

1.3 QUALITY ASSURANCE

- A. Comply with NFPA 54, "National Fuel Gas Code," for gas piping materials and components; installations; and inspecting, testing, and purging. Comply with applicable parts of NFPA 58.
- B. Comply with NFPA 70, "National Electrical Code," for electrical connections between wiring and electrically operated control devices.
- C. Comply with 2015 International Fuel Gas Code.
- D. Manufacturer: Company specializing in manufacturing products specified in this Section with ten years' experience.

- E. Fabricator: Company specializing in fabricating products specified in this Section with ten years' experience.
- F. Installer: Company specializing in performing Work of this Section with five years' of documented experience.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Store according to manufacturer's instructions.
- B. Protect piping and fittings from water, moisture, corrosion and rust.

1.5 WARRANTY

- A. Furnish two-year contractor warranty for all labor.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Medium Density Polyethylene Piping (MDPE) Underground Gas Piping:
 - a. JM Eagle.
 - b. Creek Plastics.
 - c. Charter Plastics.
 - d. Endot Industries.
 - e. Or Approved Equal.
 - 2. Gas Stops, 2-Inch NPS (DN50) and Smaller.
 - a. Hammond Valve Corp.
 - b. Jomar International, Ltd.
 - c. Maxitrol Co.
 - d. McDonald: A.Y. McDonald Mfg. Co.
 - e. Milwaukee Valve Co., Inc.
 - f. Mueller Co.
 - g. National Meter
 - h. Or Approved Equals.
 - 3. Gas Valves, 2-Inch NPS (DN50) and Smaller:
 - a. Conbraco Industries, Inc.; Apollo Div.
 - b. Watts.
 - c. Core Industries, Inc.; Mueller Steam Specialty Div.
 - d. Huber: J.M. Huber Corp.; Flow Control Div.
 - e. McDonald: A.Y. McDonald Mfg. Co.
 - f. Milliken Valve Co., Inc.

- g. Milwaukee Valve Co., Inc.
- h. Mueller Co.
- i. National Meter.
- j. Nordstrom Valves, Inc.
- k. Olson Technologies, Inc.
- l. Or Approved Equals.
- 4. Gas Valves, 2-1/2-Inch NPS (DN65) and Larger:
 - a. Core Industries, Inc.; Mueller Steam Specialty Div.
 - b. Huber: J.M. Huber Corp.; Flow Control Div.
 - c. Milliken Valve Co., Inc.
 - d. Nordstrom Valves, Inc.
 - e. Olson Technologies, Inc.
 - f. Xomox Corp.
 - g. Watts.
 - h. Or Approved Equals.
- 5. Gas Pressure Regulators
 - a. Pietro Fiorentini.
 - b. Maxitrol
 - c. Sensus
 - d. Or Approved Equals.

2.2 MATERIALS

A. Above Ground Pipes and Tubes:

- 1. Steel Pipe: ASTM A 53; Type E, electric-resistance welded or Type S, seamless; Grade B; Schedule 40; black pipe.
- 2. Pipe and Tube Fittings:
 - a. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern, with threaded ends conforming to ASME B1.20.1.
 - b. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends conforming to ASME B1.20.1.
 - c. Cast-Iron Flanges and Flanged Fittings: ASME B16.1, Classes 125 and 250.
 - d. Steel Fittings: ASME B16.9, wrought steel, butt-welding type; and ASME B16.11, forged steel.
 - e. Steel Flanges and Flanged Fittings: ASME B16.5.
 - f. Joining Materials
- 3. Joint Compound and Tape: Suitable for natural gas.
- 4. Gasket Material: Thickness, material, and type suitable for natural gas.

B. Underground Buried Piping:

- 1. Polyethylene gas piping: ASTM D2513, UAC 2000 medium density, yellow UV stabilized, PE 2406/2708. 1-year warranty.
- 2. Joints: ASTM D2513 butt fusion, socket fusion, or mechanical joint fittings approved as an accessory to pipe manufacturer complying with ASTM D2513 and required operating pressure..
- 3. Fittings: ASTM D2513 socket weld-end transitions, double O-ring design; stab-type mechanical fittings, transitional fittings, approved as an accessory to pipe manufacturer, complying with ASTM D2513 and required operating pressure.

4. Tracer Wire: solid copper, 14 gage, in safety yellow polyethylene sheathing (for installation above non-metallic polyethylene gas piping.) Coordinate w/ CMS installation.

C. Valves

1. Conform to standards listed or, where appropriate, to ANSI Z21.15.
2. Gas Ball Valves:
 - a. 2-Inch NPS (DN50) and Smaller: ASME B16.33
 - b. 2-1/2" and Larger: ASME B16.38.
 - c. 2-piece, 600 psig (1035 kPa) WOG, forged brass body and end adapter, full-port chrome-plated brass ball, virgin PTFE seats and stem packing, blow-out-proof stem with fluorocarbon elastomer O-ring and adjustable packing nut threaded to body with threaded ends conforming to ASME B1.20.1.
 - d. Locking Device: Lockable in closed position.
 - e. Handle: Vinyl insulated heavy duty zinc plated carbon steel.

D. Gas Governors and Regulators

1. High performance industrial gas governor natural gas line pressure governor. CSA approved with external vent limiter for indoor installation. Double diaphragm, 500-1 turndown. Complete lockup bubble tight shut-off, with weather cap for outdoor installation.
2. Certified to ANSI Z21.80A2005, CSA 6.22a-2005 Class 1 for pressures as noted on Gas Regulator Schedule.
3. Body & Cover: aluminum alloy.
4. External Coatings: polyurethane paint
5. Diaphragm, O-Rings & Valve: nitrile rubber.
6. Diaphragm Pan: aluminized steel.

2.3 FINISHES

- A. Paint all interior and exterior natural gas piping using high gloss safety yellow interior/exterior oil-based paint. Rustoleum Professional High Performance Protective Enamel, 242258 Safety Yellow. Or Approved Equal.
- B. If a painting contractor is not part of the general trades subcontract the Plumbing Contractor must subcontract a licensed Painting Contractor to perform the application of all painting.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify all piping is free of grease, rust, and corrosion.

3.2 PREPARATION

- A. Close equipment shutoff valves before turning off gas to premises or section of piping. Perform leakage test as specified in "Field Quality Control" Article to determine that all equipment is turned off in affected piping section.
- B. Comply with NFPA 54 Paragraph "Prevention of Accidental Ignition."

3.3 SERVICE ENTRANCE PIPING

- A. Install shutoff valve, downstream from gas meter, outside building at gas service entrance.

3.4 PIPING APPLICATIONS

- A. General: Flanges, unions, transition and special fittings, and valves with pressure ratings same as or higher than system pressure rating may be used in applications below, except where otherwise indicated.
 - 1. 1-Inch NPS (DN25) and Smaller: Steel pipe, malleable-iron threaded fittings, and threaded joints.
 - 2. 1-1/4- to 2-Inch NPS (DN32 to DN50): Steel pipe, malleable-iron threaded fittings, and threaded joints.
 - 3. 2-1/2- to 4-Inch NPS (DN65 to DN100): Steel pipe, butt-welding fittings, and welded joints.

3.5 VALVE APPLICATIONS

- A. Use gas stops for shutoff to appliances with 2-inch NPS (DN50) or smaller low-pressure gas supply.

3.6 PIPING INSTALLATIONS

- A. Underground gas piping: Pipe, fittings, and the installation shall meet the applicable requirements of the U. S. Department of Transportation, Pipeline Safety Regulations, Title 49, Code of Federal Regulations, Part 192. Private systems shall meet relevant requirements of NFPA 54/ANSI Z223.1, or NFPA 58, or ASME B31.8.
 - 1. Trench, install, and backfill piping in strict accordance with manufacturer installation instructions.
 - 2. Bury piping 24" nominal below grade, and no less than 12" below grade in all locations. Coordinate final installation depth with General Contractor and Site Contractor.
 - 3. Install yellow barrier tracer wire a minimum 12" above gas piping.
- B. Concealed Locations (if applicable): Except as specified below, install concealed gas piping in airtight conduit constructed of Schedule 40, seamless, black steel pipe or Schedule 40, PVC DWV pipe with welded joints. Vent conduit to outside and terminate with screened vent cap. Install as detailed on drawings.
 - 1. Above-Ceiling Locations: Gas piping may be installed in accessible spaces, subject to approval of authorities having jurisdiction. Gas piping is not approved in return air plenum ceilings.
 - 2. Prohibited Locations: Do not install gas piping in walls or under floors.
 - a. Exception: Accessible above-ceiling space specified above.
 - b. Exception: Tubing passing through partitions or walls.
 - c. Exception: In vented sleeve as indicated above and on the drawings.
- C. Drips and Sediment Traps: Install drips at points where condensate may collect. Include outlets of gas meters. Locate where readily accessible to permit cleaning and emptying. Do not install where condensate would be subject to freezing.
 - 1. Construct drips and sediment traps using tee fitting with bottom outlet plugged or capped. Use minimum-length nipple of 3 pipe diameters, but not less than 3 inches (75 mm) long,

and same size as connected pipe. Install with space between bottom of drip and floor for removal of plug or cap.

- D. Install gas piping at uniform grade of 0.1 percent slope upward toward risers.
- E. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.
- F. Connect branch piping from top or side of horizontal piping.
- G. Install unions in pipes 2-inch NPS (DN50) and smaller, adjacent to each valve, at final connection to each piece of equipment, and elsewhere as indicated. Unions are not required on flanged devices.
- H. Install dielectric fittings (unions and flanges) with ferrous and brass or bronze end connections, separated by insulating material, where piping of dissimilar metals is joined.
- I. Install dielectric fittings (unions and flanges) with 2 ferrous end connections, separated by insulating material, at outlet from gas meter.
- J. Install flanges on valves, specialties, and equipment having 2-1/2-inch NPS (DN65) and larger connections.
- K. Anchor piping to ensure proper direction of piping expansion and contraction. Install expansion joints, expansion loops, and pipe guides as indicated.
- L. Install vent piping for gas pressure regulators and gas trains, extend outside building, and vent to atmosphere. Terminate vents with turned-down, reducing-elbow fittings with corrosion-resistant insect screens in large end.
- M. Where elevated gas pressure greater than 7" water column, install pressure reducing valves per manufacturer installation instructions, and vent to atmosphere as needed.

3.7 JOINT CONSTRUCTION

- A. Use materials suitable for natural gas service.

3.8 VALVE INSTALLATION

- A. Install valves in accessible locations, protected from damage. Tag valves with metal tag indicating piping supplied. Attach tag to valve with metal chain.
- B. Install gas valve upstream from each gas pressure regulator. Where 2 gas pressure regulators are installed in series, valve is not required at second regulator.
- C. Install pressure relief or pressure-limiting devices so they can be readily operated to determine if valve is free; test to determine pressure at which they will operate; and examine for leakage when in closed position.

3.9 GAS REGULATOR INSTALLATION

- A. Check and verify correct pressure outlet spring is installed.
- B. Install regulators and accessory over-pressure device, monitoring regulator and associated monitoring piping in strict accordance with manufacturer installation instructions.
- C. Install per NFPA 54.
- D. Install weather cap for outdoor installation.
- E. Ensure relief valve is capped for indoor installation (for ventless regulators only.) Provide schedule 40 black iron vent piping, and vent to outdoors where vented regulators are scheduled.
- F. Do not paint regulators.
- G. Pressure test piping connections.
- H. Test outlet pressure for correct equipment inlet pressure range.

3.10 HANGER SUPPORT AND INSTALLATION

- A. Install hangers for horizontal steel piping with the following maximum spacing and minimum rod sizes:
 - 1. 1/2-Inch NPS (DN15): Maximum span, 72 inches (1829 mm); minimum rod size, 3/8 inch (10 mm).
 - 2. 3/4- and 1-Inch NPS (DN20 and DN25): Maximum span, 96 inches (2438 mm); minimum rod size, 3/8 inch (10 mm).
 - 3. 1-1/4-Inch NPS (DN32): Maximum span, 108 inches (2743 mm); minimum rod size, 3/8 inch (10 mm).
 - 4. 1-1/2- and 2-Inch NPS (DN40 and DN50): Maximum span, 108 inches (2743 mm); minimum rod size, 3/8 inch (10 mm).
 - 5. 2-1/2- to 3-1/2-Inch NPS (DN65 to DN90): Maximum span, 10 feet (3 m); minimum rod size, 1/2 inch (13 mm).

3.11 CONNECTIONS

- A. Connect gas piping to equipment and appliances using gas with shutoff valves and unions. Install gas valve upstream from and within 72 inches (1800 mm) of each appliance using gas. Install union or flanged connection downstream from valve. Include flexible connectors when indicated.
- B. Sediment Traps: Install tee fitting with capped nipple in bottom forming drip, as close as practical to inlet for appliance using gas.

3.12 ELECTRICAL BONDING AND GROUNDING

- A. Install aboveground portions of natural gas piping systems that are upstream from equipment shutoff valves, electrically continuous, and bonded to grounding electrode according to NFPA 70.

- B. Do not use gas piping as grounding electrode.

3.13 FIELD QUALITY CONTROL

- A. Inspect, test, and purge piping according to NFPA 54, Part 4 "Gas Piping Inspection, Testing, and Purging" and requirements of authorities having jurisdiction.
- B. Repair leaks and defects with new materials and retest system until satisfactory results are obtained.
- C. Verify capacities and pressure ratings of gas meters, regulators, valves, and specialties.
- D. Verify correct pressure settings for pressure regulators.
- E. Verify that specified piping tests are complete.

3.14 ADJUSTING

- A. Adjust controls and safety devices. Replace damaged and malfunctioning controls and safety devices.

3.15 CLEANING

- A. Clean piping free of oil and grime prior to applying protective safety paint.

END OF SECTION

SECTION 23 00 00

HVAC

PART 1 - GENERAL

1.1 SUMMARY

- A. This Division includes all materials, labor, equipment, tools, supervision, permits, and incidentals necessary to complete installation, test, start up, and operate in a practical and efficient manner all Mechanical Systems indicated on the Drawings and described in this Division. The work shall also include any items which, while not specifically included in the Contract Documents but are reasonable and are accepted trade practices or necessary for the proper completion of the systems.
- B. Mechanical systems in the Contract shall include the following: HVAC systems including all equipment, temperature controls, ductwork, piping, and insulation indicated on the drawings and the specifications.
- C. The General Provisions of this Contract, including General and Supplementary Conditions and other General Requirements Sections, apply to the Work specified in this Section.
- D. This Section is not intended to supersede, but to clarify the definitions in Division 1, General Requirements and Supplementary Conditions.
- E. Drawings and Specifications
 - 1. Drawings and Specifications are intended to supplement each other, and all work specified or indicated in either shall be provided.
 - 2. Drawings are diagrammatic and indicate general arrangement of work included in the Contract and shall serve only as design drawings and not as working drawings, for general layout of various equipment and systems. Should drawings disagree in themselves or with Specifications, the better quality or greater quantity of work shall be provided.
 - 3. Separate specifications over the other trades. The Mechanical Contractor shall familiarize himself with these other specifications.
 - 4. Should there be any question as to the scope of work for which the Mechanical Contractor is responsible, he shall request an interpretation before submitting his bid. After contracts are awarded, the Owner will not consider claims for extras because of the incomplete joining of the work of one contractor (or subcontractor) with another.

1.2 UNIT PRICE – MEASUREMENT AND PAYMENT

- A. HVAC System:
 - 1. Basis of Measurement: At the lump sum price bid as stated in the proposal.
 - 2. Basis of Payment: Includes all labor, equipment, and material to supply and install the proposed HVAC system as shown on plans complete.

1.3 COORDINATION OF MECHANICAL WORK

A. Responsibility

1. The Mechanical Contractor shall be responsible for all Subcontractors and Suppliers, and include in his bid all materials, labor and equipment involved in accordance with all local regulations, jurisdictional awards, and decisions and secure compliance of all parts of the Specifications and Drawings regardless of Sectional inclusion in these Specifications.
2. The Mechanical Contractor and Subcontractor shall be responsible for all parts applicable to his trade in accordance with the Specifications and Drawings, and shall be responsible for coordinating locations and arrangements of his work with all other relevant Architectural, Structural and Electrical Contractor's Specifications, Drawings and Shop Drawings

B. Site and Project Document Examination:

1. Submission of a Bid Proposal is considered evidence that the Contractor has visited the site, examined the Drawing and Specifications of all trades and has fully informed himself as to project and site conditions and is proficient, experienced and knowledgeable of all state, local and federal standards, codes, ordinances, permits, and regulations which affect every Subcontractors completion, cost and time required and that all costs are included in his Bid Proposal.

C. General Supports:

1. Mechanical Contractor shall provide all necessary channel, angle, brackets or supplementary steel as required for adequate support for all piping, specialties, and equipment, which is hung or mounted above floor, and secure approval from Architect or Engineer, in writing, before welding or bolting to steel framing or anchoring to concrete structure.
2. Where piping or equipment is suspended from concrete construction, set approved concrete inserts in formwork to receive hanger rods, such as Unistrut and where installed in metal deck use Ramset or Welds as required.

D. Wall, Floor and Ceiling & Roof Openings:

1. Locate all openings and advise the General Contractor of details and templates of all openings necessary for inspection of mechanical work.
2. In general, openings and required lintels shall be provided by the General Contractor. Size and location is the responsibility of the Mechanical Contractor. Cracks and rough edges left following installation of equipment shall be caulked or covered by the Mechanical Contractor.

E. Field Changes:

1. The Contractor shall not make any field changes that effect timing, costs or performance without written approval from the Architect/Engineer in the form of a Change Order, Field Change Order or a Supplemental Instruction. The Contractor assumes liability for any additional costs for changes made without such instruction or approval. Should any unauthorized change be determined by the Architect as lessening the value of the project, a credit will be determined and issued as a change to the Contract.

1.4 STANDARDS, CODES AND PERMITS:

- #### A. Refer to Division 1, General Requirements and Supplementary Conditions.

- B. The Mechanical Contractor and his Subcontractors shall obtain all required permits and assessments prior to any work beginning. Contractor shall verify requirement to include privilege fees and permits as part of his formal bid.
- C. All work shall comply with the latest edition of applicable standards and codes of following:
 - 1. ASA American Standards Association
 - 2. ASME American Society of Mechanical Engineers
 - 3. ASTM American Society of Testing Materials
 - 4. ANSI American National Standards Institute
 - 5. AGA American Gas Association
 - 6. ASHRAE American Society of Heating, Refrigerating, and Air Conditioning Engineers
 - 7. AWWA American Water Works Association
 - 8. NFPA National Fire Protection Association
 - 9. IBR Institute of Boiler and Radiator Manufacturers
 - 10. AWS American Welding Society
 - 11. UL Underwriter s Laboratories
 - 12. NEMA National Electric Manufacturers Association
 - 13. NEC National Electric Code
 - 14. ARA American Refrigeration Association
 - 15. OSHA Occupational Safety and Health Act
 - 16. MIOSHA Michigan Occupational Safety and Health Act
 - 17. ABMA American Boiler Manufacturers Association
 - 18. International Mechanical Code 2015
 - 19. International Plumbing Code 2015
- D. All work shall be provided and tested in accordance with all applicable local county, state laws, ordinances, codes, rules and regulations.
- E. No work shall be covered or enclosed until the work is tested in accordance with applicable codes and regulations, and successful tests witnessed and approved by authorized inspection authority. Written approvals shall be secured by Contractor and submitted to Engineer before final acceptance of work.

1.5 SUBMITTALS:

- A. Shop Drawings:
 - 1. Submit electronic PDF copy of equipment and associated materials and equipment to Architect or Engineer for review.
 - 2. Submit complete manufacturers shop drawings of all equipment, accessories and controls, including capacities, weights, dimensions, construction details, installation, controls, wiring diagrams, and motor data.
 - 3. Review of shop drawings is for general application only and is a service only and not considered as a guarantee of total compliance with or as relieving Contractor of basic responsibilities under all Contract Documents and does not approve changes in time or cost.
 - 4. Each Contractor is responsible to provide information to all other trades involved in or affected by installation of his equipment.
- B. Operating and Maintenance Instruction and Manuals:

1. Each Contractor shall provide for all major items of equipment (3) bound and indexed sets of operating and maintenance instructions to Engineer for approval. Manual shall include a complete set of shop drawings.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT:

A. Proposal Supplement:

1. Contractor to submit a supplemental document which lists the Mechanical Equipment and Materials Manufacturers, and Subcontractors list with the bid document.
2. After Proposal Supplement and Subcontractors are approved, no deviation shall be permitted without written approval of Engineer or Owner.

B. Standards:

1. All products shall be furnished by established manufacturers regularly engaged in making the type of materials to be provided and complete with all parts, accessories, connections, etc. as specified or as recommended and/or required by the manufacturer.
2. All material where applicable shall be labeled or listed by Underwriters Laboratories, Inc.
3. Erect equipment in a neat and workmanlike manner. Align, level and adjust for satisfactory operation. Install so that connecting and disconnecting of piping and accessories can be made readily, and so that parts are easily accessible for inspection, operation, maintenance and repair. Minor deviation from arrangements may be made, as approved.

C. Base Bid:

1. The Mechanical Contractor shall refer to the Mechanical Schedules and Specifications for approved equipment manufacturers. Contractor shall submit for Approved Equals during the bidding process.
2. Where base bid is not listed in specifications and if another manufacturer is listed as an approved equal, equipment from these manufacturers will be accepted contingent upon meeting the design, appearance, and functional standards established by the specified items.
3. The Contractor is liable for any added costs to himself or others and is responsible for verifying dimensions, clearance and roughing-in requirements and is responsible for advising other Contractors of variations and shall submit revised drawing layout for approval of Engineer.

D. Substitutions and Changes:

1. The Contractor shall bid the project in strict accordance with the Plans, Schedules, and Specifications. Alternative materials or methods proposed by the Mechanical Contractor shall be submitted in writing to the Engineer at least 3 Days Prior to the Bid due date and shall be preapproved for bidding. Failure to receive pre-approval will disqualify the Bid.
2. The Contractor is liable for any added costs to himself or others and is responsible for verifying dimensions, clearance and roughing-in requirements, when product not named as the basis of design is used and is responsible for advising other Contractors of variations and, if requested, submit revised drawing layout for approval of Architect.
3. Work required by Engineer to revise drawings or re-engineer mechanical systems required by equipment substituted by the Contractor or them base bid shall be paid by the Contractor to the Engineer on an hourly rate basis.

2.2 ELECTRICAL REQUIREMENTS FOR MECHANICAL WORK

A. General:

1. When the Mechanical equipment not named as the basis of design is approved for use, the Mechanical Contractor is responsible for any costs incurred by other trades, including revisions to the Electrical requirements such as conduit, wire, starters, heaters, fused switches, disconnects, or circuit breakers.
2. Electrical items furnished shall bear the Underwriter s Laboratories label and the installation shall comply with requirements of the National Electric Code, ANSI, IPCEA, IRI, and local codes, ordinances and regulations.

B. Motor Starters and Controls:

1. Unless specifically listed to be provided as an accessory to the equipment (such as roof top units, make-up air units, etc.), the Electrical Contractor shall provide all manual or magnetic motor starters as required for all motors as indicated on all Electrical Drawings.
2. Mechanical Contractor shall provide factory installed motor starters, disconnects, and convenience outlets where scheduled to be provided as an accessory to the unit. See equipment schedules.
3. The Mechanical Contractor shall provide variable frequency drives (VFDs) where scheduled to be provided as an accessory to the unit unless otherwise specified or if coordinated with the Electrical Contractor.
4. The Mechanical Contractor, Temperature Control Contractor, Equipment Supplier, and Electrical Contractor are responsible to coordinate and ensure all electrical accessories are included as part of the Base Bid.

C. Electrical Wiring and Controls:

1. Mechanical Contractor shall furnish and install all motors, drives, controllers integral to equipment and factory mounted controls for all mechanical equipment.
2. Mechanical Contractor or Temperature Control Contractor shall furnish and install all electrical devices requiring mechanical connections, and/or electrical connections, such as pressure switches, limit switches, float switches, solenoid valves, motor operated valves, motor operated dampers, fire stats, freeze stats, thermostats, override timers, E.P. s, P.E. s, temperature control cabinet, air compressor with starter, etc.
3. Temperature Control Contractor or Mechanical Contractor shall furnish and install all power and Class 2 and 3 wiring, conduit boxes for their associated equipment.
4. Electrical Contractor shall install all power wiring, conduit to motors and/or factory mounted control panels as indicated on Electrical Drawings or as indicated in Specifications.
5. All electrical wiring work by Mechanical Contractor and Temperature Control Contractor shall be in accordance with Division 26 requirements.

D. See also, Division 26, Electrical Requirements for Mechanical Equipment.

END OF SECTION

SECTION 23 05 29

HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pipe hangers and supports.
2. Hanger rods.
3. Inserts.
4. Flashing.
5. Equipment curbs.
6. Sleeves.
7. Mechanical sleeve seals.
8. Formed steel channel.
9. Firestopping and accessories for HVAC Work.
10. Equipment bases and supports.

B. Related Requirements:

1. Section 03 10 00 - Concrete Forming and Accessories.
2. Section 03 30 00 - Cast-in-Place Concrete.
3. Section 09 90 00 - Painting and Coating.
4. Section 23 31 00 - HVAC Ducts and Casings.
5. Section 23 33 00 - Air Duct Accessories.
6. Section 23 34 23 - HVAC Power Ventilators.
7. Section 23 37 00 - Air Outlets and Inlets.
8. Section 23 74 00 - Packaged Outdoor HVAC Equipment.

1.2 UNIT PRICE – MEASUREMENT AND PAYMENT

A. Concrete Work:

1. Basis of Measurement: Included in other pay items for this project.
2. Basis of Payment: Includes all associated labor, materials, equipment, placement, etc. for a complete installation.

1.3 MSS STANDARD COMPLIANCE: Comply with the following:

- A. Provide pipe hangers and supports on which materials, design, and manufacture comply with MSS SP-58.
- B. Select and apply pipe hangers and supports, complying with MSS SP-69.
- C. Fabricate and install pipe hangers and supports, complying with MSS SP-89.

- D. Terminology used in this section is defined in MSS SP-90. ABOVE STANDARDS ARE AVAILABLE FROM MSS (MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY, INC.).
- E. Regulatory Requirements: Comply with appliance plumbing codes pertaining to product materials and installation of supports and anchors.
- F. NFPA Compliance: Hangers and supports shall comply with NFPA standard No. 13 when used as a component of a fire protection system.
- G. UL and FM Compliance: Hangers, supports, and components shall be listed and labeled by UL and FM where used for fire protection piping systems.
- H. Submittals: Submit manufacturer's technical product data, including installation instructions; shop drawings; and maintenance data for each type of support and anchor

1.4 DEFINITIONS

- A. Firestopping (Through-Penetration Protection System): The material used to seal or stuff or an assembly placed in spaces between and penetrations through building materials to arrest movement of fire, smoke, heat, and hot gases through fire-rated construction.

1.5 REFERENCE STANDARDS

- A. American Welding Society:

- 1. AWS D1.1/D1.1M - Structural Welding Code - Steel.

- B. ASME International:

- 1. ASME B31.1 - Power Piping.
 - 2. ASME B31.5 - Refrigeration Piping and Heat Transfer Components.
 - 3. ASME B31.9 - Building Services Piping.

- C. ASTM International:

- 1. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials.
 - 2. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems.
 - 3. ASTM E1966 - Standard Test Method for Fire-Resistive Joint Systems.
 - 4. ASTM F708 - Standard Practice for Design and Installation of Rigid Pipe Hangers.

- D. FM Global:

- 1. FM - Approval Guide.

- E. Intertek Testing Services (Warnock Hersey Mark):

- 1. WH-ETL - Product Directory.

F. Manufacturers Standardization Society of the Valve and Fittings Industry:

1. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation.

G. UL:

1. UL - Fire-resistance-rated Systems and Products.
2. UL 263 - Fire Tests of Building Construction and Materials.
3. UL 1479 - Fire Tests of Through-Penetration Firestops.
4. UL 2079 - Tests for Fire Resistance of Building Joint Systems.

1.6 PREINSTALLATION MEETINGS

A. Section 01 30 00 - Administrative Requirements: Requirements for preinstallation meeting.

B. Convene minimum one week prior to commencing Work of this Section.

1.7 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Product Data:

1. Hangers and Supports: Submit manufacturer's catalog information, including load capacity.
2. Firestopping: Submit information on product characteristics, performance, and limitations.

C. Shop Drawings:

1. Indicate system layout with location, including critical dimensions and sizes.
2. Indicate pipe hanger and support locations, and detail of trapeze hangers.

D. Firestopping Schedule: Submit schedule of opening locations and sizes, penetrated items, and specified design numbers to seal openings to maintain fire-resistance rating of adjacent assembly.

E. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

F. Delegated Design Submittals:

1. Submit signed and sealed Shop Drawings with design calculations and assumptions for load-carrying capacity of trapeze, multiple-pipe, and riser support hangers.
2. Submit sizing methods and calculations sealed by a registered professional engineer (P.E.).
3. Firestopping Engineering Judgments: For conditions not covered by UL or WH-ETL listed designs, submit judgments by licensed P.E. suitable for presentation to authority having jurisdiction for acceptance as meeting fire protection code requirements.

G. Manufacturer Instructions:

1. Hangers and Supports: Submit special procedures and assembly of components.

2. Firestopping: Submit preparation and installation instructions.
- H. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.
- I. Qualifications Statements:
1. Submit qualifications for manufacturer, installer, and licensed professional.
 2. Submit manufacturer's approval of installer.
 3. Welders: Qualify procedures and personnel according to AWS D1.1/D1.1M.

1.8 QUALITY ASSURANCE

- A. Through-Penetration Firestopping of Fire-Rated Assemblies:
1. Comply with UL 1479 and ASTM E814.
 2. Positive Pressure Differential:
 - a. As required to achieve fire F-ratings and temperature T-ratings as indicated on Drawings, but not less than one hour.
 - b. Minimum 0.10 inch wg.
 3. Wall Penetrations: Fire F-ratings as indicated on Drawings, but not less than one hour.
 4. Floor and Roof Penetrations:
 - a. Fire F-ratings and temperature T-ratings as indicated on Drawings, but not less than one hour.
 - b. Floor Penetrations within Wall Cavities: T-rating not required.
- B. Through-Penetration Firestopping of Non-fire-rated Floor and Roof Assemblies:
1. Materials: Resist free passage of flame and products of combustion.
 2. Noncombustible Penetrating Items: Connecting maximum three stories.
 3. Penetrating Items: Materials approved by authorities having jurisdiction for connecting maximum two stories.
- C. Fire-Resistive Joints in Fire-Rated Floor, Roof, and Wall Assemblies:
1. Comply with ASTM E1966 and UL 2079.
 2. As required to achieve fire-resistance rating as indicated on Drawings for assembly in which joint is installed.
- D. Fire-Resistive Joints between Floor Slabs and Exterior Walls:
1. Comply with ASTM E119.
 2. Positive Pressure Differential:
 - a. As required to achieve fire F-ratings and temperature T-ratings as indicated on Drawings for floor assembly.
 - b. Minimum 0.10 inch wg.

E. Surface-Burning Characteristics:

1. Maximum 25/450 flame-spread/smoke-developed index.
2. Testing: Comply with ASTM E84.

F. Welding of Hanger and Support Attachments to Building Structure: Comply with applicable authority and AWS D1.1/D1.1M.

G. Perform Work according to local construction standards.

H. Maintain 2 copies of each standard affecting Work of this Section on Site.

1.9 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum ten years' documented experience.

B. Installer: Company specializing in performing Work of this Section with minimum five years' documented experience and approved by manufacturer.

C. Welders: AWS qualified within previous 12 months for employed weld types.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.

C. Store materials according to manufacturer instructions.

D. Protection:

1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
2. Provide additional protection according to manufacturer instructions.

1.11 AMBIENT CONDITIONS

A. Section 01 50 00 - Temporary Facilities and Controls: Requirements for ambient condition control facilities for product storage and installation.

B. Minimum Conditions:

1. Do not apply firestopping materials if temperature of substrate material and ambient air is below 60 degrees F.
2. Maintain this minimum temperature before, during, and for minimum three days after installation of firestopping materials.

- C. Provide ventilation in areas to receive solvent cured materials.

1.12 EXISTING CONDITIONS

A. Field Measurements:

1. Verify field measurements prior to fabrication.
2. Indicate field measurements on Shop Drawings.

1.13 WARRANTY

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for warranties.
- B. Furnish five-year manufacturer's warranty for pipe hangers and supports.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. Except as otherwise indicated, provide factory-fabricated pipe hangers and supports complying with MSS SP-58, of one of the following MSS types listed, selected by Installer to suit piping systems, in accordance with MSS SP-69 and manufacturer's published product information. Use only one type by one manufacturer for each piping service. Select size of hangers and supports to exactly fit pipe size for bare piping, and to exactly fit around piping insulation with saddle or shield for insulated piping. Provide copper-plated hangers and supports for copper-piping systems.
- B. Horizontal-Piping Hangers and Supports:
- C. Adjustable Steel Clevis Hangers: MSS Type 1.
- D. Adjustable Steel Band Hangers: MSS Type 7.
- E. Adjustable Band Hangers: MSS Type 9.
- F. Adjustable Swivel Rings, Band Type: MSS Type 10.

2.2 VERTICAL-PIPING CLAMPS:

- A. Two-Bolt Riser Clamps: MSS Type 8.
- B. Four-Bolt Riser Clamps: MSS Type 42.

2.3 HANGER-ROD ATTACHMENTS:

- A. Steel Turnbuckles: MSS Type 13.
- B. Steel Clevises: MSS Type 14.
- C. Swivel Turnbuckles: MSS Type 15.

- D. Malleable Iron Sockets: MSS Type 16.
- E. Steel Weldless Eye Nuts: MSS Type 17.

2.4 BUILDING ATTACHMENTS:

- A. Concrete Inserts: MSS Type 18.
- B. Top Beam C-Clamps: MSS Type 19.
- C. Side Beam or Channel Clamps: MSS Type 20.
- D. Center Beam Clamps: MSS Type 21.
- E. Welded Beam Attachments: MSS Type 22.
- F. C-Clamps: MSS Type 23.
- G. Top Beam Clamps: MSS Type 25.
- H. Side Beam Clamps: MSS Type 27.
- I. Steel Beam Clamps W/Eye Nut: MSS Type 28.
- J. Linked Steel Clamps W/Eye Nut: MSS Type 29.
- K. Malleable Beam Clamps: MSS Type 30.

2.5 MANUFACTURERS OF HANGERS AND SUPPORTS

- A. Manufacturers
 - 1. Miro Industries
 - 2. Cooper
 - 3. Pate Company
 - 4. MiFab
 - 5. Carpenter and Patterson
 - 6. or Approved Equal.
- B. Pipe Guides
 - 1. Provide factory-fabricated guides, of cast semi-steel or heavy fabricated steel, consisting of bolted two-section outer cylinder and base with two-section guiding spider bolted tight to pipe. Size guide and spiders to clear pipe and insulation (if any), and cylinder. Provide guides of length recommended by manufacturer to allow indicated travel.
- C. Pipe Curb Assembly
 - 1. Pipe curb assembly shall be Pate pca, or equal, 18 gauge galvanized steel, unitized construction with integral base plate insulated with 3 @ density insulation, 2 x 3 nailer, acrylic clad ABS plastic cover, fastening screws, graduated step boots with stainless steel clamps.

- D. Multiple Pipe Curb Assembly
 - 1. Heavy gauge galvanized steel, unitized, full mitered corners, all seams welded, 1-1/2" thick rigid fiberboard insulation, 2 x 4 wood nailer strip, acrylic lad ABS plastic covers, PVC boots and stainless steel clamps.
- E. Rooftop Equipment Support Curbs or Rails
 - 1. Furnish where shown or required. Equal to Pate Model ES-5A, minimum 14" high. Curbs shall be designed to support the equipment it supports on the structure as shown on plans.
- F. Rooftop Equipment Piping Support
 - 1. 100% recycled rubber with 1-1/2" galvanized strut and fastener.
 - 2. Minimum 4" height (above roof).
- G. Specification for Pipe Pier Roof Pipe Supports
 - 1. Piping on roof surfaces may be supported by a polyethylene foam block with an integral strut channel for receiving standard strut clamps and accessories. Pipe Pier shall be installed according to manufacturer's recommendations. Roof pipe supports shall be spaced according to industry standards and shall be installed to allow for expansion and contraction. Acceptable Manufacturer: Erico.

2.6 DESCRIPTION

A. Firestopping Materials:

- 1. Comply with ASTM E119, ASTM E814, UL 263, and UL 1479.
- 2. Adjacent Construction:
 - a. Achieve fire ratings as indicated on Drawings for adjacent construction.
 - b. Minimum Fire Rating: 3 hours.

B. Firestopping Materials:

- 1. Comply with ASTM E119, ASTM E814, UL 263, and UL 1479.
- 2. Adjacent Construction:
 - a. Achieve fire ratings according to indicated applicable FM, UL, and WH-ETL Design Numbers.

C. Firestop interruptions to fire-rated assemblies, materials, and components.

2.7 PERFORMANCE AND DESIGN CRITERIA

A. Firestopping:

- 1. Comply with applicable code FM, UL, and WH-ETL for fire-resistance ratings and surface-burning characteristics.
- 2. Provide certificate of compliance from authority having jurisdiction indicating approval of materials used.

2.8 FIRESTOPPING

A. Manufacturers:

1. Hilti USA.
2. 3M.
3. Or Approved Equals

Furnish materials according to NFPA standards.

B. Description:

1. Various types of products by multiple manufacturers are acceptable as required to meet specified system description and performance requirements.
2. Provide only one type for each similar application.
3. Silicone Elastomeric Firestopping: Single or Multiple-component silicone elastomeric compound and compatible silicone sealant.
4. Foam Firestopping Compounds: Single or Multiple-component foam compound.
5. Formulated Firestopping Compound of Incombustible Fibers: Formulated compound mixed with incombustible non-asbestos fibers.
6. Fiber Stuffing and Sealant Firestopping: Composite of mineral-fiber stuffing insulation with silicone elastomer for smoke stopping.
7. Mechanical Firestopping Device with Fillers: Mechanical device with incombustible fillers and silicone elastomer, covered with sheet stainless-steel jacket, joined with collars, and penetration sealed with flanged stops.
8. Intumescent Firestopping: Intumescent putty compound which expands on exposure to surface heat gain.
9. Firestop Pillows: Formed mineral-fiber pillows.

C. Color: Dark gray or as selected from manufacturer's full range of colors.

2.9 FIRESTOPPING ACCESSORIES

A. Primer: Type as recommended by firestopping manufacturer for specific substrate surfaces and as suitable for required fire ratings.

B. Permanent Dam Material:

1. Mineral fiberboard.
2. Mineral fiber matting.
3. Sheet metal.
4. Plywood or particle board.
5. Alumina silicate board.
6. As approved by NFPA and AHJ.

C. Installation Accessories: Provide clips, collars, fasteners, temporary stops or dams, and other devices required to position and retain materials in place.

D. General:

1. Furnish UL-listed products.
2. Select products with rating not less than rating of wall or floor being penetrated.

E. Nonrated Surfaces:

1. Covering for Openings in Occupied Areas Where Piping is Exposed: Stamped-steel, chrome-plated, hinged, split-ring escutcheons, or floor or ceiling plates.
2. Exterior Wall Openings below Grade: Furnish mechanical sealing device to continuously fill annular space between piping and cored opening or waterstop-type wall sleeve.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation examination.
- B. Verify that openings are ready to receive sleeves.
- C. Verify that openings are ready to receive firestopping.

3.2 PREPARATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation preparation.
- B. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other matter that may affect bond of firestopping material.
- C. Remove incompatible materials that may affect bond.
- D. Install backing or damming materials to arrest liquid material leakage.
- E. Do not drill or cut structural members.

3.3 INSTALLATION

- A. Inserts:
 1. Install inserts for placement in concrete forms.
 2. Install inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
 3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe 4 inches and larger.
 4. If concrete slabs form finished ceiling, locate inserts flush with slab surface.
 5. If inserts are omitted, drill through concrete slab and coordinate with Structural Engineer.

6. Install building attachments at required locations within concrete or on structural steel for proper piping support. Space attachments within maximum piping span length indicated in MSS SP-69. Install additional building attachments where support is required for additional concentrated loads, including valves, flanges, guides, strainers, expansion joints, and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts securely to forms. Where concrete with compressive strength less than 2500 psi is indicated, install reinforcing bars through openings at top of inserts.
7. Install hangers, supports, clamps and attachments to support piping properly from building structure; comply with MSS SP-69. Arrange for grouping of parallel runs of horizontal piping to be supported together on trapeze type hangers where possible. Install supports with maximum spacings complying with MSS SP-69. Where piping of various sizes is to be supported together by trapeze hangers, space hangers for smallest pipe size or install intermediate supports for smaller diameter pipe. Do not use wire or perforated metal to support piping, and do not support piping from other piping.
8. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers and other accessories. Except as otherwise indicated for exposed continuous pipe runs, install hangers and supports of same type and style as installed for adjacent similar piping.
9. Prevent electrolysis in support of copper tubing by use of hangers and supports which are copper plated, or by other recognized industry methods.
10. Field-Fabricated, Heavy-Duty Steel Trapezes: Fabricate from steel shapes selected for loads required; weld steel in accordance with AWS D-1.1.
11. Support fire protection systems piping independently from other piping systems.
12. Load Distribution: Install hangers and supports so that piping live and dead loading and stresses from movement will not be transmitted to connected equipment.
13. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes.
14. Install hangers and supports to allow controlled movement of piping systems and to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends and similar units. Install hangers and supports so that piping live and dead loading and stresses from movement will not be transmitted to connected equipment.
15. Install hangers and supports to provide indicated pipe slopes, and so that maximum pipe deflections allowed by ANSI B31 Pressure Piping Codes are not exceeded.
16. Comply with the following installation requirements for insulated piping:
 - a. Clamps: Attach clamps, including spacers (if any), to piping with clamps protecting through insulation; do not exceed pipe stresses allowed by ANSI B31. Do not use wall mounted clamps to support exposed piping.
 - b. Shields: Install protective shields MSS Type 40 on cold water piping that has vapor barrier. Shield shall span an arc of 180 degrees.
17. Install anchors at proper locations to prevent stresses from exceeding those permitted by ANSI B31, and to prevent transfer of loading and stresses to connected equipment.
18. Install anchors where not otherwise indicated, at ends of principal pipe-runs, at intermediate points in pipe-runs between expansion loops and bends. Make provisions for preset of anchors as required to accommodate both expansion and contraction of piping.
19. Hanger Adjustment: Adjust hangers so as to distribute loads equally on attachments.
20. Support Adjustment: Provide grout under supports so as to bring piping and equipment to proper level and elevations.
21. Installation of pipe curb assemblies and pipe seals and rooftop equipment curb or rails: Install in strict accordance with manufacturer's written instructions.

B. Pipe Hangers and Supports:

1. Comply with ASME B31.1.
2. Comply with ASTM F708 and MSS SP-58.
3. Support horizontal piping as scheduled per 2015 Michigan Mechanical Code.
4. Minimum Hanger Spacing: 1/2 inch between finished covering and adjacent Work.
5. Place hangers within 12 inches of each horizontal elbow.
6. Minimum Vertical Hanger Adjustment: 1-1/2 inches.
7. Support vertical piping at every floor.
8. If piping is installed in parallel and at same elevation, provide multiple-pipe or trapeze hangers.
9. Support riser piping independently of connected horizontal piping.
10. Design hangers for pipe movement without disengagement of supported pipe.
11. Painting and Coating:
 - a. Chemical resistant coatings are required for all hangers and supports in process and chlorine rooms.
 - b. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.
12. Insulation:
 - a. Provide clearance in hangers and from structure and other equipment for installation of insulation.

C. Sleeves:

1. Exterior Watertight Entries: Seal with mechanical sleeve seals.
2. Set sleeves in position in forms and provide reinforcing around sleeves.
3. Sizing:
 - a. Size sleeves large enough to allow for movement due to expansion and contraction.
 - b. Provide for continuous insulation wrapping.
4. Extend sleeves through floors 1 inch above finished floor level, and calk sleeves.
5. Spaces:
 - a. If piping or ductwork penetrates floor, ceiling, or wall, close off space between pipe or duct and adjacent Work with firestopping insulation and/or calk water and weathertight.
 - b. Provide close-fitting metal collar or escutcheon covers at both sides of penetration.
 - c. Install chrome-plated steel escutcheons at finished surfaces of plumbing piping in bathrooms and kitchens.

D. Firestopping:

1. Install material at fire-rated construction perimeters and openings containing penetrating sleeves, piping, ductwork, and other items requiring firestopping.

2. Apply primer where recommended by manufacturer for type of firestopping material and substrate involved, and as required for compliance with required fire ratings.
3. Apply firestopping material to uniform density and texture and in sufficient thickness to achieve required fire and smoke rating.
4. Placement: Compress fibered material to maximum 40 percent of its uncompressed size.
5. Placement:
 - a. Place foamed material in layers to ensure homogenous density, filling cavities and spaces.
 - b. Place sealant to completely seal junctions with adjacent dissimilar materials.
6. Placement: Place intumescent coating in sufficient coats to achieve required rating.
7. Dam Material: To remain.
8. Fire-Rated Surfaces:
 - a. Seal opening at floor, wall, partition, ceiling, and roof.
 - b. Install sleeve through opening and extending beyond minimum of 1 inch on both sides of building element.
 - c. Size sleeve allowing minimum of 1 inch void between sleeve and building element.
 - d. Pack void with backing material.
 - e. Seal ends of sleeve with UL-listed fire-resistive silicone compound to meet fire rating of structure being penetrated.
9. If cable tray, bus, cable bus, conduit, wireway, trough, and piping assembly penetrates fire-rated surface, install firestopping product according to manufacturer instructions.
10. Nonrated Surfaces:
 - a. Seal opening through non-fire-rated wall, partition, floor, ceiling, and roof opening.
 - b. Install sleeve through opening and extending beyond minimum of 1 inch on both sides of building element.
 - c. Size sleeve allowing minimum of 1 inch void between sleeve and building element.
 - d. Install type of firestopping material as recommended by manufacturer.
11. Occupied Spaces:
 - a. Install escutcheons, floor plates, or ceiling plates where conduit penetrates non-fire-rated surfaces in occupied spaces.
 - b. Occupied spaces include rooms with finished ceilings and where penetration occurs below finished ceiling.
12. Exterior Wall Openings below Grade: Assemble rubber links of mechanical sealing device to size of piping and tighten in place according to manufacturer instructions.

3.4 FIELD QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements: Requirements for inspecting and testing.
- B. Section 01 70 00 - Execution and Closeout Requirements: Requirements for testing, adjusting, and balancing.

- C. Inspect installed firestopping for compliance with specifications and submitted schedule.

3.5 CLEANING

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for cleaning.
- B. Clean adjacent surfaces of firestopping materials.

3.6 PROTECTION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for protecting finished Work.
- B. Protect adjacent surfaces from damage by material installation.

END OF SECTION

SECTION 23 05 53

IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Nameplates.
2. Tags.
3. Stencils.
4. Pipe markers.
5. Labels.

B. Related Sections:

1. See General Requirements - Painting and Coating: Execution requirements for painting specified by this section.

1.2 REFERENCES

- A. ASME A13.1 - Scheme for the Identification of Piping Systems: The American Society of Mechanical Engineers; 2007.
- B. ASTM D 709 - Standard Specification for Laminated Thermosetting Materials; 2001 (Reapproved 2007).

1.3 SUBMITTALS

- A. See General Requirements for Submittal procedures.
- B. Product Data: Submit manufacturers catalog literature for each product required.
- C. Shop Drawings: Submit list of wording, symbols, letter size, and color coding for mechanical identification and valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.
- D. Manufacturer's Installation Instructions: Indicate installation instructions, special procedures, and installation.
- E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 CLOSEOUT SUBMITTALS

- A. See General Requirements for Execution and Closeout Requirements.

- B. Project Record Documents: Record actual locations of tagged valves; include valve tag numbers.

1.5 QUALITY ASSURANCE

- A. Conform to ASME A13.1 for color scheme for identification of piping systems and accessories.
- B. Maintain one copy of each document on site.

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum ten years documented experience.
- B. Installer: Company specializing in performing Work of this section with minimum five years documented experience approved by manufacturer.

1.7 PRE-INSTALLATION MEETINGS

- A. See General Requirements for Administrative Requirements: Pre-installation meeting.
- B. Convene minimum two-weeks prior to commencing work of this section.

1.8 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

1.9 EXTRA MATERIALS

- A. See General Requirements - Execution and Closeout Requirements: Spare parts and maintenance products.

PART 2 - PRODUCTS

2.1 IDENTIFICATION APPLICATIONS

- A. Air Handling Units: Nameplates.
- B. Air Terminal Units: Tags.
- C. Control Panels: Nameplates.
- D. Dampers: Ceiling tacks, where located above lay-in ceiling.
- E. Heat Transfer Equipment: Nameplates.
- F. Major Control Components: Nameplates.
- G. Plumbing and Hydronic Piping: Plastic Pipe Markers.

H. Pumps: Nameplates.

I. Ductwork: Tags or Stencils

2.2 NAMEPLATES

A. Manufacturers:

1. Advanced Graphic Engraving: www.advancedgraphicengraving.com.
2. Kolbi Pipe Marker Co.: www.kolbipipemarkers.com.
3. Seton Identification Products: www.seton.com.
4. Or Approved Equal.

B. Product Description: Laminated three-layer plastic with engraved letters on light contrasting background color.

1. Letter Color: White.
2. Letter Height: 1/2 inch (12 mm).
3. Background Color: Black.
4. Plastic: Conform to ASTM D 709

2.3 TAGS

A. Plastic Tags

1. Manufacturers:

- a. Advanced Graphic Engraving: www.advancedgraphicengraving.com.
- b. Brady Corporation: www.bradycorp.com.
- c. Kolbi Pipe Marker Co.: www.kolbipipemarkers.com.
- d. Seton Identification Products: www.seton.com.
- e. Or Approved Equal.

2. Laminated three-layer plastic with engraved black letters on light contrasting background color. Tag size minimum 1-1/2 inches diameter.

B. Metal Tags

1. Manufacturers:

- a. Advanced Graphic Engraving: www.advancedgraphicengraving.com.
- b. Brady Corporation: www.bradycorp.com.
- c. Kolbi Pipe Marker Co.: www.kolbipipemarkers.com.
- d. Seton Identification Products: www.seton.com.
- e. Or Approved Equal.

2. Brass with stamped letters; tag size minimum 1-1/2 inches diameter with finished edges.

2.4 STENCILS

A. Stencils

1. Manufacturers:

- a. Brady Corporation: www.bradycorp.com.
- b. Kolbi Pipe Marker Co.: www.kolbipipemarkers.com.
- c. Seton Identification Products: www.seton.com.
- d. Or Approved Equal.

B. Stencils: With clean cut symbols and letters of following size:

- 1. 3/4 to 1-1/4 inch (20-30 mm) Outside Diameter of Insulation or Pipe: 8 inch (200 mm) long color field, 1/2 inch (15 mm) high letters.
- 2. 1-1/2 to 2 inch (40-50 mm) Outside Diameter of Insulation or Pipe: 8 inch (200 mm) long color field, 3/4 inch (20 mm) high letters.
- 3. 2-1/2 to 6 inch (65-150 mm) Outside Diameter of Insulation or Pipe: 12 inch (300 mm) long color field, 1-1/4 inch (30 mm) high letters.

C. Stencil Paint: As specified in Section 09 90 00, semi-gloss enamel, colors and lettering size conforming to ASME A13.1.

2.5 PIPE MARKERS and PIPE STICKERS

A. Color and Lettering: Conform to ASME A13.1.

B. Plastic Pipe Markers (Applied to insulated and wrapped piping).

- 1. Plastic Pipe Markers: Factory fabricated, wrap-around, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid being conveyed.
- 2. Size (including insulation) Pipe O.D. (inches) = Letter Size (inches):
 - a. 0.75" – 1" = 1/2" Letters.
 - b. 1.25" – 2.375" = 3/4" Letters.
 - c. 2.5" – 7.875" = 1.25" Letters.
 - d. 8" – 9.875" = 2.5" Letters.
 - e. 10" and larger = 3.5" Letters.

C. Plastic Tape Pipe Markers (Applied to painted uninsulated or wrapped piping).

- 1. Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings.
- 2. Size (including insulation) Pipe O.D. (inches) = Letter Size (inches):
 - a. 0.75" = 1/2" Letters.
 - b. 1" – 2.5" = 3/4" Letters.
 - c. 2.5" – 7.875" = 1.25" Letters.
 - d. 8" – 9.875" = 2.5" Letters.
 - e. 10" and larger = 3.5" Letters.

2.6 UNDERGROUND WARNING TAPE

A. Underground Warning Tape

1. Manufacturers:
 - a. Brady Corporation: www.bradycorp.com.
 - b. Kolbi Pipe Marker Co.: www.kolbipipemarkers.com.
 - c. Seton Identification Products: www.seton.com.
 - d. Or Approved Equal.
- B. Description: Polyethylene tape with metallic core for detection and location of piping with metal detector resistant to acids, alkalis and other soil components.
 1. Size: 0.004 inch6 inches
 2. Printed text as selected by Architect/Engineer in contrasting color and repeated at maximum 36 inches intervals.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Degrease and clean surfaces to receive adhesive for identification materials.

3.2 INSTALLATION

- A. Install identifying devices after completion of coverings and painting.
- B. Install plastic nameplates on all HVAC and plumbing equipment. Identify air handling units, pumps, heat transfer equipment, tanks, and water treatment devices with plastic nameplates. Identify in-line pumps and other small devices with tags.
- C. Install with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.
- D. Install labels with sufficient adhesive for permanent adhesion and seal with clear lacquer. For unfinished canvas covering, apply paint primer before applying labels.
- E. Install wrap-around pipe markers on all insulated and wrapped plumbing piping including: Storm, Sanitary, CW, HW, DHWR (recirculation), Tempered Water, and condensate. Include flow direction arrows on recirculation piping (at least one flow direction arrow next to label in each room).
- F. Install adhesive pipe markers on all painted (uninsulated) piping located indoors including: Natural Gas, and Sanitary vent (not installed within walls). For indoor exposed natural gas lines, attach yellow pipe labels with "GAS" in black lettering, at maximum 5 foot spacing.
- G. Install wrap-around pipe markers on all insulated and wrapped HVAC piping including: HWS, HWR, CHWS, CHWR, HPWS, HPWR, Condensate, STEAM (include pressure PSI) and STEAM-CONDENSATE. Include flow direction arrows on all piping. Install at least one flow direction arrow on each main pipe branch. Locate identification not to exceed 20 feet on straight runs including risers and drops, adjacent to each valve and tee, at each side of penetration of structure or enclosure, and at each obstruction.

- H. Install underground plastic pipe markers 6 to 8 inches below finished grade, directly above buried pipe.
- I. Identify control panels and major control components outside panels with plastic nameplates including: AHU Control Panels and Control Sensors and Thermostats.
- J. Identify valves in main and branch piping with tags.

END OF SECTION

SECTION 23 05 93

TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Testing, adjusting, and balancing of air systems.
2. Measurement of final operating condition of HVAC systems.

B. This section does not include:

1. Testing heat exchangers and pressure vessels for compliance with safety codes.
2. Specifications for materials for patching mechanical systems.
3. Specifications for materials and installation of adjusting and balancing devices. If devices must be added to achieve proper adjusting and balancing, refer to the system sections for materials and installation requirements.
4. Requirements and procedures for piping and ductwork systems leakage tests.

C. The following systems require test and balance:

1. Air handling equipment.
2. Exhaust Fans.
3. Ductwork
4. Diffusers, Registers, Grilles, Louvers.

1.2 REFERENCES

A. Associated Air Balance Council:

1. AABC MN-1 - National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems.

B. American Society of Heating, Refrigerating and Air-Conditioning Engineers:

1. ASHRAE 111 - Practices for Measurement, Testing, Adjusting and Balancing of Building Heating, Ventilation, Air-Conditioning and Refrigeration Systems.

C. Natural Environmental Balancing Bureau:

1. NEBB - Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems.

D. Testing Adjusting and Balancing Bureau:

1. TABB - International Standards for Environmental Systems Balance.

1.3 SUBMITTALS

- A. Reports:
 1. General: Submit testing, adjusting, and balancing reports bearing the seal and signature of the test and balance engineer or the signature and list of qualifications of a test and balance technician. The reports shall be proof that the systems have been tested, adjusted, and balanced in accordance with the referenced standards; are an accurate representation of how the systems have been installed; are a true representation of how the systems are operating at the completion of the testing, adjusting, and balancing procedures; and are an accurate record of all final quantities measured, to establish normal operating values of the systems. Follow the procedures and format specified below.
- B. See General Requirements - Submittal Procedures: Submittal procedures.
- C. Prior to commencing Work, submit proof of latest calibration date of each instrument.
- D. Field Reports: Indicate deficiencies preventing proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.
- E. Submit draft copies of report for review prior to final acceptance of Project.
- F. Furnish reports in electronic PDF format and binder manuals, complete with table of contents page and indexing tabs, with cover identification at front and side. Include set of reduced drawings with air outlets and equipment identified to correspond with data sheets, and indicating thermostat locations.

1.4 QUALITY ASSURANCE

- A. Perform Work in accordance with State standards and ASHRAE 90.1-2013.
- B. Prior to commencing Work, calibrate each instrument to be used. Upon completing Work, recalibrate each instrument to assure reliability.

1.5 QUALIFICATIONS

- A. Agency: Company specializing in testing, adjusting, and balancing of systems specified in this section with minimum ten years documented experience certified by AABC Certified or by NEBB Certified by TABB.

1.6 PRE-INSTALLATION MEETINGS

- A. See General Requirements - Administrative Requirements: Pre-installation meeting.
- B. Convene minimum one week prior to commencing work of this section.

1.7 SEQUENCING

- A. See General Requirements - Summary: Work sequence.
- B. Sequence balancing between completion of systems tested and Date of Substantial Completion.

PART 2 - PRODUCTS

2.1 Not Used.

PART 3 - EXECUTION

3.1 PRELIMINARY PROCEDURES

- A. Before commencing work, verify that systems are complete and operable. Ensure the following:
 - 1. Equipment is operable and in a safe and normal condition.
 - 2. Temperature control systems are installed complete and operable.
 - 3. Proper thermal overload protection is in place for electrical equipment.
 - 4. Final filters are clean and in place. If required, install temporary media in addition to final filters.
 - 5. Duct systems are clean of debris. .
 - 6. Fire dampers are in place and open.
 - 7. Coil fins have been cleaned and combed.
 - 8. Access doors are closed and duct end caps are in place.
 - 9. Air outlets are installed and connected.
 - 10. Duct system leakage has been minimized.
 - 11. Proper strainer baskets are clean and in place.
 - 12. Correct pump rotation.
 - 13. Correct fan rotation.
 - 14. Hydronic systems have been flushed, filled, and vented.
 - 15. Service and balance valves in water distribution system are in place and open.
 - 16. Operating voltage on fan and pump motors do not exceed motor's nameplate maximum voltage rating.
 - 17. Walk the system from the system air handling equipment to air outlets and inlets to determine variations of installation from design.
 - 18. Check all damper types for correct and locked position, and temperature control for completeness of installation before starting fans.
 - 19. Prepare report test sheets for both fans and outlets. Obtain manufacturer's outlet factors and recommended procedures for testing. Prepare a summation of required outlet volumes to permit a crosscheck with required fan volumes.
 - 20. Determine best locations in main and branch ductwork for most accurate duct traverses
 - 21. Place outlet dampers in the full open position
 - 22. Prepare schematic diagrams of system "as-built" ductwork and piping layouts to facilitate reporting
 - 23. Lubricate all motors and bearings
 - 24. Check fan belt tension

- B. Report to Architect/Engineer any major problems, defects or deficiencies noted during performance of services. Also include major problems or deficiencies in the written report.
- C. Promptly report abnormal conditions in mechanical systems or conditions, which prevent system balance.
- D. Beginning of work means acceptance of existing conditions.

3.2 PERFORMING TESTING, ADJUSTING AND BALANCING ON AIR SYSTEMS

- A. Perform testing, adjusting and balancing procedures on each system identified in drawing, in accordance with the detailed procedures outlined in the referenced standards except as may be modified below.
- B. Unless specifically instructed in writing, all work in this specification section is to be performed during the normal workday.
- C. In areas containing ceilings, remove ceiling tile to accomplish balancing work. Replace tile when work is complete and provide new tile for any tile that was damaged by this procedure. If the ceiling construction is such that access panels are required for the work of this section and the panels have not been provided, inform the owner representative.
- D. Cut insulation, ductwork and piping for installation of test probes to the minimum extent necessary for adequate performance of procedures. Patch to maintain system integrity and pressure rating of systems.
- E. In air systems employing filters, blank off sufficient filter area to simulate a pressure drop that is midway between that of a clean filter and that of a dirty filter.
- F. Test and Balance Contractor shall set diffuser flow rate (volume) by adjusting dampers installed on the ductwork. Do not use volume dampers that are integral with the diffusers to set volume if both duct and neck dampers are present.
- G. Make air quantity measurements in ducts by Pitot tube traverse of entire cross sectional area of duct.
- H. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.
- I. All Air Systems shall be balanced using a procedure, which results in minimum restrictions being imposed. At completion of balancing:
 - 1. At least one damper for an outlet/inlet shall be fully open on every branch duct.
 - 2. At least one branch duct balancing damper shall be fully open on every trunk duct.
 - 3. At least one trunk (zone) balancing damper shall be fully open from each Fan System.
 - 4. Supply/exhaust RPM shall be set so that the static pressure at the terminal that is most difficult to maintain is adequate, but not excessive.
- J. Measure and record system measurements at the fan to determine total flow. Adjust equipment as required to yield specified total flow at ventilation unit and at terminals. Proceed taking

measurements in mains and branches as required for final terminal balancing. Perform terminal balancing to specified flows after balancing branch dampers, deflectors, extractors and valves.

- K. Provide fan and motor drive sheave adjustments necessary to obtain design performance. Once drive sheave diameters have been established, replace all adjustable sheaves with solid pulleys (at Test and Balance Contractor Cost). Include in scope of services drive changes specifically noted on drawings, if any. If work indicates that any drive or motor is inadequate for the application, advise the owner representative by giving the representative properly sized motor/drive information (in accordance with manufacturers original service factor and installed motor horsepower requirements). Any changes shall keep the duct system within its design limitations with respect to the speed of the device and pressure classification of the distribution system. Material costs for sheave changes as well as time and material for motor changes will be considered a reimbursable expense and will require an itemized cost breakdown of all time and motor/drive changes submitted to owner representative; prior authorization is needed before this work is started.
- L. Measure and record static air pressure conditions across fans, coils and filters. Indicate in report if cooling coil measurements were made on a wet or dry coil and if filter measurements were made on a clean or dirty filter.
- M. Adjust outside air, return air and relief air dampers for design conditions at both the minimum and maximum settings and record both sets of data (and test methodology). If necessary, Test and Balance Contractor should return when an adequate temperature difference between the return air and outside air temperatures exists in order to determine minimum outside air damper position.
- N. For systems with Demand Control Ventilation (DCV) carbon dioxide systems, set minimum outdoor air damper position to 100% closed position ---do not set to the listed minimum position as noted on the equipment Schedule.
- O. Balance modulating dampers at extreme conditions and record both sets of data. Balance variable air volume systems at maximum air flow rate (full cooling) and minimum flow rate (full heating) and record all data.
- P. Adjust register, grille and diffuser vanes and accessories to achieve proper air distribution patterns (check with Engineer for optimal configuration), uniform space temperatures, areas free from objectionable noise and drafts — that are within the capabilities of the installed system.
- Q. Final air system measurements to be within the following range (unless directed otherwise by Engineer) of the specified CFM:
 - 1. Fans -5% to +10% of design value
 - 2. Supply grilles, registers, diffusers -10% to +10% of design value
 - 3. Return/exhaust grilles, registers -10% to +10% of design value
 - 4. Room pressurization air -5% to +5% of design value
- R. Permanently mark equipment settings including damper positions, valve positions, and control settings. Set and lock memory stops.

- S. Leave systems in proper working order by replacing belt guards, closing access doors and electrical boxes, and restoring temperature controls to normal operating settings.

3.3 PERFORMING TESTING, ADJUSTING AND BALANCING ON WATER SYSTEMS

- A. Perform testing, adjusting and balancing procedures on each system identified in drawing, in accordance with the detailed procedures outlined in the referenced standards except as may be modified below.
- B. Unless specifically instructed in writing, all work in this specification section is to be performed during the normal workday.
- C. Document type and placement of expansion tank within piping system. Indicate tank water level.
- D. Document valve type and its ability to fully regulate flow during various conditions (different flow, temperature, and control conditions).
- E. Provide motor and impeller adjustments necessary to obtain design performance. Include in scope of services changes specifically noted on drawings, if any. If work indicates that any impeller or motor is inadequate for the application, advise the owner representative by giving the representative properly sized motor/impeller information (in accordance with manufacturers original service factor and installed motor horsepower/impeller requirements). Any changes shall keep the piping system within its design limitations with respect to the speed of the device and pressure classification of the distribution system. Material costs for impeller changes as well as time and material for motor changes will be considered a reimbursable expense and will require an itemized cost breakdown of all time and motor/impeller changes submitted to owner representative; prior authorization is needed before this work is started.
- F. Measure and record pressure across pump during no flow and full flow conditions.
- G. All Hydronic Systems shall be balanced using a procedure, which results in minimum restrictions being imposed. At completion of balancing:
 - 1. At least one hydronic terminal unit balancing valve in each piping branch shall be fully open.
 - 2. At least one branch line balancing valve in each Hydronic System shall be fully open.
- H. Final water system measurements to be within the following range (unless directed otherwise by Engineer) of the specified gpm:
 - 1. Pumps -10% to +10%
 - 2. Coils, Boilers, Chillers -10% to +10%
- I. Document if balancing was accomplished using valves or by trimming impeller. Document energy savings due to trimmed impeller.
- J. If parallel pumps are designed to operate together, then measure:
 - 1. Pumps at no flow
 - 2. Both pumps at full flow
 - 3. Each pump at full flow (while the other pump is off)

- K. Measure and record design and actual pressure conditions prior and after coils, chillers, and filters.
- L. Permanently mark equipment settings including valve positions, and control settings. Set and lock memory stops.
- M. Leave systems in proper working order by closing access doors and electrical boxes and systems to normal operating settings.

3.4 DEFICIENCIES

- A. Notify General Contractor, Owner, and Owner Representative of any installation deficiencies found by the Test and Balance Contractor that were specified and/or shown on the Contract Documents. The Owner Representative will then instruct the General Contractor to correct the deficient work. All corrective work to be done at no cost to the owner.

3.5 COMMISSIONING

- A. All testing and balancing shall perform to the satisfaction of both the Engineer and Owner prior to the acceptance of the testing and balancing report as meeting the requirements of this document.
- B. Prior to building acceptance, balancing data will be spot checked with instruments similar to that used by the Test and Balance Contractor to verify compliance with this specification. Spot checking will be as follows:
 - 1. Either the Owner, Owner Representative, Engineer, or Commissioning Agent will perform or supervise the testing of a random sample of points (air and water flow rates within distribution system). At least 5%, but not less than 30, of the supply and return diffusers and one (1) or two (2) fan and pump systems will be tested.
 - 2. If any of the spot-checked points fails to meet specification criteria, another similar sample will be selected by the Owner, Owner Representative, Engineer, or Commissioning Agent.
 - 3. If any of the points in the second sample fails, then the Owner may direct the Test and Balance Contractor to repeat their testing and balancing services in their entirety at no additional cost to the Owner. Then, the Owner Representative, Engineer, or Commissioning Agent shall repeat the spot check procedure.
- C. If the Test and Balance Contractor fails to demonstrate proper compliance with this specification, the Engineer's, Owner Representative's or Commissioning Agent's costs for witnessing and reviewing three or more spot checks will be assigned to the Test and Balance Contractor by the Owner as a deduct to their contracted price. Note: The Test and Balance Contractor will not be responsible for costs related to poor design or to other factors beyond their control, though it is expected to call any design concerns and other factors beyond their control that might cause system failure to the attention of the Engineer and the Owner.

3.6 INSTRUMENTATION

- A. Provide all required instrumentation to obtain proper measurements. Application of instruments and accuracy of instruments and measurements to be in accordance with the requirements of Reference Standards and instrument manufacturer's specifications.
- B. All instruments used for measurements shall be accurate and calibrated. Calibration and maintenance of all instruments to be in accordance with the requirements of Reference Standards.
- C. Provide all necessary tools, scaffolding and ladders and other necessary instruments.

3.7 APPROVED TEST AND BALANCE CONTRACTORS

- A. Qualifications: A third party testing and balancing professional with technician's having at least 10-years of successful testing, adjusting, and balancing experience on projects with testing and balancing requirements similar to those required for this project.
- B. Codes and Standards: The Test and Balance Contractor shall be certified by one the following Test and Balance Organizations.
 - 1. National Environmental Balancing Bureau (NEBB).
 - 2. National Balancing Council (NBC).
 - 3. Associated Air Balance Council (AABC).
- C. Approved Test and Balance Contractors:
 - 1. Due to prior test and balance issues, only test and balance contractors listed below are approved for this job. No Voluntary or Deductive Alternates, or other test and balance contractors shall be accepted.
 - a. International Test and Balance, 248-559-5864
 - b. Hi-Tech Test and Balance 989-695-5498
 - c. Integrity Test and Balance 231-929-0940
- D. Report Format and Contents
 - 1. Format: Bind report forms in three-ring binders or portfolio binders. Label edge and binder front cover with label identifying project name, project number and descriptive title of contents. Divide the contents of the report into the below listed divisions, separated by divider tabs.
 - 2. Report Tags and Labels: Use equipment tags and labels (for example: AHU-1, RTU-1, SD-1, etc.) as listed on the Mechanical Drawings, when labeling report equipment.
 - General Information:
 - a. Summary and Title Page
 - b. Air Systems
 - c. Water Systems
 - d. Special Systems
- E. Report Forms
 - 1. Title Page:
 - a. Name of Testing, Adjusting, and Balancing Agency

- b. Address of Testing, Adjusting, and Balancing Agency
 - c. Telephone and facsimile numbers of Testing, Adjusting, and Balancing Agency
 - d. Project name
 - e. Project location
 - f. Project Architect
 - g. Project Engineer
 - h. Project Contractor
 - i. Project altitude
 - j. Report date
2. Summary Comments:
- a. Design versus final performance
 - b. Notable characteristics of system
 - c. Description of systems operation sequence
 - d. Summary of outdoor and exhaust flows to indicate building pressurization
 - e. Nomenclature used throughout report
 - f. Test conditions
3. Instrument List:
- a. Instrument
 - b. Manufacturer
 - c. Model number
 - d. Serial number
 - e. Range
 - f. Calibration date
4. Air Systems:
- a. Names and initials of personnel performing the balancing (on each form)
 - b. Dates balancing was performed (on each form)
 - c. Weather conditions at the time of the test (especially temperature)
 - d. All motor rated data: voltages, amps, RPM, HP, manufacturer, starter and overload protective device sizes
 - e. All motor operating data (before and after adjustments) voltages, amps, RPM, HP, BHP, and sheave size/rating and manufacturer
 - f. All fan data (design and operating): supply and return CFM, operating static pressures (suction, discharge, and fan static), fan sheave, belt size, fan RPM
 - g. All drive changes necessitated to obtain design capacities
 - h. List actual minimum outside air volumes measured for each system and the corresponding control setpoint
 - i. All supply and return air outlet airflow (CFM) readings. Include velocity measurements and AK factors where applicable. Include initial and final CFM readings at each box.
 - j. For VAV systems, record static pressure at each terminal box as well as static pressure at static pressure sensor (for temperature control system).
 - k. Measure building static pressure at building static pressure sensor and five other locations.

- l. Heating and cooling coil entering and leaving air temperatures during test (as a reference)
5. Water Systems:
 - a. Names and initials of personnel performing the balancing (on each form)
 - b. Dates balancing was performed (on each form)
 - c. All motor operating data (design and operating): voltages, amps, RPM, HP, BHP, starter and overload protective device sizes/rating
 - d. All pump data (design and operating): GPM, RPM, discharge pressure (no flow and full flow), suction pressure (no flow and full flow), total head pressure (no flow and full flow), impeller size, (ensure that pump curves are in O&M manuals)
 - e. Flow levels for each unit served (design and operating)
 - f. Heating and cooling coil water entering and leaving temperatures
 - g. See Test and Balance Appendix #1 provided below for water systems testing points
6. Test and Balance Summary:
 - a. Provide sheet describing mechanical system deficiencies.
 - b. Describe objectionable noise or drafts found during testing, adjusting and balancing.
 - c. Provide recommendations for correcting deficiencies and unsatisfactory performances and indicate whether modifications required are: within the scope of the contract; design related; or installation related.
 - d. Static pressure and CFM values at each fan system.
 - e. Static pressure and CFM values at each terminal box.
 - f. Static pressure at static pressure sensor (that ensures adequate static pressure at all terminal boxes) and at AHU static pressure sensor.
 - g. For each fan system, outside air damper position that provides required minimum outside air.
 - h. Flow rates and pressures for each hydronic system.
 - i. Pipe pressure at pressure sensor (that ensures adequate pressure at all coil valves) and at pump pressure sensor
7. Electric Motors:
 - a. Manufacturer
 - b. Model/Frame
 - c. HP/BHP and kW
 - d. Phase, voltage, amperage; nameplate, actual, no load
 - e. RPM
 - f. Service factor
 - g. Starter size, rating, heater elements
 - h. Sheave Make/Size/Bore
8. V-Belt Drive:
 - a. Identification/location
 - b. Required driven RPM
 - c. Driven sheave, diameter and RPM
 - d. Belt, size and quantity
 - e. Motor sheave diameter and RPM

- f. Center to center distance, maximum, minimum, and actual
- 9. Pump Data:
 - a. Identification/number
 - b. Manufacturer
 - c. Size/model
 - d. Impeller
 - e. Service
 - f. Design flow rate, pressure drop, BHP and kW
 - g. Actual flow rate, pressure drop, BHP and kW
 - h. Discharge pressure
 - i. Suction pressure
 - j. Total operating head pressure
 - k. Shut off, discharge and suction pressures
 - l. Shut off, total head pressure
- 10. Air Cooled Condenser:
 - a. Identification/number
 - b. Location
 - c. Manufacturer
 - d. Model number
 - e. Serial number
 - f. Entering DB air temperature, design and actual
 - g. Leaving DB air temperature, design and actual
 - h. Number of compressors
- 11. Chillers:
 - a. Identification/number
 - b. Manufacturer
 - c. Capacity
 - d. Model number
 - e. Serial number
 - f. Evaporator entering water temperature, design and actual
 - g. Evaporator leaving water temperature, design and actual
 - h. Evaporator pressure drop, design and actual
 - i. Evaporator water flow rate, design and actual
 - j. Condenser entering water temperature, design and actual
 - k. Condenser pressure drop, design and actual
 - l. Condenser water flow rate, design and actual
- 12. Cooling Tower:
 - a. Tower identification/number
 - b. Manufacturer
 - c. Model number
 - d. Serial number

- e. Rated capacity
- f. Entering air WB temperature, specified and actual
- g. Leaving air WB temperature, specified and actual
- h. Ambient air DB temperature
- i. Condenser water entering temperature
- j. Condenser water leaving temperature
- k. Condenser water flow rate
- l. Fan RPM

13. Heat Exchanger:

- a. Identification/number
- b. Location
- c. Service
- d. Manufacturer
- e. Model number
- f. Serial number
- g. Steam pressure, design and actual
- h. Primary water entering temperature, design and actual
- i. Primary water leaving temperature, design and actual
- j. Primary water flow, design and actual
- k. Primary water pressure drop, design and actual
- l. Secondary water leaving temperature, design and actual
- m. Secondary water leaving temperature, design and actual
- n. Secondary water flow, design and actual
- o. Secondary water pressure drop, design and actual

14. Cooling Coil Data:

- a. Identification/number
- b. Location
- c. Service
- d. Manufacturer
- e. Air flow, design and actual
- f. Entering air DB temperature, design and actual
- g. Entering air WB temperature, design and actual
- h. Leaving air DB temperature, design and actual
- i. Leaving air WB temperature, design and actual
- j. Water flow, design and actual
- k. Water pressure drop, design and actual
- l. Entering water temperature, design and actual
- m. Leaving water temperature, design and actual
- n. Saturated suction temperature, design and actual
- o. Air pressure drop, design and actual

15. Heating Coil Data:

- a. Identification/number
- b. Location

- c. Service
- d. Manufacturer
- e. Air flow, design and actual
- f. Water flow, design and actual
- g. Water pressure drop, design and actual
- h. Entering water temperature, design and actual
- i. Leaving water temperature, design and actual
- j. Entering air temperature, design and actual
- k. Leaving air temperature, design and actual
- l. Air pressure drop, design and actual

16. Electric Duct Heater:

- a. Manufacturer
- b. Identification/number
- c. Location
- d. Model number
- e. Design kW
- f. Number of stages
- g. Phase, voltage, amperage
- h. Test voltage (each phase)
- i. Test amperage (each phase)
- j. Air flow, specified and actual
- k. Temperature rise, specified and actual

17. Induction Unit Data:

- a. Manufacturer
- b. Identification/number
- c. Location
- d. Model number
- e. Size
- f. Design air flow
- g. Design nozzle pressure drop
- h. Final nozzle pressure drop
- i. Final air flow

18. Air Moving Equipment:

- a. Location
- b. Manufacturer
- c. Model number
- d. Serial number
- e. Arrangement/Class/Discharge
- f. Air flow, specified and actual
- g. Return air flow, specified and actual
- h. Outside air flow, specified and actual
- i. Total static pressure (total external), specified and actual
- j. Inlet pressure

- k. Discharge pressure
 - l. Sheave Make/Size/Bore
 - m. Number of Belts/Make/Size
 - n. Fan RPM
19. Exhaust Fan Data:
- a. Location
 - b. Manufacturer
 - c. Model number
 - d. Serial number
 - e. Air flow, specified and actual
 - f. Total static pressure (total external), specified and actual
 - g. Inlet pressure
 - h. Discharge pressure
 - i. Sheave Make/Size/Bore
 - j. Number of Belts/Make/Size
 - k. Fan RPM
20. Duct Traverse:
- a. System zone/branch
 - b. Duct size
 - c. Area
 - d. Design velocity
 - e. Design air flow
 - f. Test velocity
 - g. Test air flow
 - h. Duct static pressure
 - i. Air temperature
 - j. Air correction factor
21. Duct Leak Test:
- a. Description of ductwork under test
 - b. Duct design operating pressure
 - c. Duct design test static pressure
 - d. Duct capacity, air flow
 - e. Maximum allowable leakage duct capacity times leak factor
 - f. Test apparatus
 - 1) Blower
 - 2) Orifice, tube size
 - 3) Orifice size
 - 4) Calibrated
 - g. Test static pressure
 - h. Test orifice differential pressure
 - i. Leakage

22. Air Monitoring Station Data:
- a. Identification/location
 - b. System
 - c. Size
 - d. Area
 - e. Design velocity
 - f. Design air flow
 - g. Test velocity
 - h. Test air flow
23. Flow Measuring Station:
- a. Identification/number
 - b. Location
 - c. Size
 - d. Manufacturer
 - e. Model number
 - f. Serial number
 - g. Design Flow rate
 - h. Design pressure drop
 - i. Actual/final pressure drop
 - j. Actual/final flow rate
 - k. Station calibrated setting
24. Terminal Unit Data:
- a. Manufacturer
 - b. Type, constant, variable, single, dual duct
 - c. Identification/number
 - d. Location
 - e. Model number
 - f. Size
 - g. Minimum static pressure
 - h. Minimum design air flow
 - i. Maximum design air flow
 - j. Maximum actual air flow
 - k. Inlet static pressure
25. Air Distribution Test Sheet:
- a. Air terminal number
 - b. Room number/location
 - c. Terminal type
 - d. Terminal size
 - e. Area factor
 - f. Design velocity
 - g. Design air flow
 - h. Test (final) velocity

- i. Test (final) air flow
 - j. Percent of design air flow
- 26. Sound Level Report:
 - a. Location
 - b. Octave bands - equipment off
 - c. Octave bands - equipment on
 - d. RC level - equipment on
- 27. Vibration Test:
 - a. Location of points:
 - 1) Fan bearing, drive end
 - 2) Fan bearing, opposite end
 - 3) Motor bearing, center (when applicable)
 - 4) Motor bearing, drive end
 - 5) Motor bearing, opposite end
 - 6) Casing (bottom or top)
 - 7) Casing (side)
 - 8) Duct after flexible connection (discharge)
 - 9) Duct after flexible connection (suction)
 - b. Test readings:
 - 1) Horizontal, velocity and displacement
 - 2) Vertical, velocity and displacement
 - 3) Axial, velocity and displacement
 - c. Normally acceptable readings, velocity and acceleration
 - d. Unusual conditions at time of test
 - e. Vibration source (when non-complying)

END OF SECTION

SECTION 23 09 00

INSTRUMENTATION AND CONTROL FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Thermostats and Equipment Controllers.
2. Control air dampers.
3. Electric damper actuators.
4. Duct-mounted smoke detector.

B. Provide stand-alone temperature controls.

C. Temperature controls shall be explosion-proof in Class 1, Division 1 spaces.

D. The control system shall be complete with all necessary thermostats, relays and wiring, needed to provide stand-alone controls to the modified fin-tube elements.

E. Related Requirements:

1. Section 23 05 53 - Identification for HVAC Piping and Equipment.
2. Section 23 33 00 - Air Duct Accessories.

1.2 UNIT PRICE – MEASUREMENT AND PAYMENT

A. Concrete Work:

1. Basis of Measurement: Included in other pay items for this project.
2. Basis of Payment: Includes all associated labor, materials, equipment, placement, etc. for a complete installation.

1.3 EQUIPMENT AND WIRING OPERATING ENVIRONMENT

A. Ambient temperature: 32 to 110 degrees F.

B. Relative humidity: 10-90% non-condensing.

C. Electrical supply: +-10% of mains power.

1.4 REFERENCE STANDARDS

A. Air Movement and Control Association International, Inc.:

1. AMCA 500-D - Laboratory Methods of Testing Dampers for Rating.

B. American Society of Heating, Refrigerating and Air-Conditioning Engineers:

1. ASHRAE 62.1 - Ventilation for Acceptable Indoor Air Quality.

C. American Society of Mechanical Engineers:

1. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings.
2. ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.

D. National Electrical Manufacturers Association:

1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
2. NEMA DC 3 - Residential Controls - Electrical Wall-Mounted Room Thermostats.

E. National Fire Protection Association:

1. NFPA 72 - National Fire Alarm and Signaling Code.
2. NFPA 90A - Installation of Air-Conditioning and Ventilating Systems.

F. Underwriters Laboratories, Inc.

1.5 COORDINATION

- A. See General Requirements - Administrative Requirements: Requirements for coordination.

1.6 PREINSTALLATION MEETINGS

- A. See General Requirements - Administrative Requirements: Requirements for preinstallation meeting.
- B. Convene minimum 4 weeks prior to commencing Work of this Section.

1.7 SUBMITTALS

- A. See General Requirements - Submittal Procedures: Requirements for submittals.
- B. Product Data:
1. Submit description and engineering data for each control system component, including sizing as applicable.
- C. Shop Drawings:
1. Indicate operating data, system drawings, wiring diagrams, and written, detailed operational description of sequences.
- D. General
- Provide a submittal for approval before any field installation is started to include:
1. English language description of system operation.
 2. Input/output schedules and controller configurations.

3. A copy of the data base put into logical groups which represents how information will be displayed to the user.
4. Floor plans showing location of all controllers and sensors.
5. Co-ordination drawings showing interface terminal numbers and cross referenced wire numbers for all connections between the DDC and other equipment.
6. Details of all actuators, control devices and sensors.
7. Full details of each control station including equipment and wiring diagrams/terminal layouts.

E. Manuals

Provide one set of manuals, prior to commencement of commissioning to include:

1. Updated functional specification.
2. Specification sheets and technical brochures on all equipment.
3. Listings and description of application programs.
4. Programmer's manual etc.
5. Circuit diagrams.
6. Drawings.

F. Final Submission: Within one week prior to date of Substantial Completion, provide three (3) sets of manuals.

1.8 CLOSEOUT SUBMITTALS

- A. See General Requirements - Execution and Closeout Requirements: Requirements for closeout procedures.
- B. Project Record Documents: Record actual locations of control components, including panels, thermostats, and sensors.
- C. Operation and Maintenance Data: Submit inspection period, cleaning methods, recommended cleaning materials, and calibration tolerances.

1.9 APPROVED SYSTEM MANUFACTURER

- A. Approved, non-proprietary stand-alone controls include:
 1. Honeywell
 2. KMC
 3. Trane
 4. Or Approved Equal.

1.10 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum ten years' documented experience, and with service facilities within 100 miles of Project.
- B. Installer: Company specializing in performing Work of this Section with minimum five years' documented experience and approved by manufacturer.

1.11 DELIVERY, STORAGE, AND HANDLING

- A. See General Requirements - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Inspection: Accept controls on-Site in original factory packaging and inspect for damage.
- C. Store materials according to manufacturer's instructions.

1.12 EXISTING CONDITIONS

- A. Field Measurements:
 - 1. Verify field measurements prior to fabrication.
 - 2. Indicate field measurements on Shop Drawings.

1.13 WARRANTY

- A. See General Requirements - Execution and Closeout Requirements: Requirements for warranties.
- B. Furnish two-year manufacturer's warranty for each control-system component.

PART 2 - PRODUCTS

2.1 THERMOSTAT

- A. Manufacturers:
 - 1. Honeywell
 - 2. KMC
 - 3. Trane
- B. Space thermostats that control the HVAC equipment shall be digital electronic and shall include:
 - 1. Temperature Display.
 - 2. Temperature Adjustment.
 - 3. Backlit LCD/LED Display.
 - 4. Over-ride Function.
 - 5. Full 7-day programmable.
- C. Electric Room Thermostats and controllers (if applicable – See Plans):
 - 1. Explosion proof, NEMA 7, Class-1, Division 1.
 - 2. Voltage: 24 V.
 - 3. Furnish setback/setup temperature control.
 - 4. Service: Heating only.
 - 5. Covers: Locking with set point adjustment set point indication with discharge air temperature and room temperature.

D. Line Voltage Thermostats (if applicable – See Plans):

1. Selector Switch:
 - a. Integral.
 - b. Manual HAND-OFF-AUTO.
 - c. Single- or two-pole.
2. Dead Band: Maximum 2 degrees F.
3. Cover: Locking with set point adjustment.

E. Room Thermostat Accessories:

1. Thermostat Covers: High impact polycarbonate or epoxy coated steel.

2.2 CONTROL AIR DAMPERS

A. Manufacturers:

1. Ruskin
2. Greenheck
3. NCA
4. Or Approved Equal

B. Frames:

1. Materials: Extruded aluminum, welded or riveted with corner reinforcement.
2. Minimum Thickness: 16 gage or as Scheduled.

C. Blades:

1. Material: Extruded aluminum.
2. Blade Size:
 - a. Width: 5 inches.
 - b. Length: See Schedule
 - c. Minimum Thickness: See Schedule
3. Attach to minimum 1/2-inch shafts with set screws.

D. Seals:

1. Blades:
 - a. Material: Neoprene.
 - b. Mechanically attached.
 - c. Field replaceable.
2. Jambs: Stainless-steel spring.

- E. Bearings:
 - 1. Shaft: Lubricant-free, stainless steel, single row, ground, flanged, radial, antifriction type with extended inner race.
 - 2. Linkage: Oil-impregnated, sintered bronze.
- F. Outside Air Damper Leakage: Maximum rate of per ASHRAE 90.1-2013 low leakage requirements.
- G. Maximum Pressure Differential: 6-inch wg.
- H. Temperature Limits: Minus 40 to 200 degrees F.

2.3 ELECTRIC DAMPER ACTUATORS

- A. Manufacturers:
 - 1. Belimo
 - 2. Or Approved Equal.
- B. Operation: Switchable, two position spring return normally open.
- C. Enclosure: Comply with NEMA 4x.
- D. Mounting: Direct.
- E. Stroke:
 - 1. Full Stroke: 90 seconds, end to end.
 - 2. Spring Return: 15 seconds, return to normal.
- F. Protection: Electronic stall.
- G. Electrical Characteristics:
 - 1. Control Input: 120V.
- H. Nominal Power: 120 VAC.
- I. Torque: Sized for minimum 150 percent of required duty.
- J. Duty Cycle: Rated for 65,000 cycles.
- K. Accessories:
 - 1. Cover-mounted transformer.
 - 2. Auxiliary potentiometer.
 - 3. Damper linkage.
 - 4. Direct-drive feedback potentiometer.
 - 5. Output position feedback.

6. Field-selectable, rotational, spring return direction.
7. Field-adjustable zero and span.
8. End switch.

2.4 DUCT-MOUNTED SMOKE DETECTOR

- A. Comply with NFPA 72.
- B. Type: Ionization.
- C. Furnish power supply and signal circuits.
- D. Accessories:
 1. Auxiliary SPDT relay contact.
 2. Key-operated NORMAL-RESET-TEST switch.
 3. Duct sampling tubes extending width of duct.
 4. Visual indicator for detector actuation.
 5. Duct-mounted housing.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. See General Requirements - Execution and Closeout Requirements: Requirements for installation examination.
- B. Verify that pneumatic tubing is clear of water, oil, and other contaminants.
- C. Verify that compressed-air supply has operating filter and dryer before installing control devices or actuators.
- D. Verify that air-handling units and ductwork installation has been completed and that air filters are in place before installing sensors in airstreams.
- E. Verify locations of thermostats, controllers, and other exposed control sensors with Drawings before installation.
- F. Verify that building systems to be controlled are ready to operate.

3.2 INSTALLATION

- A. Install the system as recommended by the manufacturer, using only equipment recommended or acceptable to the manufacturer.
- B. Comply with the State and Local Electrical Code for electrical work.
- C. Install control wiring in exposed surface mounted conduit.

3.3 FIELD QUALITY CONTROL

- A. See General Requirements - Quality Requirements: Requirements for inspecting and testing.
- B. After completion of installation, test and adjust control equipment.
- C. Calibration:
 - 1. Check calibration of instruments.
 - 2. Recalibrate instruments out of calibration.
 - 3. Replace defective instruments.
- D. Equipment Acceptance:
 - 1. Adjust, repair, modify, or replace components failing to perform as specified, and rerun tests.
 - 2. Make final adjustments to equipment under direction of manufacturer's representative.
- E. Furnish Installation Certificate from equipment manufacturer's representative attesting that equipment has been properly installed and is ready for startup and testing.

3.4 MAINTENANCE

- A. See General Requirements - Execution and Closeout Requirements: Requirements for maintenance service.
- B. Provide service and maintenance of control system for two years from date of Substantial Completion.
- C. Furnish complete service of controls systems, including callbacks.
- D. The TCC or MC shall perform complete maintenance of the temperature control system for a period of one calendar year, at no additional cost to the Owner, commencing with the date when the system is accepted so that the said controls may be operated 24 hours a day, 7 days a week.

3.5 OPERATOR TRAINING

- A. Provide a minimum of (4) four hours of training to plant operator at start-up.
- B. Include a minimum of (8) eight hours of additional support and site visit as requested.
- C. Document training with plant operator and engineer.

END OF SECTION

SECTION 23 31 00

HVAC DUCTS AND CASINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Duct materials.
2. Single-wall, spiral round ducts.
3. Casings.
4. Ductwork fabrication.

B. Related Requirements:

1. Section 23 33 00 - Air Duct Accessories.

1.2 REFERENCE STANDARDS

A. American Society of Heating, Refrigerating and Air-Conditioning Engineers:

1. ASHRAE Handbook - Fundamentals.

B. American Welding Society:

1. AWS D1.1 - Structural Welding Code - Steel.
2. AWS D1.1M - Structural Welding Code - Steel.
3. AWS D1.2 - Structural Welding Code - Aluminum.
4. AWS D1.2M - Structural Welding Code - Aluminum.
5. AWS D9.1 - Sheet Metal Welding Code.
6. AWS D9.1M - Sheet Metal Welding Code.

C. ASTM International:

1. ASTM A36 - Standard Specification for Carbon Structural Steel.
2. ASTM A36M - Standard Specification for Carbon Structural Steel.
3. ASTM A90 - Standard Test Method for Weight [Mass] of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings.
4. ASTM A90M - Standard Test Method for Weight [Mass] of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings.
5. ASTM A240 - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
6. ASTM A240M - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
7. ASTM A568 - Standard Specification for Steel, Sheet, Carbon, Structural, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements for.

8. ASTM A568M - Standard Specification for Steel, Sheet, Carbon, Structural, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements for.
9. ASTM A653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
10. ASTM A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
11. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
12. ASTM A1008 - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable.
13. ASTM A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable.
14. ASTM A1011 - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength.
15. ASTM A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength.
16. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
17. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
18. ASTM C14 - Standard Specification for Nonreinforced Concrete Sewer, Storm Drain, and Culvert Pipe.
19. ASTM C14M - Standard Specification for Nonreinforced Concrete Sewer, Storm Drain, and Culvert Pipe (Metric).
20. ASTM C443 - Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets.
21. ASTM C443M - Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets (Metric).
22. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

D. International Code Council:

1. International Energy Conservation Code (IECC).
2. International Mechanical Code (IMC).
3. 2015 Michigan Mechanical Code (MMC).
4. ASHRAE 90.1-2013.

E. NFPA:

1. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems.
2. NFPA 90B - Standard for the Installation of Warm Air Heating and Air-Conditioning Systems.
3. NFPA 96 - Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.

F. Sheet Metal and Air Conditioning Contractors' National Association:

1. SMACNA 016 - HVAC Air Duct Leakage Test Manual.
2. SMACNA 1767 - Kitchen Ventilation Systems and Food Service Equipment Guidelines.
3. SMACNA 1884 - Fibrous Glass Duct Construction Standards.
4. SMACNA 1966 - HVAC Duct Construction Standards - Metal and Flexible.

G. UL:

1. UL 181 - Factory-Made Air Ducts and Air Connectors.
2. UL 181A - Closure Systems for Use With Rigid Air Ducts.
3. UL 1978 - Grease Ducts.

1.3 PREINSTALLATION MEETINGS

- A. See General Requirements - Administrative Requirements: Requirements for preinstallation meeting.
- B. Convene minimum two weeks prior to commencing Work of this Section.

1.4 SUBMITTALS

- A. See General Requirements - Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit manufacturer information for duct materials and manufactured spiral duct.

1.5 CLOSEOUT SUBMITTALS

- A. See General Requirements - Execution and Closeout Requirements: Requirements for submittals.

1.6 QUALITY ASSURANCE

- A. Perform Work according to SMACNA 1884 and 1966.

1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum ten years' documented experience.
- B. Installer: Company specializing in performing Work of this Section with minimum ten years' documented experience.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. See - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.

- C. Store materials according to manufacturer instructions.
- D. Protection:
 - 1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
 - 2. Provide additional protection according to manufacturer instructions.

1.9 AMBIENT CONDITIONS

- A. Section 01 50 00 - Temporary Facilities and Controls: Requirements for ambient condition control facilities for product storage and installation.
- B. Minimum Conditions: Do not install duct sealant when temperatures are less than those recommended by sealant manufacturer.
- C. Subsequent Conditions: Maintain temperatures during and after installation of duct sealant.

1.10 EXISTING CONDITIONS

- A. Field Measurements:
 - 1. Verify field measurements prior to fabrication.
 - 2. Indicate field measurements on Shop Drawings.

1.11 WARRANTY

- A. See General Requirements - Execution and Closeout Requirements: Requirements for warranties.
- B. Furnish two-year manufacturer's warranty for ducts.

PART 2 - PRODUCTS

2.1 RECTANGULAR DUCTS

- A. Performance and Design Criteria:
 - 1. Variation of duct configuration or sizes other than those of equivalent or lower loss coefficient is not permitted except by written permission of Engineer.
 - 2. Size round ducts installed in place of rectangular ducts according to ASHRAE Handbook - Fundamentals.
- B. Materials:
- C. Galvanized-Steel Ducts
 - 1. Material: ASTM A653 hot-dipped galvanized-steel sheet, FS Type B.
 - 2. Quality: Lock forming.

3. Finish: G90 zinc coating according to ASTM A90.
4. Hanger Rod:
 - a. Material: Aluminum.
 - b. Comply with ASTM A36.
 - c. Type: Threaded

D. Stainless-Steel Ducts (in Class 1 Division 1 Grit Room)

1. Material: 304 Stainless Steel.
2. Quality: Welded
3. Finish: Natural.
4. Hanger Rod:
 - a. Material: T304 Stainless Steel
 - b. Type: Threaded rod strut with stainless steel fasteners.

2.2 SINGLE-WALL, SPIRAL ROUND DUCTS (if applicable to project – See Plans)

A. Manufacturers:

1. Universal Spiral Air.
2. Spiral Manufacturing
3. Or Approved Equal

B. Description:

1. UL 181, Class 1, round spiral lockseam duct.
2. Material: G-90, Galvanized steel.

C. Minimum Duct Wall Thicknesses:

1. Diameter: 6"-8" 26 gage; 10"-16" 24 gage, 20"-24" 20 gage; 26"-32" 20 gage; 36"-40" 18 gage; 42" – 60" 16 gage.

2.3 CASINGS

A. Fabricate casings according to SMACNA 1966 and construct for indicated operating pressures.

B. Doors:

1. Reinforce access door frames with steel angles tied to horizontal and vertical plenum supporting angles.
2. Furnish hinged access doors where indicated or required for access to equipment for cleaning and inspection.

2.4 FABRICATION

A. Rectangular Ducts:

1. Fabricate and support in accordance with SMACNA HVAC Duct Construction Standards Metal and Flexible Duct. Current edition.
 - a. Provide duct material, gages, reinforcing, welding, and sealing for indicated operating pressures.
 - b. Construct T's, bends, and elbows with radius of not less than 1-1/2 times width of duct on centerline. Where not possible and where rectangular elbows must be used, provide air foil turning vanes. Where acoustical lining is indicated, provide turning vanes of perforated metal with glass fiber insulation. For stainless steel welded duct mitered transitions may be used in lieu of radius elbows or turning vanes.
 - c. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.
 - d. Rectangular duct pressure class = 4" w.g.
 - e. Stiffeners and reinforcement shall be per SMACNA duct construction standards, typically when duct dimension exceeds 36", and 4'-0" in length.

B. Round Ducts (if applicable to project):

1. According to SMACNA 1966.
2. Seams: Longitudinal.
3. Provide duct material, gages, reinforcing, and sealing for indicated operating pressures.
4. Tees, Bends, and Elbows:
 - a. Minimum Radius: 1-1/2 times centerline duct width. Short sweep elbows are not allowed.
 - b. Increase duct sizes gradually, not exceeding 15 degrees of divergence wherever possible.
 - c. Upstream of Equipment: Maximum 30 degrees.

C. Welding:

1. Continuously Welded Round and Oval Duct Fittings: Two gages heavier than duct gages according to SMACNA 1966.
2. All stainless-steel duct shall have continuous external welds. Braised or electrically welded.

D. Takeoffs:

1. Provide standard 45-degree lateral wye takeoffs.
2. If not possible due to space limitations, provide 90-degree conical tee connections.
3. Stainless steel take-offs may be 90 degree welded.

E. Sealing:

1. Seal joints between duct sections and duct seams with welds, gaskets, mastic adhesives, mastic plus embedded fabric systems, or tape.
2. Sealants, Mastics, and Tapes: Comply with UL 181A and provide products bearing appropriate UL 181A markings.

2.5 ACCESSORIES

A. Hangers and Supports:

1. Hanger rods, bolts, and strut for galvanized duct in Noncorrosive Environments: Cadmium-plated steel rods and nuts.
2. Hanger rods, bolts, and strut for stainless steel welded duct shall be 304 stainless steel.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. See General Requirements- Execution and Closeout Requirements: Requirements for installation examination.
- B. Verify sizes of equipment connections before fabricating transitions.

3.2 PREPARATION

- A. See General Requirements - Execution and Closeout Requirements: Requirements for installation preparation.
- B. Obtain manufacturer's inspection and acceptance of fabrication and installation at beginning of installation.
- C. Install temporary closures of metal or taped polyethylene plastic on open ductwork to prevent construction dust from entering ductwork system.

3.3 INSTALLATION

- A. Duct sizes indicated are inside clear dimensions. For lined ducts, maintain sizes inside lining.
- B. Install and seal metal and flexible ducts in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible.
- C. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.
- D. During construction provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.
- E. Install and seal ducts according to SMACNA 1966.
- F. Hanger and Supports:
 1. Fabricate and support ducts according to SMACNA 1884 and 1966.
 2. Threaded Rods: Provide double nuts and lock washers.

3. Building Attachments:
 - a. Provide concrete inserts or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
 - b. If possible, install concrete inserts before placing concrete.
 - c. Powder-Actuated Concrete Fasteners:
 - 1) Use only for slabs more than 4 inches thick.
 - 2) Install after concrete is placed and completely cured.
 - 3) Do not use powder-actuated concrete fasteners for seismic restraints.
4. Hanger Spacing:
 - a. Comply with SMACNA 1884 and 1966.
 - b. Install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.
 - c. Extend strap supports down both sides of ducts and turn under bottom at least 1 inch.
 - d. Secure hanger to sides and bottom of ducts with sheet metal screws.
5. Hangers Exposed to View: Provide threaded rod and angle or channel supports.
6. Vertical Ducts:
 - a. Support with steel angles or channel secured to sides of duct with welds, bolts, sheet metal screws, or blind rivets.
 - b. Support at each floor and at maximum intervals of 16 feet.
7. Upper Attachments:
 - a. Attach to structures.
 - b. Selection and Sizing: Provide pull-out, tension, and shear capacities as required for supported loads and building materials.

3.4 CLEANING

- A. See General Requirements - Execution and Closeout Requirements: Requirements for cleaning.
- B. Protect sensitive equipment with temporary filters or bypass during cleaning.
- C. Clean exterior of ductwork free of grease, grime, flux, stickers, markers, etc.

END OF SECTION

SECTION 23 33 00
AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Manual volume control dampers.
 - 2. Turning vanes.
- B. Related Sections:
 - 1. Section 23 31 00 - HVAC Ducts and Casings.

1.3 UNIT PRICE – MEASUREMENT AND PAYMENT

- A. Work:
 - 1. Basis of Measurement: Included in other pay items for this project.
 - 2. Basis of Payment: Includes all associated labor, materials, equipment, placement, etc. for a complete installation.

1.4 REFERENCES

- A. Air Movement and Control Association International, Inc.:
 - 1. AMCA 500 - Test Methods for Louvers, Dampers, and Shutters.
- B. ASTM International:
 - 1. ASTM E1 - Standard Specification for ASTM Thermometers.
- C. National Fire Protection Association:
 - 1. NFPA 90A - Standard for the Installation of Air Conditioning and Ventilating Systems.
 - 2. NFPA 92A - Recommended Practice for Smoke-Control Systems.
- D. Sheet Metal and Air Conditioning Contractors:
 - 1. SMACNA - HVAC Duct Construction Standard - Metal and Flexible.
- E. Underwriters Laboratories Inc.:

1. UL 555 - Standard for Safety for Fire Dampers.
2. UL 555C - Standard for Safety for Ceiling Dampers.
3. UL 555S - Standard for Safety for Smoke Dampers.

1.5 SUBMITTALS

- A. See General Requirements - Submittal Procedures: Submittal procedures.
- B. Product Data: Submit for the following:
 1. Volume control dampers.
- C. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.6 CLOSEOUT SUBMITTALS

- A. See General Requirements - Execution and Closeout Requirements: Closeout procedures.
- B. Operation and Maintenance Data: Submit for Combination Smoke and Fire Dampers.

1.7 QUALITY ASSURANCE

- A. Dampers tested, rated and labeled in accordance with the latest UL requirements.
- B. Damper pressure drop ratings based on tests and procedures performed in accordance with AMCA 500.
- C. NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems."
- D. NFPA 91, "Standard for the Installation of Blower and Exhaust Systems."

1.8 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum ten years documented experience.

1.9 PRE-INSTALLATION MEETINGS

- A. See General Requirements - Administrative Requirements: Pre-installation meeting.
- B. Convene minimum one week prior to commencing work of this section.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. See General Requirements - Product Requirements: Product storage and handling requirements.
- B. Protect dampers from damage to operating linkages and blades.
- C. Delivery: Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly indicating manufacturer and material.

- D. Storage: Store materials in a dry area indoor, protected from damage.
- E. Handling: Handle and lift dampers in accordance with manufacturer's instructions. Protect materials and finishes during handling and installation to prevent damage.

1.11 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

1.12 COORDINATION

- A. See General Requirements - Administrative Requirements: Coordination and project conditions.
- B. Coordinate Work where appropriate with building control Work.

1.13 WARRANTY

- A. See General Requirements - Execution and Closeout Requirements: Product warranties and product bonds.
- B. Furnish one-year manufacturer warranty for duct accessories.

PART 2 - PRODUCTS

2.1 MANUAL VOLUME CONTROL DAMPERS

- A. General: Provide field-fabricated volume-control dampers, complete with required hardware and accessories. Stiffen damper blades to provide stability under operating conditions. Provide locking device to hold single-blade dampers in a fixed position without vibration. Close duct penetrations for damper components to seal duct consistent with pressure class. Construct in accordance with SMACNA "HVAC Duct Construction Standards".
- B. Volume dampers, opposed blade dampers, used in stainless steel welded duct shall be 304 stainless steel, and shall be welded in place, or shall be fastened using 304 stainless steel fasteners.

2.2 TURNING VANES

- A. Fabricate turning vanes according to SMACNA HVAC Duct Construction Standards, Figures 2-2 through 2-7.
- B. Fabricate of 1-1/2-inch-wide, curved blades set at 3/4 inch on center, support with bars perpendicular to blades set at 2 inches on center, and set into side strips suitable for mounting in ducts.
- C. Construct turning vanes of the same material as the ducts in which they are installed. Construct turning vanes for low and medium pressure systems of 20 gauge galvanized steel or the equivalent thickness for other duct materials as shown in the specification.

- D. Turning vanes shall be double vanes as manufactured by Ductmate or approved equal or shop fabricated turning vanes constructed to the same standards. Submit samples of shop fabricated units for approval.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. See General Requirements - Administrative Requirements: Coordination and project conditions.
- B. Examine areas and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of duct accessories. Do not proceed with installation until unsatisfactory conditions are corrected.
- C. Verify ducts and equipment installation are ready for accessories.
- D. Check location of air outlets and inlets and make necessary adjustments in position to conform to architectural features, symmetry, and lighting arrangement.

3.2 INSTALLATION.

- A. Install duct accessories according to manufacturer's installation instructions and applicable portions of details of construction as shown in SMACNA standards. Provide volume damper at every take off from any duct.
- B. Provide test holes at fan inlet and outlet and elsewhere as indicated.
- C. Install turning vanes in square or rectangular 90 deg. elbows in supply and exhaust air systems, and elsewhere as indicated
- D. Install in accordance with NFPA 90A, and follow SMACNA HVAC Duct Construction Standards - Metal and Flexible. Refer to Section 23 31 00 for duct construction and pressure class.

3.3 ADJUSTING

- A. Adjust duct accessories for proper settings.
- B. Final positioning of manual dampers is specified in Division 23 Section "Testing, Adjusting, and Balancing.

END OF SECTION

SECTION 23 34 23

HVAC POWER VENTILATORS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Centrifugal Ventilators
- B. Related Requirements:
 - 1. Division 23 31 00 HVAC Ducts and Casings
 - 2. Division 26 Electrical

1.2 UNIT PRICE – MEASUREMENT AND PAYMENT

- A. HVAC Power Ventilators:
 - 1. Basis of Measurement: Included in other pay items for this project.
 - 2. Basis of Payment: Includes all associated labor, materials, equipment, placement, etc. for a complete installation.

1.3 SUBMITTALS

- A. See General Requirements - Submittal Procedures specifies requirements for submittals.
- B. General: submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.
- C. Certified fan performance curves with system operating conditions indicated.
- D. Certified fan sound power ratings.
- E. Motor ratings and electrical characteristics, voltage, plus motor and electrical accessories.
- F. Material gages and finishes, including color charts.
- G. Dampers, including housing, linkages, and operators.
- H. Shop Drawings:
 - 1. Shop Drawings shall be submitted as described under General Requirements.
 - 2. Shop Drawings shall be submitted by the manufacturer supplier, detailing equipment assemblies and indicating dimensions, weights, loadings, required clearances, method of field assembly, components, and location and size of each field connection.

- I. Maintenance data for power ventilators to include in the operation and maintenance manual specified in Division 1 and in Division 23 Section "Basic Mechanical Requirements."

1.4 QUALITY ASSURANCE

- A. Electrical Component Standard: Provide components that comply with NFPA 70 and that are listed and labeled by UL where available.
- B. Listing and Labeling: Provide electrically operated fixtures specified in this Section that are listed and labeled.
- C. The Terms "Listed" and "Labeled": As defined in the National Electrical Code, Article 100.
- D. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.
- E. AMCA Compliance: Provide products that meet performance requirements and are licensed to use the AMCA Seal.
- F. NEMA Compliance: Provide components required as part of fans that comply with applicable NEMA standards.
- G. UL Standard: Provide power ventilators that comply with UL 705.
- H. NFPA 91: Standard for the installation of "Blower and Exhaust Systems" Comply with.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Loren Cook
 - 2. Greenheck
 - 3. Or Approved Equals

2.2 CENTRIFUGAL VENTILATORS

- A. Description: Belt-driven or direct-drive centrifugal fans, as indicated, consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, curb base, and accessories.
- B. Housings:
 - 1. Upblast: Removable, spun-aluminum, dome top and outlet baffle; square, one-piece, aluminum base with venturi inlet cone.
- C. Fan Wheels: Aluminum hub and wheel with backward-inclined blades.

- D. Drive Assembly: Resiliently mounted to the housing, with the following features:
 - 1. Fan Shaft: Turned, ground, and polished steel drive shaft keyed to wheel hub.
 - 2. Shaft Bearings: Permanently lubricated, permanently sealed, self-aligning ball bearings.
 - 3. Pulleys: Cast-iron, adjustable-pitch motor pulley.
 - 4. Fan and motor isolated from exhaust air stream.
 - 5. Belt Drive or Direct Drive as listed in the Exhaust Fan Schedule.
- E. Accessories: The following items are required:
- F. Disconnect Switch: Lockable Nonfusible type, with thermal-overload protection mounted inside fan housing, factory wired through an internal aluminum conduit. Disconnect shall be lock out type.
- G. Bird Screens: Removable 1/2-inch (13-mm) mesh, aluminum or brass wire, where applicable.
- H. Dampers: Where indicated on Exhaust Fan Schedule, Mechanical Drawings, or temperature Control Specifications include:
 - 1. See Section 230900 Instrumentation and Control for HVAC.
 - 2. Motorized, parallel-blade, ASHRAE 90.1-2013, normally open.
- I. Motors:
 - 1. Refer to Division 26 for motor requirements.
 - 2. Motor Construction: NEMA MG 1, general purpose, continuous duty, Design B.
 - 3. Enclosure Type: The following features are required as indicated:
 - 4. Open drip-proof motors where satisfactorily housed or remotely located during operation
- J. Roof Curbs:
 - 1. Height: 18".
 - 2. Aluminum; mitered and welded corners; 2-inch (50-mm) thick, rigid, fiberglass insulation adhered to inside walls; and 2-inch (50-mm) wood nailer.
 - 3. Dimensions: Size as required to suit roof opening and fan base.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install according to manufacturer's written instructions.
- B. Install units with clearances for service and maintenance.

3.2 FIELD QUALITY CONTROL

- A. Adjusting
 - 1. Adjust damper linkages for proper damper operation.
 - 2. Adjust belt tension.
 - 3. Adjust sheaves.
 - 4. Lubricate bearings.

3.3 CLEANING

- A. After completing installation, inspect exposed finish. Remove burrs, dirt, and construction debris, and repair damaged finishes including chips, scratches, and abrasions.
- B. Clean fan interiors to remove foreign material and construction debris. Vacuum clean fan wheel and cabinet.

END OF SECTION

SECTION 23 37 00
AIR OUTLETS AND INLETS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Registers
2. Grilles
3. Louvers

B. Related Sections:

1. Section 23 31 00 – HVAC Ducts and Casings
2. Section 23 33 00 - Air Duct Accessories

1.2 UNIT PRICE – MEASUREMENT AND PAYMENT

A. Work:

1. Basis of Measurement: Included in other pay items for this project.
2. Basis of Payment: Includes all associated labor, materials, equipment, placement, etc. for a complete installation.

1.3 REFERENCES

A. Air Movement and Control Association International, Inc.:

1. AMCA 500 - Test Methods for Louvers, Dampers, and Shutters.

B. American Society of Heating, Refrigerating and Air-Conditioning Engineers:

1. ASHRAE 70 - Method of Testing for Rating the Performance of Air Outlets and Inlets.

C. Sheet Metal and Air Conditioning Contractors:

1. SMACNA - HVAC Duct Construction Standard - Metal and Flexible.

1.4 SUBMITTALS

A. See General Requirements - Submittal Procedures: Submittal procedures.

B. Product Data: Submit sizes, finish, and type of mounting. Submit schedule of outlets and inlets showing type, size, location, application, and noise level.

- C. Test Reports: Rating of air outlet and inlet performance.
- D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.5 CLOSEOUT SUBMITTALS

- A. See General Requirements - Execution and Closeout Requirements: Closeout procedures.

1.6 QUALITY ASSURANCE

- A. ADC Compliance: Test and rate registers, grilles, and diffusers in accordance with ADC Equipment Test Code 1062, provide Certified Ratings Seal on each unit.
- B. AMCA Compliance: Test and rate louvers, dampers, and shutters in accordance with AMCA Standard 500, provide Certified Ratings Seal on each unit.
- C. NFPA Compliance: Construct and install air outlets and inlets in accordance with NFPA 90A, and 90B.
 - 1. Comply with NFPA 91 "Standard for Installation of Blower and Exhaust Systems".
- D. Submittals: Submit manufacturer's technical product data, assembly-type shop drawings.

1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum ten years' documented experience.

1.8 PRE-INSTALLATION MEETINGS

- A. See General Requirements - Administrative Requirements: Pre-installation meeting.
- B. Convene minimum two weeks prior to commencing work of this section.

1.9 WARRANTY

- A. See General Requirements - Execution and Closeout Requirements: Product warranties and product bonds.
- B. Furnish two-year manufacturer's warranty for air outlets and inlets.

PART 2 - PRODUCTS

2.1 SUPPLY REGISTERS

- A. Manufacturers:
 - 1. Titus
 - 2. Tuttle and Bailey
 - 3. Price

4. Kreuger
 5. Or Approved Equal
- B. General: Supplier / Contractor must match size, type, performance, and style exactly as model indicates on Grilles, Registers, and Diffusers Schedule.
- C. Individually adjustable airfoil blades to discharge air along face of grille, one-way or two-way deflection as Scheduled.
- D. Material: Steel, aluminum, or stainless steel as Scheduled. Blade width as model number indicates on Schedule.
- E. Border: Surface duct or wall mount. Screw holes exposed or concealed as model number indicates on Schedule.
1. Galvanized ductwork: Use steel fasteners.
 2. Stainless steel ductwork: use stainless steel fasteners or weld directly to stainless steel duct.
- F. Manual Balance Dampers:
1. Galvanized ductwork: galvanized or aluminum.
 2. Stainless steel ductwork: 304 stainless steel.

2.2 LOUVERS

- A. Manufacturers:
1. Ruskin
 2. Greenheck
 3. NCA
 4. Or Approved Equal
- B. Product Description: Stationary with Drainable blades, with free area and performance complying with AMCA Standard 500 testing standards.
- C. Type: 2", 4" or 6" inch deep with blades on 37.5 or 45 degree blade angle with heavy channel frame as model number indicates on Schedule.
- D. Frame: 6063T5 extruded aluminum, 0.081" (2.05mm) or 0.125" (6.35mm) wall thickness as model number indicates on Schedule.
- E. Blades: 6063T5 extruded aluminum, 0.081" (2.05mm) or 0.125" (6.35mm) wall thickness as model number indicates on Schedule.
- F. Mounting: Flanged or unflanged as Schedule indicates.
- G. Bird Screen: 3/4 inch square.
- H. Finish: Provide mill, epoxy, or polyester finish as Scheduled.

- I. Color: Provide in finish color as Scheduled. Provide color swatch if noted for standard or custom color selection by Architect or Engineer as noted on Schedule.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. See General Requirements - Administrative Requirements: Coordination and project conditions.
- B. Verify inlet and outlet locations.
- C. Verify ceiling, wall, or duct systems are ready for installation.

3.2 INSTALLATION

- A. Install diffusers to ductwork with airtight connection.
- B. Install balancing dampers on duct take-off to diffusers, grilles, and registers, whether or not dampers are furnished as part of diffuser, grille, and register assembly.
- C. Install air outlets and inlets in accordance with manufacturer's written instructions and in accordance with recognized industry practices to ensure that products serve intended functions.

3.3 INTERFACE WITH OTHER PRODUCTS

- A. Check location of outlets and inlets and make necessary adjustments in position to conform to architectural features, symmetry, and lighting arrangement.
- B. Coordinate with other work, including ductwork and duct accessories, as necessary to interface installation of air outlets and inlets with other work.

END OF SECTION

SECTION 23 74 00

PACKAGED OUTDOOR HVAC EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Packaged gas-electric high efficiency single zone variable air volume roof top unit(s).
2. Stand-alone digital controls and thermostat.
3. Roof top unit accessories.
4. Roof curb.

B. Related Requirements:

1. Section 23 31 00 – HVAC Ducts and Casings

1.2 REFERENCE STANDARDS

A. National Fire Protection Association

1. NFPA 90 A & B - Installation of Air Conditioning and Ventilation Systems and Installation of Warm Air Heating and Air Conditioning Systems.
2. NFPA 54 National Fuel Gas Code.

B. American National Standards Institute

1. ANSI/ASHRAE 15 - Safety Code for Mechanical Refrigeration.
2. ANSI/ASHRAE 37 - Testing Unitary Air Conditioning and Heat Pump Equipment.
3. ANSI/ASHRAE/IES 90 A - Energy Conservation in New Building Design Standard.
4. ANSI/UL 465 - Central Cooling Air Conditioners Standard for safety requirements.
5. ANSI/NFPA 70-1990 - National Electric Code.
6. ANSI Z21.47 - Gas-Fired Central Furnaces

C. Air Conditioning and Refrigeration Institute

1. ARI 360 - Commercial and Industrial Unitary Air Conditioning Equipment testing and rating standard.
2. ARI Standards 210 and 270.
3. ARI 210/240 - Unitary Air-Conditioning Equipment and Air- Source Heat Pump Equipment. (all under 135,000 btus)
4. ARI 270 - Sound Rating of Outdoor Unitary Equipment.

D. American Society of Heating, Refrigerating, and Air-Conditioning

1. ARI 360 - Commercial and Industrial Unitary Air Conditioning Equipment testing and rating standard.

- E. Equipment shall be UL tested and certified with ANSI Z 21.47 and CSA or CGA certified as a package.

1.3 UNIT PRICE – MEASUREMENT AND PAYMENT

- A. Packaged Outdoor HVAC Equipment
 1. Basis of Measurement: Included in the lump sum price bid for HVAC system.
 2. Basis of Payment: Includes all associated labor, materials, equipment, placement, etc. for a complete installation.

1.4 SUBMITTALS

- A. See General Requirements for Submittal Procedures specifies requirements for submittals.
- B. Product Data:
 1. Provide data cut sheets on all equipment.
- C. Submit shop drawings for all equipment in accordance with general requirements.
 1. Operation and Maintenance Data.
 2. Include manufacturer's descriptive literature, start-up and operating instructions, installation instructions, and maintenance procedures

1.5 HANDLING

- A. Comply with manufacturer's installation instructions for rigging, unloading, and transporting units.
- B. Protect units from physical damage. Leave factory shipping covers in place until installation.

1.6 WARRANTY

- A. Provide a full parts and labor warranty for two years from start-up or 27 months from shipping date.
- B. Mechanical Contractor shall include two year labor warranty.

PART 2 - PRODUCTS

2.1 SUMMARY

- A. The contractor shall furnish and install package rooftop unit(s) as shown and scheduled on the contract documents. The unit(s) shall be installed in accordance with this specification and perform at the specified conditions as scheduled.

- B. MANUFACTURERS
1. Trane Corporation
 2. Aeon
 3. Or Approved Equal

2.2 UNIT DESCRIPTION

A. General:

1. See Roof Top Unit Schedule, and match type, efficiency, capacity, airflow, and accessories as scheduled.
2. Packaged high-efficiency rooftop unit shall include compressors, evaporator coils, filters, direct-drive supply fan, ASHRAE 90.1-2013 dampers, air-cooled condenser coils, ASHRAE 90.1-2013 variable speed condenser fans, modulating gas heaters, MERV 8 filters, and stand-alone digital controls with programmable thermostat and Bacnet interface board (for future use).
3. Unit shall be factory assembled and tested including leak testing of the DX coils, pressure testing of the refrigeration circuit, and run testing of the completed unit. Run test report shall be supplied with the unit in the service compartment's literature pocket.
4. Unit shall have decals and tags to indicate lifting and rigging, service areas and caution areas for safety and to assist service personnel.
5. Unit components shall be labeled, including refrigeration system components and electrical and controls components.
6. Estimated sound power levels (dB) shall be shown on the unit ratings sheet.
7. Installation, Operation, and Maintenance manual shall be supplied within the unit.
8. Laminated color-coded wiring diagram shall match factory installed wiring and shall be affixed to the interior of the control compartment's hinged access door.
9. Unit nameplate shall be provided in two locations on the unit, affixed to the exterior of the unit and affixed to the interior of the control compartment's hinged access door.
10. Native Bacnet, IP equipment controller for interconnection, interoperability, and integration into a future Bacnet-based building control system.
11. Discharge: Downflow.

B. Construction:

1. All cabinet walls, access doors, and roof shall be fabricated of double wall, impact resistant, rigid polyurethane foam panels.
2. Unit insulation shall have a minimum thermal resistance R-value of 13. Foam insulation shall have a minimum density of 2 pounds/cubic foot and shall be tested in accordance with ASTM D1929-11 for a minimum flash ignition temperature of 610°F.
3. Unit construction shall be double wall with G90 galvanized steel on both sides and a thermal break. Double wall construction with a thermal break prevents moisture accumulation on the insulation, provides a cleanable interior, prevents heat transfer through the panel, and prevents exterior condensation on the panel.
4. Unit shall be designed to reduce air leakage and infiltration through the cabinet. Cabinet leakage shall not exceed 1% of total airflow when tested at 3 times the minimum external static pressure provided in AHRI Standard 340/360. Panel deflection shall not exceed L/240 ratio at 125% of design static pressure, at a maximum 8 inches of positive or negative static pressure, to reduce air leakage. Deflection shall be measured at the midpoint of the panel height and width. Continuous sealing shall be included between panels and between access

doors and openings to reduce air leakage. Piping and electrical conduit through cabinet panels shall include sealing to reduce air leakage.

5. Roof of the air tunnel shall be sloped to provide complete drainage. Cabinet shall have rain break overhangs above access doors.
6. Access to filters, dampers, cooling coils, heaters, dampers, controllers, compressors, and electrical and controls components shall be through hinged access doors with quarter turn, zinc cast, lockable handles. Full length stainless steel piano hinges shall be included on the doors.
7. Exterior paint finish shall be capable of withstanding at least 2,500 hours, with no visible corrosive effects, when tested in a salt spray and fog atmosphere in accordance with ASTM B 117-95 test procedure.
8. Galvanized or HDPE drain pans.
9. Unit shall include lifting lugs on the top of the unit.

C. Heating Section:

1. Tubular heat exchanger design using corrosion resistant steel throughout.
2. Induced draft combustion blower.
3. Direct spark ignition (DSI) system. On initial call for heat, the combustion blower will purge the heat exchanger for 20 seconds before ignition. After three unsuccessful ignition attempts, the entire heating system will be locked out until manually reset at the thermostat/zone sensor.
4. Modulating burner.

D. Compressors:

1. Variable speed scroll compressor shall be capable of speed modulation from 15Hz to a maximum of 60 Hz. The minimum unit capacity shall be 25% of full load or less. The compressor motor shall be a permanent magnet type. Each variable speed compressor shall be matched with a specially designed, refrigerant-cooled, variable frequency drive which modulates the speed of the compressor motor and provides several compressor protection functions. Control of the variable speed compressor and inverter control, as well as tandem direct-drive, scroll type compressors, shall be integrated with the unit controller to ensure optimal equipment reliability and efficiency. Each compressor shall have a crankcase heater installed, properly sized to minimize the amount of liquid refrigerant present in the oil sump during off cycles.

E. Evaporator and Condenser Coils:

1. Internally finned, 5/16" copper tubes are mechanically bonded to a configured aluminum plate fin. The microchannel type condenser coil uses flat streamlined tubes with small ports, and metallurgical tube-to-fin bond.
2. Evaporator coil and condenser coil shall be leak tested to 600 psig. The assembled unit shall be leak tested to 465 psig. The plate fin condenser coil shall have a hybrid coil designed with slight gaps for ease of cleaning. A plastic, dual-sloped, removable and reversible condensate drain pan with through-the-base condensate drain is standard.

F. Supply Fan:

1. Unit shall include direct drive, unhooded, backward curved, direct drive or belt driven fan as scheduled.
2. Single zone VAV.
3. Blowers and motors shall be dynamically balance and mounted on rubber isolators.

4. Motors shall be premium efficiency ODP with ball bearings rated for 200,000 hours service with external lubrication points.
 5. Variable frequency drives (where required per ASHRAE 90.1-2013 shall be factory wired and mounted in the unit and shall include a 5% line reactor. Fan motors shall be premium efficiency.
- G. Condenser Fan:
1. Direct-drive, variable speed, ASHRAE 90.1-2013, statically balanced, draw-through in the vertical discharge position. The fan motor shall be permanently lubricated and shall have built-in thermal overload protection.
- H. Electrical:
1. Unit shall be provided with factory installed and factory wired, non-fused disconnect switch.
 2. Unit shall be provided with a factory installed and factory wired 115V, 12 amp GFI outlet disconnect switch in the unit control panel.
- I. Accessories:
1. Modulating natural gas burner.
 2. ASHRAE 90.1-2013 Low leakage outdoor air damper.
 3. ASHRAE 90.1-2013 100% full economizer with dry-bulb controls (set to 70 deg. F.)
 4. Barometric relief air damper.
 5. Demand Control CO2 Ventilation (DCV) controller. Set minimum position to 100% closed position (since space is rarely occupied.)
 6. Hinged access doors.
 7. 18" solid bottom, insulated, roof curb.
 8. Programmable T-stat with LCD display and monitoring controls.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Contractor shall install in strict accordance with manufacturer's instructions.
- B. Install units plumb and level.
- C. Unit footprint including intake hood must be a minimum of 10'-0" horizontally from roof edge.
- D. Install per NFPA 90A and NFPA 54.
- E. Mount unit on factory built 18" insulated roof curb. Coordinate roof type with General Contractor or Construction Manager, and Roofing Contractor.
- F. Install accessories furnished by manufacturer but not specified to be factory installed.
- G. Verify electrical wiring is installed in accordance with the manufacturer's approved submittal.

- H. Control wiring shall be included as part of the work of this section. Field wiring of zone controls to be NEC, Class I and Class II per space requirements. Coordinate with Electrical Contractor. All wiring exterior to unit shall be completed by Electrical Contractor.
- I. Factory authorized start-up: Mechanical Contractor shall work with a factory trained and authorized service technician to check, test, and commission the unit. Factory authorized personnel shall provide a copy of start-up report to Engineer for review and approval, and then include approved reports in O&M Manual.
- J. Provide two hours instruction to owner's personnel in operation and maintenance of units.
- K. Install exterior-grade plastic, UV resistant, laminate identification nameplate(s) with corrosion resistant fasteners on all units.

END OF SECTION

SECTION 26 05 05
SELECTIVE DEMOLITION FOR ELECTRICAL

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Removal of existing electrical equipment, wiring, and conduit in areas to be remodeled; removal of designated construction; dismantling, cutting and alterations for completion of the Work.
 - 2. Disposal of materials.
 - 3. Storage of removed materials.
 - 4. Identification of utilities.
 - 5. Salvaged items.
 - 6. Protection of items to remain as scheduled at end of section or as indicated on Drawings.
 - 7. Relocate existing equipment to accommodate construction.
- B. Related Sections:
 - 1. Section 02 41 16 - Structure Demolition.

1.2 UNIT PRICE – MEASUREMENT AND PAYMENT

- A. Demolition:
 - 1. Basis of Measurement: Included in the lump sum price bid as stated in the proposal.
 - 2. Basis of Payment: Includes all associated labor, equipment coordination, transport, loading/unloading, storage, etc. required to remove required materials and protect materials to be salvaged or remain.

1.3 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Shop Drawings: Indicate demolition and removal sequence and location of salvageable items; location and construction of temporary work. Describe demolition removal procedures and schedule.

1.4 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for submittals.
- B. Project Record Documents: Record actual locations of capped utilities, conduits and equipment abandoned in place, and any remaining items originally scheduled for demolition.

1.5 QUALITY ASSURANCE

- A. Perform Work in accordance with Perform Work in accordance with all applicable Federal, State, and local Codes and Ordinances.

1.6 PRE-INSTALLATION MEETINGS

- A. Section 01 30 00 - Administrative Requirements: Pre-installation meeting.
- B. Convene minimum one week prior to commencing work of this section.

1.7 SEQUENCING

- A. Section 01 10 00 - Summary: Requirements for sequencing.
- B. Sequence work as required to coordinate with other trades, avoid conflict with daily operations (where possible), and as directed on drawings.
- C. Sequence Pump Station Distribution Equipment work in order to maintain power and control functionality for a minimum of two (2) service pumps at all times throughout the duration of the project. Any temporary shutdowns requiring less than two (2) pumps be available must be approved by owner and engineer in advance, and shall be coordinated with other trades to avoid conflicts.

1.8 SCHEDULING

- A. Section 01 30 00 - Administrative Requirements: Requirements for scheduling.
- B. Schedule work to coincide with new construction.
- C. Perform noisy, malodorous, or dusty work at coordinated times to avoid conflict with other trades.
- D. Cease operations immediately when structure appears to be in danger and notify Architect/Engineer. Do not resume operations until directed.

1.9 COORDINATION

- A. Section 01 30 00 - Administrative Requirements: Requirements for coordination.
- B. Conduct demolition to minimize interference with adjacent building areas.
- C. Coordinate demolition work with Owner, Architect/Engineer, and all other trades.
- D. Coordinate and sequence demolition so as not to cause shutdown of operation of surrounding areas.
- E. Shut-down Periods:
 - 1. Arrange timing of shut-down periods of in service panels with Owner and Architect/Engineer. Do not shut down any utility without prior written approval.
 - 2. Keep shut-down period to minimum or use intermittent period as directed by Owner and Architect/Engineer.
 - 3. Maintain life-safety systems in full operation in occupied facilities, or provide notice minimum 3 days in advance.

- F. Identify salvage items in cooperation with Owner.

PART 2 - PRODUCTS

2.1 Not Used

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements: Verification of existing conditions before starting work.
- B. Verify wiring and equipment indicated to be demolished serve only abandoned facilities.
- C. Verify termination points for demolished services.

3.2 PREPARATION

- A. Erect, and maintain temporary safeguards, including warning signs and lights, barricades, and similar measures, for protection of the public, Owner, Contractor's employees, and existing improvements to remain.
- B. Temporary egress signage and emergency lighting

3.3 DEMOLITION

- A. Demolition Drawings are based on casual field observation and existing record documents. Report discrepancies to Owner, Architect/Engineer, and other Contractor(s) before disturbing existing installation.
- B. Remove exposed abandoned conduit and wire, including abandoned conduit and wire above accessible ceiling finishes. Cut conduit flush with walls and floors, and patch surfaces.
- C. Remove conduit, wire, boxes, and fastening devices to avoid any interference with new installation.
- D. Disconnect electrical systems in walls, floors, and ceilings scheduled for removal.
- E. Reconnect equipment being disturbed by renovation work and required for continued service to temporary service or nearest available panel, unless otherwise directed.
- F. Disconnect or shut off service to areas where electrical work is to be removed. Remove electrical fixtures, equipment, and related switches, outlets, conduit and wiring which are not part of final project.

- G. Install temporary wiring and connections to maintain existing systems in service during construction.
- H. Perform work on energized equipment or circuits with experienced and trained personnel.
- I. Remove, relocate, and extend existing installations to accommodate new construction.
- J. Repair adjacent construction and finishes damaged during demolition and extension work.
- K. Remove exposed abandoned grounding and bonding components, fasteners and supports, and electrical identification components, including abandoned components above accessible ceiling finishes. Cut embedded support elements flush with walls and floors.
- L. Clean and repair existing equipment to remain or to be reinstalled.
- M. Protect and retain power to existing active equipment remaining.
- N. Cap abandoned empty conduit at both ends.

3.4 EXISTING PANELBOARDS

- A. Ring out circuits in existing panel affected by the Work. Where additional circuits are needed, reuse circuits available for reuse. Install new breakers.
- B. Tag unused circuits as spare.
- C. Where existing circuits are indicated to be reused, use sensing measuring devices to verify circuits feeding Project area or are not in use.
- D. Remove existing wire no longer in use from panel to equipment.
- E. Provide new updated directories where more than three circuits have been modified or rewired.

3.5 SALVAGE ITEMS

- A. Remove and protect items indicated in Schedule and on Drawings to be salvaged and turn over to Owner, unless otherwise directed.
- B. Items of salvageable value may be removed as work progresses. Transport salvaged items from site as they are removed.

3.6 REUSABLE ELECTRICAL EQUIPMENT

- A. Carefully remove equipment, materials, or fixtures which are to be reused.
- B. Disconnect, remove, or relocate existing electrical material and equipment interfering with new installation.

- C. Relocate existing lighting fixtures as indicated on Drawings. Clean fixtures and re-lamp. Test fixture to see if it is in good working condition before installation at new location.

3.7 CLEANING

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for cleaning.
- B. Remove demolished materials as work progresses. Legally dispose.
- C. Keep workplace neat.

3.8 PROTECTION OF FINISHED WORK

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for protecting finished Work.

END OF SECTION

SECTION 26 05 19
LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes building wire and cable; nonmetallic-sheathed cable; direct burial cable; service entrance cable; armored cable; metal clad cable; and wiring connectors and connections.
- B. Related Sections:
 - 1. Section 26 05 53 - Identification for Electrical Systems.
 - 2. Section 31 23 17 - Trenching.

1.2 UNIT PRICE – MEASUREMENT AND PAYMENT

- A. Electrical and Controls, Complete:
 - 1. Basis of Measurement: Included in the lump sum price bid as stated in the proposal.
 - 2. Basis of Payment: Includes all associated labor, material, equipment coordination, transport, loading/unloading, storage, etc. required for a complete and operable system.

1.3 REFERENCES

- A. International Electrical Testing Association:
 - 1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
- B. National Fire Protection Association:
 - 1. NFPA 70 - National Electrical Code.
 - 2. NFPA 262 - Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces.
- C. Underwriters Laboratories, Inc.:
 - 1. UL 1277 - Standard for Safety for Electrical Power and Control Tray Cables with Optional Optical-Fiber Members.

1.4 SYSTEM DESCRIPTION

- A. Product Requirements: Provide products as follows:
 - 1. Solid conductor for feeders and branch circuits 10 AWG and smaller.
 - 2. Stranded conductors for control circuits.
 - 3. Conductor not smaller than 12 AWG for power and lighting circuits.
 - 4. Conductor not smaller than 14 AWG for control circuits.
 - 5. Increase wire size in branch circuits to limit voltage drop to a maximum of 3 percent.

- B. Wiring Methods: Provide the following wiring methods:
 - 1. Concealed Dry Interior Locations: Use only building wire, Type THHN/THWN insulation, in raceway, nonmetallic-sheathed cable, armored cable or metal clad cable.
 - 2. Exposed Dry Interior Locations: Use only building wire, Type THHN/THWN insulation, in raceway, nonmetallic-sheathed cable, armored cable or metal clad cable.
 - 3. Above Accessible Ceilings: Use only building wire, Type THHN/THWN insulation, in raceway, nonmetallic-sheathed cable, armored cable or metal clad cable.
 - 4. Wet or Damp Interior Locations: Use only building wire, Type THHN/THWN insulation, in raceway, direct burial cable, armored cable or metal clad cable.
 - 5. Exterior Locations: Use only building wire, Type THHN/THWN insulation, in raceway, direct burial cable, service-entrance cable, armored cable or metal clad cable.
 - 6. Underground Locations: Use only building wire, Type THHN/THWN insulation, in raceway, direct burial cable, service-entrance cable, armored cable or metal clad cable.
 - 7. Cable Tray Locations: Use only Tray cable Type TC.

1.5 DESIGN REQUIREMENTS

- A. Conductor sizes are based on copper unless indicated as aluminum or "AL".
- B. When aluminum conductor is substituted for copper conductor, size to match circuit requirements, terminations, conductor ampacity and voltage drop.

1.6 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit for building wire and each cable assembly type.
- C. Design Data: Indicate voltage drop and ampacity calculations for aluminum conductors substituted for copper conductors.
- D. Test Reports: Indicate procedures and values obtained.

1.7 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for submittals.
- B. Project Record Documents: Record actual locations of components and circuits.

1.8 QUALITY ASSURANCE

- A. Provide wiring materials located in plenums with peak optical density not greater than 0.5, average optical density not greater than 0.15, and flame spread not greater than 5 feet (1.5 m) when tested in accordance with NFPA 262.
- B. Perform Work in accordance with all applicable Federal, State, and local Codes and Ordinances.
- C. Maintain one copy of each document on site.

1.9 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

1.10 FIELD MEASUREMENTS

- A. Verify field measurements are as indicated on Drawings.

1.11 COORDINATION

- A. Section 01 30 00 - Administrative Requirements: Requirements for coordination.
- B. Where wire and cable destination is indicated and routing is not shown, determine routing and lengths required.
- C. Wire and cable routing indicated is approximate unless dimensioned. Include wire and cable lengths within 10 ft of length shown.

PART 2 - PRODUCTS

2.1 BUILDING WIRE

- A. Manufacturers:
 - 1. Cerro Wire LLC.
 - 2. General Cable; General Cable Corporation.
 - 3. Southwire Company.
 - 4. Substitutions: Section 01 60 00 - Product Requirements.
- B. Product Description: Single conductor insulated wire.
- C. Conductor: Copper.
- D. Insulation Voltage Rating: 600 volts.
- E. Insulation Temperature Rating: 105 degrees C.
- F. Insulation Material: Thermoplastic.

2.2 NONMETALLIC-SHEATHED CABLE

- A. Manufacturers:
 - 1. Cerro Wire LLC.
 - 2. General Cable; General Cable Corporation.
 - 3. Southwire Company.
 - 4. Substitutions: Section 01 60 00 - Product Requirements.
- B. Conductor: Copper.

C. Insulation Voltage Rating: 600 volts.

2.3 DIRECT BURIAL CABLE

A. Manufacturers:

1. Cerro Wire LLC.
2. General Cable; General Cable Corporation.
3. Southwire Company.
4. Substitutions: Section 01 60 00 - Product Requirements.

B. Conductor: Copper.

C. Insulation Voltage Rating: 600 volts.

D. Insulation Temperature Rating: 90 degrees C.

2.4 SERVICE ENTRANCE CABLE

A. Manufacturers:

1. Cerro Wire LLC.
2. General Cable; General Cable Corporation.
3. Southwire Company.
4. Substitutions: Section 01 60 00 - Product Requirements.

B. Conductor: Copper.

C. Insulation Voltage Rating: 600 volts.

D. Insulation: Type USE, SE, or USE-2, as approved by Utility Company.

2.5 ARMORED CABLE

A. Manufacturers:

1. Cerro Wire LLC.
2. General Cable; General Cable Corporation.
3. Southwire Company.
4. Substitutions: Section 01 60 00 - Product Requirements.

B. Conductor: Copper.

C. Insulation Voltage Rating: 600 volts.

D. Insulation Temperature Rating: 90 degrees C.

E. Insulation Material: Thermoplastic.

F. Armor Material: Aluminum.

G. Armor Design: Interlocked metal tape.

2.6 METAL CLAD CABLE

- A. Manufacturers:
 - 1. Cerro Wire LLC.
 - 2. General Cable; General Cable Corporation.
 - 3. Southwire Company.
 - 4. Substitutions: Section 01 60 00 - Product Requirements.
- B. Conductor: Copper.
- C. Insulation Voltage Rating: 600 volts.
- D. Insulation Temperature Rating: 90 degrees C.
- E. Insulation Material: Thermoplastic.
- F. Armor Material: Aluminum.
- G. Armor Design: Interlocked metal tape.
- H. Jacket: Where required.

2.7 TRAY CABLE

- A. Manufacturers:
 - 1. EGS/Appleton Electric.
 - 2. General Cable; General Cable Corporation.
 - 3. Thomas & Betts Corporation.
 - 4. Substitutions: Section 01 60 00 - Product Requirements.
- B. Product Description: Multiconductor power and control cable NFPA 70 Type TC.
- C. Conductor: Copper.
- D. Insulation: Flame-retardant.
- E. Overall Jacket: Polyvinyl Chlorine (PVC) in accordance with UL 1277.
- F. Insulation Voltage Rating: 600 volts.
- G. Insulation Temperature Rating: 90 degrees C.
- H. Listings: Finished cable UL listed as Type TC, and sunlight resistant.

2.8 UNSHIELDED NETWORK CABLE

- A. Manufacturers:
 - 1. Belden.

2. Panduit.
3. Southwire.
4. Substitutions: **Section 016000 - Product Requirements.**

- B. Product Description: TIA/EIA 568, 100-ohm, unshielded twisted pair **plenum rated** cable with 4 pairs, **22** AWG copper conductor.

2.9 SHIELDED NETWORK CABLE

- A. Manufacturers:
1. Belden.
 2. Panduit.
 3. Southwire.
 4. Substitutions: **Section 016000 - Product Requirements.**
- B. Product Description: TIA/EIA 568, 150-ohm shielded, twisted-pair **plenum rated** cable with 2 pairs, **22** AWG copper conductor.

2.10 WIRING CONNECTORS

- A. Split Bolt Connectors:
1. Manufacturers:
 - a. Burndy: Part of Hubbell Electrical Systems.
 - b. ILSCO.
 - c. Thomas & Betts Corporation.
 - d. Substitutions: Section 01 60 00 - Product Requirements.
- B. Solderless Pressure Connectors:
- a. Burndy: Part of Hubbell Electrical Systems.
 - b. ILSCO.
 - c. Thomas & Betts Corporation.
 - d. Substitutions: Section 01 60 00 - Product Requirements.
- C. Spring Wire Connectors:
1. Manufacturers:
 - a. Burndy: Part of Hubbell Electrical Systems.
 - b. ILSCO.
 - c. Thomas & Betts Corporation.
 - d. Substitutions: Section 01 60 00 - Product Requirements.
- D. Compression Connectors:
1. Manufacturers:
 - a. Burndy: Part of Hubbell Electrical Systems.
 - b. ILSCO.
 - c. Thomas & Betts Corporation.
 - d. Substitutions: Section 01 60 00 - Product Requirements.

2.11 TERMINATIONS

- A. Terminal Lugs for Wires 6 AWG and Smaller: Solderless, compression type copper.
- B. Lugs for Wires 4 AWG and Larger: Color keyed, compression type copper, with insulating sealing collars.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.
- B. Verify interior of building has been protected from weather.
- C. Verify mechanical work likely to damage wire and cable has been completed.
- D. Verify raceway installation is complete and supported.

3.2 PREPARATION

- A. Completely and thoroughly swab raceway before installing wire.

3.3 INSTALLATION

- A. Route wire and cable to meet Project conditions.
- B. Neatly train and lace wiring inside boxes, equipment, and panelboards.
- C. Identify and color code wire and cable under provisions of Section 26 05 53. Identify each conductor with its circuit number or other designation indicated.
- D. Special Techniques--Building Wire in Raceway:
 - 1. Pull conductors into raceway at same time.
 - 2. Install building wire 4 AWG and larger with pulling equipment.
- E. Special Techniques - Cable:
 - 1. Protect exposed cable from damage.
 - 2. Support cables above accessible ceiling, using spring metal clips or metal cable ties to support cables from structure or ceiling suspension system. Do not rest cable on ceiling panels.
 - 3. Use suitable cable fittings and connectors.
- F. Special Techniques - Direct Burial Cable:
 - 1. Trench and backfill for direct burial cable installation. Refer to Section 31 23 23 and Section 31 23 17. Install warning tape along entire length of direct burial cable, within 3 inches of grade.
 - 2. Use suitable direct burial cable fittings and connectors.

- G. Special Techniques - Wiring Connections:
1. Clean conductor surfaces before installing lugs and connectors.
 2. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.
 3. Tape uninsulated conductors and connectors with electrical tape to 150 percent of insulation rating of conductor.
 4. Install split bolt connectors for copper conductor splices and taps, 6 AWG and larger.
 5. Install solderless pressure connectors with insulating covers for copper conductor splices and taps, 8 AWG and smaller.
 6. Install insulated spring wire connectors with plastic caps for copper conductor splices and taps, 10 AWG and smaller.
 7. Terminate aluminum conductors with tin-plated, aluminum-bodied compression connectors only. Fill with anti-oxidant compound before installing conductor.
 8. Install suitable reducing connectors or mechanical connector adaptors for connecting aluminum conductors to copper conductors.
- H. Install stranded conductors for branch circuits 10 AWG and smaller. Install crimp on fork terminals for device terminations. Do not place bare stranded conductors directly under screws.
- I. Install terminal lugs on ends of 600 volt wires unless lugs are furnished on connected device, such as circuit breakers.
- J. Size lugs in accordance with manufacturer's recommendations terminating wire sizes. Install 2-hole type lugs to connect wires 4 AWG and larger to copper bus bars.
- K. For terminal lugs fastened together such as on motors, transformers, and other apparatus, or when space between studs is small enough that lugs can turn and touch each other, insulate for dielectric strength of 2-1/2 times normal potential of circuit.

3.4 WIRE COLOR

- A. General:
1. For wire sizes 10 AWG and smaller, install wire colors in accordance with the following:
 - a. Black and red for single phase circuits at 120/240 volts.
 - b. Black, red, and blue for circuits at 120/208 volts single or three phase.
 - c. Orange, brown, and yellow for circuits at 277/480 volts single or three phase.
 2. For wire sizes 8 AWG and larger, identify wire with colored tape at terminals, splices and boxes. Colors are as follows:
 - a. Black and red for single phase circuits at 120/240 volts.
 - b. Black, red, and blue for circuits at 120/208 volts single or three phase.
 - c. Orange, brown, and yellow for circuits at 277/480 volts single or three phase.
- B. Neutral Conductors: White. When two or more neutrals are located in one conduit, individually identify each with proper circuit number.
- C. Branch Circuit Conductors: Install three or four wire home runs with each phase uniquely color coded.
- D. Feeder Circuit Conductors: Uniquely color code each phase.

- E. Ground Conductors:
 - 1. For 6 AWG and smaller: Green.
 - 2. For 4 AWG and larger: Identify with green tape at both ends and visible points including junction boxes.

3.5 FIELD QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements
- B. Section 01 70 00 - Execution and Closeout Requirements: Field inspecting, testing, adjusting, and balancing.
- C. Inspect and test in accordance with NETA ATS, except Section 4.
- D. Perform inspections and tests listed in NETA ATS, Section 7.3.1.

END OF SECTION

SECTION 26 05 26
GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Rod electrodes.
 - 2. Active electrodes.
 - 3. Wire.
 - 4. Grounding well components.
 - 5. Mechanical connectors.
 - 6. Exothermic connections.

1.2 UNIT PRICE – MEASUREMENT AND PAYMENT

- A. Electrical & Controls, Complete:
 - 1. Basis of Measurement: Included in the lump sum price bid as stated in the Proposal.
 - 2. Basis of Payment: Includes all associated labor, material, equipment coordination, transport, loading/unloading, storage, etc. required for a complete and operable system.

1.3 REFERENCES

- A. Institute of Electrical and Electronics Engineers:
 - 1. IEEE 142 - Recommended Practice for Grounding of Industrial and Commercial Power Systems.
 - 2. IEEE 1100 - Recommended Practice for Powering and Grounding Electronic Equipment.
- B. International Electrical Testing Association:
 - 1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
- C. National Fire Protection Association:
 - 1. NFPA 70 - National Electrical Code.
 - 2. NFPA 99 - Standard for Health Care Facilities.

1.4 SYSTEM DESCRIPTION

- A. Grounding systems use the following elements as grounding electrodes:
 - 1. Edit the following list to meet Project requirements. Generally two separate electrodes are required.
 - 2. Metal underground water pipe.
 - 3. Metal building frame.
 - 4. Concrete-encased electrode.
 - 5. Rod electrode.
 - 6. Plate electrode.

1.5 PERFORMANCE REQUIREMENTS

- A. Grounding System Resistance: 5 ohms maximum.

1.6 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit data on grounding electrodes and connections.
- C. Test Reports: Indicate overall resistance to ground and resistance of each electrode.
- D. Manufacturer's Installation Instructions: Submit for active electrodes.
- E. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

1.7 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for submittals.
- B. Project Record Documents: Record actual locations of components and grounding electrodes.

1.8 QUALITY ASSURANCE

- A. Provide grounding materials conforming to requirements of NEC, IEEE 142, and UL labeled.
- B. Perform Work in accordance with all applicable Federal, State, and local Codes and Ordinances.
- C. Maintain one copy of each document on site.

1.9 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years documented experience.
- B. Installer: Company specializing in performing work of this section with minimum three (3) years documented experience or approved by manufacturer.

1.10 PRE-INSTALLATION MEETINGS

- A. Section 01 30 00 - Administrative Requirements: Pre-installation meeting.
- B. Convene minimum one week prior to commencing work of this section.

1.11 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Accept materials on site in original factory packaging, labeled with manufacturer's identification.

- C. Protect from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original packaging.
- D. Do not deliver items to project before time of installation. Limit shipment of bulk and multiple-use materials to quantities needed for immediate installation.

1.12 COORDINATION

- A. Section 01 30 00 - Administrative Requirements: Requirements for coordination.
- B. Complete grounding and bonding of building reinforcing steel prior to concrete placement.

PART 2 - PRODUCTS

2.1 ROD ELECTRODES

- A. Manufacturers:
 - 1. ERICO International Corporation.
 - 2. Harger Lightning & Grounding.
 - 3. Substitutions: Section 01 60 00 - Product Requirements.
- B. Product Description:
 - 1. Material: Copper.
 - 2. Diameter: 3/4 inch or as indicated on drawings.
 - 3. Length: 10 feet, unless otherwise indicated.
- C. Connector: Connector for exothermic welded connection.
 - 1. U-bolt clamp only allowed upon approval by Engineer.

2.2 WIRE

- A. Material: Stranded copper.
- B. Foundation Electrodes: 2 AWG.
- C. Grounding Electrode Conductor: Copper conductor bare.
- D. Bonding Conductor: Copper conductor bare.

2.3 GROUNDING WELL COMPONENTS

- A. Well Pipe: 8 inches NPS by 24 inches long concrete pipe with belled end.
- B. Well Cover: Fiberglass with legend "GROUND" embossed on cover.

2.4 MECHANICAL CONNECTORS

- A. Manufacturers:

1. Burndy: Part of Hubbell Electrical Systems.
2. ERICO International Corporation.
3. Harger Lightning & Grounding.
4. Substitutions: Section 01 60 00 - Product Requirements.

B. Description: Bronze connectors, suitable for grounding and bonding applications, in configurations required for particular installation.

2.5 EXOTHERMIC CONNECTIONS

A. Manufacturers:

1. Cadweld.
2. ERICO International Corporation.
3. Harger Lightning & Grounding.
4. Substitutions: Section 01 60 00 - Product Requirements.

B. Product Description: Exothermic materials, accessories, and tools for preparing and making permanent field connections between grounding system components.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements: Verification of existing conditions before starting work.
- B. Verify final backfill and compaction has been completed before driving rod electrodes.

3.2 PREPARATION

- A. Remove paint, rust, mill oils, and surface contaminants at connection points.

3.3 EXISTING WORK

- A. Modify existing grounding system to maintain continuity to accommodate renovations.
- B. Extend existing grounding system using materials and methods compatible with existing electrical installations, or as specified.

3.4 INSTALLATION

- A. Install in accordance with IEEE 142
1. Where sensitive equipment is present, install in accordance with IEEE 1100.
- B. Install rod electrodes at locations as indicated on Drawings. Install additional rod electrodes to achieve specified resistance to ground.
- C. Install grounding and bonding conductors concealed from view.

- D. Install grounding well pipe with cover at rod locations as indicated on Drawings. Install well pipe top flush with finished grade.
- E. Install 2 AWG bare copper wire in foundation footing as indicated on Drawings.
- F. Bond together metal siding not attached to grounded structure; bond to ground.
- G. Bond together reinforcing steel and metal accessories in water containment structures.
- H. Install ground grid under access floors. Construct grid of 2 AWG bare copper wire installed on 24 inch centers both ways. Bond each access floor pedestal to grid.
- I. Bond together each metallic raceway, pipe, duct and other metal object entering space under access floors. Bond to underfloor ground grid. Install 2 AWG bare copper bonding conductor.
- J. Install isolated grounding conductor for circuits supplying, personal computers and other such sensitive electronics in accordance with IEEE 1100.
- K. Equipment Grounding Conductor: Install separate, insulated conductor within each feeder and branch circuit raceway. Terminate each end on suitable lug, bus, or bushing.
- L. Connect to site grounding system.
- M. Bond to lightning protection system where present.
- N. Install continuous grounding using underground cold water system and building steel as grounding electrode. Where water piping is not available, install artificial station ground by means of driven rods or buried electrodes.
- O. Permanently ground entire light and power system in accordance with NEC, including service equipment, distribution panels, lighting panelboards, switch and starter enclosures, motor frames, grounding type receptacles, and other exposed non-current carrying metal parts of electrical equipment.
- P. Install branch circuits feeding isolated ground receptacles with separate insulated grounding conductor, connected only at isolated ground receptacle, ground terminals, and at ground bus of serving panel.
- Q. Accomplish grounding of electrical system by using insulated grounding conductor installed with feeders and branch circuit conductors in conduits. Size grounding conductors in accordance with NEC. Install from grounding bus of serving panel to ground bus of served panel, grounding screw of receptacles, lighting fixture housing, light switch outlet boxes or metal enclosures of service equipment. Ground conduits by means of grounding bushings on terminations at panelboards with installed number 12 conductor to grounding bus.
- R. Grounding electrical system using continuous metal raceway system enclosing circuit conductors in accordance with NEC.
- S. Permanently attach equipment and grounding conductors prior to energizing equipment.

3.5 FIELD QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements.
- B. Section 01 70 00 - Execution and Closeout Requirements: Field inspecting, testing, adjusting, and balancing.
- C. Inspect and test in accordance with NETA ATS, except Section 4.
- D. Grounding and Bonding: Perform inspections and tests listed in NETA ATS, Section 7.13.
- E. Perform ground resistance testing in accordance with IEEE 142.
- F. Perform leakage current tests in accordance with NFPA 99.
- G. Perform continuity testing in accordance with IEEE 142.
- H. When improper grounding is found on receptacles, check receptacles in entire project and correct. Perform retest.

END OF SECTION

SECTION 26 05 29
HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Conduit supports.
 - 2. Formed steel channel.
 - 3. Spring steel clips.
 - 4. Sleeves.
 - 5. Mechanical sleeve seals.
 - 6. Firestopping relating to electrical work.
 - 7. Firestopping accessories.
 - 8. Equipment bases and supports.

1.2 UNIT PRICE – MEASUREMENT AND PAYMENT

- A. Electrical & Controls, Complete:
 - 1. Basis of Measurement: Included in the lump sum price bid as stated in the proposal.
 - 2. Basis of Payment: Includes all associated labor, material, equipment coordination, transport, loading/unloading, storage, etc. required for a complete and operable system.

1.3 REFERENCES

- A. ASTM International:
 - 1. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
 - 2. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials.
 - 3. ASTM E814 - Standard Test Method for Fire Tests of Through-Penetration Fire Stops.
 - 4. ASTM E1966 - Standard Test Method for Fire-Resistive Joint Systems.
- B. FM Global:
 - 1. FM - Approval Guide, A Guide to Equipment, Materials & Services Approved By Factory Mutual Research For Property Conservation.
- C. National Fire Protection Association:
 - 1. NFPA 70 - National Electrical Code.
- D. Underwriters Laboratories Inc.:
 - 1. UL 263 - Fire Tests of Building Construction and Materials.
 - 2. UL 723 - Tests for Surface Burning Characteristics of Building Materials.
 - 3. UL 1479 - Fire Tests of Through-Penetration Firestops.
 - 4. UL 2079 - Tests for Fire Resistance of Building Joint Systems.
 - 5. UL - Fire Resistance Directory.
- E. Intertek Testing Services (Warnock Hersey Listed):

1. WH - Certification Listings.

1.4 DEFINITIONS

- A. Firestopping (Through-Penetration Protection System): Sealing or stuffing material or assembly placed in spaces between and penetrations through building materials to arrest movement of fire, smoke, heat, and hot gases through fire rated construction.

1.5 SYSTEM DESCRIPTION

- A. Firestopping Materials: ASTM E119, ASTM E814, UL 263, UL 1479 to achieve fire ratings as noted on Drawings for adjacent construction, but not less than 1 hour fire rating.
 - 1. Ratings may be 3-hours for firestopping in through-penetrations of 4-hour fire rated assemblies unless otherwise required by applicable codes.
- B. Firestop interruptions to fire rated assemblies, materials, and components.

1.6 PERFORMANCE REQUIREMENTS

- A. Firestopping: Conform to applicable codes FM, UL, WH for fire resistance ratings and surface burning characteristics.
- B. Firestopping: Provide certificate of compliance from authority having jurisdiction indicating approval of materials used.

1.7 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Shop Drawings: Indicate system layout with location and detail of trapeze hangers.
- C. Product Data:
 - 1. Hangers and Supports: Submit manufacturers catalog data including load capacity.
 - 2. Firestopping: Submit data on product characteristics, performance and limitation criteria.
- D. Firestopping Schedule (Where Applicable): Submit schedule of opening locations and sizes, penetrating items, and required listed design numbers to seal openings to maintain fire resistance rating of adjacent assembly.
- E. Design Data: Indicate load carrying capacity of trapeze hangers and hangers and supports.
- F. Manufacturer's Installation Instructions:
 - 1. Hangers and Supports: Submit special procedures and assembly of components.
 - 2. Firestopping: Submit preparation and installation instructions.
- G. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

- H. Firestopping Engineering Judgments: For conditions not covered by UL or WH listed designs, submit judgments by licensed professional engineer suitable for presentation to authority having jurisdiction for acceptance as meeting code fire protection requirements.

1.8 QUALITY ASSURANCE

- A. Through Penetration Firestopping of Fire Rated Assemblies: UL 1479 or ASTM E814 with 0.10 inch water gage minimum positive pressure differential to achieve fire F-Ratings and temperature T-Ratings as indicated on Drawings, but not less than 1-hour.
 - 1. Wall Penetrations: Fire F-Ratings as indicated on Drawings, but not less than 1-hour.
 - 2. Floor and Roof Penetrations: Fire F-Ratings and temperature T-Ratings as indicated on Drawings, but not less than 1-hour.
 - a. Floor Penetrations Within Wall Cavities: T-Rating is not required.
- B. Through Penetration Firestopping of Non-Fire Rated Floor and Roof Assemblies: Materials to resist free passage of flame and products of combustion.
 - 1. Noncombustible Penetrating Items: Noncombustible materials for penetrating items connecting maximum of three stories.
 - 2. Penetrating Items: Materials approved by authorities having jurisdiction for penetrating items connecting maximum of two stories.
- C. Fire Resistant Joints in Fire Rated Floor, Roof, and Wall Assemblies: ASTM E1966 or UL 2079 to achieve fire resistant rating as indicated on Drawings for assembly in which joint is installed.
- D. Fire Resistant Joints Between Floor Slabs and Exterior Walls: ASTM E119 with 0.10 inch water gage minimum positive pressure differential to achieve fire resistant rating as indicated on Drawings for floor assembly.
- E. Surface Burning Characteristics: Maximum 25/450 flame spread/smoke developed index when tested in accordance with ASTM E84.
- F. Perform Work in accordance with all applicable standards.
- G. Maintain two copies of each document on site.

1.9 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years documented experience.
- B. Installer: Company specializing in performing work of this section with minimum three years documented experience or approved by manufacturer.

1.10 PRE-INSTALLATION MEETINGS

- A. Section 01 30 00 - Administrative Requirements: Pre-installation meeting.
- B. Convene minimum one week prior to commencing work of this section.

1.11 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Accept materials on site in original factory packaging, labeled with manufacturer's identification.
- C. Protect from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original packaging.

1.12 ENVIRONMENTAL REQUIREMENTS

- A. Section 01 60 00 - Product Requirements: Environmental conditions affecting products on site.
- B. Do not apply firestopping materials when temperature of substrate material and ambient air is below 60 degrees F.
- C. Maintain this minimum temperature before, during, and for minimum 3 days after installation of firestopping materials.
- D. Provide ventilation in areas to receive solvent cured materials.

PART 2 - PRODUCTS

2.1 CONDUIT SUPPORTS

- A. Manufacturers:
 - 1. ERICO International Corporation.
 - 2. Thomas & Betts Corporation.
 - 3. Unistrut: Part of Atkore International.
 - 4. Substitutions; Section 01 60 00 – Product Requirements.
- B. Hanger Rods: Threaded high tensile strength galvanized carbon steel with free running threads.
- C. Beam Clamps: Malleable Iron, with tapered hole in base and back to accept either bolt or hanger rod. Set screw: hardened steel.
- D. Conduit clamps for trapeze hangers: Galvanized steel, notched to fit trapeze with single bolt to tighten.
- E. Conduit clamps - general purpose: One hole malleable iron for surface mounted conduits.
- F. Cable Ties: High strength nylon temperature rated to 185 degrees F. Self-locking.

2.2 FORMED STEEL CHANNEL

- A. Manufacturers:
 - 1. B-Line, and Eaton Business.

2. Unistrut: Part of Atkore International.
3. Substitutions: Section 01 60 00 – Product Requirements.

B. Product Description: Galvanized 12 gage thick steel. With holes 1-1/2 inches on center.

2.3 SPRING STEEL CLIPS

- A. Manufacturers:
1. B-line, an Eaton Business.
 2. Minerallac Company.
 3. Morris Products, Inc.
 4. Substitutions: Section 01 60 00 – Product Requirements.

B. Product Description: Mounting hole and screw closure.

2.4 SLEEVES

- A. Furnish materials in accordance with all applicable Federal, State, and Local Codes and Ordinances.
- B. Sleeves for Through Non-Fire Rated Floors: 18 gage thick galvanized steel.
- C. Sleeves for Through Non-Fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Steel pipe or 18 gage thick galvanized steel.
- D. Sleeves for Through Fire Rated and Fire Resistive Floors and Walls, and Fire Proofing: Prefabricated fire rated sleeves including seals, UL listed.
- E. Stuffing or Fire-stopping Insulation: Glass fiber type, non-combustible.

2.5 MECHANICAL SLEEVE SEALS

- A. Manufacturers:
1. Pipeline Seal and Insulator, Inc.
 2. Substitution: Section 01 60 00 – Product Requirements.
- B. Product Description: Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between object and sleeve, connected with bolts and pressure plates causing rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

2.6 FIRESTOPPING

- A. Manufacturers:
1. 3M Fire Protection Products.
 2. Nelson Firestop.
 3. United States Gypsum Company.
 4. Substitutions: Section 01 60 00 - Product Requirements.

- B. Product Description: Different types of products by multiple manufacturers are acceptable as required to meet specified system description and performance requirements; provide only one type for each similar application.
1. Select one or more of the following products. Coordinate with list manufacturers acceptable for this Project.
 2. Silicone Firestopping Elastomeric Firestopping: Single or Multiple component silicone elastomeric compound and compatible silicone sealant.
 3. Foam Firestopping Compounds: Single or Multiple component foam compound.
 4. Formulated Firestopping Compound of Incombustible Fibers: Formulated compound mixed with incombustible non-asbestos fibers.
 5. Fiber Stuffing and Sealant Firestopping: Composite of mineral or ceramic fiber stuffing insulation with silicone elastomer for smoke stopping.
 6. Mechanical Firestopping Device with Fillers: Mechanical device with incombustible fillers and silicone elastomer, covered with sheet stainless steel jacket, joined with collars, penetration sealed with flanged stops.
 7. Intumescent Firestopping: Intumescent putty compound which expands on exposure to surface heat gain.
 8. Firestop Pillows: Formed mineral fiber pillows.
- C. Color: As selected from manufacturer's full range of colors.

2.7 FIRESTOPPING ACCESSORIES

- A. Primer: Type recommended by firestopping manufacturer for specific substrate surfaces and suitable for required fire ratings.
- B. Dam Material: Permanent:
1. Mineral fiberboard.
 2. Mineral fiber matting.
 3. Sheet metal.
 4. Plywood or particle board.
 5. Alumina silicate fire board.
- C. Installation Accessories: Provide clips, collars, fasteners, temporary stops or dams, and other devices required to position and retain materials in place.
- D. General:
1. Furnish UL listed products.
 2. Select products with rating not less than rating of wall or floor being penetrated.
- E. Non-Rated Surfaces:
1. Stamped steel, chrome plated, hinged, split ring escutcheons or floor plates or ceiling plates for covering openings in occupied areas where conduit is exposed.
 2. For exterior wall openings below grade, furnish modular mechanical type seal consisting of interlocking synthetic rubber links shaped to continuously fill annular space between conduit and cored opening or water-stop type wall sleeve.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements: Verification of existing conditions before starting work.
- B. Verify openings are ready to receive sleeves.
- C. Verify openings are ready to receive firestopping.

3.2 PREPARATION

- A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other matter affecting bond of firestopping material.
- B. Remove incompatible materials affecting bond.
- C. Install backing and/or damming materials to arrest liquid material leakage where required.
- D. Obtain permission from Engineer before using powder-actuated anchors.
- E. Do not drill or cut structural members.

3.3 INSTALLATION - HANGERS AND SUPPORTS

- A. Anchors and Fasteners:
 - 1. Concrete Structural Elements: Provide precast inserts, expansion anchors, powder actuated anchors and preset inserts.
 - 2. Steel Structural Elements: Provide beam clamps, spring steel clips, steel ramset fasteners, and welded fasteners.
 - 3. Concrete Surfaces: Provide self-drilling anchors and expansion anchors.
 - 4. Hollow Masonry, Plaster, and Gypsum Board Partitions: Provide toggle bolts and hollow wall fasteners.
 - 5. Solid Masonry Walls: Provide expansion anchors and preset inserts.
 - 6. Sheet Metal: Provide sheet metal screws.
 - 7. Wood Elements: Provide wood screws.
- B. Inserts:
 - 1. Install inserts for placement in concrete forms.
 - 2. Install inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
 - 3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.
 - 4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
 - 5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut above flush with top of or recessed into and grouted flush with slab as indicated on drawings.
- C. Install conduit and raceway support and spacing in accordance with NEC.

- D. Do not fasten supports to pipes, ducts, mechanical equipment, or conduit.
- E. Install multiple conduit runs on common hangers.
- F. Supports:
 - 1. Fabricate supports from structural steel or formed steel channel. Install hexagon head bolts to present neat appearance with adequate strength and rigidity. Install spring lock washers under nuts.
 - 2. Install surface mounted cabinets and panelboards with minimum of four anchors.
 - 3. In wet and damp locations install steel channel supports to stand cabinets and panelboards 1 inch off wall.
 - 4. Support vertical conduit at every floor.

3.4 INSTALLATION - FIRESTOPPING

- A. Install material at fire rated construction perimeters and openings containing penetrating sleeves, piping, ductwork, conduit and other items, requiring firestopping.
- B. Apply primer where recommended by manufacturer for type of firestopping material and substrate involved, and as required for compliance with required fire ratings.
- C. Apply firestopping material in sufficient thickness to achieve required fire and smoke rating, to uniform density and texture.
- D. Where each material is installed:
 - 1. Compress fibered material to maximum 40 percent of its uncompressed size.
 - 2. Place foamed material in layers to ensure homogenous density, filling cavities and spaces. Place sealant to completely seal junctions with adjacent dissimilar materials.
 - 3. Place intumescent coating in sufficient coats to achieve rating required.
- E. Remove dam material after firestopping material has cured, unless otherwise indicated on drawings.
- F. Fire Rated Surface:
 - 1. Seal opening at floor, wall, partition, ceiling, and roof as follows:
 - a. Install sleeve through opening and extending beyond minimum of 1 inch on both sides of building element.
 - b. Size sleeve allowing minimum of 1 inch void between sleeve and building element.
 - c. Pack void with backing material.
 - d. Seal ends of sleeve with UL listed fire resistive silicone compound to meet fire rating of structure penetrated.
 - 2. Where cable tray, bus, cable bus, conduit, wireway, trough, and other raceways penetrate fire rated surface, install firestopping product in accordance with manufacturer's instructions.
- G. Non-Rated Surfaces:
 - 1. Seal opening through non-fire rated wall, partition floor, ceiling, and roof opening as follows:
 - a. Install sleeve through opening and extending beyond minimum of 1 inch on both sides of building element.

- b. Size sleeve allowing minimum of 1 inch void between sleeve and building element.
- c. Install type of firestopping material recommended by manufacturer.
- 2. Install escutcheons floor plates or ceiling plates where conduit, penetrates non-fire rated surfaces in occupied spaces. Occupied spaces include rooms with finished ceilings and where penetration occurs below finished ceiling.
- 3. Exterior wall openings below grade: Assemble rubber links of mechanical seal to size of conduit and tighten in place, in accordance with manufacturer's instructions.
- 4. Interior partitions: Seal pipe penetrations at each partition between different room types. Apply sealant to both sides of penetration to completely fill annular space between sleeve and conduit.

3.5 INSTALLATION - EQUIPMENT BASES AND SUPPORTS

- A. Provide housekeeping pads of concrete, minimum 4 inches thick and extending 6 inches beyond supported equipment.
- B. Using templates furnished with equipment, install anchor bolts, and accessories for mounting and anchoring equipment.
- C. Construct supports of steel members. Brace and fasten with flanges bolted to structure.

3.6 INSTALLATION - SLEEVES

- A. Exterior watertight entries: Seal with adjustable interlocking rubber links.
- B. Conduit penetrations not required to be watertight: Sleeve and fill with silicon foam.
- C. Set sleeves in position in forms. Provide reinforcing around sleeves.
- D. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.
- E. Extend sleeves through floors 1 inch above finished floor level. Caulk sleeves.
- F. Where conduit or raceway penetrates floor, ceiling, or wall, close off space between conduit or raceway and adjacent work with stuffing or fire stopping insulation and caulk airtight. Provide close fitting metal collar or escutcheon covers at both sides of penetration.
- G. Install chrome plated steel plastic or stainless steel escutcheons at finished surfaces.

3.7 FIELD QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements
- B. Section 01 70 00 - Execution and Closeout Requirements: Field inspecting, testing, adjusting, and balancing.
- C. Inspect installed firestopping for compliance with specifications and submitted schedule.

3.8 CLEANING

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for cleaning.
- B. Clean adjacent surfaces of firestopping materials.

3.9 PROTECTION OF FINISHED WORK

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for protecting finished Work.
- B. Protect adjacent surfaces from damage by material installation.

END OF SECTION

SECTION 26 05 33
RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes conduit and tubing, surface raceways, wireways, outlet boxes, pull and junction boxes, and handholes.
- B. Related Sections:
 - 1. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
 - 2. Section 26 05 29 - Hangers and Supports for Electrical Systems.
 - 3. Section 26 05 53 - Identification for Electrical Systems.
 - 4. Section 26 27 16 - Electrical Cabinets and Enclosures.
 - 5. Section 26 27 26 - Wiring Devices.

1.2 UNIT PRICE – MEASUREMENT AND PAYMENT

- A. Electrical & Controls, Complete:
 - 1. Basis of Measurement: Included in the lump sum price bid as stated in the proposal.
 - 2. Basis of Payment: Includes all associated labor, material, equipment coordination, transport, loading/unloading, storage, etc. required for a complete and operable system.

1.3 REFERENCES

- A. American National Standards Institute:
 - 1. ANSI C80.1 - Rigid Steel Conduit, Zinc Coated.
 - 2. ANSI C80.3 - Specification for Electrical Metallic Tubing, Zinc Coated.
 - 3. ANSI C80.5 - Aluminum Rigid Conduit - (ARC).
- B. National Electrical Manufacturers Association:
 - 1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
 - 2. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies.
 - 3. NEMA OS 1 - Sheet Steel Outlet Boxes, Device Boxes, Covers, and Box Supports.
 - 4. NEMA OS 2 - Nonmetallic Outlet Boxes, Device Boxes, Covers, and Box Supports.
 - 5. NEMA RN 1 - Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.
 - 6. NEMA TC 2 - Electrical Polyvinyl Chloride (PVC) Tubing and Conduit.
 - 7. NEMA TC 3 - PVC Fittings for Use with Rigid PVC Conduit and Tubing.

1.4 SYSTEM DESCRIPTION

- A. Raceway and boxes located as indicated on Drawings, and at other locations required for splices, taps, wire pulling, equipment connections, and compliance with regulatory requirements. Raceway and boxes are shown in approximate locations unless dimensioned. Provide raceway to complete wiring system.

- B. Underground More than 5 feet outside Foundation Wall: Provide rigid steel conduit, plastic coated conduit, or thickwall nonmetallic conduit. Provide cast metal boxes or nonmetallic handhole.
- C. Underground Within 5 feet from Foundation Wall: Provide rigid steel conduit or plastic coated conduit. Provide cast metal or nonmetallic boxes.
- D. In or Under Slab on Grade: Provide rigid steel conduit, plastic coated conduit or thickwall nonmetallic conduit. Provide cast or nonmetallic metal boxes.
- E. Outdoor Locations, Above Grade: Provide rigid steel conduit. Provide cast metal or nonmetallic outlet, pull, and junction boxes.
- F. In Slab Above Grade: Provide rigid steel conduit, intermediate metal conduit or thickwall nonmetallic conduit. Provide sheet metal boxes.
- G. Wet and Damp Locations: Provide rigid steel conduit, plastic coated conduit or thickwall nonmetallic conduit. Provide cast metal or nonmetallic outlet, junction, and pull boxes. Provide flush mounting outlet box in finished areas.
- H. Concealed Dry Locations: Provide rigid steel conduit or thickwall nonmetallic conduit. Provide sheet-metal boxes. Provide flush mounting outlet box in finished areas. Provide hinged enclosure for large pull boxes.
- I. Exposed Dry Locations: Provide rigid steel conduit or electrical metallic tubing. Provide sheet-metal boxes. Provide flush mounting outlet box in finished areas. Provide hinged enclosure for large pull boxes.

1.5 DESIGN REQUIREMENTS

- A. Minimum Raceway Size: 3/4 inch unless otherwise specified.

1.6 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Submittal procedures.
- B. Product Data: Submit for the following:
 - 1. Flexible metal conduit.
 - 2. Liquidtight flexible metal conduit.
 - 3. Nonmetallic conduit.
 - 4. Flexible nonmetallic conduit.
 - 5. Nonmetallic tubing.
 - 6. Raceway fittings.
 - 7. Conduit bodies.
 - 8. Surface raceway.
 - 9. Wireway.
 - 10. Pull and junction boxes.
 - 11. Handholes.

- C. Manufacturer's Installation Instructions: Submit application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, and installation of Product.

1.7 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Closeout procedures.
- B. Project Record Documents:
 - 1. Record actual routing of conduits larger than 1 inch.
 - 2. Record actual locations, dimensions, and mounting heights of outlet, pull, and junction boxes.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.
- B. Protect conduit from corrosion and entrance of debris by storing above grade. Provide appropriate covering.
- C. Protect PVC conduit from sunlight.

1.9 COORDINATION

- A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.
- B. Coordinate installation of outlet boxes for equipment.
- C. Coordinate mounting heights, orientation and locations of outlets mounted above counters, benches, and backsplashes.

PART 2 - PRODUCTS

2.1 METAL CONDUIT

- A. Manufacturers:
 - 1. Allied Tube & Conduit; a part of Atkore International.
 - 2. EGS/Appleton Electric.
 - 3. Thomas & Betts Corporation.
 - 4. Substitutions: Section 01 60 00 - Product Requirements.
- B. Rigid Steel Conduit: ANSI C80.1.
- C. Rigid Aluminum Conduit: ANSI C80.5.
- D. Intermediate Metal Conduit (IMC): Rigid steel.

E. Fittings and Conduit Bodies: NEMA FB 1; material to match conduit.

2.2 PVC COATED METAL CONDUIT

A. Manufacturers:

1. Plasti-Bond.
2. Thomas & Betts Corporation.
3. Substitutions: Section 01 60 00 - Product Requirements.

B. Product Description: NEMA RN 1; rigid steel conduit with external PVC coating, 20 mil thick.

C. Fittings and Conduit Bodies: NEMA FB 1; steel fittings with external PVC coating to match conduit.

2.3 FLEXIBLE METAL CONDUIT

A. Manufacturers:

1. AFC Cable Systems; a part of Atkore International.
2. EGS/Appleton Electric.
3. Southwire Company.
4. Substitutions: Section 01 60 00 - Product Requirements.

B. Product Description: Interlocked steel construction.

C. Fittings: NEMA FB 1.

2.4 LIQUIDTIGHT FLEXIBLE METAL CONDUIT

A. Manufacturers:

1. AFC Cable Systems; a part of Atkore International.
2. EGS/Appleton Electric.
3. Southwire Company.
4. Substitutions: Section 01 60 00 - Product Requirements.

B. Product Description: Interlocked steel construction with PVC jacket.

C. Fittings: NEMA FB 1.

2.5 ELECTRICAL METALLIC TUBING (EMT)

A. Manufacturers:

1. Carlon; a brand of Thomas & Betts Corporation.
2. Republic Conduit.
3. Western Tube and Conduit Corporation.
4. Substitutions: Section 01 60 00 - Product Requirements.

B. Product Description: ANSI C80.3; galvanized tubing.

C. Fittings and Conduit Bodies: NEMA FB 1; steel, set screw type.

2.6 NONMETALLIC CONDUIT

- A. Manufacturers:
 - 1. Carlon; a brand of Thomas & Betts Corporation.
 - 2. EGS/Appleton Electric.
 - 3. Substitutions: Section 01 60 00 - Product Requirements.
- B. Product Description: NEMA TC 2; Schedule 40 PVC and Schedule 80 PVC, as indicated.
- C. Fittings and Conduit Bodies: NEMA TC 3.

2.7 NONMETALLIC TUBING

- A. Manufacturers:
 - 1. Carlon; a brand of Thomas & Betts Corporation.
 - 2. Substitutions: Section 01 60 00 - Product Requirements.
- B. Product Description: NEMA TC 2.
- C. Fittings and Conduit Bodies: NEMA TC 3.

2.8 SURFACE METAL RACEWAY

- A. Manufacturers:
 - 1. Niedax Inc.
 - 2. Panduit Corp.
 - 3. Wiremold / Legrand.
 - 4. Substitutions: Section 01 60 00 - Product Requirements.
- B. Product Description: Sheet metal channel with fitted cover, suitable for use as surface metal raceway.
- C. Size: Per Code plus additional 25% spare, unless otherwise indicated.
- D. Finish: Gray enamel. Stainless steel in hazardous locations or where corrosive elements are present.
- E. Fittings, Boxes, and Extension Rings: Furnish manufacturer's standard accessories; match finish on raceway.

2.9 SURFACE NONMETAL RACEWAY

- A. Manufacturers:
 - 1. Panduit Corp.
 - 2. Wiremold / Legrand.
 - 3. Substitutions: Section 01 60 00 - Product Requirements.
- B. Product Description: Fiberglass channel with fitted cover, suitable for use as surface raceway.

- C. Size: Per Code plus additional 25% spare, unless otherwise indicated.
- D. Finish: Gray.
- E. Fittings, Boxes, and Extension Rings: Furnish manufacturer's standard accessories, finish to match raceway.

2.10 WIREWAY

- A. Manufacturers:
 - 1. Carlon; a brand of Thomas & Betts Corporation.
 - 2. Hoffman; a brand of Pentair Equipment Protection.
 - 3. Square D; by Schneider Electric.
 - 4. Substitutions: Section 01 60 00 - Product Requirements.
- B. Product Description: General purpose, Oiltight and dust-tight, or Raintight type wireway. Product rating shall match NEMA Rating for enclosures in same location.
- C. Knockouts: Manufacturer's standard. Bottom only in Wet, Damp or Outdoor locations.
- D. Size: 4 x 4 inch, 6 x 6 inch, 8 x 8 inch, and 12 x 12 inch; length as indicated on Drawings.
- E. Cover: Hinged or Screw cover with full gaskets.
- F. Connector: Slip-in or Flanged.
- G. Fittings: Lay-in type with removable top, bottom, and side; captive screws and drip shield.
- H. Finish: Rust inhibiting primer coating with gray enamel finish.

2.11 OUTLET BOXES

- A. Manufacturers:
 - 1. Allied Moulded Products, Inc.
 - 2. Carlon; a brand of Thomas & Betts Corporation.
 - 3. RACO; Hubbell.
 - 4. Substitutions: Section 01 60 00 - Product Requirements.
- B. Sheet Metal Outlet Boxes: NEMA OS 1, galvanized steel.
 - 1. Luminaire and Equipment Supporting Boxes: Rated for weight of equipment supported; furnish 1/2 inch male fixture studs where required.
 - 2. Concrete Ceiling Boxes: Concrete type.
- C. Nonmetallic Outlet Boxes: NEMA OS 2.
- D. Cast Boxes: NEMA FB 1, Type FD, cast fer alloy. Furnish gasketed cover by box manufacturer. Furnish threaded hubs.
- E. Wall Plates for Finished Areas: As specified in Section 26 27 26.

F. Wall Plates for Unfinished Areas: Furnish gasketed cover.

2.12 PULL AND JUNCTION BOXES

A. Manufacturers:

1. Emerson Process Management; Rosemount Division.
2. Hoffman; a brand of Pentair Equipment Protection.
3. RACO; Hubbell.
4. Substitutions: Section 01 60 00 - Product Requirements.

B. Sheet Metal Boxes: NEMA OS 1, galvanized steel.

C. Hinged Enclosures: As specified in Section 26 27 16.

D. Surface Mounted Cast Metal Box: NEMA 250, Type 4, 4X, or 6 (per environmental conditions); flat-flanged, surface mounted junction box:

1. Material: Galvanized cast iron.
2. Cover: Furnish with ground flange, neoprene gasket, and stainless steel cover screws.

E. In-Ground Cast Metal Box: NEMA 250, Type 6, flanged, recessed cover box for flush mounting:

1. Material: Galvanized cast iron.
2. Cover: Smooth or Nonskid cover (to match surrounding surfaces) with neoprene gasket and stainless steel cover screws.
3. Cover Legend: "ELECTRIC" unless otherwise indicated.

F. Fiberglass Concrete composite Handholes: Die-molded, glass-fiber concrete composite hand holes:

1. Cable Entrance: Pre-cut 6 inch x 6 inch cable entrance at center bottom of each side.
2. Cover: Glass-fiber concrete composite, weatherproof cover with nonskid finish.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

B. Verify outlet locations and routing and termination locations of raceway prior to rough-in.

3.2 INSTALLATION

A. Ground and bond raceway and boxes in accordance with Section 26 05 26.

B. Fasten raceway and box supports to structure and finishes in accordance with Section 26 05 29.

C. Identify raceway and boxes in accordance with Section 26 05 53.

D. Arrange raceway and boxes to maintain headroom and present neat appearance.

3.3 INSTALLATION - RACEWAY

- A. Raceway routing is shown in approximate locations unless dimensioned. Route to complete wiring system.
- B. Arrange raceway supports to prevent misalignment during wiring installation.
- C. Support raceway using coated steel or malleable iron straps, lay-in adjustable hangers, clevis hangers, and split hangers.
- D. Group related raceway; support using conduit rack. Construct rack using steel channel specified in Section 26 05 29; provide space on each for 25 percent additional raceways.
- E. Do not support raceway with wire or perforated pipe straps. Remove wire used for temporary supports
- F. Do not attach raceway to ceiling support wires or other piping systems.
- G. Construct wireway supports from steel channel specified in Section 26 05 29.
- H. Route exposed raceway parallel and perpendicular to walls.
- I. Route raceway installed above accessible ceilings parallel and perpendicular to walls.
- J. Route conduit in and under slab from point-to-point.
- K. Maximum Size Conduit in Slab Above Grade: 3/4 inch. Do not cross conduits in slab.
- L. Maintain clearance between raceway and piping for maintenance purposes.
- M. Maintain 12 inch clearance between raceway and surfaces with temperatures exceeding 104 degrees F.
- N. Cut conduit square using saw or pipe cutter; de-burr cut ends.
- O. Bring conduit to shoulder of fittings; fasten securely.
- P. Join nonmetallic conduit using cement as recommended by manufacturer. Wipe nonmetallic conduit dry and clean before joining. Apply full even coat of cement to entire area inserted in fitting. Allow joint to cure for minimum 20 minutes.
- Q. Install conduit hubs or sealing locknuts to fasten conduit to sheet metal boxes in damp and wet locations and to cast boxes.
- R. Install no more than equivalent of three 90 degree bends between boxes. Install conduit bodies to make sharp changes in direction, as around beams. Install factory elbows for bends in metal conduit larger than 2 inch size.
- S. Avoid moisture traps; install junction box with drain fitting at low points in conduit system.

- T. Install fittings to accommodate expansion and deflection where raceway crosses seismic, control and expansion joints.
- U. Install suitable pull string or cord in each empty raceway except sleeves and nipples.
- V. Install suitable caps to protect installed conduit against entrance of dirt and moisture.
- W. Surface Raceway: Install flat-head screws, clips, and straps to fasten raceway channel to surfaces; mount plumb and level. Install insulating bushings and inserts at connections to outlets and corner fittings.
- X. Close ends and unused openings in wireway.

3.4 INSTALLATION - BOXES

- A. Install wall mounted boxes at elevations to accommodate mounting heights specified in section for outlet device, unless indicated on Drawings.
- B. Adjust box location up to 10 feet prior to rough-in to accommodate intended purpose.
- C. Orient boxes to accommodate wiring devices oriented as specified in Section 26 27 26.
- D. Install pull boxes and junction boxes above accessible ceilings and in unfinished areas only.
- E. In Accessible Ceiling Areas: Install outlet and junction boxes no more than 6 inches from ceiling access panel or from removable recessed luminaire.
- F. Locate flush mounting box in masonry wall to require cutting of masonry unit corner only. Coordinate masonry cutting to achieve neat opening.
- G. Do not install flush mounting box back-to-back in walls; install with minimum 6 inches separation. Install with minimum 24 inches separation in acoustic rated walls.
- H. Secure flush mounting box to interior wall and partition studs. Accurately position to allow for surface finish thickness.
- I. Install stamped steel bridges to fasten flush mounting outlet box between studs.
- J. Install flush mounting box without damaging wall insulation or reducing its effectiveness.
- K. Install adjustable steel channel fasteners for hung ceiling outlet box.
- L. Do not fasten boxes to ceiling support wires or other piping systems.
- M. Support boxes independently of conduit.
- N. Install gang box where more than one device is mounted together. Do not use sectional box.
- O. Install gang box with plaster ring for single device outlets.

3.5 INTERFACE WITH OTHER PRODUCTS

- A. Install conduit to preserve fire resistance rating of partitions and other elements, using materials and methods in accordance with applicable codes.
- B. Route conduit through roof openings for piping and ductwork or through suitable roof jack with pitch pocket. Coordinate location with roofing installation as required.
- C. Locate outlet boxes to allow luminaires positioned as indicated on Drawings.
- D. Align adjacent wall mounted outlet boxes for switches, thermostats, and similar devices.

3.6 ADJUSTING

- A. Section 01 70 00 - Execution and Closeout Requirements: Testing, adjusting, and balancing.
- B. Adjust flush-mounting outlets to make front flush with finished wall material.
- C. Install knockout closures in unused openings in boxes.

3.7 CLEANING

- A. Section 01 70 00 - Execution and Closeout Requirements: Final cleaning.
- B. Clean interior of boxes to remove dust, debris, and other material.
- C. Clean exposed surfaces and restore finish.

END OF SECTION

SECTION 26 05 53
IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Nameplates.
 - 2. Labels.
 - 3. Wire markers.
 - 4. Conduit markers.
 - 5. Stencils.
 - 6. Underground Warning Tape.
 - 7. Lockout Devices.
- B. Related Sections:
 - 1. Section 09 90 00 - Painting and Coating.

1.2 UNIT PRICE – MEASUREMENT AND PAYMENT

- A. Electrical & Controls, Complete:
 - 1. Basis of Measurement: Included in the lump sum price bid as stated in the proposal.
 - 2. Basis of Payment: Includes all associated labor, material, equipment coordination, transport, loading/unloading, storage, etc. required for a complete and operable system.

1.3 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Submittal procedures.
- B. Product Data:
 - 1. Submit manufacturer's catalog literature for each product required.
 - 2. Submit electrical identification schedule including list of wording, symbols, letter size, color coding, tag number, location, and function.
- C. Samples:
 - 1. Submit one sample of each type of identification products applicable to project.
 - 2. Submit one nameplate, 4 x 4 inch in size illustrating materials and engraving quality.
- D. Manufacturer's Installation Instructions: Indicate installation instructions, special procedures, and installation.

1.4 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for submittals.
- B. Project Record Documents: Record actual locations of tagged devices; include tag numbers.

1.5 QUALITY ASSURANCE

- A. Perform Work in accordance with all applicable Federal, State, and local code and ordinances.

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years documented experience.
- B. Installer: Company specializing in performing Work of this section with minimum three years documented experience or approved by manufacturer.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Accept identification products on site in original containers. Inspect for damage.
- C. Accept materials on site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.
- D. Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping.

1.8 ENVIRONMENTAL REQUIREMENTS

- A. Section 01 60 00 - Product Requirements: Environmental conditions affecting products on site.
- B. Install labels and nameplates only when ambient temperature and humidity conditions for adhesive are within range recommended by manufacturer.

1.9 EXTRA MATERIALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for extra materials.
- B. Furnish two containers of any spray-on adhesives used.

PART 2 - PRODUCTS

2.1 NAMEPLATES

- A. Manufacturers:
 - 1. Craftmark Pipe Markers.
 - 2. Kolbi Pipe Marker Co.
 - 3. Seton Identification Products.
 - 4. Substitutions: Section 01 60 00 - Product Requirements.

- B. Product Description: Laminated three-layer plastic with engraved black letters on white contrasting background color, unless otherwise indicated.
- C. Letter Size:
 - 1. 1/8 inch high letters for identifying individual equipment and loads.
 - 2. 1/4 inch high letters for identifying grouped equipment and loads.
 - 3. Minimum 1/8 inch high letters for identifying any required information, not otherwise specified.
- D. Minimum nameplate thickness: 1/8 inch.

2.2 LABELS

- A. Manufacturers:
 - 1. Brady ID.
 - 2. Seton Identification Products.
 - 3. Substitutions: Section 01 60 00 - Product Requirements.
- B. Labels: Embossed adhesive tape, with 3/16 inch black letters on white background.

2.3 WIRE MARKERS

- A. Manufacturers:
 - 1. Brady ID.
 - 2. Grafoplast Wire Markers.
 - 3. Ideal Industries, Inc.
 - 4. Substitutions: Section 01 60 00 - Product Requirements.
- B. Description: Cloth tape, split sleeve, or tubing type wire markers.
- C. Legend:
 - 1. Power and Lighting Circuits: Branch circuit or feeder number as indicated on Drawings.
 - 2. Control Circuits: Control wire number as indicated on schematic and interconnection diagrams. Where shop drawings indicate a different labeling methodology at the same location, EACH wire shall bear BOTH labels for clarity.
 - 3. Communication Cables: Labels shall state both connected devices, unless otherwise indicated on Drawings.
 - a. Example 1: MODEM / FW-1 (Internet Modem -to- Firewall)
 - b. Example 2: ENET-2 / PLC-2 (Ethernet Switch 2 -to- Control Panel 2)

2.4 CONDUIT AND RACEWAY MARKERS

- A. Manufacturers:
 - 1. Brady ID.
 - 2. Ideal Industries, Inc.
 - 3. Seton Identification Products.
 - 4. Substitutions: Section 01 60 00 - Product Requirements.

- B. Description:
 - 1. Where susceptible to mechanical damage: Nameplate fastened with straps
 - 2. With flat smooth surface not susceptible to mechanical damage: Nameplate fastened with adhesive
 - 3. Without flat smooth surface: Labels fastened with adhesive
 - 4. All other locations, where identification is required: Stencils.
- C. Color:
 - 1. Medium Voltage System: Black lettering on white background.
 - 2. 480 Volt System: Black lettering on white background.
 - 3. 208 Volt System: Black lettering on white background.
 - 4. All other Systems: Black lettering on white background.
- D. Legend:
 - 1. Medium Voltage System: HIGH VOLTAGE.
 - 2. 480 Volt System: 480 VOLTS.
 - 3. 208 Volt System: 208 VOLTS.
 - 4. Instrumentation & Controls: I & C.
 - 5. Communications: COMMUNICATIONS

2.5 STENCILS

- A. Manufacturers:
 - 1. Kolbi Pipe Marker Co.
 - 2. Pipemarker.com; Brimar Industries, Inc.
 - 3. Seton Identification Products.
 - 4. Substitutions: Section 01 60 00 - Product Requirements.
- B. Stencils: With clean cut symbols and letters of following size:
 - 1. Up to 2 inches Outside Diameter of Raceway: 1/2 inch high letters.
 - 2. 2-1/2 to 6 inches Outside Diameter of Raceway: 1 inch high letters.
- C. Stencil Paint: As specified in Section 09 90 00, semi-gloss enamel, colors conforming to the following:
 - 1. Black lettering on white background.
 - 2. White lettering on gray background.
 - 3. Red lettering on white background.
 - 4. Blue lettering on white background.

2.6 UNDERGROUND WARNING TAPE

- A. Manufacturers:
 - 1. Brady ID.
 - 2. Kolbi Pipe Marker Co.
 - 3. Seton Identification Products.
 - 4. Substitutions: Section 01 60 00 - Product Requirements.
- B. Description: 4 inch wide plastic tape, detectable type, colored red or yellow, based on warning type, with suitable warning legend describing buried electrical lines.

2.7 LOCKOUT DEVICES

- A. Lockout Hasps:
 - 1. Manufacturers:
 - a. Brady ID.
 - b. Master Lock Company, LLC.
 - c. Substitutions: Section 01 60 00 - Product Requirements.
 - 2. Anodized aluminum with erasable label surface; size minimum 7-1/4 x 3 inches.
 - a. Reinforced nylon hasp may be allowed in hazardous or corrosive locations per Engineer's approval.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Degrease and clean surfaces to receive adhesive for identification materials.
- B. Prepare surfaces in accordance with Section 09 90 00 for stencil painting.

3.2 INSTALLATION

- A. Install identifying devices after completion of painting.
- B. Nameplate Installation:
 - 1. Install nameplate parallel to equipment lines.
 - 2. Install nameplate for each electrical distribution and control equipment enclosure with corrosive-resistant mechanical fasteners, or adhesive.
 - 3. Install nameplates for each control panel and major control components located outside panel with corrosive-resistant mechanical fasteners, or adhesive.
 - 4. Secure nameplate to equipment front using screws, rivets, or adhesive.
 - a. Screws shall be Standard or Philips type.
 - b. Rivets must be approved by Engineer prior to purchase and installation.
 - 5. Secure nameplate to inside surface of door on recessed panelboard in finished locations.
 - 6. Install nameplates for the following:
 - a. Switchboards.
 - b. Panelboards.
 - c. Transformers.
 - d. Service Disconnects.
 - e. Control Cabinets.
 - f. Remote Instrumentation and Control Enclosures.
 - g. Terminal Boxes.
- C. Label Installation:
 - 1. Install label parallel to equipment lines.
 - 2. Install label for identification of individual control device stations.
 - 3. Install labels for permanent adhesion and seal with clear lacquer.

- D. Wire Marker Installation:
 - 1. Install wire marker for each conductor at panelboard gutters, pull boxes, outlet and junction boxes, and each load connection.
 - 2. Mark data cabling at each end. Install additional marking at accessible locations along the cable run.
 - 3. Install labels at data outlets identifying patch panel and port designation.
 - a. If otherwise indicated on Drawings, BOTH designations shall be labeled.
- E. Conduit and Raceway Marker Installation:
 - 1. Install Conduit and Raceway marker for each Conduit and Raceway longer than 6 feet.
 - 2. Conduit and Raceway Marker Spacing: 20 feet on center.
 - 3. Raceway Painting: Identify conduit using field painting in accordance with Section 09 90 00.
 - a. Paint colored band on each conduit longer than 6 feet.
 - b. Paint bands 20 feet on center.
 - c. Color:
 - 1) 480 Volt System: Blue.
 - 2) 208 Volt System: Yellow.
 - 3) Other Systems: As indicated on Drawings.
- F. Stencil Installation:
 - 1. Apply stencil painting in accordance with Section 09 90 00.
- G. Underground Warning Tape Installation:
 - 1. Install underground warning tape along length of each underground conduit, raceway, or cable 6 to 8 inches below finished grade, directly above buried conduit, raceway, or cable.

END OF SECTION

SECTION 26 05 73
OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes short circuit and protective device coordination study encompassing portions of electrical distribution system from normal power source or sources up to and including breakers in service entrance switchboard, fuses in service entrance switchboard, main breaker in sub-distribution panels, fuses in sub-distribution panels and main breaker in each panelboard.

1.2 UNIT PRICE – MEASUREMENT AND PAYMENT

- A. Electrical & Controls, Complete:
 - 1. Basis of Measurement: Included in the lump sum price bid as stated in the proposal.
 - 2. Basis of Payment: Includes all associated labor, material, equipment coordination, transport, loading/unloading, storage, etc. required for a complete and operable system.

1.3 REFERENCES

- A. Institute of Electrical and Electronics Engineers:
 - 1. IEEE 242 - Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems (Buff Book).
- B. National Fire Protection Association:
 - 1. NFPA 70 - National Electrical Code.

1.4 DESIGN REQUIREMENTS

- A. Complete Short Circuit and Protective Device Coordination Study to meet requirements of NFPA 70.
- B. Report Preparation:
 - 1. Prepare study prior to ordering distribution equipment to verify equipment ratings required.
 - 2. Perform study with aid of computer software program.
 - 3. Obtain actual settings for all equipment incorporated into Work.
 - 4. Calculate short circuit interrupting and, when applicable, momentary duties for assumed 3-phase bolted fault short circuit current and phase to ground fault short circuit current at each of the following:
 - a. Utility supply bus.
 - b. Automatic transfer switch.
 - c. Manual transfer switch.
 - d. Engine generator.
 - e. Low-voltage switchgear.
 - f. Switchboards.
 - g. Motor control centers.
 - h. Distribution panelboards.

- i. Branch circuit panelboards.
- j. Busway.
- k. Each other significant equipment location throughout system.

C. Report Contents:

1. Include the following:
 - a. Calculation methods and assumptions.
 - b. Base per unit value selected.
 - c. One-line diagram.
 - d. Source impedance data including power company system available power and characteristics.
 - e. Typical calculations.
 - 1) Fault impedance.
 - 2) X to R ratios.
 - 3) Asymmetry factors.
 - 4) Motor fault contribution.
 - 5) Short circuit kVA.
 - 6) Symmetrical and asymmetrical phase-to-phase and phase-to-ground fault currents.
 - 7) Tabulations of calculation quantities and results.
 - f. One-line diagram revised by adding actual instantaneous short circuits available.
 - g. State conclusions and recommendations.
2. Prepare time-current device coordination curves graphically indicating coordination proposed for system, centered on conventional, full-size, log-log forms.
3. Prepare with each time-curve sheet complete title and one-line diagram with legend identifying specific portion of system covered by that particular curve sheet.
4. Prepare detailed description of each protective device identifying its type, function, manufacturer, and time-current characteristics. Tabulate recommended device tap, time dial, pickup, instantaneous, and time delay settings.
5. Plot device characteristic curves at point reflecting maximum symmetrical fault current to which device is exposed. Include on curve sheets the following:
 - a. Power company relay characteristics.
 - b. Power company fuse characteristics.
 - c. Low voltage equipment circuit breaker trip device characteristics.
 - d. Low voltage equipment fuse characteristics.
 - e. Cable damage point characteristics.
 - f. Pertinent transformer characteristics including:
 - 1) Transformer full load current.
 - 2) Transformer magnetizing inrush.
 - 3) ANSI transformer withstand parameters.
 - 4) Significant symmetrical fault current.
 - g. Pertinent motor characteristics.
 - h. Generator characteristics including:
 - 1) Phase and ground coordination of generator protective devices.
 - 2) Decrement curve and damage curve.
 - 3) Operating characteristic of protective devices.
 - 4) Actual impedance value.
 - 5) Time constants.
 - 6) Current boost data.
 - 7) Do not use typical values for generator.

- i. Transfer switch characteristics.
- j. Other system load protective device characteristics.

1.5 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Qualifications Data: Submit the following for review prior to starting study.
 - 1. Submit qualifications and background of firm.
 - 2. Submit qualifications of individual or individuals performing study.
- C. Software: Submit for review information on software proposed to be used in performing study.
- D. Product Data: Submit the following:
 - 1. Report: Summarize results of study in report format including the following:
 - a. Descriptions, purpose, basis, and scope of study.
 - b. Tabulations of circuit breaker, fuse and other protective device ratings versus calculated short-circuit duties, and commentary regarding same.
 - c. Protective device time versus current coordination curves, tabulations of relay and circuit breaker trip settings, fuse selection, and commentary regarding same.
 - d. Fault current calculations including definition of terms and guide for interpretation of computer printout.
- E. Submit copies of final report signed by professional engineer. Make additions or changes required by review comments.

1.6 QUALITY ASSURANCE

- A. Perform Work in accordance with all applicable codes, standards, and requirements.
- B. Maintain one copy of each document on site.
- C. Use commercially available software, designed specifically for short circuit and protective device coordination studies with minimum of three years documented availability approved by Architect/Engineer.
- D. Perform study in accordance with IEEE 242.

1.7 QUALIFICATIONS

- A. Study Preparer: Company specializing in performing work of this section with minimum three years documented experience and having completed three projects of similar size and complexity within the past ten years.
- B. Perform study under direct supervision of Professional Engineer experienced in design of this Work and licensed in State of Michigan with minimum of five years experience in power system analysis.

- C. Demonstrate company performing study has capability and experience to provide assistance during system start up.

1.8 PRE-INSTALLATION MEETINGS

- A. Section 01 30 00 - Administrative Requirements: Pre-installation meeting.
- B. Convene minimum one week prior to commencing work of this section.

1.9 SEQUENCING

- A. Section 01 10 00 - Summary: Requirements for sequencing.
- B. Complete study within two weeks after pre-installation meeting.
- C. Allow one week for review of completed study by Architect/Engineer.
- D. Submit short circuit and protective device coordination study to Architect/Engineer prior to receiving final approval of distribution equipment shop drawings and prior to releasing equipment for manufacturing.
- E. When formal completion of study will cause delay in equipment manufacturing, obtain approval from Architect/Engineer for preliminary submittal of study data sufficient in scope to ensure selection of device ratings and characteristics will be satisfactory.

1.10 SCHEDULING

- A. Section 01 30 00 - Administrative Requirements
- B. Schedule work to expedite collection of data to ensure completion of study for final approval of distribution equipment shop drawings prior to release of equipment for manufacturing.

1.11 COORDINATION

- A. Section 01 30 00 - Administrative Requirements: Requirements for coordination.
- B. Coordinate work with local power company.

PART 2 - PRODUCTS

2.1 Not Used

PART 3 - EXECUTION

3.1 FIELD QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements

- B. Section 01 70 00 - Execution and Closeout Requirements: Field inspecting, testing, adjusting, and balancing.
- C. Provide assistance to electrical distribution system equipment manufacturer during start up of electrical system and equipment.
- D. Select each primary protective device for delta-wye connected transformer so device's characteristic or operating band is within transformer characteristics, including point equal to 58 percent of ANSI withstand point to provide secondary line-to-ground fault protection.
- E. Separate transformer primary protective device characteristic curves from associated secondary device characteristics by 16 percent current margin to provide proper coordination and protection in event of secondary line-to-line faults.

3.2 ADJUSTING

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for starting and adjusting.
- B. Perform field adjustments of protective devices and modifications to equipment to place equipment in final operating condition. Adjust settings in accordance with approved short circuit and protective device coordination study.

END OF SECTION

SECTION 26 05 83
WIRING CONNECTIONS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes electrical connections to equipment.
- B. Related Sections:
 - 1. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables.
 - 2. Section 26 05 33 - Raceway and Boxes for Electrical Systems.

1.2 UNIT PRICE – MEASUREMENT AND PAYMENT

- A. Electrical and Controls, Complete:
 - 1. Basis of Measurement: Included in the lump sum price bid as stated in the proposal.
 - 2. Basis of Payment: Includes all associated labor, material, equipment coordination, transport, loading/unloading, storage, etc. required for a complete and operable system.

1.3 REFERENCES

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

1.4 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Submittal procedures.
- B. Product Data: Submit wiring device manufacturer's catalog information showing dimensions, configurations, and construction.
- C. Manufacturer's installation instructions.

1.5 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Submittal procedures.
- B. Project Record Documents: Record actual locations, sizes, and configurations of equipment connections.

1.6 COORDINATION

- A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.
- B. Obtain and review shop drawings, product data, manufacturer's wiring diagrams, and manufacturer's instructions for equipment furnished under other sections.

- C. Determine connection locations and requirements.
- D. Sequence rough-in of electrical connections to coordinate with installation of equipment.
- E. Sequence electrical connections to coordinate with start-up of equipment.

PART 2 - PRODUCTS

2.1 CORD AND PLUGS

- A. Manufacturers:
 - 1. Leviton Manufacturing Co., Inc.
 - 2. Pass & Seymour/Legrand (Pass & Seymour).
 - 3. Square D; by Schneider Electric.
 - 4. Substitutions: Section 01 60 00 - Product Requirements.
- B. Attachment Plug Construction: Conform to NEMA WD 1.
- C. Configuration: NEMA WD 6; match receptacle configuration at outlet furnished for equipment.
- D. Cord Construction: Type SO or SJO (to match power configuration) multiconductor flexible cord with identified equipment grounding conductor, suitable for use in damp locations.
- E. Size: Suitable for connected load of equipment, length of cord, and rating of branch circuit overcurrent protection.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.
- B. Verify equipment is ready for electrical connection, for wiring, and to be energized.

3.2 INSTALLATION

- A. Make electrical connections.
- B. Make conduit connections to equipment using flexible conduit. Use liquidtight flexible conduit with watertight connectors in damp or wet locations.
- C. Connect heat producing equipment using wire and cable with insulation suitable for temperatures encountered.
- D. Install receptacle outlet to accommodate connection with attachment plug.
- E. Install cord and cap for field-supplied attachment plug.

- F. Install suitable strain-relief clamps and fittings for cord connections at outlet boxes and equipment connection boxes.
- G. Install disconnect switches, controllers, control stations, and control devices to complete equipment wiring requirements.
- H. Install terminal block jumpers to complete equipment wiring requirements.
- I. Install interconnecting conduit and wiring between devices and equipment to complete equipment wiring requirements.

3.3 ADJUSTING

- A. Section 01 70 00 - Execution and Closeout Requirements: Testing, adjusting, and balancing.
- B. Cooperate with utilization equipment installers and field service personnel during checkout and starting of equipment to allow testing and balancing and other startup operations. Provide personnel to operate electrical system and checkout wiring connection components and configurations.

END OF SECTION

SECTION 26 09 19
ENCLOSED CONTACTORS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes enclosed contactors for lighting and general purposes.
- B. Related Sections:
 - 1. Section 26 28 13 - Fuses.

1.2 UNIT PRICE – MEASUREMENT AND PAYMENT

- A. Electrical & Controls, Complete:
 - 1. Basis of Measurement: Included in the lump sum price bid as stated in the proposal.
 - 2. Basis of Payment: Includes all associated labor, material, equipment coordination, transport, loading/unloading, storage, etc. required for a complete and operable system.

1.3 REFERENCES

- A. National Electrical Manufacturers Association:
 - 1. NEMA FU 1 - Low Voltage Cartridge Fuses.
 - 2. NEMA ICS 2 - Industrial Control and Systems: Controllers, Contactors, and Overload Relays, Rated Not More Than 2000 Volts AC or 750 Volts DC.
 - 3. NEMA ICS 5 - Industrial Control and Systems: Control Circuit and Pilot Devices.
 - 4. NEMA ICS 6 - Industrial Control and Systems: Enclosures.
 - 5. NEMA KS 1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).
- B. International Electrical Testing Association:
 - 1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
- C. Underwriters Laboratories Inc.:
 - 1. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures.

1.4 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Submittal procedures.
- B. Product Data: Submit dimensions, size, voltage ratings and current ratings.

1.5 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Closeout procedures.

- B. Project Record Documents: Record actual locations and ratings of enclosed contactors.
- C. Operation and Maintenance Data: Submit instructions for replacing and maintaining coil and contacts.

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

PART 2 - PRODUCTS

2.1 GENERAL PURPOSE CONTACTORS

- A. Manufacturers:
 - 1. Eaton.
 - 2. Square-D; by Schneider Electric.
 - 3. SIEMENS.
 - 4. Substitutions: Section 01 60 00 - Product Requirements.
- B. Product Description: NEMA ICS 2, AC general purpose magnetic contactor.
- C. Coil operating voltage: 120 volts, 60 Hertz.
- D. Poles: To match circuit configuration and control function.
- E. Product Features:
 - 1. Cover Mounted Pilot Devices: NEMA ICS 5, heavy-duty oiltight type with Form Z contacts, rated A150.
 - 2. Pushbutton: ON/OFF function, with recessed configuration.
 - 3. Selector Switch: ON/OFF/AUTOMATIC function, with rotary action.
 - 4. Indicating Light: RED lens, transformer or resistor type, with incandescent or led lamp.
 - 5. Auxiliary Contacts: One, field convertible in addition to seal-in contact.
 - 6. Relays: NEMA ICS 2, SPDT.
 - 7. Control Power Transformers: 120 volt secondary, sized as required for complete functional system, in each enclosed contactor. Furnish fused primary and secondary, and bond unfused leg of secondary to enclosure.
- F. Combination Contactors: Combine contactors with enclosed knife switch conforming to NEMA KS 1, with externally operable handle and fuse clips designed to accommodate NEMA FU 1, Class J fuses.
- G. Enclosure: NEMA ICS 6, to meet conditions. Fabricate enclosure from steel finished with manufacturer's standard gray enamel.
 - 1. Interior Dry Locations: Type 1.
 - 2. Exterior Locations: Type 3R or 4.
 - 3. Hazardous Locations: Type 4X.

2.2 LIGHTING CONTACTORS

- A. Manufacturers:
 - 1. Eaton.
 - 2. Square D; by Schneider Electric.
 - 3. SIEMENS.
 - 4. Substitutions: Section 01 60 00 - Product Requirements.
- B. Product Description: NEMA ICS 2, magnetic lighting contactor.
- C. Configuration: Mechanically held, 2 or 3 wire control.
- D. Coil operating voltage: 120 volts, 60 Hertz.
- E. Poles: To match circuit configuration and control function.
- F. Contact Rating: Match branch circuit overcurrent protection, considering derating for continuous loads.
- G. Accessories:
 - 1. Cover Mounted Pilot Devices: NEMA ICS 5, heavy-duty oiltight type with Form Z contacts, rated A150.
 - 2. Pushbutton: ON/OFF function, with recessed configuration.
 - 3. Selector Switch: ON/OFF/AUTOMATIC function, with rotary action.
 - 4. Indicating Light: GREEN lens, transformer or resistor type, with incandescent or led lamp.
 - 5. Auxiliary Contacts: One, field convertible in addition to seal-in contact.
 - 6. Relays: NEMA ICS 2, SPDT.
 - 7. Control Power Transformers: 120 volt secondary, sized as required for complete functional system, in each enclosed contactor. Furnish fused primary and secondary, and bond unfused leg of secondary to enclosure.
- H. Combination Contactors: Combine contactors with enclosed knife switch conforming to NEMA KS 1, with externally operable handle and fuse clips designed to accommodate NEMA FU 1, Class J fuses.
- I. Enclosure: NEMA ICS 6, to meet conditions. Fabricate enclosure from steel finished with manufacturer's standard gray enamel.
 - 1. Interior Dry Locations: Type 1.
 - 2. Exterior Locations: Type 3R or 4.
 - 3. Hazardous Locations: Type 4X.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install enclosed contactors as indicated on Drawings, in accordance with NECA "Standard of Installation."

- B. Install enclosed contactors plumb. Provide supports in accordance with Section 26 05 29.
- C. Height: 5 ft to operating handle.
- D. Install fuses for fusible switches. Refer to Section 26 28 13 for product requirements.
- E. Install engraved plastic nameplates. Refer to Section 26 05 53 for product requirements and location.

3.2 FIELD QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Inspect and test in accordance with NETA ATS, except Section 4.
- C. Perform inspections and tests listed in NETA ATS, Section 7.16.1.

END OF SECTION

SECTION 26 22 00
LOW-VOLTAGE TRANSFORMERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Two-winding transformers.
 - 2. Shielded transformers.
- B. Related Requirements:
 - 1. Section 03 30 00 - Cast-In-Place Concrete.
 - 2. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
 - 3. Section 26 05 29 - Hangers and Supports for Electrical Systems.
 - 4. Section 26 05 33 - Raceway and Boxes for Electrical Systems.
 - 5. Section 26 05 53 - Identification for Electrical Systems.

1.2 UNIT PRICE – MEASUREMENT AND PAYMENT

- A. Electrical & Controls, Complete:
 - 1. Basis of Measurement: Included in the lump sum price bid as stated in the proposal.
 - 2. Basis of Payment: Includes all associated labor, material, equipment coordination, transport, loading/unloading, storage, etc. required for a complete and operable system.

1.3 REFERENCE STANDARDS

- A. National Electrical Manufacturers Association:
 - 1. NEMA ST 1 - Specialty Transformers (Except General Purpose Type).
 - 2. NEMA ST 20 - Dry Type Transformers for General Applications.
- B. International Electrical Testing Association:
 - 1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

1.4 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Submittal procedures.
- B. Product Data: Submit outline and support point dimensions of enclosures and accessories, unit weight, voltage, kVA, and impedance ratings and characteristics, tap configurations, insulation system type, and rated temperature rise.
- C. Test and Evaluation Reports: Indicate loss data, efficiency at 25, 50, 75 and 100 percent rated load, and sound level.
- D. Source Quality Control Submittals: Indicate results of shop tests, factory tests, and inspections.
- E. Field Quality Control Submittals: Indicate results of Contractor furnished tests and inspections.

1.5 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Closeout procedures.
- B. Record Documentation: Record actual locations of transformers.

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.
- B. Store in clean, dry space. Maintain factory wrapping or provide additional canvas or plastic cover to protect units from dirt, water, construction debris, and traffic.
- C. Handle in accordance with manufacturer's written instructions. Lift only with lugs provided. Handle carefully to avoid damage to transformer internal components, enclosure, and finish.

PART 2 - PRODUCTS

2.1 TWO-WINDING TRANSFORMERS

- A. Manufacturers:
 - 1. Eaton.
 - 2. General Electric Company/GE Prolec.
 - 3. Schneider Electric USA, Inc.
 - 4. Substitutions: Section 01 60 00 - Product Requirements.
- B. Description: NEMA ST 20, factory-assembled, air-cooled, dry type transformers, ratings as indicated on Drawings.
- C. Operation:
 - 1. Primary Voltage: 480 volts, 1 phase, or 3 phase.
 - 2. Secondary Voltage: 120/240 volts, 1 phase, or 120/208 volts 3 phase.
 - 3. Insulation system and average winding temperature rise for rated kVA as follows:
 - a. 1-15 kVA: Class 185 with 80 degrees C rise.
 - b. 16-500 kVA: Class 220 with 115 degrees C rise.
 - 4. Case temperature: Do not exceed 35 degrees C rise above ambient at warmest point at full load.
 - 5. Winding Taps:
 - a. Transformers Less than 15 kVA: Two 5 percent below rated voltage, full capacity taps on primary winding.
 - b. Transformers 15 kVA and Larger: NEMA ST 20.
 - 6. Sound Levels: NEMA ST 20.
 - 7. Basic Impulse Level: 10 kV.
 - 8. Mounting:
 - a. 1-15 kVA: Suitable for wall mounting.

- b. 16-75 kVA: Suitable for wall, floor, or trapeze mounting.
- c. Larger than 75 kVA: Suitable for floor mounting.

D. Materials:

- 1. Ground core and coil assembly to enclosure by means of visible flexible copper grounding strap.
- 2. Coil Conductors: Continuous copper windings with terminations brazed or welded.
- 3. Enclosure:
 - a. NEMA ST 20
 - b. Furnish lifting eyes or brackets.
 - c. Indoor, Dry Locations: Type 1
 - d. Wet/Damp Locations: Type 3R

E. Fabrication:

- 1. Isolate core and coil from enclosure using vibration-absorbing mounts.
- 2. Nameplate: Include transformer connection data and overload capacity based on rated allowable temperature rise.

2.2 SHIELDED TRANSFORMERS

A. Manufacturers:

- 1. Eaton.
- 2. Schneider Electric USA, Inc.
- 3. Sola/Hevi-Duty; a brand of Emerson Electric Co.
- 4. Substitutions: Section 01 60 00 - Product Requirements.

B. Description: NEMA ST 20, factory-assembled, air-cooled, dry type shielded isolation transformers, ratings as indicated on Drawings.

C. Operation:

- 1. Primary Voltage: 480 volts, 1 phase, or 3 phase.
- 2. Secondary Voltage: 120/240 volts, 1 phase, or 120/208 volts 3 phase.
- 3. Insulation system and average winding temperature rise for rated kVA as follows:
 - a. 10-15 kVA: Class 185 with 115 degrees C rise.
 - b. 16-500 kVA: Class 220 with 150 degrees C rise.
- 4. Case temperature: Do not exceed 50 degrees C rise above ambient at warmest point at full load.
- 5. Winding Taps:
 - a. Transformers Less than 15 kVA: Two 5 percent below rated voltage, full capacity taps on primary winding.
 - b. Transformers 15 kVA and Larger: NEMA ST 20.
- 6. Sound Levels: NEMA ST 20.
- 7. Basic Impulse Level: 10 kV.
- 8. Winding Shield: Electrostatic, with separate insulated grounding connection.
- 9. Mounting:
 - a. 1-15 kVA: Suitable for wall mounting.
 - b. 16-75 kVA: Suitable for wall, floor, or trapeze mounting.
 - c. Larger than 75 kVA: Suitable for floor mounting.

D. Materials:

1. Ground core and coil assembly to enclosure with visible flexible copper grounding strap.
 2. Coil Conductors: Continuous copper windings with terminations brazed or welded.
 3. Enclosure:
 - a. NEMA ST 20
 - b. Furnish lifting eyes or brackets.
 - c. Indoor, Dry Locations: Type 1
 - d. Wet/Damp Locations: Type 3R
- E. Fabrication:
1. Isolate core and coil from enclosure using vibration-absorbing mounts.
 2. Nameplate: Include transformer connection data.

2.3 SOURCE QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements: Testing, inspection and analysis requirements.
- B. Production test each unit according to NEMA ST20.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation examination.
- B. Verify mounting supports are properly sized and located including concealed bracing in walls.

3.2 PREPARATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation preparation.
- B. Provide concrete pads under provisions of Section 03 30 00.

3.3 INSTALLATION

- A. Set transformer plumb and level.
- B. Use flexible conduit, in accordance with Section 26 05 33, 2 feet minimum length, for connections to transformer case. Make conduit connections to side panel of enclosure.
- C. Support transformers in accordance with Section 26 05 29.
 1. Mount wall-mounted transformers using integral flanges or accessory brackets furnished by manufacturer.
 2. Mount floor-mounted transformers on vibration isolating pads suitable for isolating transformer noise from building structure.
 3. Mount trapeze-mounted transformers as indicated on Drawings.
- D. Provide seismic restraints.

- E. Install grounding and bonding in accordance with Section 26 05 26.

3.4 REPAIR AND RESTORATION

- A. Repair existing transformers to remain or to be reinstalled.

3.5 FIELD QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements for inspecting and testing.
- B. Section 01 70 00 - Execution and Closeout Requirements: Requirements for testing, adjusting, and balancing.
- C. Inspect and test in accordance with NETA ATS, except Section 4.
- D. Perform inspections and tests listed in NETA ATS, Section 7.2.1.

3.6 ADJUSTING

- A. Section 01 70 00 - Execution and Closeout Requirements: Testing, adjusting, and balancing.
- B. Measure primary and secondary voltages and make appropriate tap adjustments.

3.7 CLEANING

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for cleaning.
- B. Clean existing transformers to remain or to be reinstalled.

END OF SECTION

SECTION 26 24 16
PANELBOARDS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Distribution and branch circuit panelboards.
 - 2. Electronic grade branch circuit panelboards.
 - 3. Load centers.
- B. Related Sections:
 - 1. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
 - 2. Section 26 05 53 - Identification for Electrical Systems.
 - 3. Section 26 28 13 - Fuses.

1.2 UNIT PRICE – MEASUREMENT AND PAYMENT

- A. Electrical & Controls, Complete:
 - 1. Basis of Measurement: Included in the lump sum price bid as stated in the proposal.
 - 2. Basis of Payment: Includes all associated labor, material, equipment coordination, transport, loading/unloading, storage, etc. required for a complete and operable system.

1.3 REFERENCE STANDARDS

- A. Institute of Electrical and Electronics Engineers:
 - 1. IEEE C62.41 - Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits.
- B. National Electrical Manufacturers Association:
 - 1. NEMA FU 1 - Low Voltage Cartridge Fuses.
 - 2. NEMA ICS 2 - Industrial Control and Systems: Controllers, Contactors, and Overload Relays, Rated Not More Than 2000 Volts AC or 750 Volts DC.
 - 3. NEMA ICS 5 - Industrial Control and Systems: Control Circuit and Pilot Devices.
 - 4. NEMA KS 1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).
 - 5. NEMA PB 1 - Panelboards.
 - 6. NEMA PB 1.1 - General Instructions for Proper Installation, Operation, and Maintenance of Panelboards Rated 600 Volts or Less.
- C. International Electrical Testing Association:
 - 1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
- D. National Fire Protection Association:
 - 1. NFPA 70 - National Electrical Code.

- E. UL:
 - 1. UL 50 - Cabinets and Boxes
 - 2. UL 67 - Safety for Panelboards.
 - 3. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures.
 - 4. UL 1283 - Electromagnetic Interference Filters.
 - 5. UL 1449 - Transient Voltage Surge Suppressors.
 - 6. UL 1699 - Arc-Fault Circuit Interrupters.

1.4 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit catalog data showing specified features of standard products.
- C. Shop Drawings: Indicate outline and support point dimensions, voltage, main bus ampacity, integrated short circuit ampere rating, circuit breaker, and fusible switch arrangement and sizes.
- D. Source Quality Control Submittals: Indicate results of shop or factory tests and inspections.
- E. Field Quality Control Submittals: Indicate results of Contractor furnished tests and inspections.

1.5 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for submittals.
- B. Project Record Documents: Record actual locations of panelboards and record actual circuiting arrangements.
- C. Operation and Maintenance Data: Submit spare parts listing, source and current prices of replacement parts and supplies, and recommended maintenance procedures and intervals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for maintenance products.
- B. Extra Stock Materials:
 - 1. Furnish two of each panelboard key. Panelboards keyed alike to Owner's current keying system.

1.7 QUALITY ASSURANCE

- A. Qualifications
 - 1. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years' documented experience.

PART 2 - PRODUCTS

2.1 DISTRIBUTION PANELBOARDS

- A. Manufacturers:
 - 1. Eaton.
 - 2. Siemens Industry, Inc.
 - 3. Square D; by Schneider Electric.
 - 4. Substitutions: Section 01 60 00 - Product Requirements.
- B. Description: NEMA PB 1, circuit breaker type panelboard; fusible switch type where indicated. Furnish combination controllers as indicated on Drawings.
- C. Operation:
 - 1. Service Conditions:
 - a. Temperature: Under 104 degrees F.
 - b. Altitude: 1,000 feet above sea level.
 - 2. Minimum integrated short circuit rating: 10,000 A rms symmetrical for 240 or 208 V panelboards; 65,000 A rms symmetrical for 480 V panelboards, or as indicated on Drawings.
- D. Materials
 - 1. Panelboard Bus: Copper, current carrying components, ratings as indicated on Drawings. Furnish copper ground bus in each panelboard.
 - 2. Fusible Switch Assemblies: NEMA KS 1, quick-make, quick-break, load interrupter enclosed knife switch with externally operable handle. Furnish interlock to prevent opening front cover with switch in ON position. Handle lockable in OFF position. Fuse clips: Designed to accommodate NEMA FU 1, Class R or J fuses.
 - 3. Molded Case Circuit Breakers: UL 489, circuit breakers with integral thermal and instantaneous magnetic trip in each pole. Furnish circuit breakers UL listed as Type HACR for air conditioning equipment branch circuits.
 - 4. Molded Case Circuit Breakers with Current Limiters: UL 489, circuit breakers with replaceable current limiting elements, in addition to integral thermal and instantaneous magnetic trip in each pole.
 - 5. Current Limiting Molded Case Circuit Breakers: UL 489, circuit breakers with integral thermal and instantaneous magnetic trip in each pole, coordinated with automatically resetting current limiting elements in each pole. Interrupting rating 100,000 symmetrical A, let-through current and energy level less than permitted for same size NEMA FU 1, Class RK-5 fuse.
 - 6. Controllers: NEMA ICS 2, AC general-purpose Class A magnetic or solid-state controller for induction motors rated in horsepower.
 - a. Two-Speed Controllers: Include integral time delay transition between FAST and SLOW speeds.
 - b. Full-Voltage Reversing Controllers: Include electrical interlock and integral time delay transition between FORWARD and REVERSE rotation.
 - c. Control Voltage: 120 volts, 60 Hertz.
 - d. Overload Relay: NEMA ICS 2; bimetal.
 - 1) Melting alloy, per Engineer approval.
 - e. Auxiliary Contacts: NEMA ICS 2, two each field convertible contacts in addition to seal-in contact.

- f. Cover Mounted Pilot Devices: NEMA ICS 5, heavy duty oiltight type.
- g. Pilot Device Contacts: NEMA ICS 5, Form Z, rated A150.
- h. Pushbuttons: Recessed type.
- i. Indicating Lights: Transformer or Resistor, Incandescent or LED type.
- j. Selector Switches: Rotary type.
- k. Relays: NEMA ICS 2, Minimum of Two Poles, Double-Throw (DPDT).
- l. Control Power Transformers: 120 V secondary, 500 VA minimum, in each motor starter as indicated on Drawings. Furnish fused primary and secondary, and bond unfused leg of secondary to enclosure.
- 7. Circuit Breaker Accessories: Trip units and auxiliary switches as indicated on Drawings.
- 8. Surge Suppressors: Refer to Section 26 35 53.
 - a. Installation: Integrated in panelboard section. Fully encapsulated to prevent damage to other panelboard components upon failure.
- 9. Enclosure: NEMA PB 1, Type 1 (indoor) 3R (outdoor), cabinet box. Dimensions as required for wiring and equipment, unless indicated on Drawings.
- 10. Cabinet Front: Surface door-in-door type, fastened with concealed trim clamps, screws, hinge and latch, or hinged door with flush lock, and metal directory frame.

E. Finishes:

- 1. Manufacturer's standard gray enamel.

2.2 BRANCH CIRCUIT PANELBOARDS

A. Manufacturers:

- 1. Eaton.
- 2. Siemens Industry, Inc.
- 3. Square D; by Schneider Electric.
- 4. Substitutions: Section 01 60 00 - Product Requirements.

B. Description: NEMA PB1, circuit breaker type, lighting and appliance branch circuit panelboard.

C. Materials:

- 1. Panelboard Bus: Copper, current carrying components, ratings as indicated on Drawings. Furnish copper ground bus in each panelboard; furnish insulated ground bus as indicated on Drawings.
- 2. For non-linear load applications subject to harmonics furnish 200 percent rated, plated copper, solid neutral.
- 3. Minimum Integrated Short Circuit Rating: 10,000 A rms symmetrical for 240 V panelboards; 65,000 S rms symmetrical for 480 V panelboards, or as indicated on Drawings.
- 4. Molded Case Circuit Breakers: UL 489, bolt-on type thermal magnetic trip circuit breakers, with common trip handle for all poles, listed as Type SWD for lighting circuits, Type HACR for air conditioning equipment circuits, Class A ground fault interrupter circuit breakers as indicated on Drawings. Provide UL class 760 arc-fault interrupter circuit breakers as indicated on Drawings. Do not use tandem circuit breakers.
- 5. Current Limiting Molded Case Circuit Breakers: UL 489, circuit breakers with integral thermal and instantaneous magnetic trip in each pole, coordinated with automatically resetting current limiting elements in each pole. Interrupting rating 100,000 symmetrical A, let-through current and energy level less than permitted for same size NEMA FU 1, Class RK-5 fuse.

6. Surge Suppressor: Externally mounted.
7. Enclosure: NEMA PB 1, Type 1 (Indoor), Type 3R (Outdoor).
8. Cabinet Box: Minimum 6 inches deep.

- D. Cabinet Front: Flush or Surface cabinet front with concealed trim clamps, concealed hinge, metal directory frame, and flush lock keyed alike. Finishes:
1. Finish in manufacturer's standard gray enamel.

2.3 ELECTRONIC GRADE PANELBOARD

A. Description:

1. Surge Suppressor: Component recognized according to UL 1449 and UL 1283. Either integral to panelboard or externally mounted.
 - a. Installation: Fully encapsulated to prevent damage to other panelboard components upon failure.
2. Panelboard: UL 67 listed and TVSS device UL 1449 Component Recognized. TVSS device meets UL 1449. Furnish panelboard markings with clamp voltage at TVSS terminals and clamp voltage at panelboard line terminals.

B. Performance:

1. Surge Suppressors:
 - a. Maximum single impulse current rating not less than 120 kA for each phase.
 - b. Pulse Lift Test: Capable of protecting against and surviving 5000 IEEE C62.41 Category C transients without failure or degradation.
 - c. Clamping Voltage:
 - 1) 208Y/120 Configuration:
 - a) L-N: 500 V.
 - b) N-G: 500 V.
 - c) L-G: 500 V.
 - 2) 480Y/277 Configuration:
 - a) L-N: 1,000 V.
 - b) N-G: 1,000 V.
 - c) L-G: 1,000 V.

C. Fabrication:

1. Surge Suppressor:
 - a. Furnish copper bus bars for surge current path.
 - b. Construct using surge current modules (MOV based). Each module fused with user replaceable 200,000 AIR rated fuses. Status of each module monitored on front cover of panelboard enclosure and on module.
 - c. Furnish with audible alarm activated when one of surge current modules has failed. Furnish alarm on/off to silence alarm and alarm push-to-test switch to test alarm. Locate switches and alarm on front cover of panelboard enclosure.
 - d. Furnish response time no greater than five nanoseconds for individual protection modes.
 - e. Designed to withstand maximum continuous operating voltage (MCOV) of not less than 115 percent of nominal RMS voltage.
 - f. Furnish visible indication of proper suppressor connection and operation. Lights indicate operable phase and module.

- g. Furnish minimum EFI/RFI filtering of 34 dB at 100 kHz with insertion loss ratio of 50:1 using Mil Std. 220A methodology.
- 2. Panelboards:
 - a. Top or bottom feed as indicated on Drawings. Furnish circuit directory inside door.
 - b. Construct box of galvanized steel. Box size as indicated on Drawings.
 - c. Main bus constructed of copper and rated for load current.
 - d. Furnish interior with branch circuit breakers. Furnish one circuit breaker, with appropriate Amp Rating and number of poles, as dedicated disconnect for TVSS.
 - e. Furnish standard rated neutral assembly with copper neutral bus.
 - f. Furnish with insulated ground bus and safety ground bus.
 - g. Furnish wiring gutters according to NEC.
 - h. Field connections to panelboard: main breaker type.
 - i. Construct with flush or surface mounted trim and NEMA Type 1 enclosure.
 - j. Furnish with branch breaker positions and nominal current rating as indicated on Drawings.

2.4 LOAD CENTERS

- A. Manufacturers:
 - 1. Eaton.
 - 2. Siemens Industry, Inc.
 - 3. Square D; by Schneider Electric.
 - 4. Substitutions: Section 01 60 00 - Product Requirements.
- B. Description: Circuit breaker load center, with bus ratings as indicated on Drawings.
- C. Performance:
 - 1. Minimum Integrated Short Circuit Rating: 10,000 A rms symmetrical.
- D. Materials:
 - 1. Molded Case Circuit Breakers: UL 489, plug-on type thermal magnetic trip circuit breakers, with common trip handle for poles, listed as Type SWD for lighting circuits, Class A ground fault interrupter circuit breakers as indicated on Drawings. Do not use tandem circuit breakers.
 - 2. Enclosure:
 - a. Indoor and Dry Locations: General Purpose
 - b. Outdoor, Wet, or Damp Locations: Rainproof.
- E. Box: Flush or Surface type with door and lock on door.
- F. Finishes: Finish in manufacturer's standard gray enamel.

2.5 SOURCE QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements: Testing, inspection, and analysis requirements.
- B. Independently test integral surge suppressors with category C3 high exposure waveform (20 kV-1.2/50us, 10kA-8/20 us) per IEEE C62.41.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install panelboards and load centers according to NEMA PB 1.1.
- B. Install panelboards and load centers plumb.
- C. Install recessed panelboards and load centers flush with wall finishes.
- D. Height: 6 feet to top of panelboard and load center; install panelboards taller than 6 feet with bottom no more than 4 inches above floor.
- E. Install filler plates for unused spaces in panelboards.
- F. Provide typed circuit directory for each branch circuit panelboard and load center. Revise directory to reflect circuiting changes to balance phase loads. Identify each circuit as to its clear, evident and specific purpose of use.
- G. Install engraved plastic nameplates according to Section 26 05 53.
- H. Install spare conduits out of each recessed panelboard to accessible location above ceiling or below floor. Minimum spare conduits: 25%, empty 1 inch. Identify each as spare.
- I. Ground and bond panelboard enclosure according to Section 26 05 26. Connect equipment ground bars of panels according to NFPA 70.

3.2 REPAIR AND RESTORATION

- A. Repair existing panelboards and load centers to remain or to be reinstalled.

3.3 FIELD QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements: Requirements for inspecting and testing.
- B. Inspect and test according to NETA ATS, except Section 4.
- C. Perform circuit breaker inspections and tests listed in NETA ATS, Section 7.6.
- D. Perform switch inspections and tests listed in NETA ATS, Section 7.5.
- E. Perform controller inspections and tests listed in NETA ATS, Section 7.16.1.

3.4 ADJUSTING

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for starting and adjusting.

- B. Measure steady state load currents at each panelboard feeder; rearrange circuits in panelboard to balance phase loads to within 5 percent of each other. Maintain proper phasing for multi-wire branch circuits.

3.5 CLEANING

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for cleaning.
- B. Clean existing panelboards and load centers to remain or to be reinstalled.

END OF SECTION

SECTION 26 27 16
ELECTRICAL CABINETS AND ENCLOSURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Hinged cover enclosures.
 - 2. Cabinets.
 - 3. Terminal blocks.
 - 4. Accessories.
- B. Related Requirements:
 - 1. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
 - 2. Section 26 05 29 - Hangers and Supports for Electrical Systems.
 - 3. Section 26 05 33 - Raceway and Boxes for Electrical Systems.

1.2 UNIT PRICE – MEASUREMENT AND PAYMENT

- A. Electrical & Controls, Complete:
 - 1. Basis of Measurement: Included in the lump sum price bid as stated in the proposal.
 - 2. Basis of Payment: Includes all associated labor, material, equipment coordination, transport, loading/unloading, storage, etc. required for a complete and operable system.

1.3 REFERENCE STANDARDS

- A. National Electrical Manufacturers Association:
 - 1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
 - 2. NEMA ICS 4 - Industrial Control and Systems: Terminal Blocks.

1.4 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Submittal procedures.
- B. Product Data: Submit manufacturer's standard data for enclosures, cabinets, and terminal blocks.
- C. Manufacturer's Instructions: Submit application conditions and limitations of use stipulated by product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- D. Qualification Statements
 - 1. Submit manufacturer, installer, and licensed professional experience qualifications.
 - 2. Submit manufacturer's approval of installer.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for maintenance materials.
- B. Extra Stock Materials:
 - 1. Furnish two of each key.

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years documented experience.

PART 2 - PRODUCTS

2.1 HINGED COVER ENCLOSURES

- A. Manufacturers:
 - 1. Saginaw Control Engineering
 - 2. Hoffman.
 - 3. Wiegmann; Hubbell Inc.
 - 4. Substitutions: Section 01 60 00 - Product Requirements.
- B. Description: NEMA 250, steel, stainless steel, or fiberglass enclosure.
 - 1. Indoor, Dry Locations: NEMA 1, steel
 - 2. Wet, Damp, or Outdoor Locations: NEMA 3R, steel
 - 3. Hazardous Locations: NEMA 4X, fiberglass or stainless-steel
 - 4. Covers: Continuous hinge, held closed by flush latch operable by screwdriver or key (as indicated), hasp and staple for padlock.
 - 5. Furnish interior metal panel for mounting terminal blocks and electrical components; finish with white enamel.
 - 6. Enclosure Finish: Manufacturer's standard enamel, unless stainless steel.

2.2 CABINETS

- A. Manufacturers:
 - 1. Saginaw Control Engineering
 - 2. Hammond Mfg. Co. Inc.
 - 3. Hoffman.
 - 4. Substitutions: Section 01 60 00 - Product Requirements.
- B. Description:
 - 1. Boxes: Galvanized steel.
 - 2. Box Size: As required for wiring and components plus 25% spare, or as shown on drawings.
 - 3. Backplate: Furnish interior metal panel for mounting terminal blocks and electrical components; finish with white enamel.
 - 4. Fronts: Steel, flush or surface type (as indicated) with concealed trim clamps, screw cover front, door with concealed hinge, and flush lock keyed to match branch circuit panelboard.

5. Knockouts: Manufacturer's standard, unless otherwise indicated.
6. Ratings: NEMA ICS 6:
 - a. Indoor, Dry Locations: Type 1 or 12
 - b. Wet, Damp, or Outdoor Locations: Type 3R, 4 or 4X

C. Fabrication

1. Furnish metal barriers to form separate compartments wiring of different systems and voltages.
2. Furnish accessory feet for free-standing equipment.

D. Finishes:

1. Finish with gray baked enamel.

2.3 TERMINAL BLOCKS

A. Manufacturers:

1. Allen-Bradley/Rockwell Automation.
2. Bussmann, an Eaton business.
3. Square D; by Schneider Electric.
4. Substitutions: Section 01 60 00 - Product Requirements.

B. Description:

1. Terminal Blocks: NEMA ICS 4.
2. Power Terminals: Unit construction type with closed back and tubular pressure screw connectors, rated 600 volts.
3. Signal and Control Terminals: Modular construction type, suitable for channel mounting, with tubular pressure screw connectors, rated 300 volts.
4. Furnish ground bus terminal block, with each connector bonded to enclosure.

2.4 PLASTIC RACEWAY

A. Manufacturers:

1. Panduit Corp.
2. Wiremold / Legrand.
3. Substitutions: Section 01 60 00 - Product Requirements.

B. Description: Plastic channel with hinged or snap-on cover.

2.5 CORROSION PROTECTION

A. Manufacturers; Emitter:

1. Cortec Corporation.
2. Substitutions: Section 01 60 00 - Product Requirements.
3. Description: Foam emitter to provide long term protection against corrosion by airborne contaminants.
 - a. For each enclosure, furnish quantity as indicated in manufacturer's instructions to protect the enclosure.

B. Manufacturers; Absorber:

1. Cortec Corporation.
2. Substitutions: Section 01 60 00 - Product Requirements.
3. Description: Plastic cup with breathable membrane to absorb corrosive gasses from the enclosure.
 - a. For each enclosure, furnish quantity as indicated in manufacturer's instructions to protect the enclosure.

PART 3 - EXECUTION

3.1 REPAIR AND RESTORATION

- A. Repair existing cabinets and enclosures to remain or to be reinstalled.

3.2 INSTALLATION

- A. Install enclosures and boxes plumb. Anchor securely to wall and structural supports at each corner in accordance with Section 26 05 29.
- B. Install cabinet fronts plumb.

3.3 CLEANING

- A. Section 01 70 00 - Execution and Closeout Requirements: Final cleaning.
- B. Clean existing cabinets and enclosures to remain or to be reinstalled.
- C. Clean electrical parts to remove conductive and harmful materials.
- D. Remove dirt and debris from enclosure.
- E. Clean finishes and touch up damage.

END OF SECTION

SECTION 26 27 26 WIRING DEVICES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes wall switches; wall dimmers; receptacles; multioutlet assembly; and device plates and decorative box covers.
- B. Related Sections:
 - 1. Section 26 05 33 - Raceway and Boxes for Electrical Systems.

1.2 UNIT PRICE – MEASUREMENT AND PAYMENT

- A. Electrical & Controls, Complete:
 - 1. Basis of Measurement: Included in the lump sum price bid as stated in the proposal.
 - 2. Basis of Payment: Includes all associated labor, material, equipment coordination, transport, loading/unloading, storage, etc. required for a complete and operable system.

1.3 REFERENCES

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

1.4 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Submittal procedures.
- B. Product Data: Submit manufacturer's catalog information showing dimensions, colors, and configurations.
- C. Samples: Submit two samples of each wiring device and wall plate illustrating materials, construction, color, and finish.

1.5 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

1.6 EXTRA MATERIALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Spare parts and maintenance products.
- B. Furnish two of each style, size, and finish wall plate.

PART 2 - PRODUCTS

2.1 WALL SWITCHES

- A. Manufacturers; Wall Switch:
 - 1. Leviton Manufacturing Co., Inc.
 - 2. Lutron Electronics Co., Inc.
 - 3. Pass & Seymour/Legrand (Pass & Seymour).
 - 4. Substitutions: Section 01 60 00 - Product Requirements.
- B. Product Description: NEMA WD 1, Heavy-Duty, AC only general-use snap switch.
- C. Body and Handle: Ivory plastic with toggle handle.
- D. Indicator Light: Lighted handle type switch or Separate pilot strap; red color handle or lens.
- E. Locator Light: Lighted handle type switch; green color handle.
- F. Ratings:
 - 1. Voltage: 120-277 volts, AC.
 - 2. Current: 20 amperes.

2.2 RECEPTACLES

- A. Manufacturers:
 - 1. Eaton (Arrow Hart).
 - 2. Hubbell Premise Wiring.
 - 3. Leviton Manufacturing Co., Inc.
 - 4. Substitutions: Section 01 60 00 - Product Requirements.
- B. Product Description: NEMA WD 1, Heavy-duty general use receptacle.
- C. Device Body: Ivory plastic.
- D. Configuration: NEMA WD 6, type.
- E. Convenience Receptacle: Type 5-20.
- F. GFCI Receptacle: Convenience receptacle with integral ground fault circuit interrupter to meet regulatory requirements.

2.3 WALL PLATES

- A. Manufacturers:
 - 1. Leviton Manufacturing Co., Inc.
 - 2. RACO; Hubbell.
 - 3. Square D; by Schneider Electric.
 - 4. Substitutions: Section 01 60 00 - Product Requirements.

- B. Decorative Cover Plate: Smooth 302 stainless steel.
- C. Jumbo Cover Plate: Smooth 302 stainless steel.
- D. Weatherproof Cover Plate: Stainless steel plate with threaded and gasketed device cover.

2.4 MULTIOUTLET ASSEMBLY

- A. Manufacturers:
 - 1. Cutler-Hammer.
 - 2. Wiremold / Legrand.
 - 3. Substitutions: Section 01 60 00 - Product Requirements.
- B. Multi-outlet Assembly: Sheet metal channel with fitted cover, with pre-wired receptacles, suitable for use as multi-outlet assembly.
- C. Size: As required or indicated on Drawings.
- D. Receptacles: Furnish covers and accessories to accept receptacles specified in this Section.
- E. Receptacle Spacing: As indicated on Drawings.
- F. Receptacle Color: Ivory.
- G. Channel Finish: Stainless steel.
- H. Fittings: Furnish manufacturer's standard couplings, elbows, outlet and device boxes, and connectors.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.
- B. Verify outlet boxes are installed at proper height.
- C. Verify wall openings are neatly cut and completely covered by wall plates.
- D. Verify branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.

3.2 PREPARATION

- A. Clean debris from outlet boxes.

3.3 INSTALLATION

- A. Install devices plumb and level.

- B. Install switches with OFF position down.
- C. Install receptacles with grounding pole on bottom.
- D. Connect wiring device grounding terminal to outlet box with bonding jumper and branch circuit equipment grounding conductor.
- E. Install wall plates on flush mounted switches, receptacles, and blank outlets.
- F. Install decorative plates on switch, receptacle, and blank outlets in finished areas.
- G. Connect wiring devices by wrapping solid conductor around screw terminal. Install stranded conductor for branch circuits 10 AWG and smaller. When stranded conductors are used in lieu of solid, use crimp on fork terminals for device terminations. Do not place bare stranded conductors directly under device screws.
- H. Use jumbo size plates for outlets installed in masonry walls.
- I. Install galvanized steel plates on outlet boxes and junction boxes in unfinished areas, above accessible ceilings, and on surface mounted outlets.

3.4 INTERFACE WITH OTHER PRODUCTS

- A. Coordinate locations of outlet boxes provided under Section 26 05 33 to obtain mounting heights as specified and as indicated on drawings.
- B. Install wall switch 48 inches above finished floor.
- C. Install convenience receptacle Minimum 18 inches above finished floor.

3.5 FIELD QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements
- B. Section 01 70 00 - Execution and Closeout Requirements: Field inspecting, testing, adjusting, and balancing.
- C. Inspect each wiring device for defects.
- D. Operate each wall switch with circuit energized and verify proper operation.
- E. Verify each receptacle device is energized.
- F. Test each receptacle device for proper polarity.
- G. Test each GFCI receptacle device for proper operation.

3.6 ADJUSTING

- A. Section 01 70 00 - Execution and Closeout Requirements: Testing, adjusting, and balancing.

B. Adjust devices and wall plates to be flush and level.

3.7 CLEANING

A. Section 01 70 00 - Execution and Closeout Requirements: Final cleaning.

B. Clean exposed surfaces to remove splatters and restore finish.

END OF SECTION

SECTION 26 28 13
FUSES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Fuses.

1.2 UNIT PRICE – MEASUREMENT AND PAYMENT

- A. Electrical & Controls, Complete:
 - 1. Basis of Measurement: Included in the lump sum price bid as stated in the proposal.
 - 2. Basis of Payment: Includes all associated labor, material, equipment coordination, transport, loading/unloading, storage, etc. required for a complete and operable system.

1.3 REFERENCE STANDARDS

- A. National Electrical Manufacturers Association:
 - 1. NEMA FU 1 - Low Voltage Cartridge Fuses.

1.4 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Submittal procedures.
- B. Product Data: Submit data sheets showing electrical characteristics, including time-current curves.

1.5 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Closeout procedures.
- B. Project Record Documents: Record actual sizes, ratings, and locations of fuses.

1.6 MAINTENANCE MATERIALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for maintenance materials
- B. Spare Parts:
 - 1. Furnish two fuse pullers.
- C. Extra Materials:
 - 1. Furnish three spare fuses of each Class, size, and rating installed.

1.7 QUALITY ASSURANCE

A. Qualifications:

1. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers:

1. Bussmann, an Eaton business.
2. Substitutions: Section 01 60 00 - Product Requirements.

2.2 DESIGN REQUIREMENTS

- A. Select fuses to provide appropriate levels of short circuit and overcurrent protection for the following components: wire, cable, bus structures, and other equipment. Design system to maintain component damage within acceptable levels during faults.
- B. Select fuses to coordinate with time current characteristics of other overcurrent protective elements, including other fuses, circuit breakers, and protective relays. Design system to maintain operation of device closest to fault operates.

2.3 FUSES PERFORMANCE REQUIREMENTS

- A. Main Service Switches Larger than 600 amperes: Class L (time delay).
- B. Main Service Switches: Class RK1 (time delay). RK5. J (time delay).
- C. Power Load Feeder Switches Larger than 600 amperes: Class L (time delay).
- D. Power Load Feeder Switches: Class RK1 (time delay). RK5. J (time delay).
- E. Motor Load Feeder Switches: Class RK1 (time delay). RK5. J (time delay).
- F. Lighting Load Feeder Switches Larger than 600 amperes: Class L time delay.
- G. Lighting Load Feeder Switches: Class RK1 (time delay). RK5. J (time delay).
- H. Other Feeder Switches Larger than 600 amperes: Class L time delay.
- I. Other Feeder Switches: Class RK1 (time delay). RK5. J (time delay).
- J. General Purpose Branch Circuits: Class RK1 (time delay). RK5. J (time delay).
- K. Motor Branch Circuits: Class RK1 (time delay). RK5. J (time delay).
- L. Lighting Branch Circuits: Class G.

2.4 FUSES

- A. Dimensions and Performance: NEMA FU 1, Class as specified or as indicated on Drawings.
- B. Voltage: Rating suitable for circuit phase-to-phase voltage.

2.5 CLASS RK1 (TIME DELAY) FUSES

- A. Dimensions and Performance: NEMA FU 1.
- B. Voltage: Rating suitable for circuit phase-to-phase voltage.

2.6 CLASS RK1 (NON-TIME-DELAY) FUSES

- A. Dimensions and Performance: NEMA FU 1.
- B. Voltage: Rating suitable for circuit phase-to-phase voltage.

2.7 CLASS RK5 FUSES

- A. Dimensions and Performance: NEMA FU 1.
- B. Voltage: Rating suitable for circuit phase-to-phase voltage.

2.8 CLASS J (TIME DELAY) FUSES

- A. Dimensions and Performance: NEMA FU 1.
- B. Voltage: Rating suitable for circuit phase-to-phase voltage.

2.9 CLASS J (NON-TIME-DELAY) FUSES

- A. Dimensions and Performance: NEMA FU 1.
- B. Voltage: Rating suitable for circuit phase-to-phase voltage.

2.10 CLASS T FUSES

- A. Dimensions and Performance: NEMA FU 1.
- B. Voltage: Rating suitable for circuit phase-to-phase voltage.

2.11 CLASS L (FAST-ACTING) FUSES

- A. Dimensions and Performance: NEMA FU 1.
- B. Voltage: Rating suitable for circuit phase-to-phase voltage.

2.12 CLASS L (TIME DELAY) FUSES

- A. Dimensions and Performance: NEMA FU 1.
- B. Voltage: Rating suitable for circuit phase-to-phase voltage.

2.13 CLASS G FUSES

- A. Dimensions and Performance: NEMA FU 1.
- B. Voltage: Rating suitable for circuit phase-to-phase voltage.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install fuse with label oriented so manufacturer, type, and size are easily read.
- B. Spare Parts – Provide 10% spare fuses of each type and size provided for this project.

END OF SECTION

SECTION 26 28 16.16
ENCLOSED SWITCHES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Fusible.
 - 2. Nonfusible switches.
- B. Related Sections:
 - 1. Section 26 05 29 - Hangers and Supports for Electrical Systems.
 - 2. Section 26 05 53 - Identification for Electrical Systems.
 - 3. Section 26 28 13 - Fuses.

1.2 UNIT PRICE – MEASUREMENT AND PAYMENT

- A. Electrical & Controls, Complete:
 - 1. Basis of Measurement: Included in the lump sum price bid as stated in the proposal.
 - 2. Basis of Payment: Includes all associated labor, material, equipment coordination, transport, loading/unloading, storage, etc. required for a complete and operable system.

1.3 REFERENCE STANDARDS

- A. National Electrical Manufacturers Association:
 - 1. NEMA FU 1 - Low Voltage Cartridge Fuses.
 - 2. NEMA KS 1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).
- B. International Electrical Testing Association:
 - 1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

1.4 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Submittal procedures.
- B. Product Data: Submit switch ratings and enclosure dimensions.

1.5 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Closeout procedures.
- B. Project Record Documents: Record actual locations of enclosed switches and ratings of installed fuses.

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

PART 2 - PRODUCTS

2.1 FUSIBLE SWITCH ASSEMBLIES

- A. Manufacturers:
 - 1. Eaton.
 - 2. Siemens.
 - 3. Square D; by Schneider Electric.
 - 4. Substitutions: Section 01 60 00 - Product Requirements.
- B. Description: NEMA KS 1, Type HD, enclosed load interrupter knife switch. Handle lockable in OFF position.
- C. Operation:
 - 1. Switch Ratings
 - a. Switch Rating: Horsepower rated for AC or DC as indicated on Drawings.
 - b. Short Circuit Current Rating: UL listed for 10,000 rms symmetrical amperes when used with or protected by Class H or K fuses (30-600 ampere). 200,000 rms symmetrical amperes when used with or protected by Class R or Class J fuses (30-600 ampere switches employing appropriate fuse rejection schemes). 200,000 rms symmetrical amperes when used with or protected by Class L fuses (800-1200 ampere).
- D. Materials:
 - 1. Coordinate selection in the following paragraph with fuses specified for application in enclosed switches.
 - 2. Fuse clips: Designed to accommodate NEMA FU 1 fuses.
 - a. Fuse Class to match required application.
 - 3. Enclosure: NEMA KS 1, to meet conditions. Fabricate enclosure from steel finished with manufacturer's standard gray enamel.
 - a. Interior Dry Locations: Type 1.
 - b. Exterior Locations: Type 3R or 4.
 - c. Industrial Locations: Type 4X.
 - 4. Service Entrance: Switches identified for use as service equipment are to be labeled for this application. Furnish solid neutral assembly and equipment ground bar.
 - 5. Furnish switches with entirely copper current carrying parts.

2.2 NONFUSIBLE SWITCH ASSEMBLIES

- A. Manufacturers:
 - 1. Eaton.
 - 2. Siemens.
 - 3. Square D; by Schneider Electric.
 - 4. Substitutions: Section 01 60 00 - Product Requirements.

- B. Description: NEMA KS 1, Type HD enclosed load interrupter knife switch. Handle lockable in OFF position.
- C. Operation:
 - 1. Switch Ratings
 - a. Switch Rating: Horsepower rated for AC or DC as indicated on Drawings.
 - b. Short Circuit Current Rating: UL listed for 10,000 rms symmetrical amperes when used with or protected by Class H or K fuses (30-600 ampere). 200,000 rms symmetrical amperes when used with or protected by Class R or Class J fuses (30-600 ampere switches employing appropriate fuse rejection schemes). 200,000 rms symmetrical amperes when used with or protected by Class L fuses (800-1200 ampere).
- D. Materials:
 - 1. Enclosure: NEMA KS 1, to meet conditions. Fabricate enclosure from steel finished with manufacturer's standard gray enamel.
 - a. Interior Dry Locations: Type 1.
 - b. Exterior Locations: Type 3R or 4.
 - c. Industrial Locations: Type 4X.
 - 2. Service Entrance: Switches identified for use as service equipment are to be labeled for this application. Furnish solid neutral assembly and equipment ground bar.
 - 3. Furnish switches with entirely copper current carrying parts.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install enclosed switches where indicated.
- B. Install enclosed switches plumb. Provide supports in accordance with Section 26 05 29.
- C. Height: 5 feet to operating handle.
- D. Install fuses for fusible disconnect switches. Refer to Section 26 28 13 for product requirements.
- E. Install engraved plastic nameplates in accordance with Section 26 05 53. Engrave nameplates with the equipment served and the panel and circuit number supplying the switch.
- F. Apply adhesive tag on inside door of each fused switch indicating NEMA fuse class and size installed.

3.2 FIELD QUALITY CONTROL

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for testing, adjusting, and balancing.
- B. Inspect and test in accordance with NETA ATS, except Section 4.
- C. Perform inspections and tests listed in NETA ATS, Section 7.5.

3.3 CLEANING

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for cleaning.
- B. Clean existing enclosed switches to remain or to be reinstalled.

END OF SECTION

SECTION 26 29 23
VARIABLE-FREQUENCY MOTOR CONTROLLERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes installation and startup of owner supplied variable frequency controllers.
- B. Related Sections:
 - 1. Section 26 28 13 - Fuses.

1.2 UNIT PRICE – MEASUREMENT AND PAYMENT

- A. Electrical & Controls, Complete:
 - 1. Basis of Measurement: Included in the lump sum price bid as stated in the proposal.
 - 2. Basis of Payment: Includes all associated labor, material, equipment coordination, transport, loading/unloading, storage, etc. required to install owner supplied equipment for a complete and operable system.

1.3 REFERENCES

- A. Institute of Electrical and Electronics Engineers:
 - 1. IEEE C62.41 - Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits.
- B. National Electrical Manufacturers Association:
 - 1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
 - 2. NEMA FU 1 - Low Voltage Cartridge Fuses.
 - 3. NEMA ICS 7 - Industrial Control and Systems: Adjustable Speed Drives.
 - 4. NEMA ICS 7.1 - Safety Standards for Construction and Guide for Selection, Installation, and Operation of Adjustable Speed Drive Systems.
- C. International Electrical Testing Association:
 - 1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

1.4 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Closeout procedures.
- B. Operation and Maintenance Data: Submit instructions complying with NEMA ICS 7.1. Include procedures for starting and operating controllers, and describe operating limits possibly resulting in hazardous or unsafe conditions. Include routine preventive maintenance schedule.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.

- B. Store in clean, dry space. Maintain factory wrapping or provide additional canvas or plastic cover to protect units from dirt, water, construction debris, and traffic.
- C. Handle in accordance with manufacturer's written instructions. Lift only with lugs provided. Handle carefully to avoid damage to components, enclosure, and finish.

1.6 ENVIRONMENTAL REQUIREMENTS

- A. Section 01 60 00 - Product Requirements.
- B. Conform to NEMA ICS 7 service conditions during and after installation of variable frequency controllers.

1.7 MAINTENANCE SERVICE

- A. Section 01 70 00 - Execution and Closeout Requirements: Maintenance service.
- B. Furnish service and maintenance of variable frequency controller for one year from Date of Substantial Completion.

PART 2 - PRODUCTS

2.1 VARIABLE FREQUENCY CONTROLLER

- A. SEE APPENDIX A FOR EQUIPMENT CUTSHEETS
- B. Manufacturers:
 - 1. Square D, by Schneider Electric.
 - a. Altivar, ATV630 Series
 - 2. Substitutions: Not Permitted.
- C. Product Description: NEMA ICS 7, enclosed variable frequency controller suitable for operating indicated loads. Select unspecified features and options in accordance with NEMA ICS 7.1.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.
- B. Verify building environment is maintained within service conditions required by manufacturer.

3.2 INSTALLATION

- A. Install in accordance with NEMA ICS 7.1.
- B. Tighten accessible connections and mechanical fasteners after placing controller.

- C. Install fuses in fusible switches.
- D. Select and install overload heater elements in motor controllers to match installed motor characteristics.
- E. Install engraved plastic nameplates in accordance with Section 26 05 53.
- F. Neatly type label inside controller door identifying motor served, nameplate horsepower, full load amperes, code letter, service factor, and voltage/phase rating. Place label in clear plastic holder.
- G. Ground and bond controller in accordance with Section 26 05 26.

3.3 FIELD QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Inspect and test in accordance with NETA ATS, except Section 4.
- C. Perform inspections and tests listed in NETA ATS, Section 7.16 and NEMA ICS 7.1.

3.4 MANUFACTURER'S FIELD SERVICES

- A. Section 01 40 00 - Quality Requirements: Manufacturer's field services.
- B. Prepare and startup variable frequency controller.

3.5 DEMONSTRATION AND TRAINING

- A. Coordinate 4 hours of instruction each for two persons, to be conducted at project site with manufacturer's representative.

END OF SECTION

SECTION 26 32 13
ENGINE GENERATORS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes installation and startup of owner supplied engine generator set, exhaust silencer and fittings, transfer switch, fuel fittings, battery, charger, and automatic transfer switch.
- B. Related Sections:
 - 1. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
 - 2. Section 26 05 53 - Identification for Electrical Systems.
 - 3. Section 26 36 13 - Enclosed Transfer Switches.

1.2 UNIT PRICE – MEASUREMENT AND PAYMENT

- A. Electrical & Controls, Complete:
 - 1. Basis of Measurement: Included in the lump sum price bid as stated in the proposal.
 - 2. Basis of Payment: Includes all associated labor, material, equipment coordination, transport, loading/unloading, storage, etc. required to install owner supplied equipment for a complete and operable system.

1.3 REFERENCES

- A. National Electrical Manufacturers Association:
 - 1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
 - 2. NEMA ICS 10 - Industrial Control and Systems: AC Transfer Switch Equipment.
 - 3. NEMA MG 1 - Motors and Generators.
- B. International Electrical Testing Association:
 - 1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
- C. National Fire Protection Association:
 - 1. NFPA 30 - Flammable and Combustible Liquids Code.
 - 2. NFPA 99 - Standard for Health Care Facilities.
 - 3. NFPA 110 - Standard for Emergency and Standby Power Systems.
- D. Underwriters Laboratories Inc.:
 - 1. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures.

1.4 SYSTEM DESCRIPTION

- A. Description: Engine generator assembly and accessories to provide source of power for Level 1 and 2 applications in accordance with NFPA 110, and conforming to NFPA 99.
- B. Capacity: 500 kW, 625 kVA at elevation of 1000 feet above sea level, standby rating using specified engine cooling scheme.

1.5 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Closeout procedures.
- B. Operation and Maintenance Data: Submit instructions and service manuals for normal operation, routine maintenance, oil sampling and analysis for engine wear, and emergency maintenance procedures.

1.6 MAINTENANCE SERVICE

- A. Section 01 70 00 - Execution and Closeout Requirements: Maintenance service.
- B. Furnish service and maintenance of engine generator and transfer switch for one year from Date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GENERATOR

- A. SEE APPENDIX A FOR EQUIPMENT CUTSHEETS

2.2 AUTOMATIC TRANSFER SWITCH

- A. SEE APPENDIX A FOR EQUIPMENT CUTSHEETS

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install engraved plastic nameplates in accordance with Section 26 05 53.
- B. Ground and bond generator and other electrical system components in accordance with Section 26 05 26.

3.2 FIELD QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements
- B. Section 01 70 00 - Execution and Closeout Requirements: Field inspecting, testing, adjusting, and balancing.
- C. Inspect and test in accordance with NETA ATS, except Section 4.
- D. Perform inspections and tests listed in NETA ATS, Section 7.22.
- E. Contractor shall fill fuel tank prior to start-up and testing.
- F. Engineer to be present during generator start-up and testing. Provide at least one week advance notice.
- G. Provide full load test utilizing portable test bank, for four hours minimum. Simulate power failure including operation of transfer switch, automatic starting cycle, and automatic shutdown, and return to normal.
- H. During test, record the following at 20 minute intervals:
 - 1. Kilowatts.
 - 2. Amperes.
 - 3. Voltage.
 - 4. Coolant Temperature.
 - 5. Ambient Temperature.
 - 6. Frequency.
 - 7. Oil Pressure.
- I. Test alarm and shutdown circuits by simulating conditions.
- J. Contractor shall refill fuel tank following completion of start-up and testing.

3.3 MANUFACTURER'S FIELD SERVICES

- A. Section 01 40 00 - Quality Requirements: Manufacturer's field services.
- B. Coordinate preparation and start up of engine-generator assembly with manufacturer's representative.

3.4 ADJUSTING

- A. Section 01 70 00 - Execution and Closeout Requirements: Testing, adjusting, and balancing.
- B. Adjust generator output voltage and engine speed to meet specified ratings.

3.5 CLEANING

- A. Section 01 70 00 - Execution and Closeout Requirements: Final cleaning.

- B. Clean engine and generator surfaces. Replace oil and fuel filters with new.

3.6 DEMONSTRATION AND TRAINING

- A. Coordinate four (4) hours of instruction each for two persons, to be conducted at project site with manufacturer's representative.
- B. Describe loads connected to emergency and standby system and restrictions for future load additions.
- C. Simulate power outage by interrupting normal source, and demonstrate system operates to provide emergency and standby power.

END OF SECTION

SECTION 26 35 53
VOLTAGE REGULATORS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Transient voltage surge suppressors.
- B. Related Sections:
 - 1. Section 26 24 13 - Switchboards.
 - 2. Section 26 24 16 - Panelboards.

1.2 UNIT PRICE – MEASUREMENT AND PAYMENT

- A. Electrical & Controls, Complete:
 - 1. Basis of Measurement: Included in the lump sum price bid as stated in the proposal.
 - 2. Basis of Payment: Includes all associated labor, material, equipment coordination, transport, loading/unloading, storage, etc. required for a complete and operable system.

1.3 REFERENCES

- A. Institute of Electrical and Electronics Engineers:
 - 1. IEEE 1100 - Recommended Practice for Powering and Grounding Electronic Equipment.
 - 2. IEEE C62.41 - Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits.
 - 3. IEEE C62.45 - Guide on Surge Testing for Equipment Connected to Low-Voltage AC Power Circuits.
- B. National Electrical Manufacturers Association:
 - 1. NEMA LS 1 - Low Voltage Surge Protection Devices.
- C. National Fire Protection Association:
 - 1. NFPA 70 - National Electrical Code.
 - 2. NFPA 780 - Standard for the Installation of Lightning Protection Systems.
- D. UL:
 - 1. UL 1283 - Electromagnetic Interference Filters.
 - 2. UL 1449 - Transient Voltage Surge Suppressors.

1.4 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit capacity, dimensions, weights, details, and wiring configuration.

- C. Test Reports:
 - 1. Indicate let-through voltage test data.
 - 2. Submit spectrum analysis of each unit.
 - 3. Submit test reports from nationally recognized independent testing laboratory verifying suppressors can survive published surge current rating.
- D. Manufacturer's Installation Instructions: Submit installation instructions and connection requirements.
- E. Manufacturer's Certificate: Certify transient voltage surge suppression device complies with UL 1449 Second Edition Surge Voltage Ratings.

1.5 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for submittals.
- B. Project Record Documents: Record actual locations of transient voltage surge suppressors.
- C. Operation and Maintenance Data: Submit manufacturer's descriptive literature, installation instructions, and maintenance and repair data.

1.6 QUALITY ASSURANCE

- A. List individual units under UL 1449 and UL 1283.
- B. Perform Work according to all applicable Federal, State, and Local Codes and Ordinances.
- C. Maintain one copy of each document on Site.

1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years' documented experience.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Accept equipment on Site in factory packaging. Inspect for damage.
- C. Protect equipment from damage by providing temporary covers until construction is complete in adjacent space.

1.9 WARRANTY

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for warranties.

- B. Furnish five-year manufacturer's warranty for transient voltage surge suppressor part failure.

PART 2 - PRODUCTS

2.1 TRANSIENT VOLTAGE SURGE SUPPRESSOR (TVSS)

- A. Manufacturers:
 - 1. Square D, by Schneider Electric.
 - 2. Eaton.
 - 3. Siemens Industry, Inc.
 - 4. Substitutions: Section 01 60 00 - Product Requirements.
- B. Product Description: Surge protective devices for protection of AC electrical circuits.
- C. Types: Service entrance switchboards, Enclosed switchgear, Busway systems, Distribution switchboards, Power panelboards, Lighting panelboards.
- D. Unit Operating Voltage: As indicated on Drawings.
- E. Maximum Continuous Operating Voltage: Greater than 115 percent of nominal system operating voltage.
- F. Construction:
 - 1. Finish: Factory finish of baked enamel.
 - 2. Balanced Suppression Platform: Equally distribute surge current to metal oxide varistor (MOV) components to ensure equal stressing and maximum performance. Furnish surge suppression platform with equal impedance paths to each matched MOV.
 - 3. Internal Connections: Hardwired with connections using low impedance conductors and compression fittings.
 - 4. Safety and Diagnostic Monitoring: Equipped with standard overcurrent protection:
 - a. Continuous monitoring of fusing system.
 - b. Monitor individual MOVs (including neutral to ground). Capable of identifying open circuit failures not monitored by conventional fusing systems.
 - c. Monitor for overheating in each mode due to thermal runaway.
 - d. Furnish green and red solid state indicator light on each phase. Absence of green light and presence of red light indicates which phases have been damaged. Fault detection activates flashing trouble light. Units not capable of detecting open circuit damage, thermal conditions, and over current will not be accepted.
 - 5. Labeling: Permanently affix UL 1449 suppression voltage ratings and CSA to unit.
- G. Rating:
 - 1. Electrical Noise Filter: Furnish each unit with high performance EMI/RFI noise rejection filter. Electric line noise attenuation no less than 45 dB at 100 kHz using MIL-STD-220A insertion loss test method.
- H. Accessories:
 - 1. Digital display transient event counter with manual reset.
 - 2. Local audible alarm.

3. Form C dry contacts one normally open (NO) and one normally closed (NC) for remote status monitoring.
 4. Remote monitor panel with indicating lights and audible alarm for mounting in remote location.
 5. Push-to-test feature.
- I. Surge Current Capacity:
1. Total Surge Current Survival Based on 8-by-20-microsecond Waveform:
 - a. Service Entrance (Switchboards, Switchgear, and MCCs):
 - 1) Minimum Surge Current per Phase: 250kA.
 - 2) Minimum Surge Current per Mode: 125kA.
 - b. High-Exposure Rooftop Locations:
 - 1) Minimum Surge Current per Phase: 160kA.
 - 2) Minimum Surge Current per Mode: 80kA.
 - c. Distribution and Branch Locations (Panelboards, MCCs, Bus Ducts):
 - 1) Minimum Surge Current per Phase: 120kA.
 - 2) Minimum Surge Current per Mode: 60kA.
- J. Protection Modes: For Wye configured system, furnish device with directly connected suppression elements between line-neutral (L-N), line-ground (L-G), and neutral-ground (N-G). For Delta configured system, furnish device with suppression elements between line to line (L-L) and line to ground (L-G).
- K. Do not exceed following for maximum UL 1449 suppression voltage ratings:
1. WYE; L-N, L-G, N-G:
 - a. 208Y/120: 400 V.
 - b. 480Y/277: 800 V.
 - c. 600Y/347: 1,200 V.
 2. Delta; L-L, L-G:
 - a. 208Y/120: 800 V.
 - b. 480Y/277: 1,500 V.
 - c. 600Y/347: 2,000 V.
- L. ANSI/IEEE Catalog C3 Let Through Voltage: Based on ANSI/IEEE C62.41 and C62.45 recommended procedures for Catalog C3 surges (20 kV, 10kA) and not less than:
1. 208Y/120; L-N: 500 V.
 2. 480Y/277; L-N: 900 V.
 3. 600Y/347; L-N: 1,300 V.
- M. ANSI/IEEE Cat. B3 Let Through Voltage: Based on ANSI/IEEE C62.41 and C62.45 recommended procedures for ANSI/IEEE Catalog B3 Ringwave (6 kV, 500 amps) not less than:
1. 208Y/120:
 - a. WYE; L-N, L-G, N-G: 400 V.
 - b. L-N: 170 V.
 2. 480Y/277:
 - a. WYE; L-N, L-G, N-G: 800 V.
 - b. L-N: 300 V.
 3. 600Y/347:
 - a. WYE; L-N, L-G, N-G: 1,200 V.
 - b. L-N: 470 V.

2.2 SOURCE QUALITY CONTROL AND TESTS

- A. Section 01 40 00 - Quality Requirements: Testing, inspection, and analysis requirements.
- B. Test units to specified surge ratings to ensure devices will achieve required life expectancy and reliability. Testing to full ratings also verifies internal construction quality of suppressors. Provide withstand testing for each mode and each phase basis.
- C. Perform actual let-through voltage test data in form of oscillograph results for ANSI/IEEE C62.41 Catalog C3 (20 kV, 10 kA), Catalog C1 (6 kV, 3 kA), and Catalog. B3 (6 kv, 500 A at 100 kHz) tested according to ANSI/IEEE C62.45.
- D. Perform spectrum analysis of each unit based on MIL-STD-220A test procedures between 50 kHz and 200 kHz verifying device noise attenuation exceeds 45 dB at 100 kHz.
- E. Perform test verifying suppressors can survive published surge current rating for each mode and each phase basis. Test wave based on ANSI/IEEE C62.41, 8-by-20-microsecond current wave.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements.
- B. Verify mounting area is ready for equipment.
- C. Verify circuit rough-ins are at correct location.

3.2 INSTALLATION

- A. Install according to IEEE 1100.
- B. Install service entrance suppressors in switchboard or switchgear at point of origination for each power configuration within distribution system.
- C. Install distribution and branch suppressors in panelboards.
- D. Install using direct bus bar connection.
- E. Install indicator lights, trouble alarms, and surge counter in face of switchboard, switchgear, and panelboard.
- F. Install with maximum conductor length of 14 inches. Install suppressor with internal fusing.

END OF SECTION

SECTION 26 36 13
ENCLOSED TRANSFER SWITCHES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes installation and startup of owner supplied transfer switches.
- B. Related Sections:
 - 1. Section 03 30 00 - Cast-In-Place Concrete for concrete pads.
 - 2. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
 - 3. Section 26 05 29 - Hangers and Supports for Electrical Systems.
 - 4. Section 26 05 53 - Identification for Electrical Systems.
 - 5. Section 26 32 13 - Engine Generators for testing requirements.

1.2 UNIT PRICE – MEASUREMENT AND PAYMENT

- A. Electrical & Controls, Complete:
 - 1. Basis of Measurement: Included in the lump sum price bid as stated in the proposal.
 - 2. Basis of Payment: Includes all associated labor, material, equipment coordination, transport, loading/unloading, storage, etc. required to install owner supplied equipment for a complete and operable system.

1.3 REFERENCES

- A. National Electrical Manufacturers Association:
 - 1. NEMA ICS 10 - Industrial Control and Systems: AC Transfer Switch Equipment.
- B. International Electrical Testing Association:
 - 1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
- C. Underwriters Laboratories Inc.:
 - 1. UL 1008 - Transfer Switch Equipment.

1.4 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Closeout procedures.
- B. Project Record Documents: Record actual locations of enclosed transfer switches.
- C. Operation and Maintenance Data: Submit routine preventative maintenance and lubrication schedule. List special tools, maintenance materials, and replacement parts.

1.5 MAINTENANCE SERVICE

- A. Section 01 70 00 - Execution and Closeout Requirements: Maintenance service.
- B. Furnish service and maintenance of transfer switches for one year from Date of Substantial Completion.

PART 2 - PRODUCTS

2.1 AUTOMATIC TRANSFER SWITCH

- A. SEE APPENDIX A FOR EQUIPMENT CUTSHEETS

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install housekeeping pads in accordance with Section 03 30 00 where applicable.
- B. Install engraved plastic nameplates in accordance with Section 26 05 53.

3.2 FIELD QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements.
- B. Section 01 70 00 - Execution and Closeout Requirements.
- C. Inspect and test in accordance with NETA ATS, except Section 4.
- D. Perform inspections and tests listed in NETA ATS, Section 7.22.3.

3.3 MANUFACTURER'S FIELD SERVICES

- A. Section 01 40 00 - Quality Requirements.
- B. Check out transfer switch connections and operations and place in service.

3.4 ADJUSTING

- A. Section 01 70 00 - Execution and Closeout Requirements.
- B. Adjust control and sensing devices to achieve specified sequence of operation.

3.5 DEMONSTRATION AND TRAINING

- A. Demonstrate operation of transfer switch in bypass, normal, and emergency modes.

END OF SECTION

SECTION 26 51 00
INTERIOR LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes interior luminaires, lamps, ballasts, and accessories.

1.2 UNIT PRICE – MEASUREMENT AND PAYMENT

- A. Electrical & Controls, Complete:
 - 1. Basis of Measurement: Included in the lump sum price bid as stated in the proposal.
 - 2. Basis of Payment: Includes all associated labor, material, equipment coordination, transport, loading/unloading, storage, etc. required for a complete and operable system.

1.3 REFERENCES

- A. American National Standards Institute:
 - 1. ANSI C82.1 - American National Standard for Lamp Ballast-Line Frequency Fluorescent Lamp Ballast.
 - 2. ANSI C82.4 - American National Standard for Ballasts-for High-Intensity-Discharge and Low-Pressure Sodium Lamps (Multiple-Supply Type).

1.4 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Submittal procedures.
- B. Shop Drawings: Indicate dimensions and components for each luminaire not standard product of manufacturer.
- C. Product Data: Submit dimensions, ratings, and performance data.
- D. Samples: Submit two color chips 3 x 3 inch in size illustrating luminaire finish color where indicated in luminaire schedule.

1.5 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

1.6 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

1.7 MAINTENANCE MATERIALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Spare parts and maintenance products.

- B. Furnish one of each lens type.
- C. Furnish one set of replacement lamps for each lamp type installed.
- D. Furnish one of each ballast and driver type.

PART 2 - PRODUCTS

2.1 INTERIOR LUMINAIRES

- A. Product Description: Complete interior luminaire assemblies, with features, options, and accessories as scheduled.
- B. Refer to Section 01 60 00 - Product Requirements for product options.

2.2 FLUORESCENT BALLASTS

- A. Manufacturers:
 - 1. Cooper Lighting
 - 2. Lithonia Lighting
 - 3. Lumark Lighting
 - 4. Substitutions: Section 01 60 00 - Product Requirements.
- B. Product Description: Electronic ballast instant start less than 10 percent THD, suitable for lamps specified, with voltage to match luminaire voltage.

2.3 FLUORESCENT LAMPS

- A. Manufacturers:
 - 1. As provided by Luminaire Manufacturer.
 - 2. Substitutions: Section 01 60 00 - Product Requirements.

2.4 LED FIXTURES

- A. Manufacturers:
 - 1. As scheduled on drawings.
 - 2. Substitutions: Substitutions: Not Permitted.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install suspended luminaires using pendants supported from swivel hangers. Install pendant length required to suspend luminaire at indicated height.
- B. Support luminaires larger than 2 x 4 foot size independent of ceiling framing.
- C. Locate recessed ceiling luminaires as indicated on Drawings.

- D. Install surface mounted luminaires plumb and adjust to align with building lines and with each other. Secure to prevent movement.
- E. Exposed Grid Ceilings: Support surface-mounted luminaires on grid ceiling directly from building structure.
- F. Install recessed luminaires to permit removal from below.
- G. Install recessed luminaires using accessories and firestopping materials to meet regulatory requirements for fire rating.
- H. Install clips to secure recessed grid-supported luminaires in place.
- I. Install wall-mounted luminaires at height as indicated on Drawings.
- J. Install accessories furnished with each luminaire.
- K. Connect luminaires to branch circuit outlets provided under Section 26 05 33 as indicated on Drawings.
- L. Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within luminaire.
- M. Install specified lamps in each luminaire.
- N. Interface with air handling accessories furnished and installed under Section 23 37 00, where/as required.
- O. Ground and bond interior luminaires in accordance with Section 26 05 26.

3.2 FIELD QUALITY CONTROL

- A. Section 01 70 00 - Execution and Closeout Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Operate each luminaire after installation and connection. Inspect for proper connection and operation.

3.3 ADJUSTING

- A. Section 01 70 00 - Execution and Closeout Requirements: Testing, adjusting, and balancing.
- B. Aim and adjust luminaires as indicated on Drawings.

3.4 CLEANING

- A. Section 01 70 00 - Execution and Closeout Requirements: Final cleaning.
- B. Remove dirt and debris from enclosures.

C. Clean photometric control surfaces as recommended by manufacturer.

D. Clean finishes and touch up damage.

3.5 PROTECTION OF FINISHED WORK

A. Section 01 70 00 - Execution and Closeout Requirements: Protecting finished work.

B. Relamp luminaires having failed lamps at Substantial Completion.

END OF SECTION

SECTION 26 52 00
EMERGENCY LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes emergency lighting units and exit signs.
- B. Related Sections:
 - 1. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
 - 2. Section 26 05 33 - Raceway and Boxes for Electrical Systems.

1.2 UNIT PRICE – MEASUREMENT AND PAYMENT

- A. Electrical & Controls, Complete:
 - 1. Basis of Measurement: Included in the lump sum price bid as stated in the proposal.
 - 2. Basis of Payment: Includes all associated labor, material, equipment coordination, transport, loading/unloading, storage, etc. required for a complete and operable system.

1.3 REFERENCES

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

1.4 SYSTEM DESCRIPTION

- A. Emergency lighting to comply with requirements.

1.5 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Submittal procedures.
- B. Product Data: Submit dimensions, ratings, and performance data.
- C. Samples: Submit two color chips 3 x 3 inch in size illustrating unit finish color.

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

1.7 MAINTENANCE MATERIALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Spare parts and maintenance products.
- B. Furnish one set of replacement lamps for each lamp installed.
- C. Furnish one replacement battery for each battery type and size.

PART 2 - PRODUCTS

2.1 EXIT SIGNS

- A. Manufacturers:
 - 1. Cooper
 - 2. Lithonia
 - 3. Substitutions: Section 01 60 00 - Product Requirements.
- B. Product Description: Exit sign fixture.
- C. Housing: Extruded aluminum or Sheet steel.
- D. Face: Translucent face with red letters on white background
- E. Directional Arrows: As indicated on Drawings.
- F. Mounting: Universal, for field selection.
- G. Battery: 6 or 12 volt, nickel-cadmium type, with 1.5 hour capacity.
- H. Battery Charger: Dual-rate type, with sufficient capacity to recharge discharged battery to full charge within twelve hours.
- I. Lamps: LED, 5 W per side, maximum.
- J. Input Voltage: 120 volts.

2.2 EMERGENCY POWER SUPPLY

- A. Manufacturers:
 - 1. As supplied by Luminaire Manufacturer.
 - 2. Substitutions: Section 01 60 00 - Product Requirements.
- B. Product Description: Emergency battery power supply suitable for installation in ballast/driver compartment of luminaire.
- C. Lamp Ratings: 1100 lumens, minimum.
- D. Battery: Sealed lead calcium type, rated for 10-year life.
- E. Include TEST switch and AC ON indicator light, installed to be operable and visible from outside of assembled luminaire.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install suspended exit signs using pendants supported from swivel hangers. Install pendant length required to suspend sign at indicated height.
- B. Install surface-mounted emergency lighting units and exit signs plumb and adjust to align with building lines and with each other. Secure to prevent movement.
- C. Install wall-mounted emergency lighting units and exit signs at height as indicated on Drawings.
- D. Install accessories furnished with each emergency lighting unit and exit sign.
- E. Connect emergency lighting units and exit signs to branch circuit outlets provided in Section 26 05 33 as indicated on Drawings.
- F. Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within unit.
- G. Install specified lamps in each emergency lighting unit and exit sign.
- H. Ground and bond emergency lighting units and exit signs in accordance with Section 26 05 26.

3.2 FIELD QUALITY CONTROL

- A. Section 01 70 00 - Execution and Closeout Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Operate each unit after installation and connection. Inspect for proper connection and operation.

3.3 ADJUSTING

- A. Section 01 70 00 - Execution and Closeout Requirements: Testing, adjusting, and balancing.
- B. Aim and adjust lamp fixtures as indicated on Drawings.
- C. Position exit sign directional arrows as indicated on Drawings.

3.4 PROTECTION OF FINISHED WORK

- A. Section 01 70 00 - Execution and Closeout Requirements: Protecting finished work.
- B. Relamp emergency lighting units and exit signs having failed lamps at Substantial Completion.

END OF SECTION

SECTION 26 56 00
EXTERIOR LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes exterior luminaires and accessories.

1.2 UNIT PRICE – MEASUREMENT AND PAYMENT

- A. Site Lighting, Complete:
 - 1. Basis of Measurement: Included in the lump sum price bid as stated in the proposal.
 - 2. Basis of Payment: Includes all associated labor, material, equipment coordination, transport, loading/unloading, storage, etc. required for a complete and operable system.

1.3 REFERENCES

- A. American National Standards Institute:
 - 1. ANSI C82.1 - American National Standard for Lamp Ballast-Line Frequency Fluorescent Lamp Ballast.
 - 2. ANSI C82.4 - American National Standard for Ballasts-for High-Intensity-Discharge and Low-Pressure Sodium Lamps (Multiple-Supply Type).
 - 3. ANSI O5.1 - Wood Poles, Specifications and Dimensions.

1.4 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Submittal procedures.
- B. Shop Drawings: Indicate dimensions and components for each luminaire not standard Product of manufacturer.
- C. Product Data: Submit dimensions, ratings, and performance data.
- D. Samples: Submit two color chips 3 x 3 inch in size illustrating luminaire finish color where indicated in luminaire schedule.

1.5 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.

1.7 COORDINATION

- A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.
- B. Furnish bolt templates and pole mounting accessories to installer of pole foundations.

1.8 MAINTENANCE MATERIALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Spare parts and maintenance products.
- B. Furnish one of each lamp installed.
- C. Furnish one gallon of touch-up paint for each different painted finish and color.
- D. Furnish one ballast and driver of each type installed.

PART 2 - PRODUCTS

2.1 LUMINAIRES

- A. Product Description: Complete exterior luminaire assemblies, with features, options, and accessories as scheduled.
- B. Refer to Section 01 60 00 - Product Requirements for product options. Substitutions are not permitted.

2.2 LAMPS - GENERAL

- A. Minimum Efficacy, Lamps Greater Than 100 Watts: 60 lumens/W, except where otherwise indicated or permitted by applicable code.

2.3 LED FIXTURES

- A. Manufacturers:
 - 1. As indicated on Drawings.
 - 2. Substitutions: Not Permitted.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements: Coordination and Project conditions.

3.2 INSTALLATION

- A. Install lamps in each luminaire.

- B. Bond and ground luminaries, metal accessories and metal poles in accordance with Section 26 05 26. Install supplementary grounding electrode at each pole.

3.3 FIELD QUALITY CONTROL

- A. Section 01 70 00 - Execution and Closeout Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Operate each luminaire after installation and connection. Inspect for improper connections and operation.
- C. Measure illumination levels to verify conformance with performance requirements.
- D. Take measurements during night sky, without moon or with heavy overcast clouds effectively obscuring moon.

3.4 ADJUSTING

- A. Section 01 70 00 - Execution and Closeout Requirements: Testing, adjusting, and balancing.
- B. Aim and adjust luminaries to provide illumination levels and distribution as indicated on Drawings.

3.5 CLEANING

- A. Section 01 70 00 - Execution and Closeout Requirements: Final cleaning.
- B. Clean photometric control surfaces as recommended by manufacturer.
- C. Clean finishes and touch up damage.

3.6 PROTECTION OF FINISHED WORK

- A. Section 01 70 00 - Execution and Closeout Requirements: Protecting finished work.
- B. Relamp luminaries having failed lamps at Substantial Completion.

END OF SECTION

SECTION 28 20 00
VIDEO SURVEILLANCE

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes installation and startup of owner supplied Video Surveillance system.
- B. Related Requirements:
 - 1. Section 26 05 26 - Grounding and Bonding for Electrical Systems: Grounding and bonding of video surveillance equipment.

1.2 UNIT PRICE – MEASUREMENTS AND PAYMENTS

- A. Controls and SCADA:
 - 1. Basis of Measurement: As part of the lump sum for Pump Station Controls, SCADA, and Security system.
 - 2. Basis of Payment: Includes all labor, materials, and equipment to provide and install the owner supplied Controls and SCADA system as shown on the contract documents and as stated in the specifications.

1.3 REFERENCE STANDARDS

- A. Society of Motion Picture and Television Engineers:
 - 1. SMPTE-170M - Composite Analog Video Signal - NTSC for Studio Applications.

1.4 COORDINATION

- A. Section 01 30 00 - Administrative Requirements: Requirements for coordination.
- B. Coordinate Work of this Section with Work of other Sections.

1.5 PREINSTALLATION MEETINGS

- A. Section 01 30 00 - Administrative Requirements: Requirements for preinstallation meeting.
- B. Convene minimum one week prior to commencing Work of this Section.

1.6 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for submittals.
- B. Project Record Documents: Record actual locations of cameras and routing of associated cable.

1.7 QUALITY ASSURANCE

- A. Perform Work according to all applicable codes and standards.
- B. Maintain one copy of each standard affecting Work of this Section on Site.

1.8 QUALIFICATIONS

- A. Installer: Company specializing in performing Work of this Section with minimum three years' documented experience and approved by manufacturer.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- C. Store materials according to manufacturer instructions.
- D. Protection:
 - 1. Protect materials from moisture and dust by storing in clean, dry location remote from areas involved in construction operations areas.
 - 2. Provide additional protection according to manufacturer instructions.

1.10 AMBIENT CONDITIONS

- A. Section 01 50 00 - Temporary Facilities and Controls: Requirements for ambient condition control facilities for product storage and installation.
- B. Conform to manufacturer's standard service conditions during and after installation of components.

1.11 EXISTING CONDITIONS

- A. Field Measurements:
 - 1. Verify field measurements prior to installation.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

- A. Video surveillance and monitoring at points as indicated on Drawings.

2.2 CAMERAS

- A. SEE APPENDIX A FOR EQUIPMENT CUTSHEETS

2.3 MONITORS

- A. SEE APPENDIX A FOR EQUIPMENT CUTSHEETS

2.4 DIGITAL VIDEO RECORDERS

- A. SEE APPENDIX A FOR EQUIPMENT CUTSHEETS

PART 3 - EXECUTION

3.1 PREPARATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation preparation.
- B. Install engraved plastic nameplates as specified in Section 28 05 53 - Identification for Electronic Safety and Security.
- C. Ground and bond video surveillance equipment as specified in Section 26 05 26 - Grounding and Bonding for Electrical Systems.

3.2 FIELD QUALITY CONTROL

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for testing, adjusting, and balancing.
- B. Manufacturer Services: Coordinate services of manufacturer's representative experienced in installation of products furnished under this Section for not less than 8 hours on Site for installation, inspection, startup, supervision of final wiring connections and system adjustments, field testing, and instructing Owner's personnel in maintenance of equipment.
- C. Equipment Acceptance:
 - 1. Adjust, repair, modify, or replace components failing to perform as specified and rerun tests.
 - 2. Make final adjustments to equipment under direction of manufacturer's representative.
- D. Furnish Installation Certificate from equipment manufacturer's representative attesting that equipment has been properly installed and is ready for startup and testing.

3.3 ADJUSTING

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for starting and adjusting.
- B. Adjust manual lens irises to meet lighting conditions.

3.4 DEMONSTRATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for demonstration and training.
- B. Coordinate equipment startup, shutdown, routine maintenance, and emergency repair procedures to Owner's personnel.

3.5 MAINTENANCE

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for maintenance service.
- B. Furnish service and maintenance of video surveillance system's installation for one year from date of Substantial Completion.

END OF SECTION

SECTION 31 08 13

PILE LOAD TESTING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Pile load testing.
 - 2. Documented test results.
- B. Related Sections:
 - 1. Section 312000 – Grading, Excavation and Fill
 - 2. Section 316216 - Steel Piles.

1.2 REFERENCES

- A. ASTM International:
 - 1. ASTM D1143 - Standard Test Method for Piles Under Static Axial Compressive Load.
 - 2. ASTM D3689 - Standard Test Methods for Deep Foundations Under Static Axial Tensile Load.
 - 3. ASTM D4945 - Standard Test Method for High-Strain Dynamic Testing of Piles.

1.3 SUBMITTALS

- A. Section 013300 - Submittal Procedures: Requirements for submittals.
- B. Shop Drawings: Indicate test method and equipment, load type, calibration equipment.

1.4 QUALITY ASSURANCE

- A. Perform Work in accordance with the following:
 - 1. Compressive Load Tests: ASTM D1143, ASTM D4945.
 - 2. Uplift Load Tests: ASTM D3689.
- B. Perform Work in accordance with State of Michigan, City of Saginaw standards.
- C. Maintain one copy of each document on site.

1.5 QUALIFICATIONS

- A. Monitor test pile placement and elevations under direct supervision of Geotechnical Professional Engineer experienced in design of this Work and licensed in Saginaw, in the State of Michigan.

1.6 SEQUENCING

- A. Section 011000 - Summary: Requirements for sequencing.

- B. Sequence Work to allow other piling and Work during testing.

PART 2 - PRODUCTS

2.1 EQUIPMENT

- A. Equipment Type, Load Carrying Device, Load, and Instrumentation: Conform to ASTM 1143, ASTM D4945, ASTM D3689 of same type as will be used for pile placement of the Work.
- B. Quantity: Provide one test crib for pile load testing.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 013000 - Administrative Requirements: Verification of existing conditions before starting work.
- B. Verify site conditions will support cribbing and load for testing purposes.

3.2 PREPARATION

- A. Establish stable working elevation for test equipment.

3.3 TESTING

- A. Perform load tests.
- B. Load Test The Following:
 - 1. Test 1 indicator piles at location as directed by Engineer.
- C. Subject piles to 2 times design load.
- D. Acceptable Permanent Set of Piles After Load Testing: 1/8".
- E. When tested piles do not conform to requirements, perform additional testing of other piles.

3.4 FIELD QUALITY CONTROL

- A. Section 014000 - Quality Requirements: Field inspecting, testing, adjusting, and balancing.
- B. An independent inspection firm will be engaged to observe and document test method and results.
- C. Document test equipment used, method of calibration and recording, test results, recommendations or modification of piling method used.
- D. Accurately record actual dimensions and locations of tested piles and movement or distortion caused by testing.

3.5 EQUIPMENT REMOVAL

- A. Remove test and temporary load equipment from site.

END OF SECTION

SECTION 31 10 00

SITE CLEARING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Removing surface debris.
 - a. Site Clearing
 - b. Channel Clearing, Grubbing, and Snagging
 - c. Site Demolition and Removal
 - d. Remove Existing Vegetation
 - e. Tree Removal
 - 2. Removing designated pavement and curbs.
 - 3. Removing designated trees, shrubs, and other plant life.
 - 4. Removing abandoned utilities.
 - 5. Excavating topsoil.
- B. Related Sections:
 - 1. Section 31 22 13 - Rough Grading.
 - 2. Section 31 25 00 - Erosion and Sedimentation Controls.
 - 3. Section 31 23 16 - Excavation.
 - 4. Section 32 91 19 - Landscape Grading.

1.2 UNIT PRICE - MEASUREMENT AND PAYMENT

- A. Site Clearing:
 - 1. Basis of Measurement: Included in the lump sum price bid for site clearing.
 - 2. Basis of Payment: Includes material, labor, and equipment for removal and disposal of brush, and equipment for clearing of site, loading and removing waste material as indicated in specifications and/or drawings, loading and removing of unsalvageable structures, excavation, and removing and hauling all debris off site as specified on the drawings. Also includes, removal of bituminous pavement, concrete pavement, curb and gutter as indicated.

1.3 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit data for herbicide. Indicate compliance with applicable codes for environmental protection.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Herbicide:
 - 1. Garlon 3A or approved equal shall be used on brush having diameter of 1 inch or less.
 - 2. 25 percent Garlon 4 or approved equal and 75 percent Ax-it shall be used on all cut stumps and brush greater than 1 inch per manufacturer's specifications.
 - 3. All herbicides shall contain a dye additive so that sprayed areas can be visually identified.
 - 4. Applicator shall be certified.
 - 5. Herbicide use shall conform to all environmental restrictions and the manufacturer's recommendations for the specific area treated.
 - 6. Use only in locations approved by Engineer and with materials approved by Engineer and Owner.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements: Verification of existing conditions before starting work.
- B. Verify existing plant life designated to remain is tagged or identified.

3.2 PREPARATION

- A. Verify that existing plant life designated to remain is tagged or identified.
- B. The Contractor shall investigate for himself/herself what trees, brush, etc. must be removed and verify with the Engineer.
- C. Call Local Utility Line Information service not less than three working days before performing Work.
 - 1. Request underground utilities to be located and marked within and surrounding construction areas.

3.3 PROTECTION

- A. Locate, identify, and protect utilities indicated to remain, from damage.
- B. Protect trees, plant growth, and features designated to remain, as final landscaping. The Contractor will be charged for any damage that occurs to trees not marked for removal. Costs are as follows:

Tree Diameter	Cost
1 inch – 3 inch	\$120
3 inch – 6 inch	\$150
6 inch – 9 inch	\$240
9 inch – 12 inch	\$300

1. The Owner and Engineer will determine if the damage that occurs to any trees will necessitate payment.
 2. All protection measures must be approved by the Engineer.
- C. Protect bench marks, survey control points, and existing structures from damage or displacement. Protect survey stakes and survey monuments. If monuments, stakes or benchmarks are damaged or destroyed, the Contractor will be responsible for replacements costs.
- D. All trees outside of right-of-way and those trees within right-of-way specified by Owner shall be protected.

3.4 CLEARING

- A. Clear areas required for access to site and execution of Work as approved by Engineer.
- B. Remove trees and tree stumps within excavated areas and project limits as specified on the drawings and as necessary for construction. Haul all material and dispose of offsite.
- C. Remove existing storm sewer, headworks, manholes, and catch basins as described on the drawings and within the influence of construction. Any structure or piping shown on the drawing to be affected by the proposed work shall be removed completely.
- D. Clear all undergrowth, debris and downfalls with minimum disturbance to soil. Seed all disturbed areas according to Seeding Specification.
- E. Apply herbicide to remaining stumps to inhibit growth.

3.5 REMOVAL

- A. Remove debris, rock, and extracted plant life from site.
1. Clear areas required for access to site and execution of work unless otherwise indicated on the plans or in the specifications.
- B. Remove pavement, curbs, and debris as indicated on the plans.

- C. Continuously clean-up and remove waste materials from site. Do not allow materials to accumulate on site.
- D. Do not burn or bury materials on site. Leave site in clean condition.

3.6 TOPSOIL EXCAVATION

- A. Excavate topsoil from areas to be further excavated, relandscaped, or regraded without mixing with foreign materials for use in finish grading.
- B. Do not excavate wet topsoil.
- C. Stockpile in area designated on site to depth not exceeding 8 feet and protect from erosion.
- D. Do not remove topsoil from site.

3.7 DEBRIS MANAGEMENT

- A. Debris shall be disposed of as indicated on the plans and as directed by the Engineer.
- B. All woody debris shall be hauled from site.
- C. All other debris shall be removed from the site and disposed of in accordance with local and state regulations.
- D. Coordinate debris management with Engineer prior to construction.

3.8 FENCES AND/OR OTHER PRIVATE PROPERTY

- A. Contractor shall notify Landowners and Engineer of conflicts and provide reasonable cooperation and assistance.
- B. Contractor shall carefully remove, salvage, and replace existing fence as directed by the plans and specifications. Care shall be taken not to damage materials during disassembly. Damaged materials shall be replaced at the Contractor's expense.
- C. Any structures outside of drain right-of-way shall not be disturbed. Contractor shall correct all damage outside of right-of-way at own expense.

END OF SECTION

SECTION 31 22 13

ROUGH GRADING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Excavating topsoil.
 - a. Strip and stockpile topsoil.
 - b. Strip and remove wetland topsoil.
2. Excavating subsoil.
 - a. Surficial sand excavation.
3. Cutting, grading, filling, rough contouring, compacting, rough grading, and shaping the site for site structures, building pads, embankment construction, residential lot, roadway embankment and cut, clay liner, scarify, blend, and compact subgrade, and spoil deposition.

B. Related Sections:

1. Section 31 10 00 - Site Clearing: Excavating topsoil.
2. Section 31 23 16 - Excavation: Building excavation.
3. Section 31 23 17 - Trenching: Trenching and backfilling for utilities.
4. Section 31 23 23 - Fill: General building area backfilling.
5. Section 32 91 19 - Landscape Grading: Finish grading with topsoil to contours.

1.2 UNIT PRICE - MEASUREMENT AND PAYMENT

A. Strip and Stockpile Topsoil:

1. Basis of Measurement: Included in the unit price bid of the item being installed.
2. Basis of Payment: Includes all labor and equipment required for stripping organic topsoil and stockpiling as shown on the drawings and as directed by the Engineer.

B. Sitework and Grading:

1. Basis of Measurement: At the lump sum price bid as stated in the proposal.
2. Basis of Payment: Includes all labor, equipment, and material to all miscellaneous site improvements and perform/construct grading shown on plans that do not have a dedicated bid item. Including signs, bollard, etc.

1.3 REFERENCES

A. American Association of State Highway and Transportation Officials:

1. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop.

B. ASTM International:

1. ASTM C136 - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.

2. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³)).
3. ASTM D1556 - Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method.
4. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN-m/m³)).
5. ASTM D2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method.
6. ASTM D2419 - Standard Test Method for Sand Equivalent Value of Soils and Fine Aggregate.
7. ASTM D2434 - Standard Test Method for Permeability of Granular Soils (Constant Head).
8. ASTM D2922 - Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
9. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).

C. Michigan Department of Transportation (MDOT)

1. MDOT Density Control Handbook, current addition.
2. MDOT Standard Specifications for Construction, current addition.
3. Test Method for Density of Soil in Place with loss by wash less than 15 percent - One Point Michigan Cone Test.
4. Test Methods for Density of Soil with loss by wash greater than 15 percent - One Point T-99 Test.

1.4 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Samples: Submit, in air-tight containers, 10 lb sample of each type of fill to testing laboratory.
- C. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

1.5 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for submittals.
- B. Project Record Documents: Accurately record actual locations of utilities remaining by horizontal dimensions, elevations or inverts, and slope gradients.

1.6 QUALITY ASSURANCE

- A. MDOT Density Control Handbook, current edition.
- B. MDOT Standard Specifications for Construction, current edition.
- C. Test Method for Density of Soil in Place with loss by wash less than 15 percent – One Point Michigan Cone Test.
- D. Test Method for Density of Soil with loss by wash greater than 15 percent – One Point T-99 Test.

- E. ASTM D2922 – Test Methods of Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).

PART 2 - PRODUCTS

2.1 MATERIALS

- A. See Section 31 23 23 Fill

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements: Verification of existing conditions before starting Work.
- B. Verify survey bench mark and intended elevations for the Work are as indicated on Drawings.
- C. Verify that fill materials to be used are acceptable.

3.2 PREPARATION

- A. Call Miss Dig service not less than three Working days before performing Work.
 - 1. Request underground utilities to be located and marked within and surrounding construction areas.
- B. Identify required lines, levels, contours, and datum.
- C. Notify utility company to remove and relocate utilities.
- D. Protect utilities indicated to remain from damage.
- E. Protect plant life, lawns, rock outcropping and other features remaining as portion of final landscaping.
- F. Protect bench marks, survey control point, existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.

3.3 TOPSOIL EXCAVATION

- A. Excavate topsoil from areas to be further excavated, relandscaped, or regraded, without mixing with foreign materials for use in finish grading.
- B. Do not excavate wet topsoil.
- C. Stockpile in area designated on site to depth not exceeding 8 feet and protect from erosion.
- D. Do not remove topsoil from site.

3.4 SUBSOIL EXCAVATION

- A. Excavate subsoil from areas to be further excavated, relandscaped, or regraded.
- B. Do not excavate wet subsoil or excavate and process wet material to obtain optimum moisture content.
- C. When excavating through roots, perform Work by hand and cut roots with sharp axe.
- D. Stockpile excavated material in area designated on site in accordance with the drawings.
- E. Benching Slopes: Horizontally bench existing slopes greater than 1: 4 to key placed fill material to slope to provide firm bearing.
- F. Stability: Replace damaged or displaced subsoil as specified for fill.
- G. Spoil leveling shall be done in accordance with Section 31 23 16 – Excavation.

3.5 FILLING

- A. Fill areas to contours and elevations with unfrozen materials.
- B. Place fill material in continuous layers and compact.
- C. Place material in continuous layers as follows:
 - 1. Subsoil Fill: Maximum 12 inches compacted depth.
 - 2. Structural Fill: Maximum 8 inches compacted depth.
 - 3. Granular Fill: Maximum 8 inches compacted depth.
- D. Maintain optimum moisture content of fill materials to attain required compaction density.
- E. Slope grade away from building minimum 5 percent slope for minimum distance of 10 ft, unless noted otherwise.
- F. Make grade changes gradual. Blend slope into level areas.
- G. Repair or replace items indicated to remain damaged by excavation or filling.

3.6 TOLERANCES

- A. Section 01 40 00 - Quality Requirements: Tolerances.
- B. Top Surface of Subgrade: Plus or minus 1/10 foot from required elevation.

3.7 FIELD QUALITY CONTROL

- A. Section 01 70 00 - Execution and Closeout Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Perform laboratory material tests in accordance with AASHTO T180.

- C. Perform in place compaction tests in accordance with the following:
 - 1. Density Tests: ASTM D1556 or ASTM D2922.
 - 2. Moisture Tests: ASTM D3017.
- D. When tests indicate Work does not meet specified requirements, remove Work, replace and retest.
 - 1. Remove Work, replace and retest at no cost to Owner.
- E. Frequency of Tests: As required to ensure installation meets specifications.

3.8 SCHEDULES

- A. Fill under Grass Areas: Subsoil Type D fill, to 6 inches below finish grade.
- B. Fill Under Concrete Building Pads, Concrete Pads:
 - 1. Type B fill, to within 4" of underside of concrete slab.
- C. Backfill for Utility Trenches:
 - 1. Bedding as specified in individual utility specification section.
 - 2. Backfill material as specified in Section 31 23 17 - Trenching and as defined here in for typed fill.
- D. Fill for Subgrade and Undercutting:
 - 1. Type B fill to proposed subgrade elevation, in dry areas.
 - 2. Type A in wet areas and for undercutting backfill, unless otherwise directed by the Engineer.

END OF SECTION

SECTION 31 23 16

EXCAVATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Soil densification.
2. Excavating for building foundations.
3. Excavating for slabs-on-grade.
4. Excavating for site structures.
5. Excavating for landscaping.
6. Excavating for Open Channel, Earth Excavation, Spoil Leveling, Spoil Hauling, Subgrade Undercutting and Backfilling, Subgrade Undercutting and TopSoil Fill, Stream Channel Restoration Grading.

B. Related Sections:

1. Section 31 22 13 - Rough Grading: Topsoil and subsoil removal from site surface.
2. Section 31 23 17 - Trenching
3. Section 31 23 23 - Fill.
4. Section 31 10 00 - Site Clearing.
5. Section 01 50 00 - Construction Facilities.
6. Section 33 42 13 – Public Pipe Culverts.

1.2 UNIT PRICE - MEASUREMENT AND PAYMENT

A. Subgrade Undercutting and Backfilling:

1. Basis of Measurement: By cubic yard for sub grade undercut.
2. Basis of Payment: Includes all material, labor, and equipment to remove poor subgrade below the proposed subgrade elevations shown on the drawings. Replace with Type A fill as indicated or directed by the Engineer. Compact as specified in Section 31 23 23 – Fill.

B. Earth Excavation:

1. Basis of Measurement: Included in the unit price bid for items requiring excavation.
2. Basis of Payment: Includes labor and equipment necessary to excavate soils as necessary to install proposed equipment, site feature, etc. as shown on the drawings; load, haul, and dispose of spoils as indicated on the drawings and specifications; stockpile materials to be re-used on site.

1.3 REFERENCES

- ###### A. Local utility standards when working within 24 inches of utility lines.

1.4 SUBMITTALS

- A. Excavation Protection Plan: Describe sheeting, shoring, and bracing materials and installation required to protect excavations and adjacent structures and property; include structural calculations to support plan.
- B. Shop Drawings: Indicate soil densification grid for each size and configuration footing requiring soils densification.

1.5 QUALITY ASSURANCE

- A. Perform Work in accordance with MDOT Standard Specifications for Construction, current edition.

1.6 QUALIFICATIONS

- A. Prepare excavation protection plan under direct supervision of Professional Engineer experienced in design of this Work and licensed in State of Michigan.

PART 2 - PRODUCTS

- 2.1 Not Used.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Call Miss Dig service not less than three working days before performing Work.
 - 1. Request underground utilities to be located and marked within and surrounding construction areas.
- B. Identify required lines, levels, contours, and datum.
- C. Notify utility company to remove and relocate utilities.
- D. Protect utilities indicated to remain from damage.
- E. Protect plant life, lawns, rock outcroppings and other features remaining as portion of final landscaping.
- F. Protect bench marks, survey control points, existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.
- G. Protect grade and slope stakes.

3.2 EXCAVATION

- A. Underpin adjacent structures which may be damaged by excavation work.
- B. Excavate subsoil to accommodate building foundations, slabs-on-grade, paving, site structures, and construction operations.
- C. Excavate to working elevation for piling work.
- D. Compact disturbed load bearing soil in direct contact with foundations to original bearing capacity; perform compaction in accordance with Section 31 23 23 and Section 31 23 17.
- E. Slope banks with machine to angle of repose or less until shored.
- F. Do not interfere with 45 degree bearing splay of foundations.
- G. Grade top perimeter of excavation to prevent surface water from draining into excavation.
- H. Trim excavation. Remove loose matter.
- I. Remove lumped subsoil, boulders, and rock up to 1/3 cu yd measured by volume. Remove larger material as specified in Section 31 23 23.
- J. Notify Engineer of unexpected subsurface conditions.
- K. Correct areas over excavated areas as directed by Engineer.
- L. Remove excess and unsuitable material from site.
- M. Stockpile subsoil in area designated on site to depth not exceeding 8 feet and protect from erosion.
- N. Repair or replace items indicated to remain damaged by excavation.
- O. Earth Excavation
 - 1. Clear site in accordance with Section 31 10 00 - Site Clearing.
 - 2. Excavate detention areas to the subgrade elevations, dimensions and cross sections specified on drawings.
 - 3. Underpin, brace, or shore adjacent structures, which may be damaged by excavation work, including utilities and pipe chases.
 - 4. Machine slope banks to required slopes.
 - 5. Notify Engineer of unexpected subsurface conditions and discontinue affected Work in area until notified to resume Work.
 - 6. Correct unauthorized excavation at no cost of Owner.
 - 7. Remove and haul material from site or dispose of materials on Site as specified on the drawings. Payment for these items is included in the Earth Excavation pay item.
 - 8. Dewater excavations as necessary for construction. Payment for dewatering shall be included in the Earth Excavation pay item.
 - 9. Grade top perimeter of excavation to prevent surface water from draining into excavation.

10. Provide, operate and maintain pumping equipment to keep excavation free of water.
11. Remove lumped subsoil, boulders, and rock.
12. Correct areas over excavated by error in accordance with Section 31 23 23 – Fill.

P. Subgrade Undercutting and Backfilling

1. In areas that are suspect and may require subgrade undercutting, notify Engineer immediately. Do not proceed until it is agreed subgrade undercutting is required and quantities can be documented.
2. Remove the subgrade undercut quantity of material as determined adequate by Engineer.
3. Backfill with Type A fill for Work under structures, crossings, etc. Backfill with Embankment Material for embankment construction. All Work shall be according to the drawings and directed by the Engineer.
4. Compact fill material as specified in Section 31 23 23 - Fill.

3.3 FIELD QUALITY CONTROL

- A. Section 01 70 00 - Execution and Closeout Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Request visual inspection of bearing surfaces by Architect/Engineer before installing subsequent work.
- C. If tests indicate Work does not meet specified requirements, remove Work, replace and retest at no cost to the Owner.
- D. Frequency of Tests: As directed by the Engineer.

3.4 PROTECTION

- A. Prevent displacement or loose soil from falling into excavation; maintain soil stability.
- B. Protect bottom of excavations and soil adjacent to and beneath foundation from freezing.
- C. Protect structures, utilities and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth operations.
- D. Protect landscape areas, mailboxes, trees, fences, lawns, etc. Any damage to these areas are the responsibility of the Contractor.

END OF SECTION

SECTION 31 23 17

TRENCHING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Excavating trenches for utilities from 5 feet outside building to utility service.
2. Compacted fill from top of utility bedding to subgrade elevations.
3. Backfilling and compaction.
4. Trenching for Storm Sewer.

B. Related Sections:

1. Section 03 30 00 - Cast-In-Place Concrete.
2. Section 31 22 13 - Rough Grading.
3. Section 31 23 16 – Excavation.
4. Section 31 23 23 - Fill: General Backfilling.
5. Section 31 37 00 - Riprap.
6. Section 32 91 19 - Landscape Grading.

1.2 REFERENCES

A. American Association of State Highway and Transportation Officials:

1. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop.

B. ASTM International:

1. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³)).
2. ASTM D1556 - Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method.
3. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN-m/m³)).
4. ASTM D2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method.
5. ASTM D2922 - Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
6. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).
7. ANSI/ASTM C136 - Method for Sieve Analysis of Fine and Coarse Aggregates.
8. ASTM C12 - Standard Practice for Installing Vitrified Clay Pipe Lines.
9. ASTM D2321 - Standard Practice for Underground Installation of Thermoplastic Gravity - Flow Applications.

1.3 DEFINITIONS

- A. Utility: Any buried pipe, duct, conduit, or cable.

1.4 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Excavation Protection Plan: Describe sheeting, shoring, and bracing materials and installation required to protect excavations and adjacent structures and property; include structural calculations to support plan.
- C. Product Data: Submit data for geotextile fabric indicating fabric and construction.
- D. Samples: Submit, in air-tight containers, 10 lb sample of each type of fill to testing laboratory.
- E. Materials Source: Submit name of imported fill materials suppliers.
- F. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

1.5 QUALITY ASSURANCE

- A. Perform Work in accordance with MDOT Standard Specifications for Construction, current edition.

1.6 QUALIFICATIONS

- A. Prepare excavation protection plan under direct supervision of Professional Engineer experienced in design of this Work and licensed in State of Michigan.

1.7 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.
 - 1. Verify that survey benchmarks and intended elevations for the Work are as shown on the drawings.

1.8 COORDINATION

- A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.
- B. Verify Work associated with lower elevation utilities is complete before placing higher elevation utilities.

PART 2 - PRODUCTS

2.1 FILL MATERIALS

SEE SECTION 31 23 23

PART 3 - EXECUTION

3.1 LINES AND GRADES

- A. Lay pipes to lines and grades indicated on Drawings.
 - 1. Architect/Engineer reserves right to make changes in lines, grades, and depths of utilities when changes are required for Project conditions.
- B. Use laser-beam instrument with qualified operator to establish lines and grades when required by Engineer.
- C. Maintain grade alignment of pipe using string line parallel with grade line and vertically above centerline of pipe.
 - 1. Establish string line on level batter boards at intervals of not more than 25 feet.
 - 2. Install batter boards spanning trench, rigidly anchored to posts driven into ground on both sides of trench.
 - 3. Set three adjacent batter boards before laying pipe to verify grades and line.
 - 4. Determine elevation and position of string line from elevation and position of offset points or stakes located along pipe route.
 - 5. Do not locate pipe using side lines for line or grade.

3.2 PREPARATION

- A. Call Miss Dig service not less than three working days before performing Work.
 - 1. Request underground utilities to be located and marked within and surrounding construction areas.
- B. Identify required lines, levels, contours, and datum locations.
- C. Protect plant life, lawns, rock outcropping and other features remaining as portion of final landscaping.
- D. Protect bench marks, existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.
 - 1. Protect grade and slope stakes.
- E. Maintain and protect above and below grade utilities indicated to remain.
- F. Establish temporary traffic control and detours when trenching is performed in public right-of-way. Relocate controls and reroute traffic as required during progress of Work.

3.3 TRENCHING

- A. Excavate subsoil required for utilities to utility service.
- B. Remove lumped subsoil, boulders, and rock up to 1/6 cubic yard, measured by volume.
 - 1. Remove lumped subsoil, boulders, and rock 6 inches below bottom of pipe.

2. Where soil in the bottom of the trench is unsuitable in the opinion of the Engineer, excavate below the trench bottom and place Type A fill, as directed by the Engineer. See Section 31 23 16 – Excavation, Subgrade Undercutting and Section 31 23 23 – Fill.
- C. Perform excavation within 24 inches of existing utility service in accordance with utility's requirements.
 - D. Do not advance open trench more than 200 feet ahead of installed pipe.
 - E. Cut trenches sufficiently wide to enable installation and allow inspection. Remove water or materials that interfere with Work.
 1. Excavate on the required line to the depth required below the pipe grade for bedding thickness required.
 2. Grade top perimeter of excavation to prevent surface water from draining into excavation.
 3. Notify Owner's representative of unexpected subsurface conditions and discontinue affected Work in area until notified to resume Work.
 4. Protect excavation by methods required to prevent cave-in or loose soil from falling into excavation.
 5. Provide, operate, and maintain pumping equipment to keep trench free of water.
 - F. Trenches for pipe shall be excavated to the following minimum of and maximum widths measured at the top of the pipe:

<u>Pipe Size</u>	<u>Trench Width</u>	
	<u>Minimum</u>	<u>Maximum</u>
6" and smaller	18"	24"
8" & 10"	24"	30"
12" & 15"	30"	36"
18"	34"	40"
21"	38"	42"
24"	42"	46"
27"	45"	49"
30"	49"	53"
36"	56"	60"
Larger than 36"	I.D. + 20"	I.D. + 24"

1. Where trench widths exceed the maximum specified above, the Owner's representative may require special bedding or the use of extra strength pipe at the Contractor's expense.
 2. Minimum trench width is 18 inches.
- G. Excavate trenches to depth indicated on Drawings. Provide uniform and continuous bearing and support for bedding material, pipe, and utilities.
 1. Place and compact bedding below the pipe to the depth specified on the drawings.
 2. Support pipe and conduit during placement and compaction of bedding fill.
 - H. Do not interfere with 45 degree bearing splay of foundations.

- I. When Project conditions permit, slope side walls of excavation starting 2 feet above top of pipe. When side walls cannot be sloped, provide sheeting and shoring to protect excavation as specified in this section.
- J. When subsurface materials at bottom of trench are loose or soft, excavate to greater depth as directed by Architect/Engineer until suitable material is encountered. Notify Architect/Engineer prior to completing Undercut and Backfill Operations and request instructions.
- K. Cut out soft areas of subgrade not capable of compaction in place. Backfill with Fill Type A and compact to density equal to or greater than requirements for subsequent backfill material.
- L. Trim excavation. Hand trim for bell and spigot pipe joints. Remove loose matter.
- M. Correct areas over excavated areas with compacted backfill as specified for authorized excavation or replace with fill concrete as directed by Architect/Engineer.
 - 1. Correct unauthorized excavation at no cost to Owner.
 - 2. Correct over excavated by error with Type A fill in accordance with Section 31 23 23 Fill.
- N. Stockpile subsoil in area designated on site to depth not exceeding 8 feet and protect from erosion.
- O. Stockpile excavated material in area designated on site.
- P. Level subsoil in the right-of-way on site except in yard areas.

3.4 SHEETING AND SHORING

- A. Sheet, shore, and brace excavations to prevent danger to persons, structures and adjacent properties and to prevent caving, erosion, and loss of surrounding subsoil.
- B. Support trenches more than 5 feet deep excavated through unstable, loose, or soft material. Provide sheeting, shoring, bracing, or other protection to maintain stability of excavation.
- C. Design sheeting and shoring to be removed at completion of excavation work.
 - 1. Use trench boxes or other form of temporary protection when required by OSHA and MIOSHA Standards or when protection of existing utilities is necessary.
- D. Repair damage caused by failure of the sheeting, shoring, or bracing and for settlement of filled excavations or adjacent soil.
- E. Repair damage to new and existing Work from settlement, water or earth pressure or other causes resulting from inadequate sheeting, shoring, or bracing.

3.5 BACKFILLING

- A. Backfill trenches to contours and elevations with unfrozen fill materials.
- B. Systematically backfill to allow maximum time for natural settlement. Do not backfill over porous, wet, frozen, or spongy subgrade surfaces.

- C. Place geotextile fabric over Fill Type A prior to placing subsequent fill materials.
- D. Place fill material in continuous layers and compact.
 - 1. See Section 31 23 23 – Fill.
 - 2. Place 4 inches tamped Type B fill along the side of the pipe, filling any void space under the pipe. Execute tamping with a T bar or other tamping device approved by the Engineer.
 - 3. Place additional tamped Type B fill alongside the pipe to a height equal to the top of the pipe.
 - 4. Place and compact Type B fill material to 12 inches above the top of the pipe unless shown otherwise on the Project drawings.
- E. Place material in continuous layers as follows:
 - 1. Subsoil Fill: Maximum 12 inches compacted depth.
 - 2. Structural Fill: Maximum 8 inches compacted depth.
 - 3. Granular Fill: Maximum 8 inches compacted depth.
- F. Employ placement method that does not disturb or damage foundation perimeter drainage or utilities in trench.
- G. Maintain optimum moisture content of fill materials to attain required compaction density.
- H. Do not leave more than 30 feet of trench open at end of working day.
- I. Protect open trench to prevent danger to the public.

3.6 TOLERANCES

- A. Section 01 40 00 - Quality Requirements: Tolerances.
- B. Top Surface of Backfilling Under Paved Areas: Plus or minus 1/2 inch from required elevations.
- C. Top Surface of General Backfilling: Plus or minus 1 inch from required elevations.

3.7 FIELD QUALITY CONTROL

- A. Section 01 70 00 - Execution and Closeout Requirements: Field inspecting, testing, adjusting, and balancing.
- B. MDOT Standard Specifications for Construction, current edition.
- C. Perform in place compaction tests in accordance with the following:
 - 1. Density Tests: ASTM D1556, or ASTM D2922.
 - 2. Moisture Tests: ASTM D3017.
- D. When tests indicate Work does not meet specified requirements, remove Work, replace, compact, and retest at no cost to the Owner.
- E. Frequency of Tests: As directed by the Engineer.

F. Proof roll compacted fill surfaces under pavement. See Section 31 23 23 – Fill.

3.8 PROTECTION OF FINISHED WORK

A. Section 01 70 00 - Execution and Closeout Requirements: Protecting finished work.

B. Reshape and re-compact fills subjected to vehicular traffic during construction.

END OF SECTION

SECTION 31 23 19

DEWATERING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Dewatering system.
 - 2. Surface water control system.
 - 3. Monitoring wells.
 - 4. System operation and maintenance.
 - 5. Water disposal.
- B. Related Sections:
 - 1. Section 31 23 16 - Excavation.
 - 2. Section 31 23 17 - Trenching.
 - 3. Section 31 25 00 - Erosion and Sedimentation Controls.
 - 4. Section 31 22 13 - Rough Grading.

1.2 UNIT PRICE - MEASUREMENT AND PAYMENT

- A. Dewatering:
 - 1. Basis of Measurement: Included in the lump sum price bid for temporary dewatering and cofferdam.
 - 2. Basis of Payment: Includes dewatering system design, material, equipment and labor necessary for dewatering as necessary for construction and/or determined by the Engineer.

1.3 REFERENCES

- A. ASTM International:
 - 1. ASTM C33 - Standard Specification for Concrete Aggregates.

1.4 DEFINITIONS

- A. Dewatering includes the following:
 - 1. Lowering of ground water table and intercepting horizontal water seepage to prevent ground water from entering excavations or trenches.
 - 2. Reducing piezometric pressure within strata to prevent failure or heaving of excavations or trenches.
 - 3. Disposing of removed water.
- B. Surface Water Control: Removal of surface water within open excavations.

1.5 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Shop Drawings: Signed and sealed by Professional Engineer.
 - 1. Indicate dewatering system layout, well depths, well screen lengths, dewatering pump locations, pipe sizes and capacities, grades, filter sand gradations, surface water control devices, valves, and water disposal method and location.
 - 2. Indicate primary and standby power system location and capacity.
 - 3. Indicate layout and depth of monitoring wells, piezometers and flow measuring devices for system performance measurement.
 - 4. Include detailed description of dewatering and monitoring system installation procedures and maintenance of equipment.
 - 5. Include description of emergency procedures to follow when problems arise.
- C. Product Data: Submit data for each of the following:
 - 1. Dewatering Pumps: Indicate sizes, capacities, priming method, motor characteristics.
 - 2. Pumping equipment for control of surface water within excavation.
- D. Design Data: Signed and sealed by Professional Engineer.
 - 1. Indicate design values, analyses, and calculations to support design.
 - 2. Include description and profile of geology, soil, and groundwater conditions.
- E. Field Reports: Test and monitoring reports as specified in Field Quality Control article.

1.6 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for submittals.
- B. Project Record Documents: Record actual locations and depths of capped wells and piping abandoned in place.

1.7 QUALITY ASSURANCE

- A. Comply with authorities having jurisdiction for the following:
 - 1. Drilling and abandoning of wells used for dewatering systems.
 - 2. Water discharge and disposal from pumping operations.
- B. Obtain permit from EPA under National Pollutant Discharge Elimination System (NPDES), for storm water discharge from construction sites.
- C. Perform Work in accordance with Michigan department of Transportation standard.
- D. Maintain one copy of each document on site.

1.8 QUALIFICATIONS

- A. Installer: Company specializing in performing Work of this section with minimum 5 years documented experience and responsible for design, operation, and maintenance of dewatering system.
 - 1. Assume sole responsibility for dewatering and surface water control systems and for loss or damage resulting from partial or complete failure of protective measures and settlement or resultant damage caused by ground water control operations.
- B. Design, install, and monitor operation of dewatering under direct supervision of Professional Engineer experienced in design of this Work and licensed in State of Michigan.

1.9 SEQUENCING

- A. Section 01 10 00 - Summary: Requirements for sequencing.
- B. Sequence work to obtain required permits before start of dewatering operations.
- C. Sequence work to install and test monitoring systems minimum 7 days before testing and operating dewatering systems.
- D. Sequence work to install and test dewatering and surface water control systems minimum 7 days before starting excavation and trenching.

1.10 COORDINATION

- A. Section 01 30 00 - Administrative Requirements: Requirements for coordination.
- B. Coordinate work to permit the following construction operations to be completed on dry stable substrate.
 - 1. Excavation for structures specified in Section 31 23 16.
 - 2. Trenching for utilities specified in Section 31 23 17.

PART 2 - PRODUCTS

2.1 NOT USED

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements: Verification of existing conditions before starting work.
- B. Check MISS DIG at 1-800-482-7171 and Call Local Utility Line Information service not less than three working days before performing Work.

1. Request underground utilities to be located and marked within and surrounding construction areas.
- C. Contractor shall be aware of and conform to the requirements of the State of Michigan in all dewatering operations. The Contractor shall also be responsible for the rules set down under the Ground Water Quality Control Section of the Well Construction Code.
- D. The Contractor shall provide and maintain adequate dewatering equipment to remove and dispose of all surface and ground water from all excavations and trenches or other parts of Work.
- E. Excavation shall be kept dry during the preparation of the subgrade and continually thereafter until Work within that excavation etc. is complete as approved by the Engineer.
- F. Contractor shall repair all Work damaged due to failure of dewatering operation as determined by Engineer.
- G. All excavations for concrete structures or trenches, which extend down to or below the static ground water elevations, shall be dewatered by lowering the ground water surface a minimum of 24 inches below the bottom of the excavation as approved by the Engineer.
- H. Surface water shall be diverted or prevented from entering the excavations without leaving the Project Site.

3.2 PREPARATION

- A. Protect existing adjacent buildings, structures, and improvements from damage caused by dewatering operations.

3.3 MONITORING WELLS

- A. Install monitoring wells at locations indicated on shop drawings as specified for dewatering wells.
- B. Test each monitoring well point to verify installation is performing properly.
- C. Install piezometers, calibrate, and test for proper operation.
- D. Protect monitoring well standpipes from damage by construction operations.
- E. Maintain accessibility to monitoring wells continuously during construction operations.
- F. Maintain monitoring wells until groundwater is allowed to return to normal level.

3.4 DEWATERING SYSTEM

- A. Install Work in accordance with Michigan Department of Transportation standards.

3.5 SURFACE WATER CONTROL SYSTEM

- A. Provide ditches, berms, and other devices to divert and drain surface water from excavation area as directed by Engineer.
- B. Divert surface water and seepage water within excavation areas into sumps and pump water into drainage channels and storm drains in accordance with requirements of agencies having jurisdiction.
- C. Control and remove unanticipated water seepage into excavation.

3.6 WATER DISPOSAL

- A. Discharge water into existing storm sewer system or drainage channels as directed by Engineer.

3.7 SYSTEM REMOVAL

- A. Remove dewatering and surface water control systems after dewatering operations are discontinued.
- B. Remove piezometers and monitoring wells.

END OF SECTION

SECTION 31 23 23

FILL

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Backfilling building perimeter to subgrade elevations.
2. Backfilling site structures to subgrade elevations.
3. Fill under slabs-on-grade.
4. Fill under paving.
5. Fill for over-excavation.
6. Consolidation and Compaction.
7. Fill Under Roadways, Driveways, Sidewalks, Parking Lots, and Other Traveled Surfaces.
8. Utility Trench Backfilling.
9. Backfill for Drain Crossing and Traveled Surfaces.
10. Fill Materials.
11. Building Pads Filling to Subgrade Elevations.
12. Site Berming.
13. Fill Under Slabs-on-Grade Pads.
14. Fill Subgrade Undercutting.

B. Related Sections:

1. Section 31 22 13 - Rough Grading.
2. Section 31 23 16 - Excavation.
3. Section 31 23 17 - Trenching.
4. Section 31 37 00 - Riprap.
5. Section 32 91 19 - Landscape Grading.
6. Section 33 41 13 - Public Storm Utility Drainage Piping.
7. Section 03 30 00 - Cast-in-Place Concrete.

1.2 UNIT PRICE - MEASUREMENT AND PAYMENT

A. Backfill Materials:

1. Basis of Measurement: Included in unit price bid for the pay item being installed unless otherwise stated.
2. Basis of Payment: Includes material, labor, and equipment necessary to backfill and compact to proposed subgrade as specified for this Project.

1.3 REFERENCES

A. American Association of State Highway and Transportation Officials:

1. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop.

B. ASTM International:

1. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³)).
2. ASTM D1556 - Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method.
3. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN-m/m³)).
4. ASTM D2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method.
5. ASTM D2922 - Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
6. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).

C. Michigan Department of Transportation (MDOT)

1. MDOT Standard Specification for Construction, current edition.
2. MDOT Density Control Handbook, current edition.

D. ANSI/ASTM

1. ANSI/ASTM C136 or MTM 108 & 109 - Method for Sieve Analysis of Fine and Coarse Aggregates.
2. ANSI/ASTM C117 or MTM 108 - Test method for materials finer than 15mm (No. 200 Sieve) in mineral aggregates by washing.

1.4 SUBMITTALS

- A. Product Data: Submit data for geotextile fabric indicating fabric and construction.
- B. Samples: Submit, in air-tight containers, 10 lb sample of each type of fill to testing laboratory.
- C. Materials Source: Submit name of imported fill materials suppliers.
- D. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

1.5 QUALITY ASSURANCE

- A. Perform Work in accordance with MDOT Standard Specifications for Construction, current edition.

PART 2 - PRODUCTS

2.1 FILL MATERIALS

- A. Type A - Coarse Stone Fill: MDOT 6A, 100% crushed - for wet excavation, excavation within open drain, backfill for subgrade undercutting for poor soil or in pipe trench, compacted to a minimum of 95 percent of the materials maximum dry density, in layers not to exceed 12 inches loose depth, unless otherwise specified. A ballast type crushed stone free of shale, clay, friable material, sand, and debris graded in accordance with ANSI/ASTM C136.

- B. Type B - Granular Fill and Subbase: MDOT Class II - for dry excavation, pipe bedding to 12" above pipe, and trench backfill within roadway influence or dry excavation. Compacted to a minimum of 95 percent of the materials maximum dry density as determined by Michigan one point cone method in layers not to exceed 12 inches loose depth. Substitute with Type A MDOT 6A coarse stone for wet excavation.
- C. Type C - Structural Fill: MDOT Class I - for lower area of excess excavation over 24", compacted to a minimum of 95 percent of the materials maximum dry density as determined by Michigan one point cone method in layers not to exceed 12 inches loose depth.
- D. Type D - Native Subsoil: Site soils reused, free of gravel larger than 3 inch size, organic material, and debris, backfill above bedding of pipe to subgrade in greenbelt area. Compacted to a minimum of 90 percent of the materials maximum dry density, in layers not to exceed 12 inches loose depth, unless otherwise specified or as approved by the Engineer.
- E. Type E - Dense Aggregate: MDOT 22A for base course under Hot Mix Asphalt surfaces and Class I shoulders and approaches, compacted to 98% of the maximum unit weight at no greater than optimum moisture content.
- F. Type F – MDOT Standard Flowable Fill Non-Excavatable (Fill Class C concrete) – for headwall, sheet piling repair, and culvert storm sewer backfilling.
- G. Type G - Clay Embankment: Silty or sandy clay soils meeting the criteria for the designation of "CL" in accordance with the United Soil Classification System – for clay embankment construction, compacted to a minimum of 90% of its maximum dry density and at a moisture content ranging from 0 to 3 percent above of the optimum moisture as determined by the modified proctor method in layers not to exceed 12 inches loose depth. The Contractor shall provide samples of the proposed clay embankment material to the Geotechnical Engineer for visual examination and possible laboratory testing/analysis to confirm the material meets the criteria for the designation of "CL." Approved material shall be excavated from the borrow area free from frozen soil, organics, or other deleterious materials.
- H. Type H - Granular Embankment: MDOT Class I, Class II, or Class III – for granular embankment construction, compacted to a minimum of 95% of its maximum dry density as determined by the Michigan one point cone method in layers not to exceed 12 inches loose depth. The Contractor shall provide samples of the proposed sand embankment material to the Geotechnical Engineer for visual examination and possible laboratory testing/analysis to confirm the material meets the specified material type. Approved material shall be excavated from the borrow area free from frozen soil, organics, or other deleterious materials.

2.2 ACCESSORIES

- A. Filter Fabric: Section 31 32 21 – Filter Fabric

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements: Coordination and Project conditions.
- B. Verify subdrainage, damp proofing, or waterproofing installation has been inspected.
- C. Verify underground tanks are anchored to their own foundations to avoid flotation after backfilling.
- D. Verify structural ability of unsupported walls to support loads imposed by fill.
- E. Verify that all fill materials to be used are acceptable.
- F. Verify foundation and/or perimeter drainage installation has been inspected.

3.2 PREPARATION

- A. Compact subgrade to density requirements for subsequent backfill materials.
- B. Cut out soft areas of subgrade not capable of compaction in place. Backfill with structural fill and compact to density equal to or greater than requirements for subsequent fill material.
 - 1. In areas that are suspect and may require subgrade undercutting, notify Engineer immediately. Do not proceed until it is agreed subgrade undercutting is required and quantities can be documented. See Section 31 23 16 - Excavation.
- C. Scarify subgrade surface to depth of 6 inch.
- D. Proof roll to identify soft spots; fill and compact to density equal to or greater than requirements for subsequent fill material.
 - 1. Thoroughly proof-roll all areas of building pads, slabs-on-grade, bituminous pavement, concrete curb and gutter and sidewalks with a fully loaded tandem-axle truck, or its equivalent.
 - 2. Loose or soft areas revealed during the proof-rolling operations are to be compacted or removed and replaced according to See Section 31 23 16 - Excavation.

3.3 BACKFILLING

- A. Backfill areas to contours and elevations with unfrozen materials.
- B. Systematically backfill to allow maximum time for natural settlement. Do not backfill over porous, wet, frozen or spongy subgrade surfaces.
- C. Place geotextile fabric over Type A fill prior to placing next lift of fill.
- D. Place material in continuous layers as follows:
 - 1. Subsoil Fill: Maximum 12 inches compacted depth.
 - 2. Structural Fill: Maximum 8 inches compacted depth.

3. Granular Fill: Maximum 8 inches compacted depth.

- E. Employ placement method that does not disturb or damage other Work or foundation perimeter drainage conduit in trenches.
- F. Maintain optimum moisture content of backfill materials to attain required compaction density.
- G. Backfill against supported foundation walls. Do not backfill against unsupported foundation walls.
- H. Slope grade away from building minimum 2 percent slope for minimum distance of 10 ft, unless noted otherwise.
- I. Make gradual grade changes. Blend slope into level areas.
- J. Remove surplus backfill materials from site.
- K. Leave fill material stockpile areas free of excess fill materials.
- L. Type B – Granular Fill: Place and compact materials as specified in Part 2 of this Section.
- M. Type D – Native Subsoil: Place on compact materials as specified in Part 2 of this Section.
- N. Machine compact under springline of pipe with T-bar or Engineer approved equivalent.
- O. Backfill simultaneously on all side of utility structures, manholes, and catchbasins.
- P. Backfill wet excavation and subgrade undercutting according to Section 31 23 16 - Excavation.

3.4 TOLERANCES

- A. Section 01 40 00 - Quality Requirements: Tolerances.
- B. Top Surface of Backfilling Within Building Areas: Plus or minus 1 inch from required elevations.
- C. Top Surface of Backfilling Under Paved Areas: Plus or minus 0.10 foot, inch from required elevations.
- D. Top Surface of General Backfilling: Plus or minus 1 inch from required elevations.

3.5 FIELD QUALITY CONTROL

- A. Section 01 70 00 - Execution and Closeout Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Perform laboratory material tests in accordance with AASHTO T180.
- C. Perform in place compaction tests in accordance with the following:
 - 1. Density Tests: ASTM D1556 or ASTM D2922.
 - 2. Moisture Tests: ASTM D3017.

- D. When tests indicate Work does not meet specified requirements, remove Work, replace and retest at no cost to Owner.
- E. Tests and analysis of fill material will be performed in accordance with One Point Michigan Cone Test.
- F. Compaction testing will be performed in accordance with MDOT standard requirements.
- G. Frequency of tests: At the discretion of the Engineer.
- H. Proof roll compacted fill surfaces under slabs-on-grade.

3.6 PROTECTION OF FINISHED WORK

- A. Section 01 70 00 - Execution and Closeout Requirements: Protecting finished Work.
- B. Reshape and re-compact fills subjected to vehicular traffic.

END OF SECTION

SECTION 31 25 00

EROSION AND SEDIMENTATION CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. System Description.
 - 2. Quality Assurance.
 - 3. Regulatory Requirements.
 - 4. Method of Payment.
- B. Related Sections:
 - 1. Section 03 10 00 - Concrete Forming and Accessories.
 - 2. Section 03 20 00 - Concrete Reinforcing.
 - 3. Section 03 30 00 - Cast-In-Place Concrete.
 - 4. Section 31 10 00 - Site Clearing.
 - 5. Section 31 23 16 - Excavation.
 - 6. Section 31 23 23 - Fill.
 - 7. Section 31 37 00 - Riprap.
 - 8. Section 32 92 19 - Seeding.

1.2 SYSTEM DESCRIPTION

- A. Methods of control are identified on drawings by numbers corresponding to the keying system found in the Michigan Association of County Drain Commissioner's Soil Erosion and Sedimentation Control Authorized Public Agency Procedures Manual.
- B. The notation "T" or "P" following the number (as shown on the Drawings) indicates whether the control measure is temporary or permanent.
- C. Additional control measures shall be employed as required by the site conditions and applicable enforcing agency having project jurisdiction.

1.3 UNIT PRICE - MEASUREMENT AND PAYMENT

- A. Soil Erosion Prevention and Sedimentation Control:
 - 1. Basis of Measurement: Included in the lump sum bid price for soil erosion and sedimentation control.
 - 2. Basis of Payment: Includes all material, equipment, labor, setup, relocation, and all other aspects to accomplish this work.

1.4 REGULATORY REQUIREMENTS

- A. Submit installation time schedule for temporary and permanent soil erosion prevention and sedimentation control measures to applicable enforcing agency having jurisdiction, as well as to Engineer. Make submittals prior to start of construction.
- B. Part 91, Soil Erosion and Sedimentation Control of the Natural Resources and Environmental Protection Act 1994 PA 451, as Amended:
 - 1. The Contractor is responsible for compliance to Part 91 Soil Erosion and Sedimentation Control of the Natural Resources and Environmental Protection Act 1994 PA 451, as Amended and is responsible for compliance in accordance with the Michigan Association of County Drain Commissioner's (MACDC) Soil Erosion and Sedimentation Control (SESC) Authorized Public Agency (APA) procedures manual. If for any reason, the Owner is found to be in violation of Act 91 due to the Contractor found in non-compliance, the Contractor will be fully responsible for any fines and costs incurred by Owner, including legal defense and any and all costs associated with a violation.
 - 2. The Contractor acknowledges that the procedures manual is available at www.macdc.net and has reviewed and understands the manual.
 - 3. The Contractor acknowledges the Owner's right to enter on to the project and install or repair any soil erosion control measures at Contractor's expense after notice to Contractor allowing time for the repair or installation to be made by Contractor. Such repair or installation may be made by Owner or by a third-party Contactor of Owner.
- C. Contractor shall obtain all permits and pay all fees for plan review and inspection as required by applicable enforcing agency having jurisdiction.

1.5 SUBMITTALS

- A. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

1.6 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for submittals.

1.7 QUALITY ASSURANCE

- A. Perform Work in accordance with the Soil Erosion and Sedimentation Control, Part 91 of Act 451 of 1994.

1.8 PRE-INSTALLATION MEETINGS

- A. Section 01 30 00 - Administrative Requirements: Pre-installation meeting.
- B. Convene minimum one week prior to commencing work of this section.

1.9 ENVIRONMENTAL REQUIREMENTS

- A. Section 01 60 00 - Product Requirements: Environmental conditions affecting products on site.

- B. Do not place grout when air temperature is below freezing.
- C. Do not place concrete when base surface temperature is less than 40 degrees F, or surface is wet or frozen.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. In accordance with applicable Section for specified materials.

PART 3 - EXECUTION

3.1 EXAMINATION AND PREPARATION

- A. Identify required lines, levels, contours, and datum.
- B. Field locate known utility locations. Notify Engineer of conflicts and attain removal or relocation instructions prior to continuing installation activities.
- C. Maintain and protect existing utilities to remain.

3.2 PROTECTION OF ADJACENT WORK

- A. Protect adjacent structures and property which may be damaged by execution of work.
- B. Protect existing trees, shrubs, landscaping and lawn areas designated to remain.

3.3 INSTALLATION AND MAINTENANCE

- A. Construct soil erosion prevention and sedimentation control measures in accordance with the plans and manufacture's recommendations.
- B. Schedule planned control measures with construction operation to limit the area of any disturbed land to the shortest possible period of exposure.
- C. Conduct all earth changes so as to effectively reduce accelerated soil erosion and resulting sedimentation.
- D. Remove all sediment from runoff water before it leaves the site.
- E. Inspect, maintain, and repair temporary control measures until permanent control measures are implemented. Remove all temporary control measures once permanent protection is established.
- F. Maintain permanent control measures until final acceptance by Owner.
- G. Protect all installed and existing catchbasin inlets. Remove protection after final inspection of the project.

- H. Execute work by methods to minimize raising dust from construction operations.
- I. Do not deposit trash, debris, or sediment in tile or open drains.
- J. Immediately repair trenches located within the traveled surface or roadways.
- K. Landscape construction areas as soon as practical after work is completed.

END OF SECTION

SECTION 31 32 21

FILTER FABRIC

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Filter Fabric for Plain Riprap Applications.
 - 2. Filter Fabric for Heavy Riprap Applications.
- B. Related Sections:
 - 1. Section 31 22 13 – Rough Grading
 - 2. Section 31 23 23 – Fill.

1.2 UNIT PRICE – MEASUREMENT AND PAYMENT

- A. Filter Fabric:
 - 1. Basis of Measurement: Included in unit price for Work item being accomplished, whichever applies.
 - 2. Basis of Payment: Includes material, labor, and equipment for installation according to plans, specifications, and manufacturer's instructions.

1.3 REFERENCES

- A. ASTM D-4632 - Test method for Tensile Strength and Elongation
- B. ASTM D-3786 - Test method for Mullen Burst.
- C. ASTM D-4533 - Test method for Trapezoidal Tear Strength.
- D. ASTM D-3787 - Test method for Puncture Strength.
- E. ASTM D-4751 - Test method for Apparent Opening Size.
- F. ASTM D-4491 - Test method for Coefficient of Permeability

1.4 COORDINATION

- A. Section 01 30 00 – Administrative Requirements specifies requirements for coordination.
- B. Coordinate Work of this Section with Section 31 37 00 – Riprap.

1.5 SUBMITTALS

- A. Submit shop drawings and product data for all items to be installed and/or constructed within this Section.
- B. Submit manufacturer's instructions for all product data.

- C. Submit manufacturer's certificate, which shall show actual test values obtained for the physical properties as tested for compliance with the specifications, for all product data.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Mechanically bonded, non-woven, long-chain polymeric fibers or yarns. The edges of the fabric shall be finished to prevent the outer fiber from pulling away from the fabric.
1. Filter fabric for groundwater infiltration applications (french drains, trench drains, pipe joint wrap, etc.) and embankment filter fabric is to have, at minimum, the following properties:

Tensile Strength	100 lbs
Tensile Elongation (max)	100 %
Mullen Burst	210 psi
Trapezoidal Tear Strength	40 lbs
Puncture Strength	65 lbs
Apparent Opening Size (max)	70 sieve
Flow Rate	140 gal/min/ft ²

2. Filter fabric for plain riprap applications (riprap, riprap spillways, etc.) and concrete box culvert joints are to have, at minimum, the following properties:

Tensile Strength	155 lbs
Tensile Elongation (max)	100 %
Mullen Burst	315 psi
Trapezoidal Tear Strength	65 lbs
Puncture Strength	95 lbs
Apparent Opening Size (max)	70 sieve
Flow Rate	110 gal/min/ft

3. Filter fabric for heavy riprap applications is to have, at minimum, the following properties:

Tensile Strength	200 lbs
Tensile Elongation (max)	100 %
Mullen Burst	350 psi
Trapezoidal Tear Strength	75 lbs
Puncture Strength	100 lbs
Apparent Opening Size (max)	80 sieve
Flow Rate	95 gal/min/ft ² Open Area

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 01 70 00 - Execution and Closeout Requirements specifies requirements for installation examination.

- B. Verify the correct fabric is specified for the specific use.
- C. At the time of installation, the filter fabric may be rejected at the discretion of the Engineer if it has been removed from its protective cover for over 72 hours or has defects, tears, punctures, flow deterioration, or damage incurred during manufacture, transportation or storage.
- D. No torn, punctured, or otherwise damaged fabric shall be installed.

3.2 PREPARATION

- A. Section 01 70 00 - Execution and Closeout Requirements specifies requirements for installation preparation.
- B. Remove large stones or other debris, which could damage the filter fabric.
- C. Adjacent Surfaces: Protect adjacent surfaces.

3.3 STORAGE

- A. During all periods of shipment and storage, the filter fabric shall be protected from abrasion, direct sunlight, ultraviolet rays, and temperatures greater than 140 degrees Fahrenheit (or as directed by the manufacturer). To the extent possible, the fabric shall be maintained wrapped in its protective covering.

3.4 INSTALLATION

- A. All joints/overlaps in material shall be a minimum of 2 feet.
- B. Any damaged material shall be repaired by placing a piece of fabric that is sufficiently large to cover the damaged area plus 2 feet of adjacent undamaged geotextile in all directions.
- C. Finish according to specific use requirements.
- D. Edges of filter fabric shall be toed in 12 inches unless specified otherwise. Work will not pass inspection if filter fabric is not "toed in."

3.5 PROTECTION

- A. Section 01 70 00 - Execution and Closeout Requirements specifies requirements for protecting finished Work.
- B. Do not permit Traffic over unprotected surface.
- C. Take care placing material over filter fabric so as not to damage the material.

END OF SECTION

SECTION 31 37 00

RIPRAP

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Riprap placed loose.
- B. Related Sections:
 - 1. Section 31 22 13 - Rough Grading.
 - 2. Section 31 23 16 - Excavation: Excavating for riprap.
 - 3. Section 31 23 23 - Fill.
 - 4. Section 32 91 19 - Landscape Grading: Topsoil placement.

1.2 UNIT PRICE - MEASUREMENT AND PAYMENT

- A. Heavy Riprap Bank Protection:
 - 1. Basis of Measurement: At the unit price bid per square yard as stated in the proposal.
 - 2. Basis of Payment: Includes material, labor, and equipment for installation of filter fabric, placement of heavy riprap, excavation, and grading to provide required contours.

1.3 QUALITY ASSURANCE

- A. Furnish each aggregate material from single source throughout the Work.
- B. Perform Work in accordance with MDOT Standard Specifications for Construction, current edition.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Heavy Riprap – Sound, tough, durable rock or uniformly white crushed limestone free from structural defects. Material to be uniform in size and not less than 16 inches in the least dimension, with an average of 18 inches to 24 inches diameter conforming to MDOT 916.01. No rebar, steel, or paint by-products shall be mixed with the material. Concrete and bituminous/asphalt material is not acceptable.
- B. All materials must be approved by Engineer before use on project.
- C. Filter Fabric – As specified in Section 31 32 21 – Filter Fabric.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Exact location of riprap, shall be determined by Engineer during construction.

3.2 RIPRAP BANK PROTECTION

- A. Clear topsoil and rough grade to required contours. Over excavate protection area equal to the thickness of the protection.
- B. Place filter fabric with all edges "toed in" a minimum of 12 inches. Riprap will not pass inspection if filter fabric is not "toed in."
- C. Place protection on filter fabric; tamp protection until individual pieces are firmly bedded.
- D. Hand place stone, if necessary, to assure that there are no void spaces in protection. Upon completion the filter fabric should not be visible.
- E. Bank and grade protection shall be installed as needed per location as directed by the Engineer.

END OF SECTION

SECTION 31 41 16
SHEET PILING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Steel sheet piling for:
 - a. Retaining walls.
 - b. Weirs.
 - c. Caissons.
 - d. Cofferdams.
 - e. Bulkheads.
 - f. Excavation and Support Systems.
 - g. Dewatering.
 - h. Backfill.
- B. Related Sections:
 - 1. Section 03 30 00 - Cast-In-Place Concrete.
 - 2. Section 31 23 16 - Excavation.

1.2 UNIT PRICE – MEASUREMENT AND PAYMENT

- A. Sheet Piling:
 - 1. Basis of Measurement: At the lump sum price bid for sheet pile and cap as stated in the proposal.
 - 2. Basis of Payment: Includes all labor, equipment, and material to install sheet piling and pile cap as shown on plans, complete.

1.3 REFERENCES

- A. ASTM International:
 - 1. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.
 - 2. ASTM A123/A123M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 - 3. ASTM A307 - Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength.
 - 4. ASTM A325 - Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
 - 5. ASTM A328/A328M - Standard Specification for Steel Sheet Piling.
 - 6. ASTM A385/A385M - Standard Practice for Providing High-Quality Zinc Coatings (Hot-Dip).
 - 7. ASTM A490 - Standard Specification for Heat-Treated Steel Structural Bolts, 150 ksi Minimum Tensile Strength.
 - 8. ASTM A563 - Standard Specification for Carbon and Alloy Steel Nuts.

9. ASTM A572/A572M - Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel.
10. ASTM A588/A588M - Standard Specification for High-Strength Low-Alloy Structural Steel with 50 ksi (345 MPa) Minimum Yield Point, with Atmospheric Corrosion Resistance.
11. ASTM A690/A690M - Standard Specification for High-Strength Low-Alloy Nickel, Copper, Phosphorus Steel H-Piles and Sheet Piling with Atmospheric Corrosion Resistance for Use in Marine Environments.
12. ASTM A857/A857M - Standard Specification for Steel Sheet Piling, Cold Formed, Light Gage.
13. ASTM A913/A913M - Standard Specification for High-Strength Low-Alloy Steel Shapes of Structural Quality, Produced by Quenching and Self-Tempering Process (QST).
14. ASTM B695 - Standard Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel.
15. ASTM E376 - Standard Practice for Measuring Coating Thickness by Magnetic-Field or Eddy-Current (Electromagnetic) Examination Methods.
16. ASTM F436 - Standard Specification for Hardened Steel Washers.

B. American Welding Society:

1. AWS D1.1 - Structural Welding Code - Steel.
2. AWS D1.5 - Bridge Welding Code.

1.4 DEFINITIONS

- A. Hot Rolled (HR) - Sections are produced by traditional hot-mill procedure with rough shape reduced during series of stages to final form. Interlocks are formed by flow of metal.
- B. Cold Formed (CF): Sections produced by passing pre-finished sheet steel through series of rolls while in cold state, forming edges into hook and grip type interlock.
 1. Wall Thicknesses: 0.25 inch (6 mm) and greater.
- C. Z-Type - (Designation Z): Conforms to letter Z shape and is applicable for medium to deep walls.
- D. Larssen and Other - (Designation U): Conforms to letter U shape and is applicable for medium to deep walls.
- E. Shallow Arch Straight Web - (Designation SA or S): Flat sections with strong interlocks but little beam strength, usually for filled cell construction.
- F. Arch Shape and Light Weight Gage Sheets (Designation A): Used for shallow wall construction.

1.5 DESIGN REQUIREMENTS

- A. Sheet piling section specified and shown on Drawings establishes design and functional requirements for sheet piling installation.

1.6 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

- B. Product Data:
 - 1. Submit material certification, details of sheet piling, mill test reports, piling driving equipment certification and interlocking joint strength test procedure.
 - 2. Include data for joint sealants.
 - 3. Include manufacturer's data sheets on cranes and driving equipment.
- C. Shop Drawings:
 - 1. Indicate location and extent of sheet piling, details of top protection, tip reinforcement, splices, cut off method, corrosion protection.
 - 2. Include complete dimensions and details of sheet piling sections.
 - 3. Include sequence of driving and detailed drawings of templates or other temporary guide structures.
 - 4. Indicate proposed procedures for removing driven sheet piling.
 - 5. Indicate list and size of proposed equipment including cranes, barges, driving equipment, extractors, protection caps, and other installation and removal accessories.
 - 6. Indicate detailed procedures and features for protection of existing structures or other installations.
 - 7. Include details of storage and handling procedures.
- D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.7 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for submittals.
- B. Project Record Documents:
 - 1. Record actual locations of sheet piling and top and bottom elevations.
 - 2. Provide driving records with hammer blows for final 12 inches of driving.

1.8 QUALITY ASSURANCE

- A. Perform welding in accordance with AWS D1.1 and AWS D1.5.
- B. Furnish each type sheet piling from a single source.
- C. Perform Work in according to State of Michigan and local jurisdiction standards.

1.9 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.
- B. Installer: Company specializing in performing Work of this section with minimum three years documented experience.
- C. Welders and Welding Procedures: AWS D1.1 qualified within previous 12 months.

- D. Contractor shall be solely responsible for installing, maintaining, and removing temporary structures required to comply with this Section. Contractor shall also be solely responsible for adequacy of design for dewatering systems and method of permanently sealing the permanent jacking casing to the planned penetration in the receiving pit/cofferdam. Contractor shall also be solely responsible for design of all elements needed to comply with this Section if modifications to any as designed elements furnished on the drawings are made.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Delivery:
 - 1. Deliver sheet piling with manufacturer's logo and mill identification mark on each sheet piling.
 - 2. Inspect for damage.
- C. Handling:
 - 1. Use handling holes or lifting devices to prevent damage.
 - 2. Lift sheet piling in a manner to prevent permanent deformation.
- D. Storage:
 - 1. According to manufacturer instructions.
 - 2. Support on level racks spaced not more than 10 feet (3000 mm) apart nor more than 2 feet (600 mm) from ends. Arrange supports for multiple lifts aligned vertically.
 - 3. Arrange supports for multiple lifts aligned vertically.
- E. Protection:
 - 1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
 - 2. Protect sheet piling in a manner to prevent damage to coatings.
 - 3. Provide additional protection according to manufacturer instructions.

1.11 SCHEDULING

- A. Section 01 30 00 - Administrative Requirements: Requirements for scheduling.
- B. Schedule sheet piling submittals sufficiently in advance of pre-installation meeting to ensure Architect/Engineer's review is complete.

1.12 COORDINATION

- A. Section 01 30 00 - Administrative Requirements: Requirements for coordination.

PART 2 - PRODUCTS

2.1 STEEL SHEET PILING - Z SHAPE, HOT ROLLED, JOINT BS (BALL & SOCKET)

- A. Sheet Piling: Comply with ASTM A572/A572M; Grade 60.

2.2 COMPONENTS

- A. Splices and Other Fabrication Appurtenances:
 - 1. Structural Steel
 - 2. Structural Steel ASTM A572/A572M; Grade 50.
- B. Bolts, Nuts and Washers:
 - 1. Bolts:
 - a. Comply with ASTM A307.
 - 2. High Strength Bolts: ASTM A325; Type 1.
 - 3. Nuts: ASTM A563 (ASTM A563M) heavy hex type.
 - 4. Washers: ASTM F436 (ASTM F436M); Type 1.
- C. Finish: ASTM A153/A153M; hot-dip galvanized.
- D. Welding Materials: AWS D1.1; type required for materials being welded.
 - 1. Using EX70XX Welding Electrodes.
- E. Other Materials as indicated on the drawings.

2.3 JOINT SEALANTS

- A. Description: Two-component hydrophilic liquid-rubber sealant suitable for total immersion and capable of resisting 150-foot hydrostatic head.

2.4 FABRICATION

- A. Sheet Piling and Specially Fabricated Sections:
 - 1. Full Length.
 - 2. As indicated on Drawings.
 - 3. Furnish standard pulling holes.
- B. Tees, Wyes, Corners, and Cross Pieces:
 - 1. Match sheet-piling sections.
 - 2. Minimum Web Thickness: 1/2 inch.
- C. Interlock Joints:
 - 1. Clean joint surfaces.
 - 2. Mix and install joint sealant according to manufacturer instructions in female side of joint.

D. Components to Receive Galvanized Coating: Comply with ASTM A385/A385M.

2.5 FINISHES

A. Preparation: Comply with SSPC-SP 10

B. Extent: As indicated on Drawings.

C. Coatings:

1. Uncoated.

2.6 SOURCE QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements: Testing, inspection and analysis requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Verification of existing conditions before starting Work.

1. Verify that field measurements and survey benchmarks are as indicated on the drawings.

B. Locate and flag existing utilities.

C. Protect utilities and structures near the Work from damage during installation of sheeting or excavation.

3.2 TEMPLATES

A. Provide template or driving frame suitable for aligning, supporting, and maintaining sheet piling in correct position during setting and driving:

1. Structural frame sufficiently rigid to resist lateral driving forces.
2. Provide minimum two levels of support at 1/3 points not less than 20 feet.
3. Provide wood blocking to bear against webs of alternate sheet piling.
4. Provide outer restraints to prevent sheets from warping or wandering.
5. Provide visible markings on templates to verify correct sheet piling location and direction.

3.3 PREPARATION

A. Verify equipment on site conforms to approved Submittal.

B. Use driving method that will not cause damage to nearby structures.

C. Notify adjacent and affected land owners and building occupants minimum 7 days before proceeding with the Work.

D. Verify cranes will not impact overhead utilities.

- E. Protect structures including overhead and buried utilities near the Work, from damage.
- F. Prepare to place sheet piling from existing site elevations.
- G. Field Touchup of Sheet-Piling Coating:
 - 1. Provide touchup system for repair of coating defects compatible with shop coating.
 - 2. Before driving, touch up abraded surfaces in coating, and clean and touch up field welds.
 - 3. Apply touchup coating to match shop coating.
- H. Leave permanent sheet piling in place as part of completed Work.
- I. Remove temporary sheet piling when no longer required and remove from site.

3.4 PILING HAMMER

- A. Use piling hammer complying with requirements indicated on Drawings and approved submittals.
- B. Keep hammer in good mechanical condition.
- C. Operate hammer at speed and pressure recommended by manufacturer.
- D. When energy per blow is less than 80 percent of rated energy per blow as specified by manufacturer of piling hammer, make necessary repairs to improve energy output to value of at least 80 percent of rated energy per blow, or replace piling hammer.
- E. Use protective cap during driving to prevent damage to top of sheet piling.

3.5 INSTALLATION

- A. Drive sheet piling only in presence of Engineer.
 - 1. Use driving method not capable of causing damage to nearby structures.
- B. Installation Work and procedures shall conform to the drawings and approved shop drawings submitted as part of this Section.
- C. Alignment:
 - 1. Maintain sheet piling vertical during driving.
 - 2. Align top of sheet piling normal to driving force of piling, hammer, and leads, to minimize bowing of piling during impact of hammer ram.
 - 3. If required, take corrective action to prevent observable impact bowing of piling at final driving resistance.
- D. Piling Types:
 - 1. Drive Z-type piling with male interlock forward or leading.
 - 2. Drive Z- and U-type piling in pairs.
- E. Sheet Piling:
 - 1. Incrementally drive sheets or pairs of sheets such that tip of any sheet or pair is not more than 4 feet below adjacent sheet or pair.

2. Jetting or predrilling of sheet piling is not permitted.
 3. Drive sheet piling to minimum tip penetration and to driving resistance as indicated on Drawings.
- F. If driving is interrupted before refusal, drive additional 12 inches before resuming recording of performance data.
- G. Cap Section: Cut off tops of sheet piling to indicated elevations, and prepare piling top to receive top finish construction as indicated on Drawings.
- 3.6 WELDING AND SPLICING
- A. Perform welding in accordance with AWS D1.1 for shielded metal arc welding.
- 3.7 ERECTION TOLERANCES
- A. Section 01 40 00 - Quality Requirements: Tolerances.
- B. Maximum Variation from Vertical for Plumb Sheet Piling: 1: 48.
- C. Maximum Variation from Sheet Piling Cut-Off Elevation: See pile cap detail on drawings which require seal welding.
- D. Maximum Out-of-Position: 2 inches.
- 3.8 FIELD QUALITY CONTROL
- A. Inspect for imperfections in joint interlock capable of impeding installation.
- B. Inspect for damage to shop coatings before installation.
- C. Reject damaged sheet piling sections or repair as required prior to installing.

END OF SECTION

SECTION 31 50 13

EXCAVATION SUPPORT SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Sheet piling, Shoring, and Bracing.
- B. Related Sections:
 - 1. Section 31 22 13 – Rough Grading.
 - 2. Section 31 23 16 – Excavation.
 - 3. Section 31 23 17 – Trenching.
 - 4. Section 33 05 23 – Trenchless Utility Installation.

1.2 UNIT PRICE - MEASUREMENT AND PAYMENT

- A. Excavation Support Systems:
 - 1. Basis of Measurement: Included in the unit bid price for other pay items being installed as stated in proposal.
 - 2. Basis of Payment: Includes material, equipment and labor necessary to install temporary excavation support to construct proposed Project. This includes, but is not limited to sheet piling, cofferdams, trench boxes, tiebacks, and any other items to support trenching and excavations. All excavation support shall be designed and sealed by the Contractor's registered professional engineer and submitted to the Owner's Engineer for review. Design costs to be paid for by the Contractor.

1.3 REFERENCE STANDARDS

- A. Standards:
 - 1. ASTM A-328 - Standard Specifications for Sheet Piling.
 - 2. ASTM A-572 - Grades 50, High Strength.
 - 3. ASTM A-690 - High Strength, Corrosion Resistant.
- B. Conform to applicable OSHA regulations.

1.4 PREINSTALLATION MEETINGS

- A. Section 01 30 00 - Administrative Requirements specifies requirements for preinstallation meeting.
- B. Convene minimum one week prior to commencing Work of this Section.

1.5 SUBMITTALS

- A. Submit shop drawings and product data for all items to be installed and/or constructed within this Section.

- B. Submit manufacturer's instructions for all product data.
- C. Shop drawings shall include sheeting, shoring, and bracing design and calculations prepared and sealed by a registered professional engineer.
- D. Product shall include component sizes, dimensions, and finishes.

1.6 QUALITY ASSURANCE

- A. Perform Work according to Michigan Department of Transportation Standard Specifications for Construction, current edition.

1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years' documented experience.
- B. Fabricator: Company specializing in fabricating products specified in this Section with minimum three years' documented experience.
- C. Installer: Company specializing in performing Work of this Section with minimum three years' documented experience and approved by manufacturer.
- D. Licensed Professional: Professional engineer experienced in design of specified Work and licensed in State of Michigan.

1.8 EXISTING CONDITIONS

- A. Field Measurements: Verify field measurements prior to fabrication. Indicate field measurements on Shop Drawings.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Timber and lumber for shoring and bracing shall be new, merchantable pine, Douglas Fir or spruce, unless otherwise shown or specified. Secondhand timber or lumber shall not be used where strength and/or appearance are important considerations.
- B. Steel for sheeting, shoring, and bracing shall be as per the referenced ASTM specifications.
- C. Temporary Sheeting: Select section modulus, embedment depth and bracing required to complete the work unless noted on the drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Installation Standards: Install Work according to OSHA standards.
- B. The Contractor is responsible for the design and location of all sheeting, shoring, and bracing.
- C. Where required to properly support the surfaces of excavations and to protect the construction Work and workmen, sheeting, bracing and shoring shall be provided.
- D. If the Engineer is of the opinion that at any point sufficient or proper supports have not been provided, he may order additional supports at the expense of the Contractor, but neither the placing of such additional supports by the order of the Engineer nor the failure of the Engineer to order such additional supports placed shall release the Contractor from his responsibility for the sufficiency of such supports and the integrity of the Work.
- E. Damage to new or existing structures occurring through settlements due to failure or lack of sheeting or bracing shall be repaired by the Contractor at his own expense.
- F. Conflict of opinion as to whether the settlement is due to the Work of the Contractor or to any other cause will be determined by the Engineer.
- G. In general, the sheeting and bracing shall be removed, as the trench or excavation is refilled, in such a manner as to avoid the caving in of the Work.
- H. Fill voids left by the withdrawal of the sheeting by ramming, or otherwise as directed.
- I. Obtain permission of the Engineer prior to the removal of any shoring, sheeting or bracing.
- J. When sheeting and bracing is removed, the Contractor shall assume full responsibility for injury to structures or to other property or persons arising from failure to leave in place such sheeting or bracing.
- K. For the purpose of preventing injury to the structures, or to other property or to persons, the Contractor shall leave in place any sheeting or bracing shown on the drawings or ordered in writing by the Engineer.
- L. Cut off sheeting left in place at the elevation ordered but not less than 24" below the final ground surface.
- M. Bracing remaining in place shall be driven up tight.
- N. Measurements and payment for sheeting and bracing ordered by Engineer left in place will be made as extra work, unless noted otherwise.
- O. The right of the Engineer to order sheeting and bracing left in place shall not be construed as creating any obligation on his part to issue such orders.

END OF SECTION

SECTION 31 62 16

STEEL PILES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Rolled steel section piles.

B. Related Sections:

1. Section 03 30 00 - Cast-In-Place Concrete.
2. Section 31 08 13 - Pile Load Tests.
3. Section 31 23 16 - Excavation.

1.2 UNIT PRICES - MEASUREMENT AND PAYMENT

A. H-Piles:

1. Basis of Measurement: At the unit price bid per each as stated in the proposal.
2. Basis of Payment: Includes all labor, equipment, and material to install the proposed piles as shown on plans.

1.3 REFERENCES

A. ASTM International:

1. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.
2. ASTM A572 - Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel.
3. ASTM A588 - Standard Specification for High-Strength Low-Alloy Structural Steel with 50 ksi (345 MPa) Minimum Yield Point to 4-in. (100-mm) Thick.
4. ASTM A690/A690M - Standard Specification for High-Strength Low-Alloy Nickel, Copper, Phosphorus Steel H-Piles and Sheet Piling with Atmospheric Corrosion Resistance for Use in Marine Environments.
5. ASTM A913/A913M - Standard Specification for High-Strength Low-Alloy Steel Shapes of Structural Quality, Produced by Quenching and Self-Tempering Process (QST).
6. ASTM A992/A992M - Standard Specification for Structural Steel Shapes.

B. American Welding Society:

1. AWS D1.1 - Structural Welding Code - Steel.
2. AWS D1.5 - Bridge Welding Code.

C. SSPC: The Society for Protective Coatings:

1. SSPC PA 2 - Measurement of Dry Coating Thickness with Magnetic Gages.
2. SSPC SP 5 - White Metal Blast Cleaning.

1.4 SCHEDULING

- ###### A. Section 013000 – Administrative Requirements: Requirements for scheduling.

- B. Schedule Work to perform driving between the hours of 8 am and 5 pm.
- C. Schedule indicator piles.
- D. Do not drive piles until excavation or filling of area surrounding piles is completed to design grades indicated on Drawings.
- E. Do not drive piles until mud-line is clear of debris or other material interfering with pile driving.
- F. When concrete is less than seven days old, do not drive piles closer to concrete than distance computed by formula below.
 - 1. $D = 1/7 \sqrt{E}$:
 - a. E = Energy of pile hammer in foot-pounds
 - b. D = Distance in feet

1.5 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit details of collars, tips, splices, cushion blocks, etc.
- C. Shop Drawings:
 - 1. Indicate details and schedule of pile installation sequence.
 - 2. Identify recommended pile length and shapes to suit design loads.
- D. Manufacturer's Mill Certificate: Certify steel piles meet or exceed specified requirements.
- E. Welder Certificates: Certify welders and welding procedures employed on Work, verifying AWS qualification within previous 12 months.
- F. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

1.6 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for submittals.
- B. Project Record Documents: Accurately record the following:
 - 1. Sizes, lengths, and locations of piles.
 - 2. Sequence of driving.
 - 3. Number of blows per foot for entire length of piles and measured set for last 10 blows.
 - 4. Identify piles requiring drilling, and hole diameters.
 - 5. Final base and top elevations.
 - 6. Driving force of each hammer blow.

1.7 QUALITY ASSURANCE

- A. Perform Work according to construction standards set forth by the City of Saginaw and the State of Michigan.
- B. Maintain one copy of each document on site.

1.8 QUALIFICATIONS

- A. Installer: Company specializing in performing work of this section with three years documented experience.
- B. Monitor pile driving operations by Geotechnical Engineer experienced in this Work and licensed in the State of Michigan.
- C. Welders Certificates: Certify welders employed on the Work, verifying AWS qualification within previous 12 months.

1.9 PRE-INSTALLATION MEETINGS

- A. Section 01 30 00 - Administrative Requirements: Pre-installation meeting.
- B. Convene minimum one week prior to commencing Work of this section.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Protect shop coated piles from damage to applied coating. Use nylon slings to handle coated piles.
- C. Store materials according to manufacturer instructions.
- D. Protection:
 - 1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
 - 2. Protect shop coated piles from damage to applied coating.
 - 3. Provide additional protection according to manufacturer instructions.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Drive piles to load supporting capacity of 60 tons as indicated on Drawings.

2.2 MATERIALS

- A. Piles: ASTM 572; structural steel, rolled HP12x53 sections, minimum 50 ksi yield strength; sizes and lengths as required to achieve design loads.
- B. Splice Plate: 5/8" minimum Grade 50 ksi.
- C. Accessories: Points, driving cap; to suit pile shape.

2.3 PILE HAMMER

- A. Use pile hammer complying with requirements indicated on Drawings.

- B. Keep hammer in good mechanical condition.
- C. Operate hammer at speed and pressure recommended by manufacturer.
- D. During pile driving operations, Geotechnical Engineer shall make occasional measurements of velocity of hammer ram. Furnish Hammer Performance Analyzer (radar gun device), as manufactured by Pile Dynamics, Inc., or approved equal for Geotechnical Engineer use.
- E. When energy per blow is less than 80 percent of rated energy per blow as specified by manufacturer of pile hammer, make necessary repairs to improve energy output to value of at least 80 percent of rated energy per blow, or replace pile hammer.

2.4 SHOP FINISHING

- A. Notify Professional Engineer when piles are furnished on-site. Professional engineer to inspect piles prior to installation.
- B. Blast Cleaning of Steel Surfaces:
 - 1. Comply with SSPC SP 5.
 - 2. Use steel shot or grit.

2.5 SOURCE QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements: Testing, inspection and analysis requirements.
- B. Test sample piles according to Geotechnical Report.
- C. Maintain record of tests and inspections. Submit test and inspection record.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements: Verification of existing conditions before starting work.

3.2 PREPARATION

- A. Obtain prior approval of hammer type to be used.
- B. Use driving method which will not cause damage to nearby structures.
- C. Notify adjacent and affected land owners and building occupants with 14 day notice before proceeding with the Work.
- D. Protect structures including overhead and buried utilities near the Work, from damage.
- E. Prepare to place piles from existing site elevations and excavated working elevations.

3.3 INSTALLATION

- A. Drive piles only in presence of Geotechnical Engineer.

- B. Use rigid frame, fixed lead type driving equipment capable of supporting pile firmly in vertical position or to required batter.
- C. Align top of pile normal to driving force of pile, hammer and leads to minimize bowing of pile during impact of hammer ram.
- D. Where groups of piles are required, drive center pile of group first and then drive remaining piles in group progressing outward from center.
- E. Drive piles to minimum tip penetration and to driving resistance indicated on Drawings.
- F. Take corrective action, when required, to prevent observable impact bowing of pile at final driving resistance.
- G. When driving resistance prohibits advancing pile to required minimum tip penetration, spud, jet, jet and drive, or use other means as necessary to advance pile to required minimum tip penetration. Then drive pile to required resistance indicated on Drawings. After jetting pile, re-drive adjacent piles to required resistance.
- H. Pre-drilling or pre-augering hole of maximum diameter 2 inches smaller than pile flange dimension may be used to advance pile to penetration no deeper than required minimum tip penetration. Then drive pile to required resistance indicated on Drawings.
- I. Protect pile head during driving, using cap-block cushion consisting of alternate plates of phenolic laminate and aluminum designed to prevent damage to piles while transmitting required hammer energy to pile top as indicated on Drawings, with full bearing on pile butt for even distribution of hammer blow.
- J. Deliver hammer blows to central axis of pile.
- K. When driving is interrupted before refusal, drive an additional 12 inches before resuming recording of performance data.
- L. Re-drive piles which have lifted due to driving adjacent piles, or by soil uplift.
- M. Do not damage piles during driving operations.
- N. Cut off tops of piles to elevations indicated and prepare pile top to receive pile caps and grade beams

3.4 WELDING AND SPLICING

- A. Perform welding according to AWS D1.1, AWS D1.5 for shielded metal arc welding.
- B. Only use welders qualified according to AWS D1.1, AWS D1.5.
- C. Reinforce pile tips, as indicated on Drawings.
- D. Splice pile sections with one of the following:
 - 1. Complete penetration butt weld of flanges and web.
 - 2. Splice plates on web and flanges with fillet welds.
- E. Use jig or alignment device during welding to maintain required specified.

- F. For splices made during pile installation, rigid frame pile leads may be used as jig.
- G. Use only butt weld splices within 20 feet from pile cut-off elevation or design grade, whichever is lower.
- H. Comply with the following for number, type and location of splices:
 - 1. No more than three splices for piles over 100 feet long.
 - 2. No more than two splices for piles up to 100 feet long.
 - 3. No splice closer than 25 feet from tip.

3.5 ERECTION TOLERANCES

- A. Section 01 40 00 - Quality Requirements: Tolerances.
- B. Maximum Variation from Vertical for Plumb Piles: One in 48.
- C. Maximum Variation from Pile Cut-Off Elevation: 1 inch, minimum pile cap embedment 6".
- D. Maximum Out-of-Position: 2 inches.
- E. Maximum Variation in Centerline after Splicing: 3/8 inch in 40 feet for undriven portion.

3.6 FIELD QUALITY CONTROL

- A. Section 014000 - Quality Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Perform inspection of foundations according to applicable code.
- C. Perform load tests to requirements of Section 310813 – Pile Load Testing.
- D. Test Piles: Same diameter and type as specified for other piling, placed in same manner.
- E. Accepted test piles may be used in the Work.
- F. Unacceptable Piles: Piles that fail tests, are placed out of position, are below cut-off elevations, or are damaged.
- G. Provide additional piles or replace piles to conform to specified requirements.

END OF SECTION

SECTION 32 11 23

AGGREGATE BASE COURSES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Aggregate subbase.
 - 2. Aggregate base course.
- B. Related Sections:
 - 1. Section 31 22 13 - Rough Grading.
 - 2. Section 31 23 17 - Trenching.
 - 3. Section 31 23 23 - Fill.
 - 4. Section 31 37 00 - Riprap.
 - 5. Section 32 91 19 - Landscape Grading.
 - 6. Section 33 05 13 - Manholes and Structures.

1.2 UNIT PRICE - MEASUREMENT AND PAYMENT

- A. Aggregate Base, 22A, 8":
 - 1. Basis of Measurement: At the unit price bid per square yard, as stated in the Proposal.
 - 2. Basis of Payment: Includes providing and placing 22A crushed limestone, grading, shaping, compacting, and all labor, material and equipment.

1.3 REFERENCES

- A. American Association of State Highway and Transportation Officials:
 - 1. AASHTO M288 - Standard Specification for Geotextile Specification for Highway Applications.
 - 2. AASHTO M147-65 – Materials for Aggregates and Soil-Aggregate.
- B. ASTM International:
 - 1. ASTM D1556 - Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method.
 - 2. ASTM D2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method.
 - 3. ASTM D2922 - Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
 - 4. ASTM D2940 - Standard Specification for Graded Aggregate Material For Bases or Subbases for Highways or Airports.
 - 5. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).
 - 6. ASTM D4313 – Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
 - 7. ASTM C136 – Sieve Analysis of Fine and Coarse Aggregates.
- C. MDOT Standard Specifications for Construction, current edition.

1.4 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data:
 - 1. Submit data for geotextile fabric.
- C. Samples: Submit, in air-tight containers, 10 lb sample of each type of aggregate fill to testing laboratory.
 - 1. As directed by the Engineer.
- D. Materials Source: Submit name of aggregate materials suppliers.
- E. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

1.5 QUALITY ASSURANCE

- A. Furnish each aggregate material from single source throughout the Work.
- B. Perform Work in accordance with Michigan Department of Transportation Standard Specifications for Construction, current edition.

PART 2 - PRODUCTS

2.1 AGGREGATE MATERIALS

- A. Type E – Dense Aggregate: MDOT 22A for base course surfaces, compacted to 98% of the maximum unit weight at no greater than optimum moisture content.

2.2 ACCESSORIES

- A. Geotextile Fabric: AASHTO M288; non-woven, polypropylene.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements: Verification of existing conditions before starting work.
- B. Verify compacted substrate is dry and ready to support paving and imposed loads.
 - 1. Proof roll substrate with minimum two passes to identify soft spots.
 - 2. Remove soft substrate and replace with compacted fill as specified in Section 31 23 23.
- C. Verify substrate has been inspected, gradients and elevations are correct.

3.2 PREPARATION

- A. Correct irregularities in substrate gradient and elevation by scarifying, reshaping, and re-compacting.

- B. Do not place fill on soft, muddy, or frozen surfaces.

3.3 AGGREGATE PLACEMENT

- A. Spread aggregate over prepared substrate to total compacted thickness indicated on Drawings.
- B. Roller compact aggregate to 95 percent maximum density.
 - 1. As determined by Michigan one point cone method.
- C. Level and contour surfaces to elevations, profiles, and gradients indicated.
- D. Add small quantities of fine aggregate to coarse aggregate when required to assist compaction.
- E. Maintain optimum moisture content of fill materials to attain specified compaction density.
 - 1. If excess water is apparent, remove aggregate and aerate to reduce moisture content.
- F. Use mechanical tamping equipment in areas inaccessible to compaction equipment.
- G. Place aggregate to the width as shown on the drawings and compact as specified for the aggregate material being placed according to the Michigan one point cone method.

3.4 TOLERANCES

- A. Section 01 40 00 - Quality Requirements: Tolerances.
- B. Maximum Variation From Flat Surface: 3/8 inch measured with 10 foot straight edge.
- C. Maximum Variation From Thickness: 1/4 inch.
- D. Maximum Variation From Elevation: 1/2 inch.

3.5 FIELD QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements and 017000 - Execution and Closeout Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Compaction testing will be performed in accordance with MDOT standard requirements.
- C. When tests indicate Work does not meet specified requirements, remove Work, replace and retest at no cost to the Owner.
- D. Frequency of tests: as directed by the Engineer.
- E. Graduation of Aggregate: In accordance with ASTM C136.
- F. Furnish material certification from Supplier as required by the Engineer.

END OF SECTION

SECTION 32 31 13

CHAIN LINK FENCES AND GATES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Fence framework, fabric, and accessories.
 - 2. Excavation for post bases.
 - 3. Concrete foundation for posts.
 - 4. Manual gates and related hardware.
 - 5. Privacy slats.

1.2 UNIT PRICE - MEASUREMENT AND PAYMENT

- A. Chain Link Fence – 8' Tall:
 - 1. Basis of Measurement: At the lump sum bid price as stated in the proposal.
 - 2. Basis of Payment: Includes all labor, equipment, and material to construct the proposed fence as shown on the drawings. Includes fence, gates, all required posts, top rail, bottom rail, concrete footings, etc. for a complete installation.

1.3 REFERENCES

- A. ASTM International:
 - 1. ASTM A121 - Standard Specification for Metallic-Coated Carbon Steel Barbed Wire.
 - 2. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - 3. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 - 4. ASTM A392 - Standard Specification for Zinc-Coated Steel Chain-Link Fence Fabric.
 - 5. ASTM A491 - Standard Specification for Aluminum-Coated Steel Chain-Link Fence Fabric.
 - 6. ASTM A817 - Standard Specification for Metallic-Coated Steel Wire for Chain-Link Fence Fabric and Marcellled Tension Wire.
 - 7. A1011/A1011M-07 Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength
 - 8. ASTM B429/B429M - Standard Specification for Aluminum-Alloy Extruded Structural Pipe and Tube.
 - 9. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete.
 - 10. ASTM F552 - Standard Terminology relating to Chain Link Fencing.
 - 11. ASTM F567 - Standard Practice for Installation of Chain-Link Fence.
 - 12. ASTM F626 - Standard Specification for Fence Fittings.
 - 13. ASTM F668 - Standard Specification for Polyvinyl Chloride (PVC) and Other Organic Polymer-Coated Steel Chain-Link Fence Fabric.
 - 14. ASTM F900 - Standard Specification for Industrial and Commercial Swing Gates.

15. ASTM F934 - Standard Specification for Standard Colors for Polymer-Coated Chain Link Fence Materials.
16. ASTM F1043 - Standard Specification for Strength and Protective Coatings on Metal Industrial Chain Link Fence Framework.
17. ASTM F1083 - Standard Specification for Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures.
18. ASTM F1183 - Standard Specification for Aluminum Alloy Chain Link Fence Fabric.
19. ASTM F1184 - Standard Specification for Industrial and Commercial Horizontal Slide Gates.
20. ASTM F1345 - Standard Specification for Zinc - 5% Aluminum -Mischmetal Alloy-Coated Steel Chain-Link Fence Fabric.
21. ASTM A120 – Pipe, Steel, Black and Hot-Dipped Zinc Coated (Galvanized) Welded and Seamless, for Ordinary Uses.
22. ASTM A428 – Weight of Coating on Aluminum-Coated Iron or Steel Articles.
23. ASTM A585 – Aluminum-Coated Steel Barbed Wire.
24. ASTM C94 – Ready-mixed Concrete.

- B. Chain Link Fence Manufacturers Institute:
 1. CLFMI - Product Manual.

1.4 SYSTEM DESCRIPTION

- A. Fence Height as indicated on Drawings.
 1. Not including barbed wire as indicated on the drawings.
- B. Line Post Spacing: At intervals not exceeding 10 feet.
- C. Fence Post and Rail Strength: Conform to ASTM F1043 Heavy Industrial Fence quality.
- D. Gate Width: See drawings for gate width.

1.5 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Shop Drawings: Indicate plan layout, spacing of components, post foundation dimensions, hardware anchorage, gates, and schedule of components.
- C. Product Data: Submit data on fabric, posts, accessories, fittings and hardware.

1.6 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Closeout procedures.
- B. Project Record Documents: Accurately record actual locations of property perimeter posts relative to property lines and easements.
- C. Operation and Maintenance Data: Procedures for submittals.

1.7 QUALITY ASSURANCE

- A. Supply material in accordance with CLFMI - Product Manual.
- B. Perform installation in accordance with ASTM F567.

1.8 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years-experience.
- B. Installer: Company specializing in performing work of this section with minimum 3 years-experience.

1.9 DELIVERY, STORAGE AND HANDLING

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Deliver fence fabric and accessories in packed cartons or firmly tied rolls.
- C. Identify each package with manufacturer's name.
- D. Store fence fabric and accessories in secure and dry place.

1.10 FIELD MEASUREMENTS

- A. Verify that field measurements are as indicated on the shop drawings.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers:
 - 1. Cyclone Fence, Inc. Product Chain Link Fence.
 - 2. Anchor Fence, Inc. Product Chain Link Fence.
 - 3. Semmerling Manufacturing Corporation.
 - 4. Or Equal.

2.2 MATERIALS

- A. Caps: Malleable iron galvanized sized to post diameter, set screw retainer.
- B. Extension Arms: Cast steel galvanized to accommodate 3 strands of barbed wire, single arm, sloped to 45 degrees.
- C. Gate Hardware: Fork latch with gravity drop, three 180 degrees gate hinges per leaf, and hardware for padlock.

2.3 COMPONENTS

- A. Line, Corner, Terminal, and Gate Posts: Diameters as specified on drawings.
- B. Top and Brace Rail: Diameter as specified on the drawings, plain end, sleeve coupled.
- C. Gate Frame: 2-inch minimum diameter for welded fabrication.
- D. Fabric: 2-inch diamond mesh interwoven wire, 9 gauge thick, top selvage twisted tight, bottom selvage knuckle end closed.

2.4 GATES

- A. General:
 - 1. Gate Types, Opening Widths and Directions of Operation: As indicated on Drawings.
 - 2. Factory assemble gates.
 - 3. Design gates for operation by one person.
- B. Swing Gates:
 - 1. Fabricate gates to permit 180 degree swing.
 - 2. Gates Construction: ASTM F900 with welded corners. Use of corner fittings is not permitted.
- C. Sliding Gates:
 - 1. Framing and Posts: ASTM F1184, Class 2 for internal rollers.
 - 2. Rollers for overhead and cantilever sliding gates: Bearing type. Furnish non-sealed bearings with grease fitting for periodic maintenance.
 - 3. Secure rollers to post or frame without welding.

2.5 FINISHES

- A. Components and Hardware: Galvanized to ASTM A123; 2.0 ounces/square feet.
- B. Fabric: Aluminum coating to ASTM A428; 0.40 ounces/square feet.
- C. Accessories: Same finish as framing.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install framework, fabric, accessories and gates in accordance with ASTM F567.
- B. Set intermediate, terminal, and gate posts plumb, in concrete footings with top of footing 2 inches above finish grade. Slope top of concrete for water runoff.
- C. Line Post Footing Depth Below Finish Grade: 3.5 feet

- D. Corner, Gate and Terminal Post Footing Depth Below Finish Grade: 3.5 feet
- E. Brace each gate and corner post to adjacent line post with horizontal center brace rail. Install brace rail one bay from end and gate posts.
- F. Install top rail through line post tops and splice with 6 inches long rail sleeves.
- G. Place fabric on outside of posts and rails.
- H. Do not stretch fabric until concrete foundation has cured 28 days.
- I. Stretch fabric between terminal posts or at intervals of 100 feet maximum, whichever is less.
- J. Position bottom of fabric 2 inches above finished grade.
- K. Fasten fabric to top rail, line posts, braces, and bottom rail with tie wire at maximum 15 inches on centers.
- L. Attach fabric to end, corner, and gate posts with tension bars and tension bar clips.
- M. Install support arms sloped outward and attach barbed wire; tension and secure.
- N. Support gates from gate posts. Do not attach hinged side of gate from building wall.
- O. Install gate with fabric to match fence. Install three hinges on each gate leaf, latch, catches.
- P. Install posts with 6 inches maximum clear opening from end posts to buildings, fences and other structures.
- Q. Excavate holes for posts to diameter and spacing indicated on Drawings without disturbing underlying materials.

3.2 ERECTION TOLERANCES

- A. Section 01 40 00 - Quality Requirements: Tolerances.
- B. Maximum Variation From Plumb: 1/4 inch
- C. Maximum Offset From Indicated Position: 1 inch
- D. Minimum distance from property line: 6 inches
- E. Components shall not infringe adjacent to property lines.

END OF SECTION

SECTION 32 91 13
SOIL PREPARATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Preparation of subsoil.
 - 2. Soil testing.
 - 3. Placing topsoil.
- B. Related Sections:
 - 1. Section 31 22 13 - Rough Grading.
 - 2. Section 31 23 17 - Trenching.
 - 3. Section 32 91 19 - Landscape Grading.
 - 4. Section 32 92 19 – Seeding.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

- A. Topsoil: Excavated from site and free of weeds.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements: Verification of existing conditions before starting work.
- B. Verify prepared soil base is ready to receive the Work of this section.

3.2 PREPARATION OF SUBSOIL

- A. Prepare sub-soil to eliminate uneven areas and low spots. Maintain lines, levels, profiles and contours. Make changes in grade gradual. Blend slopes into level areas.
- B. Remove foreign materials, weeds and undesirable plants and their roots. Remove contaminated sub-soil.
- C. Scarify subsoil to depth of 3 inches where topsoil is to be placed. Repeat cultivation in areas where equipment, used for hauling and spreading topsoil, has compacted sub-soil.

3.3 PLACING TOPSOIL

- A. Spread topsoil to minimum depth of 4 inches over area to be seeded. Rake until smooth.
- B. Place topsoil during dry weather and on dry unfrozen subgrade.
- C. Remove vegetation matter and foreign non-organic material from topsoil while spreading.
- D. Grade topsoil to eliminate rough, low or soft areas, and to ensure positive drainage.
- E. Install edging at periphery of seeded areas in straight lines to consistent depth.

END OF SECTION

SECTION 32 91 19

LANDSCAPE GRADING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Final grade topsoil for finish landscaping.
 - 2. Topsoil.
- B. Related Sections:
 - 1. Section 31 22 13 - Rough Grading.
 - 2. Section 31 23 17 - Trenching.
 - 3. Section 31 23 23 - Fill.
 - 4. Section 32 92 19 - Seeding.

1.2 UNIT PRICE - MEASUREMENT AND PAYMENT

- A. Cleanup and Restoration:
 - 1. Basis of Measurement: Included in the lump sum bid item for cleanup and restoration.
 - 2. Basis of Payment: Includes all labor, excavation, fill for landscape grading necessary to obtain the required contours, replacement of necessary fences, trees, shrubs, guard rail, mail boxes, and other landscaping necessary to return Work area to preconstruction conditions. Includes final grading during construction or from settling. Includes installation of 4 inches of topsoil, which matches quality of existing topsoil in lawn areas.
- B. Topsoil:
 - 1. Basis of Measurement: Included in the lump sum bid item for cleanup and restoration.
 - 2. Basis of Payment: Includes all labor, material, and equipment necessary to salvage, place, grade, and lightly compact topsoil to the depth and grades as shown on the drawings. Onsite topsoil may be reused as shown on the drawings and as directed by the Engineer.

PART 2 - PRODUCTS

2.1 MATERIAL

- A. Topsoil: Min. 4 inches compacted depth, unless otherwise stated.
- B. Topsoil: Friable loam; free of subsoil, roots, grass, excessive amount of weeds, stone, and foreign matter; acidity range (pH) of 5.5 to 7.5; containing a minimum of 4 percent and a maximum of 25 percent organic matter. Topsoil shall be imported as specified on the plans.

- C. Contractor shall conduct fertility and calcium tests on all topsoil to be used in lawn and planting areas to assure that soil conditions are ready to receive plantings.
- D. Submit lab results or samples for testing as requested by the Owner or Engineer if imported topsoil is used.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements: Verification of existing conditions before starting work.
- B. Verify building and trench backfilling have been inspected.
- C. Verify substrate base has been contoured and compacted.
- D. Beginning Work of this Section requires acceptance of existing conditions.

3.2 SUBSOIL PREPARATION

- A. Eliminate uneven areas and low spots. Remove debris, roots, branches, and stones, in excess of 1/2 inch in size. Remove and dispose of offsite any subsoil contaminated with petroleum products.
- B. Scarify subgrade to minimum depth of 8 inches where topsoil is scheduled. Scarify in areas where equipment used for hauling and spreading topsoil has compacted subsoil.

3.3 PLACING TOPSOIL

- A. Place topsoil to a minimum 4 inches compacted depth in areas where seeding, sodding and planting is scheduled.
- B. Use topsoil in relatively dry state. Do not place topsoil when weather conditions are excessively windy.
- C. Handle and place topsoil only when weather and soil moisture permits.
- D. Placement of topsoil in frozen or muddy conditions shall not be permitted.
- E. Fine grade topsoil eliminating rough or low areas. Maintain levels, profiles, and contours of subgrade.
- F. Remove stone, roots, grass, weeds, debris, and foreign material while spreading.
- G. Manually spread topsoil around trees and plants to prevent damage.
- H. Lightly compact placed topsoil in preparation for seeding, fertilizing, and mulching.

- I. Fertilizer and lime shall be applied at the minimum rates indicated by tests and shall be raked into the top 2 inches of the topsoil.
- J. Remove surplus subsoil and topsoil from Site.
- K. Import topsoil as necessary to match the depths as specified on the plans.
- L. Leave stockpile area and site clean and raked, ready to receive landscaping.
- M. Place required trees, shrubs, fences, and mail boxes in their proper locations.
- N. All grades must have positive drainage to a manhole, catchbasin, drain, etc. No ponding must occur in graded areas. Contractor will be required to regrade if ponding occurs in landscaped or yard areas.

3.4 TOLERANCES

- A. Section 01 40 00 - Quality Requirements: Tolerances.
- B. Top of Topsoil: Plus or minus 1/2 inch.

3.5 PROTECTION OF INSTALLED WORK

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for protecting finished Work.
- B. Prohibit construction traffic over topsoil.

END OF SECTION

SECTION 32 92 19

SEEDING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Fertilizing.
 - 2. Seeding.
 - 3. Hydroseeding.
 - 4. Mulching.
 - 5. Maintenance.
- B. Related Sections:
 - 1. Section 31 22 13 - Rough Grading.
 - 2. Section 31 23 17 - Trenching.
 - 3. Section 32 91 13 - Soil Preparation.
 - 4. Section 32 91 19 - Landscape Grading.
 - 5. Section 31 10 00 - Site Clearing.
 - 6. Section 31 23 16 - Excavation.
 - 7. Section 31 23 23 - Fill.

1.2 UNIT PRICE - MEASUREMENT AND PAYMENT

- A. Seeding, Fertilizing and Mulching:
 - 1. Basis of Measurement: At the lump sum price bid as stated in the proposal.
 - 2. Basis of Payment: Includes labor, equipment, and material necessary to seed all disturbed areas not specified to receive other seeding or planting treatments. This includes finish grading, subsoil, daily seeding with approved seed mix, mulching, watering and maintenance to provide for uniform grass growth and any reseeded and erosion repair. Re-seeding and erosion repair is included to provide for uniform grass growth at the completion of the project and up to one year after completion.

1.3 REFERENCES

- A. ASTM International:
 - 1. ASTM C602 - Standard Specification for Agricultural Liming Materials.

1.4 DEFINITIONS

- A. Weeds: Vegetative species other than specified species to be established in given area.

1.5 SUBMITTALS

- A. Product Data: Submit data for seed mix, fertilizer, mulch, erosion control blankets, and other accessories.

- B. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.
 - 1. Provide seed mixture in containers showing percentage of seed mix, year of production, net weight, date of packaging, any tags from seed bags and any receipts associated with seeding.

1.6 QUALITY ASSURANCE

- A. Provide seed mixture in containers showing percentage of seed mix, germination percentage, inert matter percentage, weed percentage, year of production, net weight, date of packaging, and location of packaging.
- B. The Contractor shall make arrangements to obtain seed materials with nurseries a maximum 30 days after he/she is awarded contract and provide a list of suppliers to the Engineer.
- C. The Contractor will provide a final list of all species purchased to the Engineer a minimum of 90 days prior to seeding

1.7 QUALIFICATIONS

- A. Seed Supplier: Company specializing in manufacturing Products specified in this section.
- B. Installer: The seeding Contractor must be experienced and specialized in seeding the respective species as determined by the Engineer. He/she shall properly supervise a competent staff. The Contractor must have the necessary equipment to complete this task.
- C. Maintenance Services: Shall be provided by the Contractor for up to one year to guarantee establishment of growth.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.
- B. Deliver grass seed mixture in sealed containers. Seed in damaged packaging is not acceptable.
- C. Deliver fertilizer in waterproof bags showing weight, chemical analysis, and name of manufacturer.

1.9 MAINTENANCE SERVICE

- A. Maintain seeded and sodded areas immediately after placement until grass is well established, exhibits a vigorous growing condition and is accepted by the Owner. Guarantee reseeding of bare areas for one year following acceptance.

1.10 COORDINATION

- A. Coordinate Work under provisions of Section 01 30 00 – Administrative Requirements.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Topsoil:
1. Reused - free of subsoil, roots, grass, excessive amount of weeds, stone, and foreign matter.
 2. Topsoil: Imported, friable loam; free of subsoil, roots, grass, excessive amount of weeds, stone, and foreign matter; acidity range (ph) of 5.5 to 7.5; containing a minimum of 4 percent and a maximum of 25 percent organic matter.
 3. Topsoil furnished from outside the project limits shall be approved by the Engineer.

B. MDOT General Roadside Seed Mix, TGM (Turf Medium to Heavy Soil)

% by Weight	Common Name
10	Kentucky Blue Grass
20	Perennial Ryegrass
30	Hard Fescue
40	Creeping Red Fescue

Apply per MDOT standards and specifications, minimum 220 lb/acre

- C. Fertilizer:
1. Apply 500 pounds per acre (12 pounds per 1000 square feet) of 12-12-12 commercial grade fertilizer or Engineer approved equivalent
- D. Mulch:
1. Apply 1200 pounds per acre (28 pounds per 1000 square feet) small grain straw mulch that is clean and weed free on all seeded areas unless otherwise indicated.
 2. Apply tackifier to mulch according to manufacturer's recommendations as approved by the Engineer.
- E. Hydroseeding Mulching Material:
1. Apply 1400 pounds/acre of Conwed Verdoyl #2000 with hydraulic seeder.
- F. Mulch Blankets:
1. Install North American Green S75 as indicated on the plans or directed by the Engineer.
 2. Install all mulch blankets with wooden stakes. Stake according to manufacturer's recommendations as approved by the Engineer.
- G. Lime: ASTM C602, agricultural limestone containing a minimum 80 percent calcium carbonate equivalent.
- H. Water: Clean, fresh and free of substances or matter capable of inhibiting vigorous growth of grass.
- I. Stakes: Softwood lumber, chisel pointed.

2.2 SOURCE QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements: Testing, inspection and analysis requirements.

- B. Analyze to ascertain percentage of nitrogen, phosphorus, potash, soluble salt content, organic matter content, and pH value.
- C. Provide recommendation for fertilizer and lime application rates for specified seed mix as result of testing.
- D. Testing is not required when recent tests and certificates are available for imported topsoil. Submit these test results to testing laboratory. Indicate, by test results, information necessary to determine suitability.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements: Verification of existing conditions before starting work.
- B. Verify that prepared soil base is ready to receive the Work of this section and that the necessary excavation Work has been completed. See Section 32 91 19 - Landscape Grading and Section 31 23 16 – Excavation
- C. Disc and cultipack (roll) site to ensure a flat and firm seedbed.

3.2 FERTILIZING

- A. Apply lime at application rate recommended by soil analysis. Work lime into top 6 inches of soil.
- B. Apply fertilizer at application rate recommended by soil analysis.
- C. Apply after smooth raking of topsoil and prior to roller compaction.
- D. Do not apply fertilizer at same time or with same machine used to apply seed.
- E. Mix fertilizer thoroughly into upper 2 inches of topsoil.
- F. Lightly water soil to aid dissipation of fertilizer. Irrigate top level of soil uniformly.

3.3 SEEDING

- A. Daily seed and mulch all finished graded areas with approved seed mix.
- B. Apply mixes at the specified rates.
- C. Additional seeding is required until uniform growth of grass is established.
- D. Apply seed at rate specified above evenly in two intersecting directions. Rake in lightly.
- E. Do not seed areas in excess of that which can be mulched on same day.
- F. Do not sow when ground is too dry or when winds are over 12 mph.

- G. Immediately following seeding, apply mulch as specified.
- H. Apply water with fine spray immediately after each area has been mulched. Saturate to 4 inches of soil.
- I. Seeding method:
 - 1. Hand broadcast native seed mix, and cover crop in designated areas. Mix seed with a lightweight inert material such as damp sawdust or vermiculite.
 - 2. For areas larger than 1 acre a mechanical planter, such as a Truax drill, may be used.
 - 3. Upon completion of seeding, rake or drag seed so that it is lightly covered with soil (approx. ¼ inch deep). The site should then be rolled to firm the seed into the soil. Approximately 25 percent of the seed should still be visible on the surface.
- J. Apply mulch or mulch blankets at specified rates of application evenly on prepared seedbed and maintain clear of trees and shrubs. Allow sunlight to penetrate mulch so as not to cover more than 70% of the soil surface or as directed by the Engineer.

3.4 MAINTENANCE

- A. Immediately reseed areas, which show bare spots.
- B. Repair any eroded areas and reseed immediately.
- C. Final payment will not be issued until a uniform growth of grass is established for period of one year on all areas disturbed as a result of the construction of this Project. A minimum of eighty percent of the species seeded shall be established prior to final payment.
- D. The Contractor shall be responsible for watering during the one year guarantee period.
- E. Monitor all seeded areas during site visits for water stress.
- F. The Contractor shall replace, at no cost to the Owner, all dead vegetation during the Guarantee period.
- G. Judgment of the plant's health will be the Engineers or the Owners.
- H. Protection from traffic and erosion in newly seeded areas is the responsibility of the Contractor. Safety fences and/or silt fences with appropriate signage may be used at the Contractor's expense until the grasses and flowers are fully established.

END OF SECTION

SECTION 33 05 13

MANHOLES AND STRUCTURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Cast-in-place concrete manholes and structures with transition to cover frame, covers, anchorage, and accessories.
2. Modular precast concrete manholes and structures with tongue-and-groove joints and transition to cover frame, covers, anchorage, and accessories.
3. Masonry manhole and structure sections with masonry transition to cover frame, covers, anchorage, and accessories.
4. Doghouse manhole connections to existing storm sewer lines.
5. Bedding and cover materials.
6. Pile support systems.

B. Related Sections:

1. Section 03 10 00 - Concrete Forming and Accessories.
2. Section 03 20 00 - Concrete Reinforcing.
3. Section 03 30 00 - Cast-in-Place Concrete.
4. Section 31 23 16 - Excavation.
5. Section 31 23 23 - Fill.
6. Section 33 41 13 - Public Storm Utility Drainage Piping.

1.2 UNIT PRICE - MEASUREMENT AND PAYMENT

A. Catch Basins:

1. Basis of Measurement: By each catch basin.
2. Basis of Payment: Includes all material, labor, and equipment necessary for trenching, backfilling, bedding, structure installation, connection to sewer piping, adjusting rings, castings, grates, and shop drawings. Catch basins complete as shown on the plans and as stated in the specifications. When replacing an existing structure, includes reconnection of all existing pipes to proposed structure.

1.3 REFERENCE STANDARDS

A. American Association of State Highway Transportation Officials:

1. AASHTO M91 - Standard Specification for Sewer and Manhole Brick (Made from Clay or Shale).
2. AASHTO M288 - Standard Specification for Geotextile Specification for Highway Applications.
3. AASHTO M306 - Standard Specification for Drainage, Sewer, Utility, and Related Castings.

B. American Concrete Institute:

1. ACI 530/530.1 - Building Code Requirements and Specification for Masonry Structures.

C. ASTM International:

1. ASTM A48 - Standard Specification for Gray Iron Castings.
2. ASTM A123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
3. ASTM C32 - Standard Specification for Sewer and Manhole Brick (Made From Clay or Shale).
4. ASTM C55 - Standard Specification for Concrete Building Brick.
5. ASTM C361 - Standard Specification for Reinforced Concrete Low-Head Pressure Pipe.
6. ASTM C478 - Standard Specification for Precast Reinforced Concrete Manhole Sections.
7. ASTM C497 - Standard Test Methods for Concrete Pipe, Manhole Sections, or Tile.
8. ASTM C913 - Standard Specification for Precast Concrete Water and Wastewater Structures.
9. ASTM C923 - Standard Specification for Resilient Connectors between Reinforced Concrete Manhole Structures, Pipes, and Laterals.

1.4 SUBMITTALS

- A. Product Data: Submit data for manhole covers, component construction, features, configuration, dimensions.
- B. Shop Drawings:
 1. Indicate structure locations and elevations.
 2. Indicate sizes and elevations of piping, conduit, and penetrations.
- C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- D. Manufacturer Instructions: Submit detailed instructions on installation requirements, including storage and handling procedures.
- E. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.
- F. Qualifications Statements:
 1. Submit qualifications for manufacturer and installer.
 2. Submit manufacturer's approval of installer.

1.5 QUALITY ASSURANCE

- A. Perform Work according to MDOT Standard Specifications for Construction, current edition.

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years' documented experience.
- B. Installer: Company specializing in performing Work of this Section with minimum three years' documented experience.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- C. Comply with precast concrete manufacturer's instructions and ASTM C913 for unloading, storing, and moving precast manholes and drainage structures.
- D. Storage:
 - 1. Store precast concrete manholes and drainage structures to prevent damage to Owner's property or other public or private property.
 - 2. Repair property damaged from materials storage.

1.8 AMBIENT CONDITIONS

- A. Section 01 50 00 - Temporary Facilities and Controls: Requirements for ambient condition control facilities for product storage and installation.
- B. Cold Weather Requirements: Comply with ACI 530/530.1.

PART 2 - PRODUCTS

2.1 MANHOLES AND STRUCTURES

- A. Manhole and Structure Sections:
 - 1. Concrete: Barrel and conical top and flat top sections. (Nominal Diameters of 2' to 8')
 - a. Reinforced, precast concrete pipe section conforming to ASTM C-478.
 - b. Nominal diameter as indicated on the drawings.
 - c. Precast reinforced concrete base as indicated as drawing and approved by Engineer, or integral base.
 - d. Tongue and groove premium joints with o-ring gaskets or approved equal.

2.2 FRAMES AND COVERS

- A. Castings as indicated on the Drawings.

2.3 RISER RINGS

- A. Manufacturers:
 - 1. Furnish materials in accordance to MDOT Standard Specifications for Construction, current edition.
 - 2. Comply with ASTM C478

2.4 ACCESSORIES

- A. Geotextile Filter Fabric per Section 31 32 21 – Filter Fabric.

- B. Bedding/Backfill Materials: See Section 31 23 23 – Fill.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation examination.
- B. Verify that items provided by other Sections of Work are properly sized and located.
- C. Verify that built-in items are in proper location and are ready for roughing into Work.
- D. Verify correct size of manhole and structure excavation.

3.2 PREPARATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation preparation.
- B. Mark each precast structure by indentation or waterproof paint showing date of manufacture, manufacturer, and identifying symbols and numbers as indicated on Drawings to indicate its intended use.
- C. Coordinate placement of inlet and outlet pipe or duct sleeves required by other Sections.
- D. Do not install manholes and structures where Site conditions induce loads exceeding structural capacity of manholes or structures.
- E. Inspect precast concrete manholes and structures immediately prior to placement in excavation to verify that they are internally clean and free from damage; remove and replace damaged units.

3.3 INSTALLATION

- A. Excavation and Backfill:
 - 1. Excavate for manholes and structures as specified in Section 31 23 16 - Excavation and in indicated locations and depths.
 - 2. Provide clearance around sidewalls of manhole or structure for construction operations including placing backfill and placement of geotextile filter fabric.
 - 3. If groundwater is encountered, prevent accumulation of water in excavations; place manhole or structure in dry trench.
 - 4. Where possibility exists of watertight manhole or structure becoming buoyant in flooded excavation, anchor manhole or structure to avoid flotation, as approved by Architect/Engineer.
- B. Install manholes and structures supported at proper grade and alignment on crushed stone bedding as indicated on Drawings.

- C. Backfill excavations for manholes and structures as specified in Section 31 23 16 – Excavation and Section 31 23 23 - Fill.
- D. Form and place manhole or structure cylinder plumb and level, to correct dimensions and elevations.
- E. Cut and fit for pipe.
- F. Grout base of shaft sections to achieve slope to exit piping, trowel smooth, and contour to form continuous drainage channel as indicated on Drawings.
- G. Set cover frames and covers level to correct elevations without tipping.
- H. Precast Concrete Manholes and Structures:
 - 1. Lift precast components at lifting points designated by manufacturer.
 - 2. When lowering manholes and structures into excavations and joining pipe to units, take precautions to ensure that interior of pipeline and structure remains clean.
 - 3. Set precast structures, bearing firmly and fully on crushed stone bedding, compacted as specified in Section 31 23 16 - Excavation and Section 31 23 23 - Fill or on other support system as indicated on Drawings.
 - 4. Assembly:
 - a. Assemble multi-section manholes and structures by lowering each section into excavation.
 - b. Install rubber gasket joints between precast sections according to manufacturer's recommendations.
 - c. Lower, set level, and firmly position base section before placing additional sections.
 - 5. Remove foreign materials from joint surfaces and verify sealing materials are placed properly.
 - 6. Maintain alignment between sections by using guide devices affixed to lower section.
 - 7. Joint sealing materials may be installed on Site or at manufacturer's plant.
 - 8. Verify that installed manholes and structures meet required alignment and grade.
 - 9. Remove knockouts or cut structure to receive piping without creating openings larger than required to receive pipe; fill annular spaces with mortar.
 - 10. Cut pipe flush with interior of structure.
 - 11. Shape inverts through manhole and structures as indicated on Drawings.
- I. Castings:
 - 1. Set frames using mortar and masonry as indicated on Drawings.

3.4 FIELD QUALITY CONTROL

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for testing, adjusting, and balancing.
- B. Test concrete manhole and structure sections according to ASTM C497.
- C. Vertical Adjustment of Existing Manholes and Structures:
 - 1. If required, adjust top elevation of existing manholes and structures to finished grades as indicated on Drawings.
 - 2. Frames, Grates, and Covers:

- a. Carefully remove frames, grates, and covers cleaned of mortar fragments.
 - b. Reset to required elevation according to requirements specified for installation of castings.
- 3. Reinforcing Bars:
 - a. Remove concrete without damaging existing vertical reinforcing bars if removal of existing concrete wall is required.
 - b. Clean vertical bars of concrete and bend into new concrete top slab or splice to required vertical reinforcement as indicated on Drawings.

END OF SECTION

SECTION 33 41 13

PUBLIC STORM UTILITY DRAINAGE PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Storm drainage piping.
 - 2. Piping accessories.
 - 3. Drainage structures.
 - 4. Bedding and cover materials.
 - 5. Pile support systems.
 - 6. Pipe support systems.
 - 7. Concrete encasement and cradles.
- B. Related Sections:
 - 1. Section 03 20 00 - Concrete Reinforcing.
 - 2. Section 31 23 16 - Excavation.
 - 3. Section 31 23 17 - Trenching.
 - 4. Section 31 23 23 - Fill.
 - 5. Section 33 05 13 - Manholes and Structures.

1.2 UNIT PRICE - MEASUREMENT AND PAYMENT

- A. Storm Sewer (All sizes and materials):
 - 1. Basis of Measurement: At the unit price bid per linear foot as stated in the proposal.
 - 2. Basis of Payment: Includes all material, labor, and equipment necessary for trenching, dewatering, backfilling, bedding (both granular and crushed aggregate), pipe, installation, fittings, connections to existing structures, relocation of buried lines and cables, filter fabric, and accessories as stated in the specifications and indicated on the plans.

1.3 REFERENCE STANDARDS

- A. American Association of State Highway and Transportation Officials:
 - 1. AASHTO M170 - Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.
 - 2. AASHTO M288 - Standard Specification for Geotextile Specification for Highway Applications.
 - 3. AASHTO M294 - Standard Specification for Corrugated Polyethylene Pipe, 300- to 1500-mm (12- to 60-in.) Diameter.
- B. ASTM International:
 - 1. ASTM C76 - Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.

2. ASTM C443 - Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets.
3. ASTM C1103 - Standard Practice for Joint Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines.
4. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³).
5. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN-m/m³).
6. ASTM D2235 - Standard Specification for Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings.
7. ASTM D6938 - Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).

1.4 PREINSTALLATION MEETINGS

- A. Section 01 30 00 - Administrative Requirements: Requirements for preinstallation meeting.
- B. Convene minimum one week prior to commencing Work of this Section.

1.5 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit data indicating pipe and pipe accessories.
- C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- D. Manufacturer Instructions: Submit detailed instructions on installation requirements, including storage and handling procedures.
- E. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.
- F. Qualifications Statements:
 1. Submit qualifications for manufacturer and installer.
 2. Submit manufacturer's approval of installer.

1.6 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for submittals.
- B. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.7 QUALITY ASSURANCE

- A. Perform Work according with MDOT Standard Specifications for Construction, current edition.

1.8 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years' documented experience.
- B. Installer: Company specializing in performing Work of this Section with minimum three years' documented experience.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- C. Storage:
 - 1. Store materials according to manufacturer instructions.
 - 2. Block individual and stockpiled pipe lengths to prevent moving.
 - 3. Do not place pipe or pipe materials on private property or in areas obstructing pedestrian or vehicle traffic.
 - 4. Do not place pipe flat on ground; cradle to prevent point stress.
- D. Protection:
 - 1. Keep UV-sensitive materials out of direct sunlight.
 - 2. Provide additional protection according to manufacturer instructions.

PART 2 - PRODUCTS

2.1 STORM DRAINAGE PIPING

- A. ASTM C-76 III, IV, V Reinforced Concrete Pipe nominal sizes 48"-12" plain joint for main line storm sewer and catch basin leads, with premium joints and wrapped with filter fabric (see section -31 32 21 - Filter Fabric).
- B. PVC (SDR 35) nominal size 10" with bell and spigot joints that are water tight.

2.2 DRAINAGE STRUCTURES

- A. Description: As specified in Section 33 05 13 - Manholes and Structures.

2.3 MATERIALS

- A. Description: As specified in Section 31 23 23 – Fill.
- B. Bedding and Cover:
 - 1. As specified in Section 31 23 23 – Fill and as shown on the drawings.
- C. Subsoil: No rocks more than 6 inches in diameter, frozen earth, or foreign matter.

2.4 ACCESSORIES

- A. Geotextile Filter Fabric as specified in Section 31 32 21.

2.5 REINFORCING

- A. Steel reinforcing bars and mesh must comply with American Iron and Steel requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation examination.
- B. Verify that excavation base is ready to receive Work.
- C. Verify that excavations, dimensions, and elevations are as indicated on Drawings.

3.2 PREPARATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation preparation.
- B. Correct over-excavation with per Section 31 23 23 - Fill.
- C. Remove large stones and other hard matter that could damage piping or impede consistent backfilling or compaction.
- D. Hand trim excavations to required elevations. Correct over excavation with fill material.
- E. Cut out soft areas of subgrade not capable of insitu compaction. Backfill with MDOT 6AA course aggregate and compact to density equal to or greater than requirements for support of pipe or structure and subsequent backfill material.
- F. Hand trim excavation for accurate placement of pipe to elevations indicated allowing for bedding thickness.

3.3 INSTALLATION

- A. Excavation and Bedding:
 - 1. Excavate pipe trench as specified in Section 31 23 17 - Trenching.
 - 2. Hand trim excavation for accurate placement of piping to indicated elevations.
 - 3. Dewater excavations to maintain dry conditions to preserve final grades at bottom of excavation.
 - 4. Provide sheeting and shoring as specified in Section 31 23 17 - Trenching.
 - 5. Level materials in continuous layers not exceeding compacted depth of 12 inches.

6. Maintain optimum moisture content of bedding material to attain required compaction density.
7. Install pipe on compacted subgrade meeting bedding requirements.
8. Cradle bottom 20 percent of diameter to avoid point load.
9. Compact to 95 percent maximum density within influence of improved surfaces.
10. Place geotextile fabric over backfill as indicated on Drawings.

B. Piping:

1. Install pipe, fittings, and accessories in accordance with ASTM Standards and manufacturer's instructions.
2. Place pipe on specified bedding.
3. Lay pipe to slope gradients noted on layout drawings by the use of a laser beam alignment method proven reliable and operated by competent, experienced personnel.
4. Place remainder of bedding as specified. Do not displace or damage pipe when compacting.
5. Contractor shall use appropriate measures, approved by the engineer to provide a sealed connection between the storm sewer and appurtenances.
6. Wrap joints of concrete pipe with a 24" wide strip of filter fabric overlapping ends 12-inch minimum. Secure with tape.
7. Seal joints watertight.

- C. Installation Standards: Install Work according to MDOT Standard Specifications for Construction, current edition.

3.4 TOLERANCES

- A. Section 01 40 00 - Quality Requirements: Requirements for tolerances.
- B. Maximum Variation from Indicated Pipe Slope: 1/8 inch in 10 feet.

3.5 FIELD QUALITY CONTROL

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for testing, adjusting, and balancing.
- B. Request inspection by Architect/Engineer prior to and immediately after placing aggregate cover over pipe.
- C. HP storm pipe shall be mandrel tested by Contractor according to MDOT Construction Advisory CA 2011-08.

3.6 PROTECTION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for protecting finished Work.
- B. Protect pipe and aggregate cover from damage or displacement until backfilling operation is in progress.

END OF SECTION

SECTION 40 05 71.16

FLAP GATES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Stainless steel flap gates.

1.2 DEFINITIONS

- A. Seating Head: The distance from centerline of gate to maximum water level of channel.

1.3 UNIT PRICE – MEASUREMENT AND PAYMENT

- A. Flap Gates (Alternate Bid Item):
 - 1. Basis of Measurement: At the unit price bid per each as stated in the proposal.
 - 2. Basis of Payment: Includes all labor, material, and equipment required to remove existing flap gates, provide and install new flap gates on existing pump station. Includes anchors, grout, adjustments, and testing.

1.4 PREINSTALLATION MEETINGS

- A. Section 01 30 00 - Administrative Requirements: Requirements for preinstallation meeting.
- B. Convene minimum one week prior to commencing Work of this Section.

1.5 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit manufacturer's product information for system materials and component equipment.
- C. Shop Drawings:
 - 1. Indicate system materials and component equipment.
 - 2. Indicate installation and anchoring requirements, fasteners, and other details.
 - 3. Indicate gate location, size, design pressure.
- D. Manufacturer's Certificate:
 - 1. Certify that products meet or exceed specified requirements.
- E. Delegated Design Submittals: Submit Shop Drawings with design calculations and assumptions for seating and unseating pressure pressures.

F. Manufacturer Instructions: Submit detailed instructions on installation requirements, including storage and handling procedures.

G. Qualifications Statements:

1. Submit qualifications for manufacturer.

1.6 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for submittals.

B. Project Record Documents: Record actual locations of installed flap gates and components.

1.7 QUALIFICATIONS

A. The manufacturer shall have experience in the production of substantially similar equipment and shall show evidence of satisfactory operating in at least 50 installations. The manufacturer's shop welds, welding procedures and welders shall be qualified and certified in accordance with the requirement of the latest edition of ASME, Section IX.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.

C. Store materials according to manufacturer instructions.

D. Protection:

1. Store in dry location remote from construction operations areas.

2. Provide additional protection according to manufacturer instructions.

1.9 EXISTING CONDITIONS

A. Field Measurements:

1. Verify field measurements prior to fabrication.

2. Indicate field measurements on Shop Drawings.

1.10 WARRANTY

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for warranties.

B. Furnish five-year manufacturer's warranty for flap gates.

PART 2 - PRODUCTS

2.1 STAINLESS STEEL FLAP GATES

A. Manufacturers:

1. Fontaine Aquanox
2. or approved equal.

B. Description:

1. Configuration: Circular.
2. Seating Head: 10 feet.
3. Opening Diameter: As indicated on Drawings.

C. Seat:

1. Configuration:
 - a. Flat back made for mounting to concrete wall with extra wide flange or spigot back for CMP pipe connections.
 - b. One piece.
2. Cover:
 - a. Configuration: One piece.
 - b. Furnish lifting eye for manual operation.
 - c. Constructed of stainless steel structural members capable of with standing specified pressure without deformation.
3. Material: Stainless Steel.

D. Seals:

1. Material: EPDM.
2. Seals shall be made of resilient neoprene attached to the body by means of a retainer ring for flaps up to 24" (610mm). Seals shall be made of EPDM attached to the frame with a stainless steel retainer for flaps over 24" (610 mm).

E. Hinges:

1. Hinges shall consist of a stainless steel pin and shall have a UHMWPE bushing.

F. Hinge Arms:

1. Hinge arms shall be made of structural members or formed plates. Gates 30" (762 mm) and over in diameter shall have a 2-hinge arm arrangement, with 2 pivot joints per arm, an adjustable lower pivot with limited rotation and an adjustable upper hinge lug arrangement to permit adjustment of the gate opening sensitivity to unseating head.

G. Fasteners: Stainless steel.

2.2 MATERIALS

Part	Material
Body, cover, hinges, hinge arm	Stainless steel ASTM A-240 Type 304L or 316L
Hinge bushing	Ultra high molecular weight polyethylene (UHMWPE) ASTM D-4020
Seal for flaps up to 24" (610 mm)	Neoprene ASTM D-2000 Grade 2 BC-510
Seal for flaps over 24" (610 mm)	EPDM ASTM D-2000
Fasteners	ASTM F593 and F594 GR1 for type 304 and GR2 for type 316

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation examination.
- B. Verify that items provided by other Sections of Work are ready to receive Work of this Section.

3.2 INSTALLATION

- A. According to manufacturer instructions and as indicated on Drawings.
- B. Flap Gates Attached to Concrete: Mount using anchor bolts and grout in place.

3.3 FIELD QUALITY CONTROL

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for testing, adjusting, and balancing.
- B. Inspection:
 - 1. Verify alignment of gate and components.
 - 2. Verify that gate operates smoothly and does not bind.

C. Testing:

1. Leakage: Not exceeding 0.1 gpm/ft. of seating perimeter under 20 feet of seating head.

D. Manufacturer Services: Furnish services of manufacturer's representative experienced in installation of products furnished under this Section for not less than 3 days on Site for installation, inspection, field testing, and instructing Owner's personnel in maintenance of equipment.

E. Equipment Acceptance:

1. Adjust, repair, modify, or replace components failing to perform as specified and rerun tests.
2. Make final adjustments to equipment under direction of manufacturer's representative.

F. Furnish installation certificate from equipment manufacturer's representative attesting that equipment has been properly installed and is ready for startup and testing.

3.4 ADJUSTING

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for starting and adjusting.

B. Adjust flap gates to provide smooth operation.

3.5 DEMONSTRATION

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for demonstration and training.

B. Demonstrate equipment operation, routine maintenance, and emergency repair procedures to Owner's personnel.

END OF SECTION

SECTION 40 67 00
CONTROL SYSTEM EQUIPMENT PANELS AND RACKS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes installation and startup of owner supplied pump control system including power disconnect, pump alternation, intrinsically safe control, lightning protection, push buttons, indicating lights, and control relays.
- B. Related Sections:
 - 1. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables.
 - 2. Section 26 05 33 - Raceway and Boxes for Electrical Systems.
 - 3. Section 26 05 83 - Wiring Connections.

1.2 UNIT PRICE – MEASUREMENTS AND PAYMENTS

- A. Controls and SCADA:
 - 1. Basis of Measurement: As part of the lump sum for Pump Station Controls, SCADA, and Security system.
 - 2. Basis of Payment: Includes all labor, materials, and equipment to provide and install the owner supplied Controls and SCADA system as shown on the contract documents and as stated in the specifications.

1.3 REFERENCES

- A. National Electrical Manufacturers Association:
 - 1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
- B. Underwriters' Laboratories
 - 1. UL 508 - Industrial Control Equipment.

1.4 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for submittals.
- B. Project Record Documents: Record actual locations of control panel and final wiring diagrams and connections.
- C. Operation and Maintenance Data: Submit operation and maintenance instructions for components and devices.

1.5 QUALITY ASSURANCE

- A. Perform Work in accordance with UL 508.

- B. Provide components compatible with functions required to form complete working system.
- C. Provide UL 508 label on complete assembly.
- D. Perform Work in accordance with all applicable codes and standards.
- E. Maintain one copy of each document on site.

1.6 PRE-INSTALLATION MEETINGS

- A. Section 01 30 00 - Administrative Requirements: Pre-installation meeting.
- B. Convene minimum one week prior to commencing work of this section.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Inspect for damage.
- C. Store in areas protected from weather, moisture, or possible damage; do not store directly on ground; handle to prevent damage to wiring and components.

1.8 COORDINATION

- A. Section 01 30 00 - Administrative Requirements: Requirements for coordination.
- B. Coordinate work and component requirements with controlled pumps.

PART 2 - PRODUCTS

2.1 PUMP CONTROL PANEL

- A. SEE APPENDIX A FOR EQUIPMENT CUTSHEETS

2.2 COMPONENTS

- A. SEE APPENDIX A FOR EQUIPMENT CUTSHEETS

2.3 LIQUID LEVEL CONTROL SYSTEM

- A. SEE APPENDIX A FOR EQUIPMENT CUTSHEETS

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements: Verification of existing conditions before starting work.
- B. Verify correct power supply is available.
- C. Verify pumps are installed.

3.2 INSTALLATION

- A. Install control panel at location indicated on Drawings.
- B. Install control panel in accordance with manufacturer's instructions.

3.3 FIELD QUALITY CONTROL

- A. Section 01 70 00 - Execution and Closeout Requirements.
- B. Coordinate with supplier: Start-up pump control system by energizing system equipment and testing operation of hardware and process control logic under supervision of manufacturer's representative and in presence of Architect/Engineer.

3.4 MANUFACTURER'S FIELD SERVICES

- A. Section 01 40 00 - Quality Requirements: Requirements for manufacturer's field services.
- B. Coordinate services of manufacturer's representative experienced in installation of products furnished under this specification for not less than 5 work days on-site for installation inspection and field testing, and instructing Owner's personnel in maintenance of equipment.
- C. Certify that equipment has been properly installed and is ready for start-up and testing.

3.5 DEMONSTRATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for demonstration and training.
- B. Coordinate demonstration of equipment startup, shutdown, routine maintenance, alarm condition responses, and emergency repair procedures to Owner's personnel.

END OF SECTION

SECTION 40 72 23
RADAR LEVEL METERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes installation and startup of owner supplied Radar-level measurement devices and Transmitters.
- B. Related Requirements:
 - 1. Section 26 05 83 - Wiring Connections: Control power wiring requirements.

1.2 UNIT PRICE – MEASUREMENTS AND PAYMENTS

- A. Controls and SCADA:
 - 1. Basis of Measurement: As part of the lump sum for Pump Station Controls, SCADA, and Security system.
 - 2. Basis of Payment: Includes all labor, materials, and equipment to provide and install the owner supplied Controls and SCADA system as shown on the contract documents and as stated in the specifications.

1.3 REFERENCE STANDARDS

- A. International Electrotechnical Commission:
 - 1. IEC 61508 - Functional safety of electrical/electronic/programmable electronic safety-related systems.
 - 2. IEC 61511 - Corrigendum 1 - Functional safety - Safety instrumented systems for the process industry sector.
- B. National Electrical Manufacturers Association:
 - 1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
- C. NSF International:
 - 1. NSF 61 - Drinking Water System Components - Health Effects.
 - 2. NSF 372 - Drinking Water System Components - Lead Content.

1.4 COORDINATION

- A. Section 01 30 00 - Administrative Requirements: Requirements for coordination.
- B. Coordinate Work of this Section with Site Work.

1.5 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for closeout procedures.
- B. Project Record Documents: Record actual locations and final orientation of equipment and accessories.

1.6 QUALITY ASSURANCE

- A. Ensure that materials of construction of wetted parts are compatible with process liquid.
- B. Materials in Contact with Potable Water: Certified to NSF 61 and NSF 372.
- C. Perform Work according to all applicable codes and standards.
- D. Maintain one copy of each standard affecting Work of this Section on Site.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- C. Store materials according to manufacturer instructions.
- D. Protection:
 - 1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
 - 2. Provide additional protection according to manufacturer instructions.

PART 2 - PRODUCTS

2.1 RADAR-LEVEL MEASUREMENT DEVICES

- A. SEE APPENDIX A FOR EQUIPMENT CUTSHEETS

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation examination.

- B. Verify that items provided by other Sections of Work are ready to receive Work of this Section.

3.2 INSTALLATION

- A. Coordinate location and orientation of level probe assemblies with final equipment installations.
- B. Ensure that instruments are located to be easily accessible for maintenance.
- C. Installation Standards: Install Work according to all applicable codes and standards.

3.3 FIELD QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements.
- B. Section 01 70 00 - Execution and Closeout Requirements.
- C. Manufacturer Services: Coordinate services of manufacturer's representative experienced in installation of products furnished under this Section for not less than 2 hours (per Device) on Site for installation, inspection, field testing, and instructing Owner's personnel in maintenance of equipment.
- D. Coordinate installation certificate from equipment manufacturer's representative attesting that equipment has been properly installed and is ready for startup and testing.

3.4 DEMONSTRATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for demonstration and training.
- B. Coordinate demonstration of equipment startup, shutdown, routine maintenance, and emergency repair procedures to Owner's personnel.

END OF SECTION

SECTION 40 72 43
PRESSURE AND DIFFERENTIAL PRESSURE TYPE LEVEL METERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes installation and startup of owner supplied Hydrostatic-level measurement devices and Transmitters.
- B. Related Requirements:
 - 1. Section 26 05 83 - Wiring Connections: Control power wiring requirements.

1.2 UNIT PRICE – MEASUREMENTS AND PAYMENTS

- A. Controls and SCADA:
 - 1. Basis of Measurement: As part of the lump sum for Pump Station Controls, SCADA, and Security system.
 - 2. Basis of Payment: Includes all labor, materials, and equipment to provide and install the owner supplied Controls and SCADA system as shown on the contract documents and as stated in the specifications.

1.3 REFERENCE STANDARDS

- A. International Electrotechnical Commission:
 - 1. IEC 61508 - Functional safety of electrical/electronic/programmable electronic safety-related systems.
 - 2. IEC 61511 - Corrigendum 1 - Functional safety - Safety instrumented systems for the process industry sector.
- B. NSF International:
 - 1. NSF 61 - Drinking Water System Components - Health Effects.
 - 2. NSF 372 - Drinking Water System Components - Lead Content.

1.4 COORDINATION

- A. Section 01 30 00 - Administrative Requirements: Requirements for coordination.
- B. Coordinate Work of this Section with work in Wet Well area.

1.5 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements.
- B. Project Record Documents: Record actual locations and final orientation of equipment and accessories.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- C. Store materials according to manufacturer instructions.
- D. Protection:
 - 1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
 - 2. Provide additional protection according to manufacturer instructions.

PART 2 - PRODUCTS

2.1 HYDROSTATIC-LEVEL MEASUREMENT DEVICES

- A. SEE APPENDIX A FOR EQUIPMENT CUTSHEETS

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation examination.
- B. Verify that items provided by other Sections of Work are ready to receive Work of this Section.

3.2 INSTALLATION

- A. Coordinate location and orientation of level probe assemblies with final equipment installations.
- B. Ensure that instruments are located to be easily accessible for maintenance.

3.3 FIELD QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements.
- B. Section 01 70 00 - Execution and Closeout Requirements.
- C. Manufacturer Services: Coordinate services of manufacturer's representative experienced in installation of products furnished under this Section for not less than 2 hours (per device) on Site for installation, inspection, field testing, and instructing Owner's personnel in maintenance of equipment.

- D. Coordinate installation certificate from equipment manufacturer's representative attesting that equipment has been properly installed and is ready for startup and testing.

3.4 DEMONSTRATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for demonstration and training.
- B. Coordinate demonstration of equipment startup, shutdown, routine maintenance, and emergency repair procedures to Owner's personnel.

END OF SECTION

SECTION 46 21 72

SELF-CLEANING TRASHRACK SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

- A. Duperon Corporation shall provide self-cleaning trashrack units, including the designing, furnishing and technical assistance during installation. The self-cleaning trashrack units shall be manufactured by Duperon Corporation, 1200 Leon Scott Court, Saginaw, Michigan, (517)-754-8800, or equal, and in accordance with this Section.
- B. Each trashrack unit shall include the following:
 - 1. Self-cleaning trashracks.
 - 2. All accessories needed for proper operation.
 - 3. Support framing.
 - 4. Safety covers.
 - 5. Controls.
 - 6. Technical assistance.
 - 7. Testing.
 - 8. Spare parts.
- C. The equipment furnished shall be fabricated, assembled and in proper operating condition in full conformity with approved drawings, specifications, engineering data, and recommendations furnished by the equipment manufacturer.
- D. Manufacturer's personnel for technical assistance during installation shall comply with the safety requirements in accordance with applicable codes/regulations.
- E. The trashrack units shall be of the front-cleaned/rear return type. It shall be designed to remove forms of matted, buoyant or semi-buoyant debris that comes into contact with the face of the trashrack and shall convey said debris over the top of the trashrack for discharge.
- F. The Plans and Specifications do not show the final design of the self-cleaning trashrack system, but show the limiting dimensions. The equipment supplier shall submit engineering drawings for approval prior to manufacturing.
- G. The lifting capacity of each trashrack shall be 3,000 pounds whether the load is on one lifting chain or across all lifting chains of a unit. The angle of the rack inclination shall be 60 degrees from the horizontal.

1.2 UNIT PRICE – MEASUREMENT AND PAYMENT

- A. Trash Rack – Install Only
 - 1. Basis of Measurement: At the lump sum price bid as stated in the Proposal.
 - 2. Basis of Payment: Includes all labor, equipment, and material to install the Owner provided trash rack as shown on plans. Includes any accessories needed for installation not provided by Owner.

1.3 REFERENCES

- A. American National Standards Institute (ANSI):
 - 1. ANSI B18.6.2 - (1972) Slotted Head Cap Screws, Square Head Set Screws, and Slotted Headless Set Screws (R1983)
 - 2. ANSI B46.1 – (1985) Surface Texture (Surface Roughness, Waviness, and Lay)
- B. American Society for Testing and Materials (ASTM):
 - 1. ASTM A 36 – (1989) Structural Steel
 - 2. ASTM A 307 – (1989) Carbon Steel Bolts and Studs, 60,000 psi Tensile
 - 3. ASTM A 48 – Cast Iron Castings
- C. American Welding Society (AWS):
 - 1. AWS D1.1 – Structural Welding Code – Steel
- D. American Institute of Steel Construction (AISC):
 - 1. Manual of Steel Construction
- E. Research Council on Structural Connections:
 - 1. (1988) Load and Resistance Factor Design Specifications for Structural Joints Using ASTM A 325 or A 490 Bolts.

1.4 SUBMITTALS

- A. The equipment manufacturer shall submit the following items in sets of **(6)**: (Note: Shop drawings shall be understood to include, but not limited to, design calculations for the trashracks loads upon owner structure (and resistance to seismic forces, if applicable), fabrication and installation drawings, lists, graphs and operating instructions.)
 - 1. Equipment to be furnished, assembly and subassembly drawings, specifications, engineering data, and recommendations furnished by the equipment manufacturer.
 - 2. Design calculations for the following:
 - a. Loading of trashrack upon site structures.
 - b. Adequate resistance to seismic forces, if applicable.
 - 3. As-built drawings of the trashrack structure, controls, and accessories.
 - 4. Provision of trashrack construction materials, start up and test procedures.
 - 5. List of Spare Parts and special tools (if applicable).
 - 6. **(6)** O & M Manuals for the self-cleaning trashrack (to be shipped separately from equipment to the Engineer prior to delivery of the equipment).

PART 2 - PRODUCTS

2.1 COMPONENTS

- A. Trashrack:
 - 1. Trashrack bars shall be of A36 structural steel, a minimum of 3/8 inch x 4-inch flat bar and shall be spaced to maintain a 2-3 inch clear opening, and shall occupy the full width of the trashrack bay opening. The top of the trashrack shall extend above the deck to a minimum height of 10 feet. Braces and supports shall be designed in accordance with the Manual of Steel Construction (AISC), to fit the concrete outline shown on the Plans. The trashrack shall be anchored on the bay floor and deck, and shall be able to withstand a **two (2)** foot head differential.

- B. Stripper Assembly:
 - 1. A stripper assembly shall be provided to clean the lifting fingers and force debris to discharge.
- C. Screening Rakes:
 - 1. Rakes (or lifting fingers) shall be attached to the screen chains at maximum. 10 foot centers. Fasteners on the rake shall be galvanized A325 structural and stainless steel. Stainless steel where applicable shall be provided with positive locking devices. Lifting fingers shall be a minimum of nine (9) inches in height.
- D. Screen Chains:
 - 1. The screen chains shall be 11.1 mm x 59.18 mm x 16.66 mm, Grade 80, electrically galvanized coated and shall have a breaking force of 16,000 pounds. The chains shall be evenly spaced on 10-1/2 inch centers and shall operate at a rate of seven (7) feet per minute. No shafts, sprockets, or bearings shall be located underwater. The chains shall travel up the face of the trashrack and shall return behind the trashrack.
- E. Drive Unit:
 - 1. The electric gear motor shall be shaft mounted and weatherproof. The motor shall be 1-1/2 HP (or of sufficient size), 1750 rpm, 3 phase, 60 cycle, 230/460 volt. Final drive speed shall be approximately 2 rpm. The motor shall have a heater to eliminate condensation. The motor shall have adequate capacity. Each trashrack shall operate independently and will have its own drive unit and driven components.
- F. Filler Screen:
 - 1. Filler screens shall be provided per manufacturer recommendations to assure that there is no space wider than the opening between bars to prevent passage of larger solids than allowed through the screen.
- G. Controls:
 - 1. (1) CUSTOM Basic On/Off/Overload Pkg. - For 3PH/480V incoming power supply. Includes a common control panel for all self-cleaning trashracks (SCTs) in a single N4X SSTL enclosure with provisions for remote push button stations. SCT controls include Forward and Reversing contactors and Emotron power shaft monitors for torque overload protection (one ea. unit) and only manual operation.
 - 2. STANDARD NEMA 4X Remote Push Button Stations per each unit– Includes operators for Forward, Jog Reverse and E-Stop. Requires field wiring to corresponding terminals in main control panel (by others).
- H. Spare Parts and Special Tools:
 - 1. There are no special tools required for installation and maintenance of the trashrack.
 - a. Spare parts shall be interchangeable with, and shall be made of the same material as the corresponding part to be replaced. Spare parts shall include:
 - 1) One (1) stripper panel
 - 2) Six (6) complete lifting car assemblies
 - 3) One (1) chain (sized for specific unit)
 - 4) One (1) spare motor

2.2 MATERIALS

- A. Materials shall conform to the following:
 - 1. Structural steel shapes, flats, plates and bars shall conform to ASTM A36.

2. Bolts and nuts shall conform to ASTM A307, or A325 as required.
3. Expansion anchors shall conform to FS FF-S-325, Interim Amendment No. 3, Group II, Type 4, Class 1. Where the expansion anchor is specified to be stainless steel, the bolt washer, and split ring or wedge pairs shall be stainless steel. Carbon steel components shall not be used in conjunction with stainless steel.
4. Cap screws shall conform to ANSI B18.6.2, bronze or stainless steel, at the Contractor's option.
5. Stainless steel bolting materials shall conform to ASTM A 193.
6. Castings for lower guides, drive castings, and lifting cars shall be constructed of close-grained cast iron (ASTM A 48 and C 130).
7. Rails and other miscellaneous steel shall be hot rolled (ASTM A 575).
8. Drive shaft shall be of 1144 CD and of sufficient size to transmit the power required.
9. Drive shaft bearings shall be a four (4) bolt flange unisphere spherical roller bearing, self-aligning, with a radial load rating of 7310# at 50 rpm and 100,000 hours-life.
10. Rake chain shall be 11.1mm chain capable of a minimum 16,000 pound test. The ultimate breaking point shall be no less than 16,000 pounds.
11. Fasteners will be hot dipped galvanized A325 structural as required and stainless steel to withstand corrosion.
12. The 480 volt, three-phase electrical components shall comply with the latest standard of ASA, AIEE and NEMA wherever applicable. All shall be listed as complying with the requirement of UL Inc., or other recognized testing organizations for the particular service to be encountered.

PART 3 - EXECUTION

3.1 DESIGN

- A. Design shall be in accordance with the Manual of Steel Construction (ASIC).

3.2 FABRICATION AND WORKMANSHIP

- A. Metalwork shall be free from warp, twists, dents, buckle and other defects. Installation shall be neat, plumb, square, straight and in alignment. Provisions shall be made for expansion throughout to avoid damage. Surfaces shall be cleaned and left free from stains, marks, or other defects or any other defects of any kind. Abrasive or corrosive cleaning agents and lacquer thinner shall not be used.

3.3 TESTING

- A. After the trashrack units have been installed and adjusted, each unit shall be operated for a minimum of three complete chain rotation cycles to test the unit's operation.

3.4 PAINTING

- A. The trashrack and raking components shall be painted in accordance with the manufacturer's recommendations and as approved by the Engineer. Surfaces to be coated shall be clean and dry and free of surface defects by sandblasting to near white finish. Primer and moisture-cured urethane top coat shall be applied per AWA/ANSI standards and to paint manufacturer's specifications.
 1. Finish Coat: TNEMEC SERIES 46H-413 HI-BUILD TENEME-TAR AT 16.0-20.0 MILS DFT.

2. Touchup Paint: Self-cleaning trashrack manufacturer shall ship a sufficient amount of topcoat with the trashrack units for touch up painting (to be performed by contractor). A minimum of one (1) gallon should be shipped with appropriate MSDS and technical data sheets.

3.5 GUARANTEE

- A. A written one-year standard warranty from the date of acceptance of the project shall be provided by the equipment supplier to guarantee that there shall be no defects in material or workmanship in any item supplied.

END OF SECTION

SECTION 46 41 23
SUBMERSIBLE MIXERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Submersible propeller mixers and accessories.

B. Related Requirements:

1. Section 05 50 00 - Metal Fabrications.
2. Section 26 05 03 - Equipment Wiring Connections.

1.2 UNIT PRICE – MEASUREMENT AND PAYMENT

A. Mixing Pumps, Install Only:

1. Basis of Measurement: At the unit price bid as stated in the Proposal.
2. Basis of Payment: Includes all labor, equipment, materials, and coordination required to install the Owner supplied submersible mixer pumps as outlined in the plans and specifications. Includes all necessary hardware, mounting devices, and any other required accessories for a complete installation as shown on the plans.

1.3 REFERENCE STANDARDS

A. American Bearing Manufacturers Association:

1. ABMA 9 - Load Ratings and Fatigue Life for Ball Bearings.
2. ABMA 11 - Load Ratings and Fatigue Life for Roller Bearings.

B. National Electrical Manufacturers Association:

1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

C. National Sanitation Foundation:

1. NSF 61 - Drinking Water System Components - Health Effects.
2. NSF 372 - Drinking Water System Components - Lead Content.

1.4 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Product Data:

1. Submit wiring and control diagrams, installation and anchoring requirements, fasteners, and other details.

- C. Manufacturer's Instructions: Follow manufacturer's detailed instructions on installation requirements, including storage and handling procedures.

1.5 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for closeout procedures.
- B. Project Record Documents: Record actual locations and final orientation of mixers.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for maintenance materials.

1.7 QUALITY ASSURANCE

- A. Perform Work according to County standards.
- B. Maintain one copy of each standard affecting the Work of this Section on-Site.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Take delivery of, store, protect and handle products under provisions of Section 01 60 00.
- B. Accept equipment on site, along with Owner present, in original factory packaging; inspecting for damage.

1.9 EXISTING CONDITIONS

- A. Field Measurements:
 - 1. Verify field measurements prior to fabrication.
 - 2. Indicate field measurements on Shop Drawings.

1.10 WARRANTY

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for warranties.

PART 2 - PRODUCTS

2.1 SEE APPENDIX A FOR EQUIPMENT CUTSHEETS

2.2 GENERAL

- A. Each pump is a Flygt Mixer Model 4610.410 capable of handling screened sewage. The mixers shall be able to be raised and lowered and shall be easily removed for inspection or service without the need for personnel to enter the wet well, trash rack, or discharge areas. A sliding guide bracket shall be an integral part of the mixer unit.

- B. Pump Characteristics:
 - 1. Number of Pump(s): 6
 - 2. 1.2 HP motors

2.3 TRAINING

- A. Manufacturer has provided up to 8 hours on site start-up assistance and training by a factory or authorized representative after installation of Vertical Axial Flow pumps by Contractor. Contractor shall coordinate with Owner and manufacturer on training of use with mixer pumps during start up of the Vertical Axial Flow pumps.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation examination.
- B. Verify layout, type, and orientation of piping connections.
- C. Verify that specified installation locations will accommodate mixer, piping, and accessories.

3.2 INSTALLATION

- A. Install equipment according to manufacturer's instructions.
- B. Install in accordance with the requirements indicated on the Contract drawings and Engineer approved shop drawings. SEE APPENDIX A for preliminary shop drawings.

3.3 FIELD QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements: Requirements for inspecting and testing.

3.4 ADJUSTING

- A. Adjust work under provisions of Section 01 70 00.
- B. Adjust equipment to achieve specified requirements.

3.5 CLEANING

- A. Prior to project acceptance, inspect site for dirt, debris, garbage, splashed material and damage. Clean or repair accordingly. Remove from the job site all tools, surplus materials, scrap and debris.

END OF SECTION

APPENDIX A

OWNER PROCURED

EQUIPMENT INFORMATION

*Note: The documents and product information included in this appendix are preliminary only. The products represented by the information in this appendix have been previously procured by the Owner through the Equipment Procurement Bid. The bidding documents and bid tabulations from the equipment procurement bid are included in Appendix C. The Owner will furnish copies of the final shop drawings to the Contractor for the contractor's review and dimensional verification once the contract has been awarded.



**Duperon
Self-Cleaning
Trashrack**



Installation Guide

.....

Unloading, Placement & Installation

General Data

Our commitment... “you’ll like working with us!”

It’s a bold statement and one that we hold as a standard when working with engineers, owners, customers and/or contractors. Each project is reviewed to determine how we might continually improve our product, service, ease of installation, instructions and communications. We invite your feedback!



800.383.8479

989.754.8800

Fax: 989.754.2175

Web Site: www.duperon.com

Project Contacts

Duperon Project Manager Ms.Jodi Jaskiewicz
jjaskiewicz@duperon.com

Technical Assistance **Dave Wagoner**
Dwagoner@duperon.com

Please read these instructions carefully!

To avoid costly damage, it is important to read the following information carefully. As a contractor, you will be held responsible for the proper unloading, placement, installation and start up of the unit.

General Data

Please read these instructions carefully!

To avoid costly damage, it is important to read the following information carefully. As a contractor, you will be held responsible for the proper unloading, placement, installation and start up of the unit.

Our commitment... “you’ll like working with us!”

It’s a bold statement and one that we hold as a standard when working with engineers, owners, customers and/or contractors. Each project is reviewed to determine how we might continually improve our product, service, ease of installation, instructions and communications. We invite your feedback!



Resources

Resources Required for Installation

Personnel (estimated)

Number of Employees:	4
Preparation of Trashrack	1 day
Installation of Trashrack:	1 day

Equipment

- ✓☐ Crane: sufficient for 15 ton pick and Rigging, including spreader bar
- ✓☐ Miscellaneous Tools for Anchor Bolts
- ✓☐ Welder and Grinder
- ✓☐ Ladders, scaffolding, etc.

Purchases

- ✓☐ Necessary Controls, Control Accessories, Wiring

NOTE: See Pre Installation tasks on Page 5 and determine resource requirements based upon site specific tasks that may need to be performed.

Unloading

Rigging and Pick Points

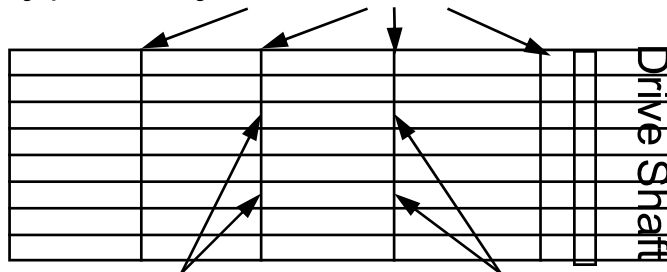
Rigging

The best and safest rigging are chains with the appropriate buckles for lifting. A **spreader bar** should be used to avoid undue pressure against bars that could cause bending or other damages. A spreader bar is typically not required for trashracks with a width of 6 feet or less.

Pick Points

The Self-Cleaning Trashrack can be picked on the outside channels at any horizontal cross beam. When unloading from the truck, balance the weight evenly using 4 pick points with a spreader bar. Or, you may have 4 pick points on a horizontal member without a spreader bar, but located closely enough not to bend the bars when the unit is lifted.

You may pick at any horizontal member at the c-channel.



You may pick at a horizontal cross beam but must use caution not to create side loads on the bar that would cause them to bend.

Illustration 1

CAUTION: Never lift units with the bars.

Pre-Installation

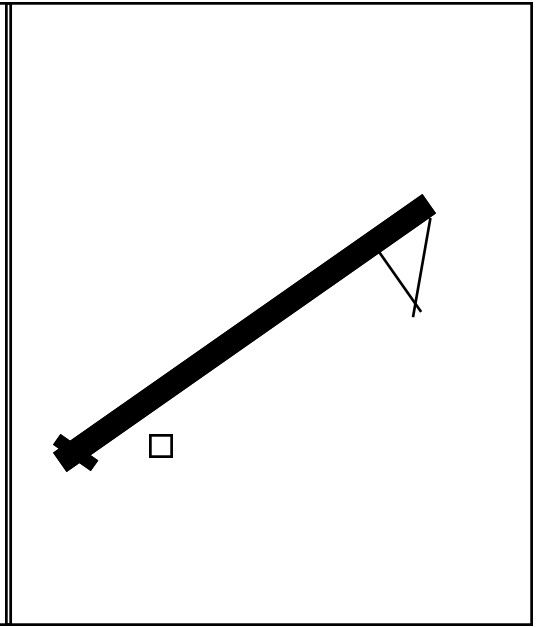
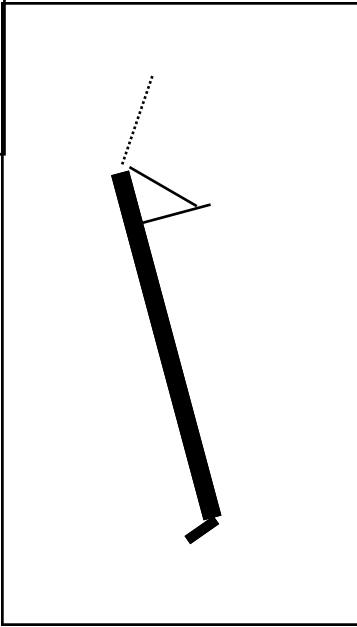
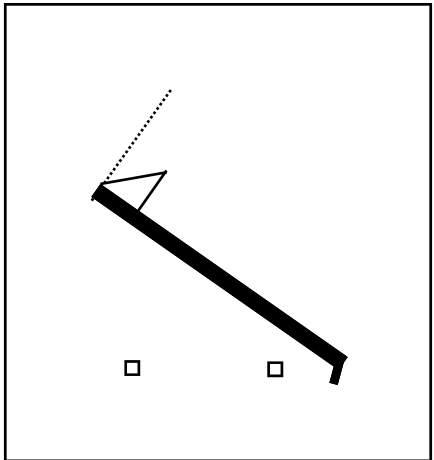
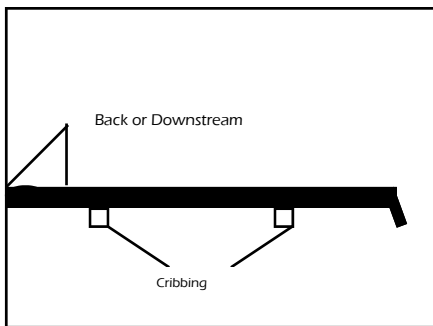
Pre-Installation Checklist

- ✓ □ Verify that an area is available near the installation that is large enough to set the trashracks flat on blocks or timber for pre-installation preparation. Be certain that there is room to roll the racks if necessary. Be careful not to damage lifting fingers when setting on timbers. The racks can be set on either the upstream (front) or downstream (back) side.
- ✓ □ Inspect units upon arrival to determine if all components have been received and the condition of the unit upon arrival. Note losses or damages on the bill of lading and have the driver sign. Advise Duperon Corporation immediately.
- ✓ □ Check bolts and set-screws for tightness due to vibration during shipping.
- ✓ □ Check oil levels—units should have been shipped full. Examine bearings and motor for signs of leakage or damage.
- ✓ □ Remove temporary protective and/or containment devices used for shipment
- ✓ □ Fasten any subassemblies that may have been removed for shipping purposes
- ✓ □ Assure that all lifting chains are properly aligned by checking for twists that may have occurred during shipment or unloading
- ✓ □ Touch up painting as needed
- ✓ □ De-water forebay and remove debris prior to installation if applicable

Rolling Unit

From Face Down to Face Up

Use the horizontal cross bar under the drive shaft assembly. Place the chain underneath the unit going around the drive shaft. Lift slowly, assuring that the load is not causing a deflection in the drive shaft. Pivot until the unit is vertical. Use caution to keep the feet of the unit off the ground to prevent damage to foot. Guide with secondary pick/lift equipment. Pivot fully, slowly lowering the unit onto the cribbing flat on the ground.



Lifting & Safety

Once it has been determined that the load is distributed evenly and there is no distortion of the I-Beam, connect the crane's center ball cable with one chain per the center of each rack (usually at the second horizontal cross member from the bottom).

SAFETY FIRST! NEVER WALK UNDERNEATH A LOAD!

Use typical safety measures for this type of rigging and equipment placement. We have had units let go, but luckily, no one was within distance to be injured.



Attach ropes to the unit to help control skipping across the concrete.

Placement

Placement OK?

IMPORTANT INSTALLATION NOTES: Directions based on standing upstream facing downstream

- ✓ □ Install units from right to left. Connections can be made on grade to combine equipment prior to lift. Contractor to determine lifting limits for crane and other site equipment.
 - ✓ □ Check to see that guards, Support Beam, channel wall supports and trashrack feet are square, and rack maintains clearances.
 - ✓ □ Due to angle on the floor of the forebay, grout as necessary.
-

Anchoring

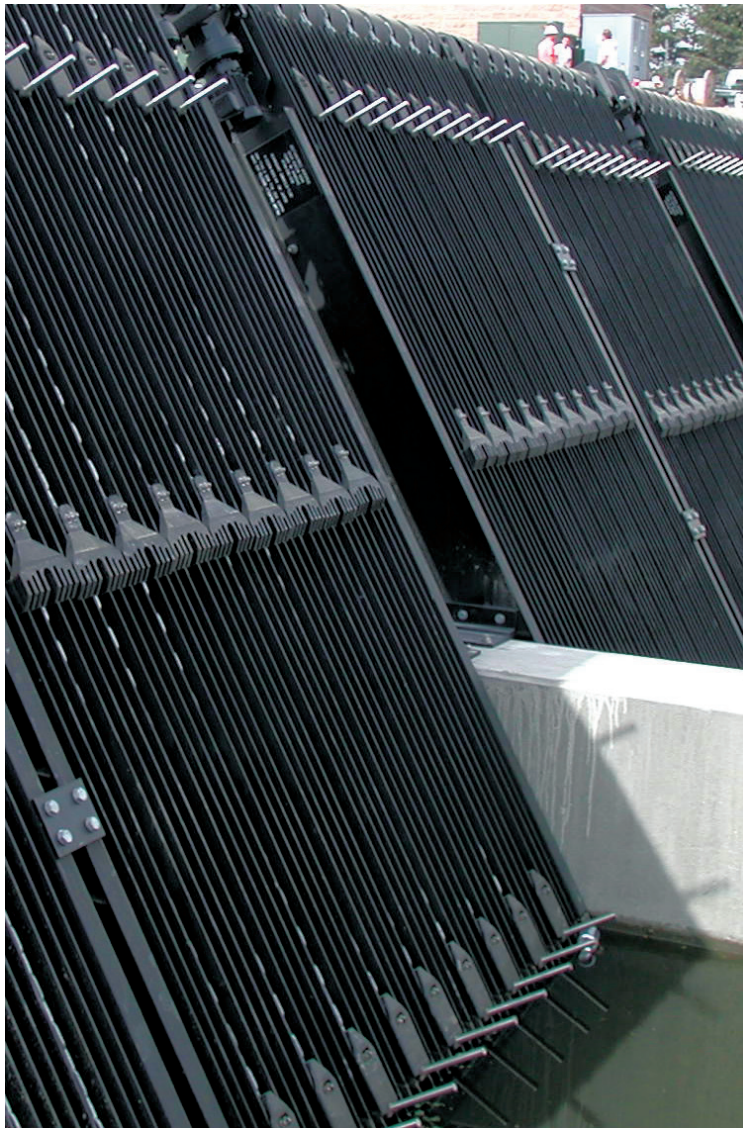
After all has been determined as square and in the proper location as shown on drawings

Anchor the unit to operating deck with anchor plates/support brackest, using 1/2" dia HILTI's with RE-500 SD system.

Anchor unit to channel bottom using 1/2 & 3/4" anchors as shown on the 2172A001 drawings.

Use provided touch up paint at all field welded locations.

Handles High Volumes, High Velocity, and All Types of Debris for Absolute Flow Protection



Duperon® SCT Maximum Duty Self-Cleaning Trashrack

Robustly simple front cleaning, rear return Duperon® Self-Cleaning Trashrack technology. Utilizes A36 steel with Duperon® standard coatings.

- Lifting Capacity of 3,000 lbs.
- Can Remain Unused for Long Periods, Yet Reliably Begin Operation During a Storm or Rain Event
- Built-In Redundancy: Each Chain Operates Independently. Cleaning Will Continue Even if One Chain Strand is Out of Service
- Self-Tripping Lifting Fingers: Debris Heavier than 3,000 lbs. is Automatically Bypassed

The Duperon® SCT

- No Underwater Bearings or Sprockets
- Cleans All of the Screen All of the Time
- Front Cleaning, Rear Return Means Lifting Fingers Do Not Have to Penetrate the Upstream Debris
- Prevents Debris from Sliding Down, Accumulating and Blocking Screen—Water Flow is Assured
- Easy to Install and Easy to Operate



Actual debris removed by the Duperon® SCT.



TYPICAL APPLICATIONS

Large/high volume open channel conditions, hydroelectric, co-generation, nuclear power plant, flood control, stormwater, water intake, drainage pump stations and diversion dams.

UNIT WIDTHS

5 to 10 feet wide

UNIT LENGTH

10 feet to 100 feet

ANGLE OF INSTALLATION

30 degrees recommended

STANDARD MATERIALS OF CONSTRUCTION

- A36 Steel, with Duperon® standard coating or hot-dipped galvanized
- Stainless Steel also available
- Epoxy-Coated CL40 Iron Cars
- 304 Stainless Steel Lifting Fingers

BAR OPENING

- 2 inches at bars
- 3 inches at chain path

LIFTING FINGER SPACING

Every 10 feet

LIFTING CAPACITY

3,000 lbs

TYPICAL MOTOR

- 1.5 HP
- Single Phase or 3 Phase Options

STANDARD OPERATING SPEED

- 2.16 RPM output
- Lifting Fingers move 7 feet/minute

SHIPPING DATA

Ships fully assembled

STANDARD CONTROLS OPTIONS

Packages range from simple start/stop to sophisticated automation. Motor overload protection provided. Contact Duperon® for further details and assistance in selecting the perfect package for your site.

OPERATION OPTIONS

- Manual
- Timed Sequences
- Activation by Head Differential
- Auto operation available for remote locations



To Learn more about Duperon® Adaptive Technology,™ scan this QR code or visit www.duperon.com

Duperon® ADAPTIVE TECHNOLOGY™
Let's Build a System that Works for You™

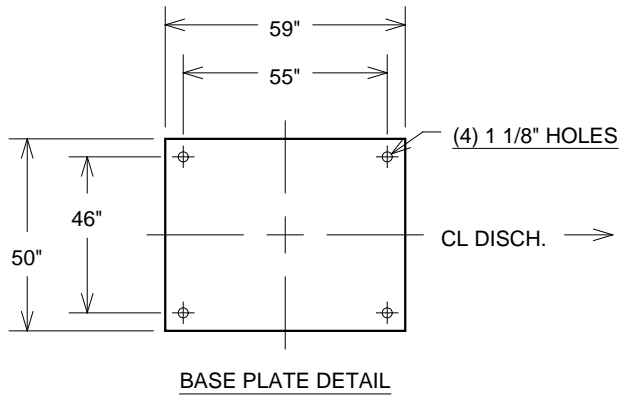
1200 Leon Scott Court | Saginaw, MI 48601 | P 989.754.8800 | F 989.754.2175 | TF 800.383.8479 | www.duperon.com

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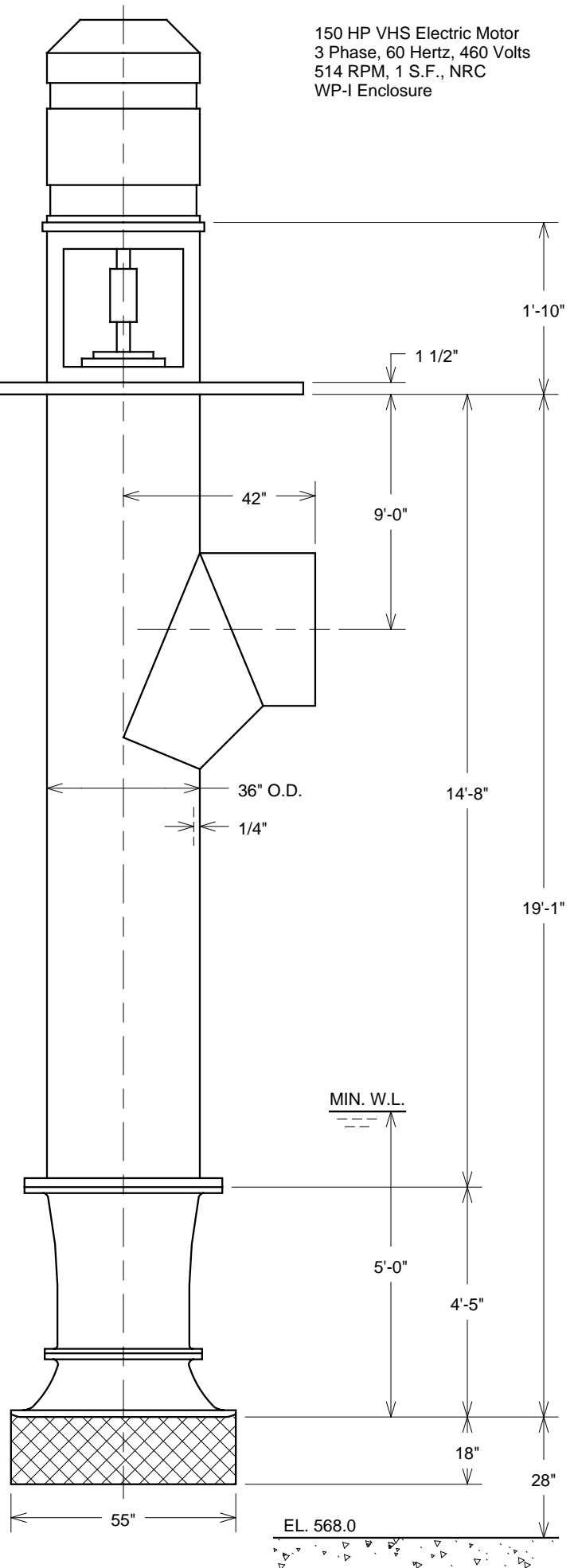
3009/3/16/0M

Oil Lubrication

150 HP VHS Electric Motor
3 Phase, 60 Hertz, 460 Volts
514 RPM, 1 S.F., NRC
WP-I Enclosure



EL.589.42



Customer Name: Kennedy Ind.

Job Name: Saginaw CPW, Gage Drain Pump Station
35,000 GPM @ 10.3' ft. TDH

CASCADE PUMP COMPANY
SANTA FE SPRINGS, CALIFORNIA

#42AP Propeller Pump
36" O.D. Discharge

DATE 12/22/20 SCALE NONE

DRAWN
AJV

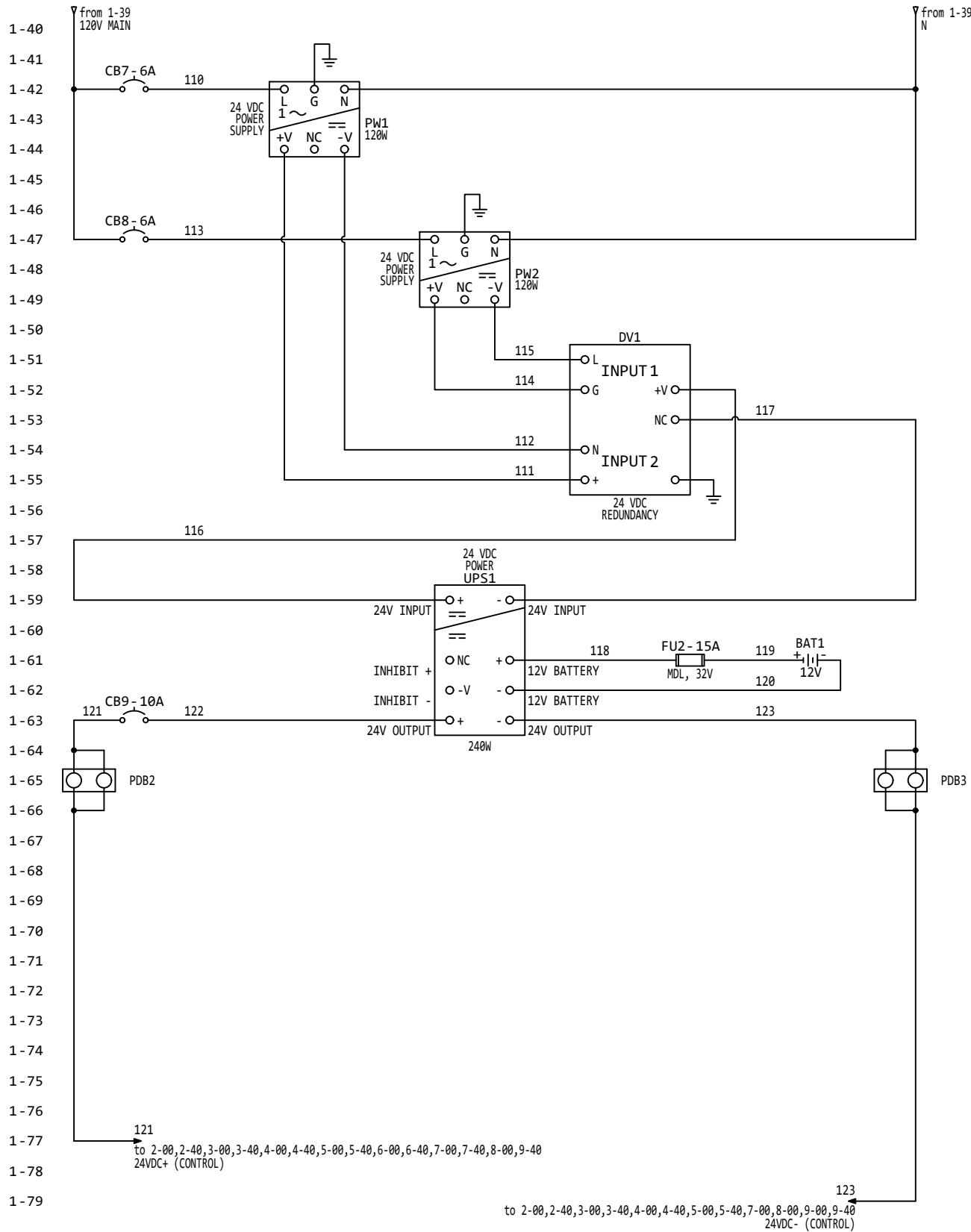
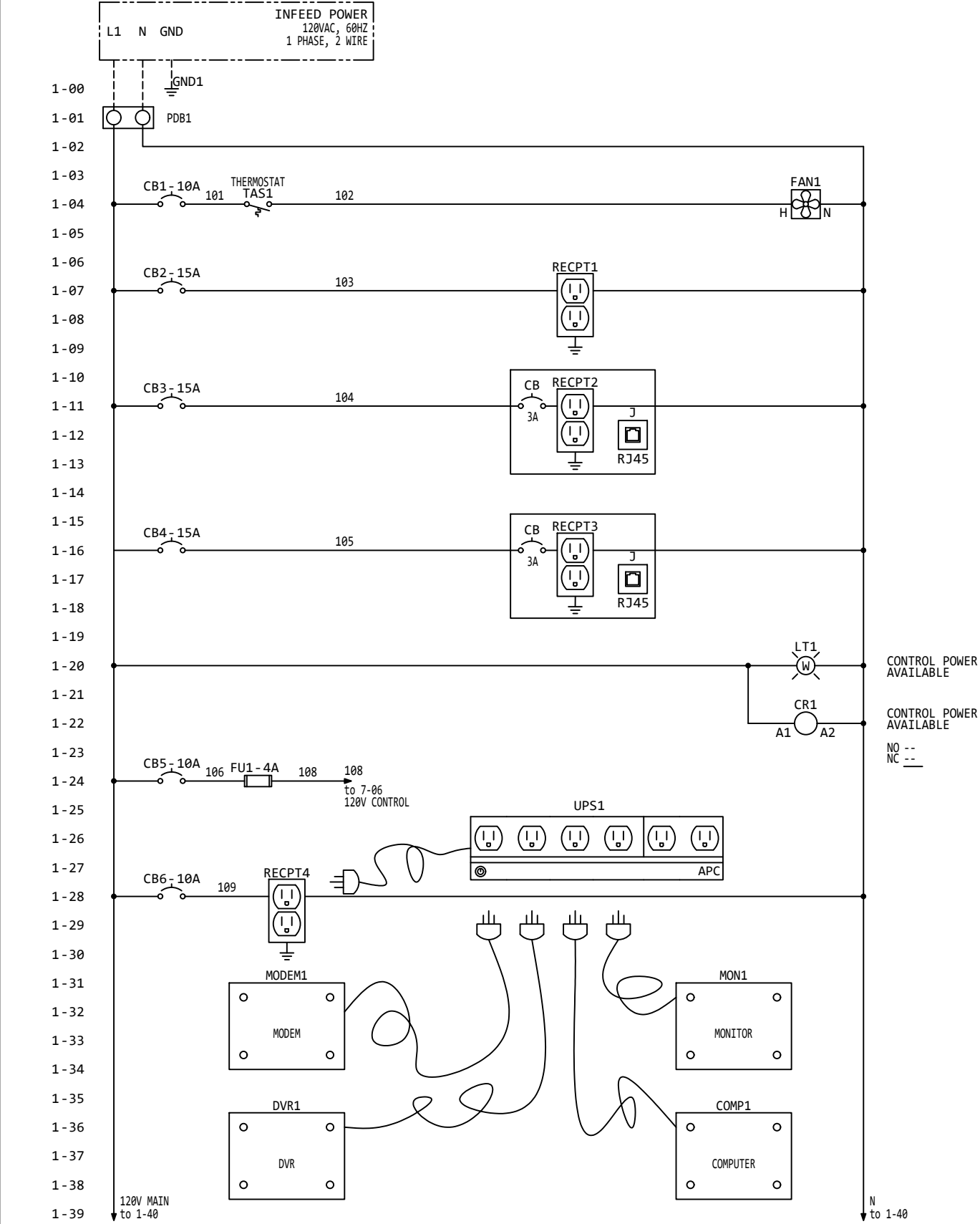
CHECKED

18-230-B3

TAGS	QTY	IFS	CATALOG	MANUFACTURER	DESCRIPTION	QUERY2	QUERY3
ENCLOSURE	1	1052305	AASHLF1218	HOFFMAN	SHELF, ENCL, 12IN X 18IN	ENC SHELF	TYPE 1
ENCLOSURE	1	6001864	APWK2919NFSS	HOFFMAN	WINDOW KIT, 29.00 x 19.00, STAINLESS STEEL, 29.00 x 19.00 IN	WINDOW KIT	NEMA 4X
ENCLOSURE	2	1031477	SCE-DSTOPK	SAGINAW	DOOR STOP KIT, TYPE 1	DOOR STOP KIT	TYPE 1
FAN1	2	6001684	AVK88	HOFFMAN	LOUVER PLATE KIT, 10.56 x 9.50, STEEL, 10.56 x 9.50 IN	LOUVER PLATE KIT	NEMA 4
ENCLOSURE	1	1035422	SCE-72P72	SAGINAW	PLATE, BACK, 72X72 N3R, 4, 4X, 12 SAGINAW	STEEL	BACK PANEL
TAS1	1	1035576	CTS	INGRAM	THERMOSTAT, ADJUSTABLE 30-140 F, 1 NO	THERMOSTAT	30-140 F
FAN1	1	1021631	SP100A-1123XBT.GN	SUNON	FAN, 117 CFM, 115 VAC, 4.72X1.49"	117CFM	SIDE MOUNT
FAN1	2	1021633	09450-F/30	QUALTEK	GUARD, FILTER 30PPI, PLASTIC, 4.72"	GUARD	SIDE MOUNT
FAN1	1	1021632	8141	QUALTEK	GUARD, FINGER, METAL, 4.72"	GUARD	SIDE MOUNT
PDB1,PDB2,PDB3	3	1047503	CC1412	MARATHON	Cover: 2-pole bloc 115 Amp 141 SERIES	COVER	1.42" x 2.40"
PDB1,PDB2,PDB3	3	6000531	1412400	MARATHON	POWER DISTRIBUTION BLOCK, 2-POLE W/COVER	1x 14-2	4x 16-10
TB1,TB2,TB3,TB4	227	1038973	3044131	PHOENIX CONTACT	UNIVERSAL TERMINAL BLOCK - UT 6	FEED-THROUGH	57AMPS
TB2	14	1039246	3044157	PHOENIX CONTACT	UNIVERSAL GROUND TERMINAL BLOCK - UT 6-PE	FEED-THROUGH GROUND	57AMPS
GND1	1	1026029	AU-0	ILSCO	GROUND LUG, ALUMINIUM, LUG SIZE 0	GROUND LUG	2x 14-1/0
UPS1	1	1066052	CP1000PFCLCDTAA	CYBERPOWER	UNINTERRUPTIBLE POWER SUPPLY 1000VA	120VAC	TAA SERIES
PW1,PW2	2	1049131	CS5.243	PULS	UNIVERSAL 24VDC POWER SUPPLY, UL508, 5AMP	24VDC/5.0A	SINGLE-PHASE
DV1	1	1065530	YR20.246	PULS	REDUNDANCY MODULE, 2x24-28VDC IN, 1x24-28VDC OUT, 20A MAX	24VDC/20.0A	SINGLE-PHASE
CB1,CB5,CB6,CB9	4	1030217	M9F42110	SCHNEIDER ELECTRIC	MINIATURE CIRCUIT BREAKER MULTI 9 - C60N - 1 POLE - 10AMP - C CURVE	1-POLE MINIATURE CIRCUIT BREAKER	10AMP
CB2,CB3,CB4	3	1030942	M9F42115	SCHNEIDER ELECTRIC	MINIATURE CIRCUIT BREAKER MULTI 9 - C60N - 1 POLE - 15AMP - C CURVE	1-POLE MINIATURE CIRCUIT BREAKER	15AMP
CB7,CB8	2	1033951	M9F42106	SCHNEIDER ELECTRIC	MINIATURE CIRCUIT BREAKER MULTI 9 - C60N - 1 POLE - 6AMP - C CURVE	1-POLE MINIATURE CIRCUIT BREAKER	6AMP
CB10	1	1030216	M9F42103	SCHNEIDER ELECTRIC	MINIATURE CIRCUIT BREAKER MULTI 9 - C60N - 1 POLE - 3AMP - C CURVE	1-POLE MINIATURE CIRCUIT BREAKER	3AMP
ENCLOSURE	1	1043167	SCE-72EL7224SSLPL	SAGINAW	ENCLOSURE, N4X 304SS, 72X72X24, EL, 3PTL, SAG	TWO-DOOR ENCLOSURE	NEMA 4X

TAGS	QTY	IFS	CATALOG	MANUFACTURER	DESCRIPTION	QUERY2	QUERY3
FU1	1	1040023	KTK-R-4	BUSSMANN	FUSE - CLASS CC	FAST ACTING	600VAC
FU1	1	1031446	DFCC1	SCHNEIDER ELECTRIC	1 POLE FUSE BLOCK - CLASS CC, 1/10-30AMPS, 600VAC FUSE HOLDER		600VAC
FU2	1	1027938	MDL-15-R	BUSSMANN	FUSE - MDL, 1/4" - 1 1/4", 15AMP, 32VAC	TIME DELAY, GLASS TUBE WITH NICKEL-	32VAC
FU2	1	1049087	3004265	PHOENIX CONTACT	TERM,FUSED,1P,UK6,3 HESILED,CARTRIDGE,LED 12- 30V AC/DC	6.3 x 32 mm	30v
XD7	1	NEW	XTP50N-030- N40140F	PRO SENSE	TRANSDUCER, TEMPERATURE, 4-20mA, -40-140F	CURRENT	XTP50
XD7	1	NEW	7024-12341- 3212500	MURRELEKTRONIK	TRANSDUCER, TEMPERATURE, CABLE,M12,4- POLE,82FT	CABLE	M12 4P
HMI1	1	1041173	V1210-T20BJ	UNITRONICS	HMI/PLC MODULE	VISION	12"
HMI1	1	1035392	V200-19-ET2	UNITRONICS	HMI/PLC, ETHERNET MODULE, V570 AND UP	ETHERNET	5.7"-12"
MODEM1	1	NEW	05224- MODEMXXXX	KENNEDY	CSP-KENNEDY MODEM, ETH, 120VAC	MODEM	MODEM
MON1	1	NEW	05224-MONXXXX	KENNEDY	CSP-KENNEDY PC MONITOR, 120VAC	MONITOR	PANEL MOUNT
DVR1	1	NEW	05224-DVRXXXX	KENNEDY	CSP-KENNEDY DVR, 120VAC	DVR	RACK MOUNT
COMP1	1	NEW	05224-COMPXXXX	KENNEDY	CSP-KENNEDY COMPUTER, 120VAC	COMPUTER	PANEL MOUNT
EM2,EM3,EM4	3	1037536	IO-DI16	UNITRONICS	IO INPUT/OUTPUT MODULE, 16 DC INPUTS, 24VDC POWER	IO	INPUT
ES1,ES2	2	1054639	2891002	PHOENIX	ETHERNET SWITCH, UNMANAGED, INDUSTRIAL, 8 PORT, 24VDC	ETHERNET SWITCH	8 PORT
FIRE1	1	NEW	05224-EDR-G902	MOXA	CSP-KENNEDY FIREWALL, 24VDC	FIREWALL	RACK MOUNT
MODEM2	1	NEW	05224- MODEM2XXXX	KENNEDY	CSP-KENNEDY MODEM, ETH, 24VDC	MODEM	MODEM
EM1	1	1030209	EX-D16A3-RO8	UNITRONICS	EX INPUT/OUTPUT MODULE, 16 DC INPUTS, 3 ANALOG INPUTS, 8 RELAY OUTPUTS, 24VDC POWER	EX	COMBINATION
EM5	1	1033323	IO-AO6X	UNITRONICS	IO INPUT/OUTPUT MODULE, 6 ANALOG OUTPUTS, 24VDC POWER	IO	OUTPUT
PLC1	1	1038581	V200-18-E46B	UNITRONICS	V200 INPUT/OUTPUT MODULE, 18 DC INPUTS, 9 ANALOG INPUTS, 15 RELAY OUTPUTS, 2 TRANSISTOR	V200	COMBINATION
ISB1,ISB2,ISB3,ISB4,ISB 5,ISB6	6	1047680	MZB87P	TURCK	ZENER BARRIER, 1CH, 4-20MA, K1075, MZB87P, TURCK 1 CHANNEL		20-35VDC
CR1	1	1032613	RSL1PVFU	SCHNEIDER ELECTRIC	PLUG-IN RELAY, TYPE ZELIO, INTERFACE RELAY, 1 C/O	TYPE RSL	120VAC/VDC
CR1	2	1032614	RSLZ2	SCHNEIDER ELECTRIC	PLUG-IN RELAY, JUMPER BAR 20-POS	TYPE RSL	NA

TAGS	QTY	IFS	CATALOG	MANUFACTURER	DESCRIPTION	QUERY2	QUERY3
CR10,CR11,CR12,CR13,CR14,CR15,CR16,CR17,	28	1031573	RSL1PVBU	SCHNEIDER ELECTRIC	PLUG-IN RELAY, TYPE ZELIO, INTERFACE RELAY, 1 C/O	TYPE RSL	24VAC/VDC
CR24	1	1028815	RXZE2M114M	SCHNEIDER ELECTRIC	SOCKET FOR RELAYS TYPE RXM	TYPE RXM	SOCKET
CR24	1	1030213	RXM4AB2BD	SCHNEIDER ELECTRIC	PLUG-IN MINIATURE RELAY, TYPE RXM, SOCKET RXZE2M114M, WITH LED	TYPE RXM	24VDC
LT1	1	1039334	9001-SKP1W31	SQD	WHITE PILOT LIGHT - STANDARD, NEMA 4/4X/13	30.5mm	120VAC XFMR
LT10,LT2,LT3,LT4,LT5,LT6,LT7,LT8,LT9	9	1040199	9001-SKP35G31	SQD	GREEN PILOT LIGHT - STANDARD, NEMA 4/4X/13	30.5mm	24VAC/VDC FULL VOLT
AL1	1	1032855	SBN1224AD-R	INGRAM	BEACON, SBN LED, RED, TYPE 4X, 12-24VDC	LED	12-24VDC
RECPT1,RECPT4	2	1040368	GF15WLA	HUBBELL	DUPLEX, GFCI, WHT	15 AMP	125 VOLT
RECPT1	1	1028216	RAC 660	RACO	OUTLET, HANDY BOX, METAL	OUTLET	HANDY BOX
RECPT2,RECPT3	2	1032998	P-R33-K3RF3	GRACEPORT	DUPLEX RECEPTACLE, GFCI, NEMA 4X, 2 POLE, 3-WIRE W/ ETHERNET PORT	3 AMP	125 VOLT
BAT1	1	1024952	LC-RA1212P1	PANASONIC	BATTERY, 12V, 12AH, LEAD ACID	12VDC	12AH
LABEL	1	1005699	1005699	PRIMEX	LABEL, WARNING, DISCONNECT POWER, ENGLISH / FRENCH, LARGE	LABEL	DISCONNECT POWER
LABEL	1	1024481	1024481	PRIMEX	LABEL, WARNING, INTRINSICALLY SAFE CIRCUITS, UL698A, ENGLISH / FRENCH	LABEL	EXPLOSION HAZARD
LABEL	1	1028503	1028503	SJE-RHOMBUS	LABEL, SERIAL NUMBER, UL698A, ASHLAND	UL	ASSEMBLY
LABEL	1	1028758	1028758	SJE-RHOMBUS	LABEL, UL698A, ASHLAND, E151538-A	UL	ASSEMBLY
SCHEMATIC	1	1028516	PRODUCT SCHEMATIC	SJE-RHOMBUS	LABEL, SCHEMATIC, MATCHES PANEL NUMBER	LABEL	SCHEMATIC



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SHEET NUMBER
1 OF 14

NO.	REVISION HISTORY	DATE	BY
5.0	RE-SUBMITTAL	5/26/20	ARS
4.0	RE-SUBMITTAL	5/12/20	ARS
3.0	RE-SUBMITTAL	4/17/20	NG/AS
2.0	RE-SUBMITTAL	2/21/20	SEL
1.0	INITIAL SUBMITTAL	10/14/20	SEL



KENNEDY INDUSTRIES INC.
SAGINAW, MI
GAGE DRAIN-SPICER ENG

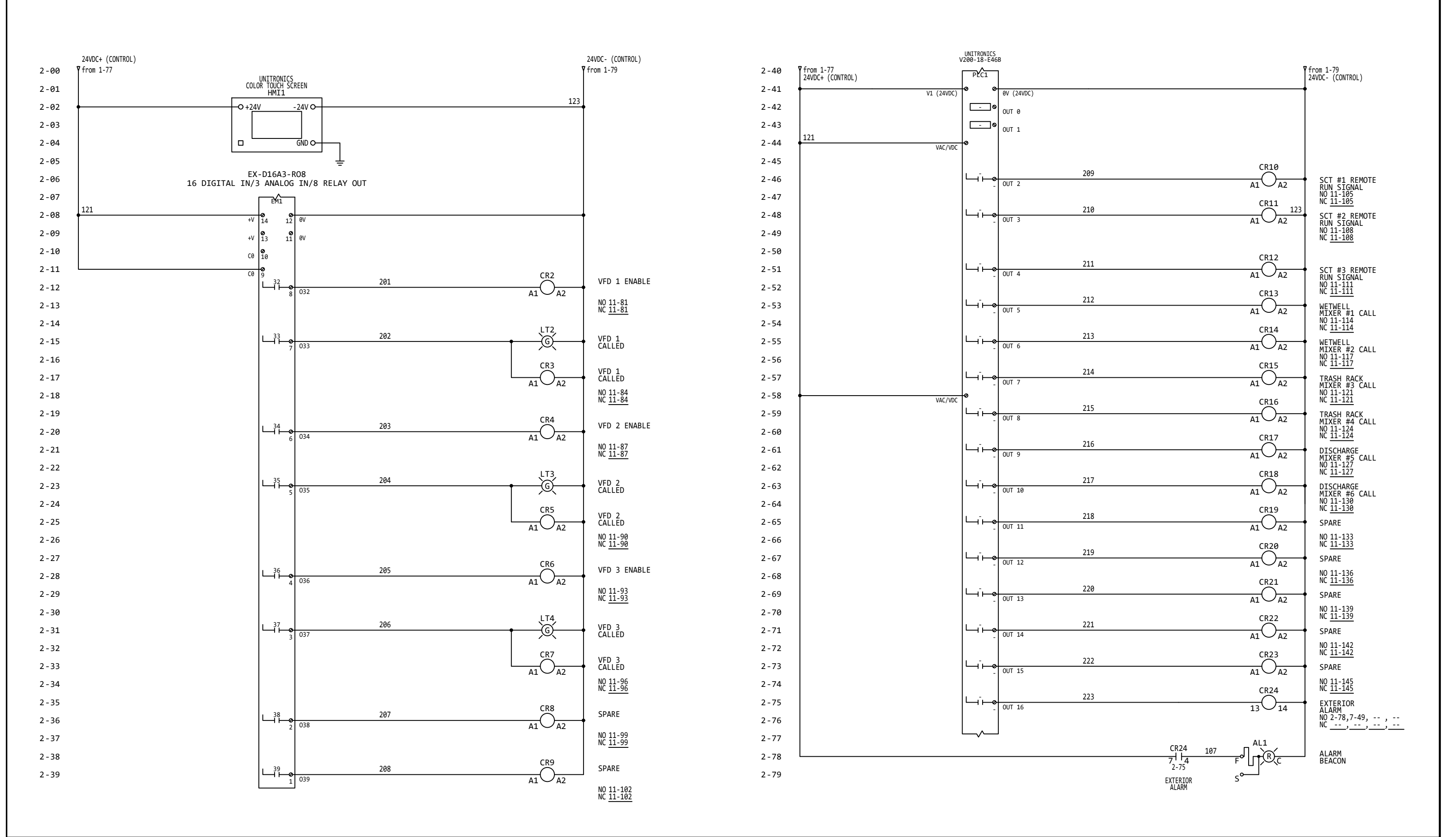
DRAWN BY
SEL

DATE
10/3/19

PANEL REQUIREMENTS
SYM.
VOLTAGE 120 VAC
PHASE 1 PHASE
FREQUENCY 60 Hz
SCCR 5 kA
TOTAL FLA 48.18
TYPE 3R

LARGEST MOTOR POWER REQUIREMENTS
HP
FLA
N/A
N/A

PROJECT NUMBER
4005072A



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SHEET NUMBER
2 OF 14

NO.	REVISION HISTORY	DATE	BY
5.0	RE-SUBMITTAL	5/26/20	ARS
4.0	RE-SUBMITTAL	5/12/20	ARS
3.0	RE-SUBMITTAL	4/17/20	NG/AS
2.0	RE-SUBMITTAL	2/21/20	SEL
1.0	INITIAL SUBMITTAL	10/14/20	SEL



KENNEDY INDUSTRIES INC.
SAGINAW, MI
GAGE DRAIN-SPICER ENG

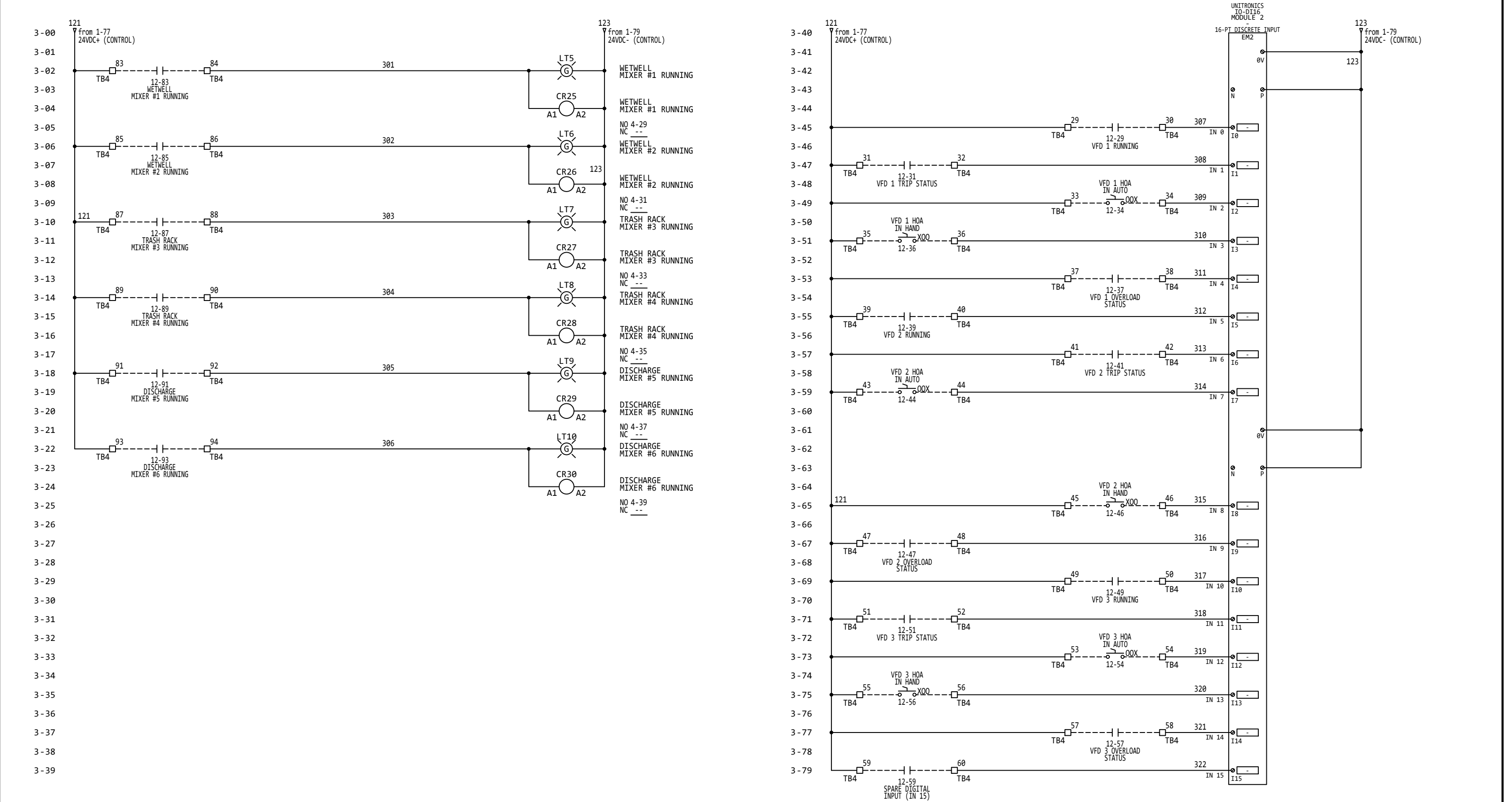
DRAWN BY
SEL

DATE
10/3/19

PANEL REQUIREMENTS
SYM.
VOLTAGE 120 VAC
PHASE 1 PHASE
FREQUENCY 60 Hz
SCCR 5 kA
TOTAL FLA 48.18
TYPE 3R

LARGEST MOTOR POWER REQUIREMENTS
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FLA
N/A
N/A

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SHEET NUMBER
3 OF 14

NO.	REVISION HISTORY	DATE	BY
5.0	RE-SUBMITTAL	5/26/20	ARS
4.0	RE-SUBMITTAL	5/12/20	ARS
3.0	RE-SUBMITTAL	4/17/20	NG/AS
2.0	RE-SUBMITTAL	2/21/20	SEL
1.0	INITIAL SUBMITTAL	10/14/20	SEL



KENNEDY INDUSTRIES INC.
SAGINAW, MI
GAGE DRAIN-SPICER ENG

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SEL

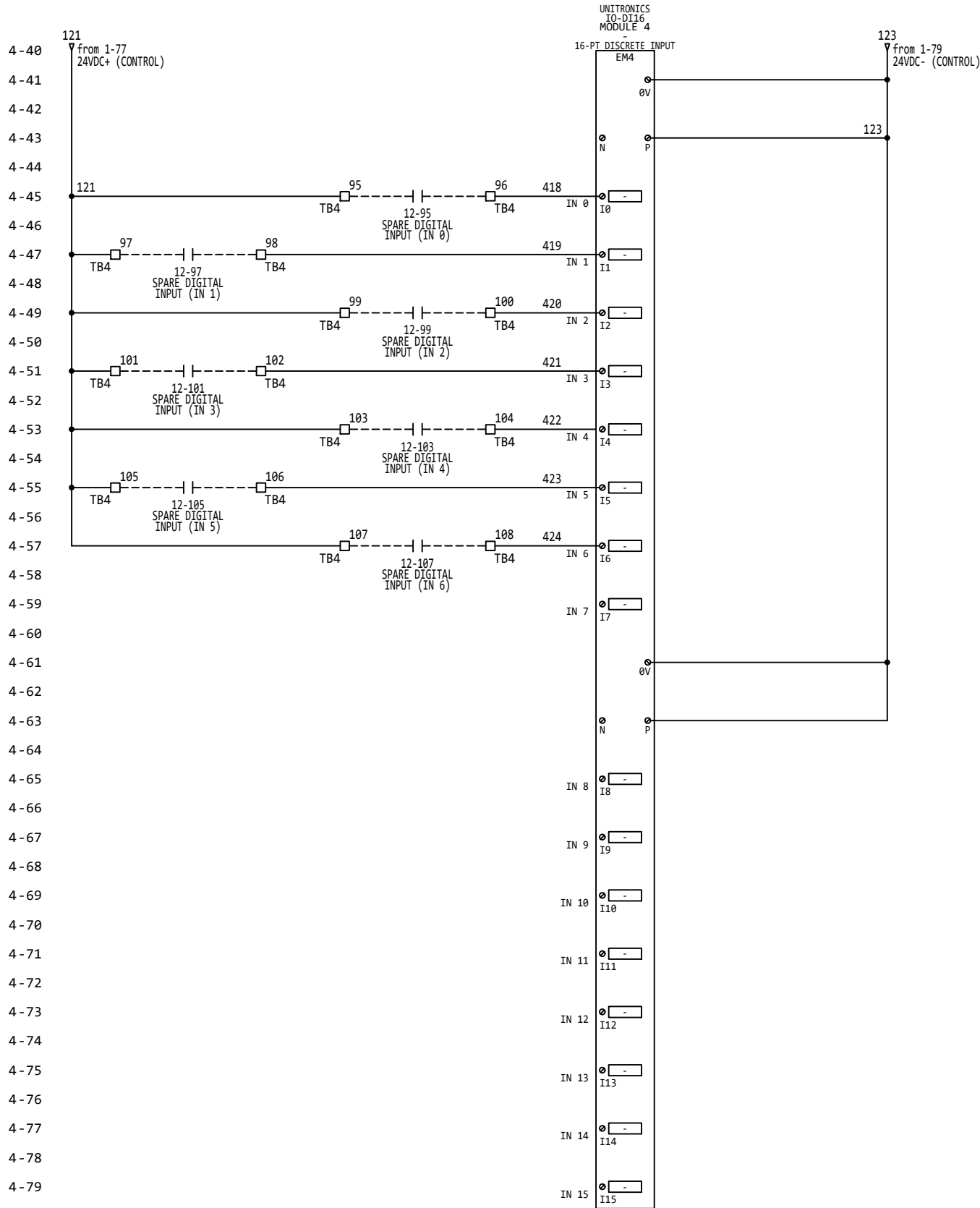
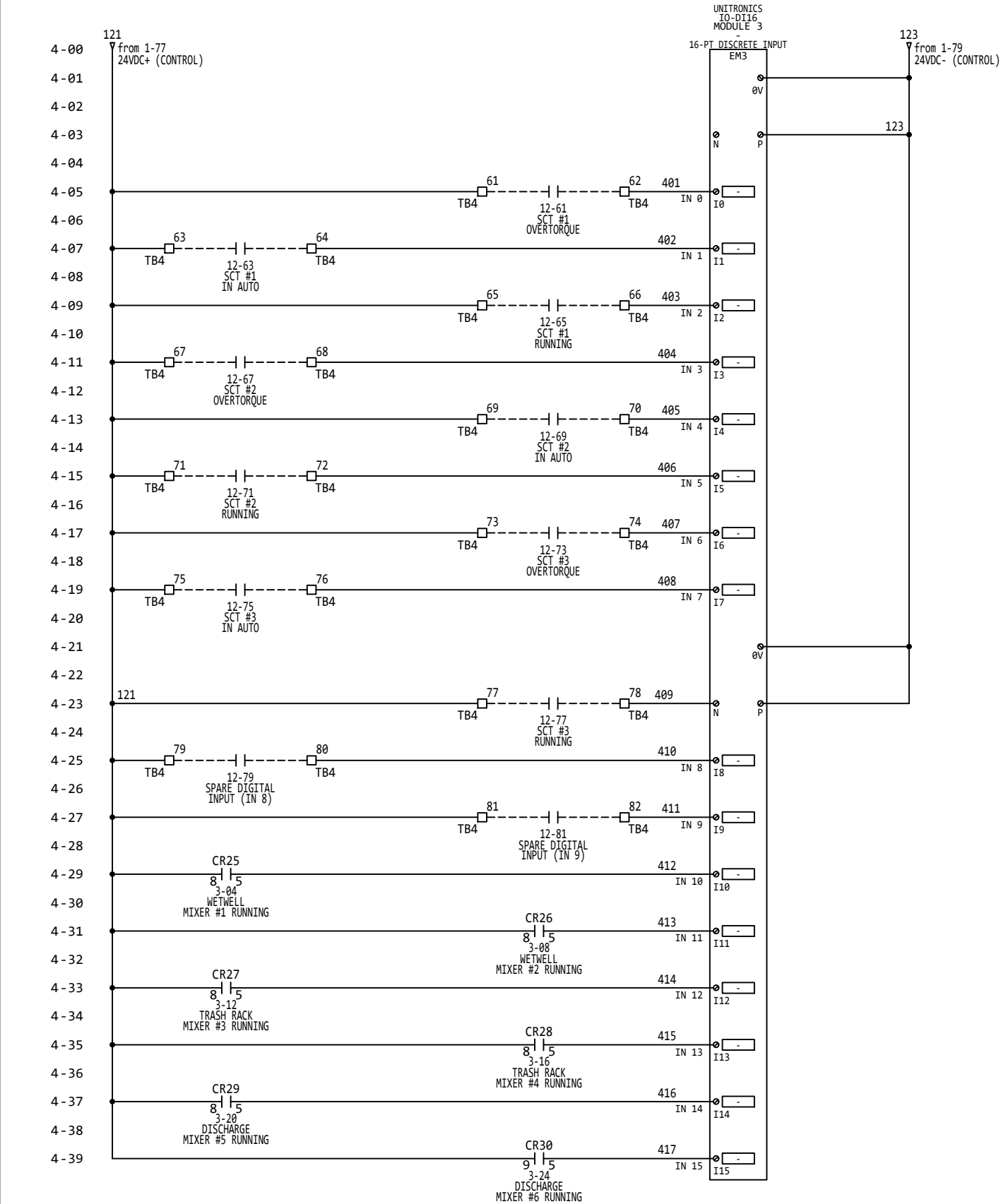
DATE
10/3/19

PANEL REQUIREMENTS
SYM.
VOLTAGE 120 VAC
PHASE 1 PHASE
FREQUENCY 60 Hz
SCCR 5 kA
TOTAL FLA 48.18
TYPE 3R

LARGEST MOTOR POWER REQUIREMENTS
HP
FLA

N/A
N/A

PROJECT NUMBER
4005072A



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SHEET NUMBER
4 OF 14

NO.	REVISION HISTORY	DATE	BY
5.0	RE-SUBMITTAL	5/26/20	ARS
4.0	RE-SUBMITTAL	5/12/20	ARS
3.0	RE-SUBMITTAL	4/17/20	NG/AS
2.0	RE-SUBMITTAL	2/21/20	SEL
1.0	INITIAL SUBMITTAL	10/14/20	SEL



KENNEDY INDUSTRIES INC.
SAGINAW, MI
GAGE DRAIN-SPICER ENG

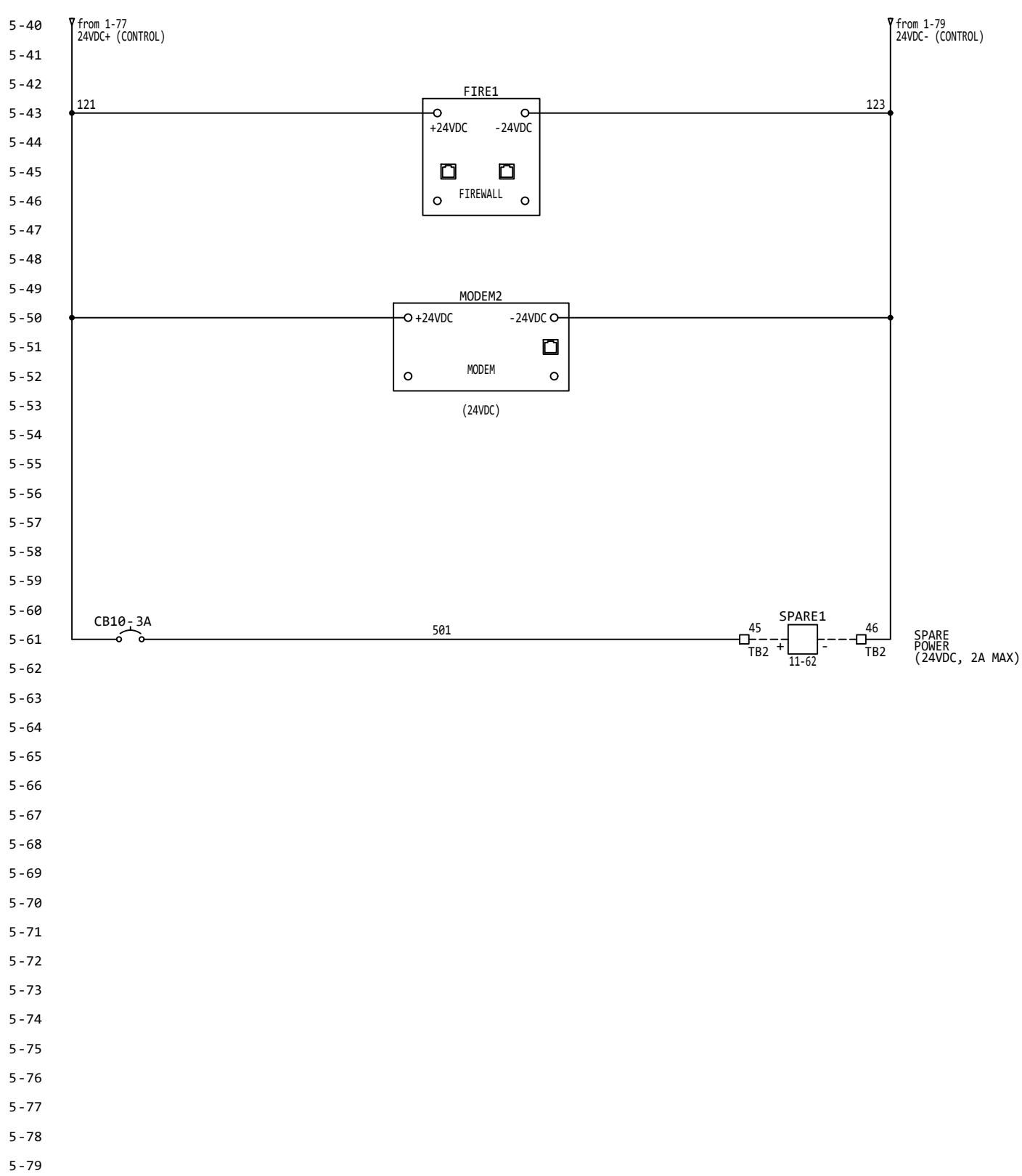
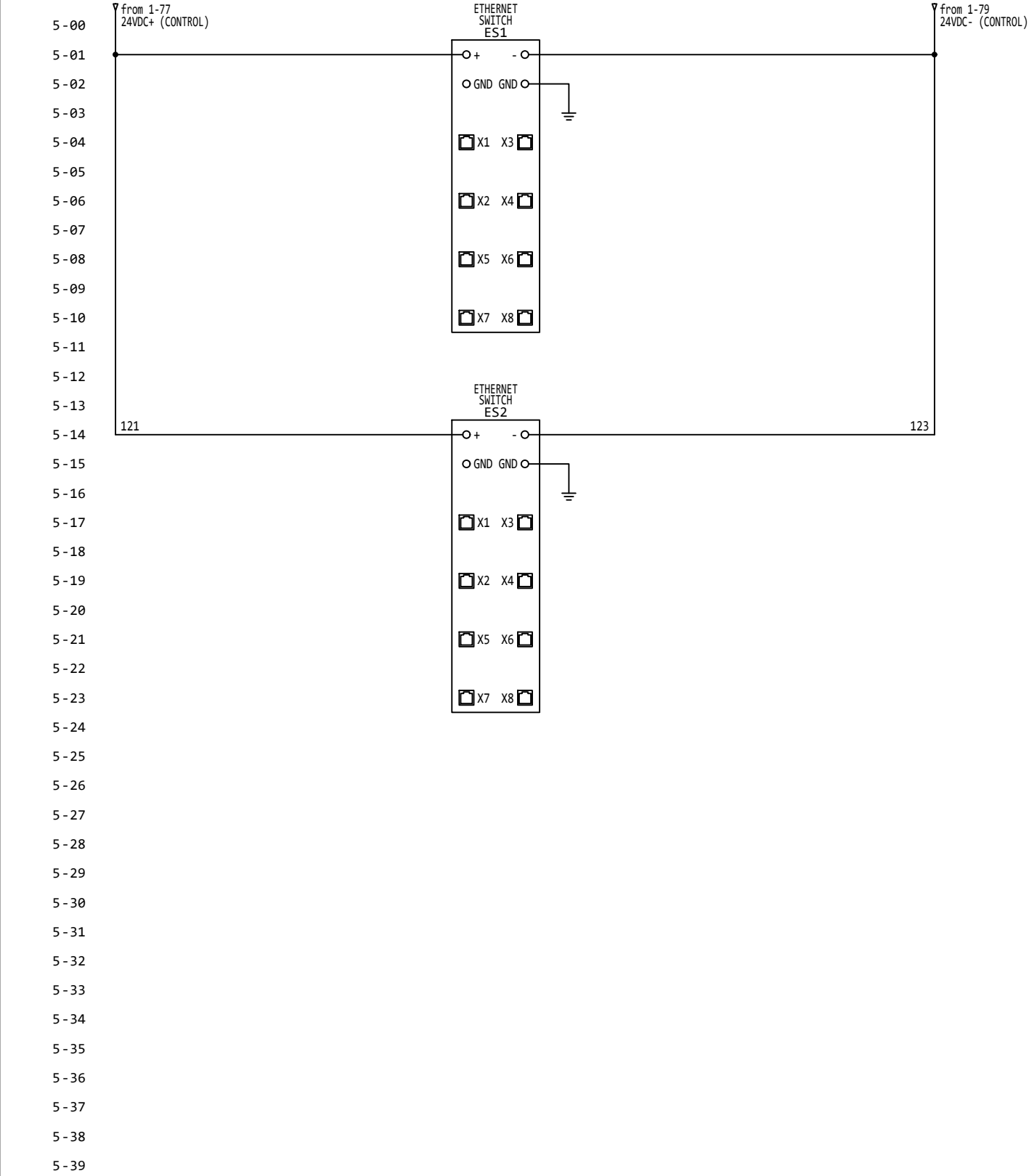
DRAWN BY
SEL

DATE
10/3/19

PANEL REQUIREMENTS
SYM.
VOLTAGE 120 VAC
PHASE 1 PHASE
FREQUENCY 60 Hz
SCCR 5 kA
TOTAL FLA 48.18
TYPE 3R

LARGEST MOTOR POWER REQUIREMENTS
HP
FLA
N/A
N/A

PROJECT NUMBER
4005072A



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SHEET NUMBER
5 OF 14

NO.	REVISION HISTORY	DATE	BY
5.0	RE-SUBMITTAL	5/26/20	ARS
4.0	RE-SUBMITTAL	5/12/20	ARS
3.0	RE-SUBMITTAL	4/17/20	NG/AS
2.0	RE-SUBMITTAL	2/21/20	SEL
1.0	INITIAL SUBMITTAL	10/14/20	SEL



KENNEDY INDUSTRIES INC.
SAGINAW, MI
GAGE DRAIN-SPICER ENG

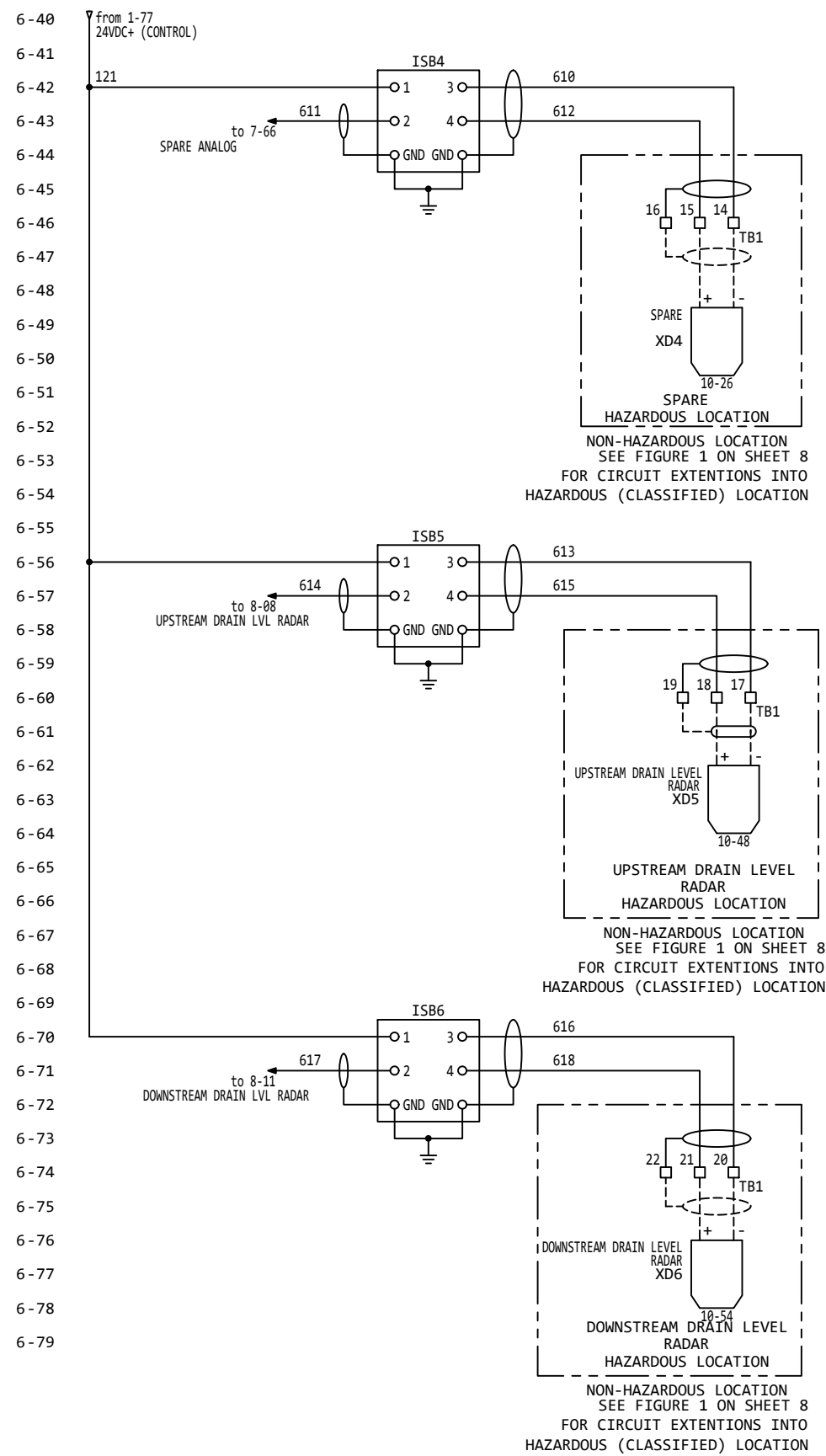
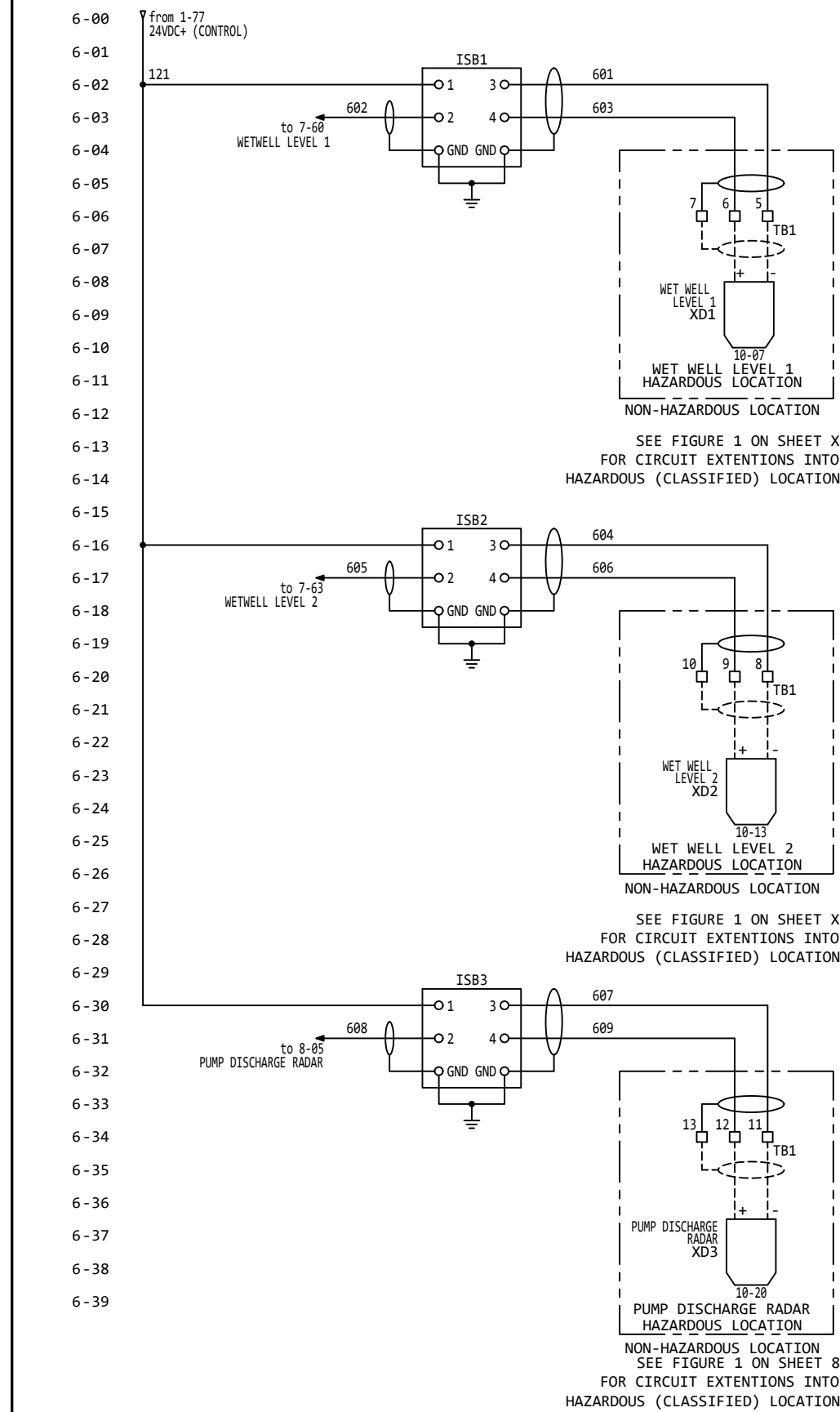
DRAWN BY
SEL

DATE
10/3/19

PANEL REQUIREMENTS	
SYM.	
VOLTAGE	120 VAC
PHASE	1 PHASE
FREQUENCY	60 Hz
SCCR	5 kA
TOTAL FLA	48.18
TYPE	3R

LARGEST MOTOR POWER REQUIREMENTS	
HP	N/A
FLA	N/A

PROJECT NUMBER
4005072A



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SHEET NUMBER			
6 OF 14			
REVISION HISTORY			
NO.	REVISION	DATE	BY
5.0	RE-SUBMITTAL	5/26/20	ARS
4.0	RE-SUBMITTAL	5/12/20	ARS
3.0	RE-SUBMITTAL	4/17/20	NG/AS
2.0	RE-SUBMITTAL	2/21/20	SEL
1.0	INITIAL SUBMITTAL	10/14/20	SEL

PRIMEX

primexcontrols.com
22650 County Highway 6 - Detroit Lakes, MN 56501
888-342-5753

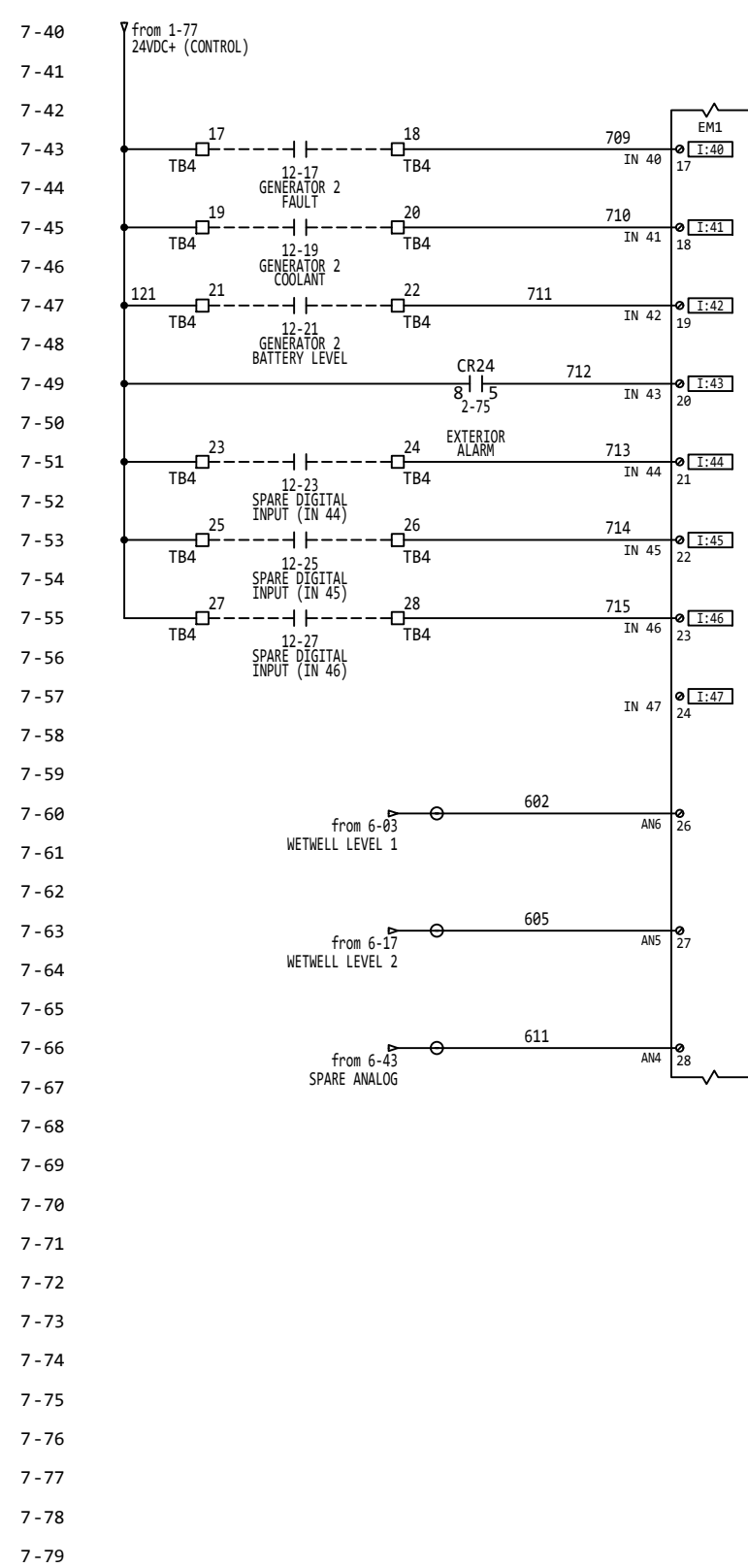
KENNEDY INDUSTRIES INC.
SAGINAW, MI
GAGE DRAIN-SPICER ENG

DRAWN BY
SEL

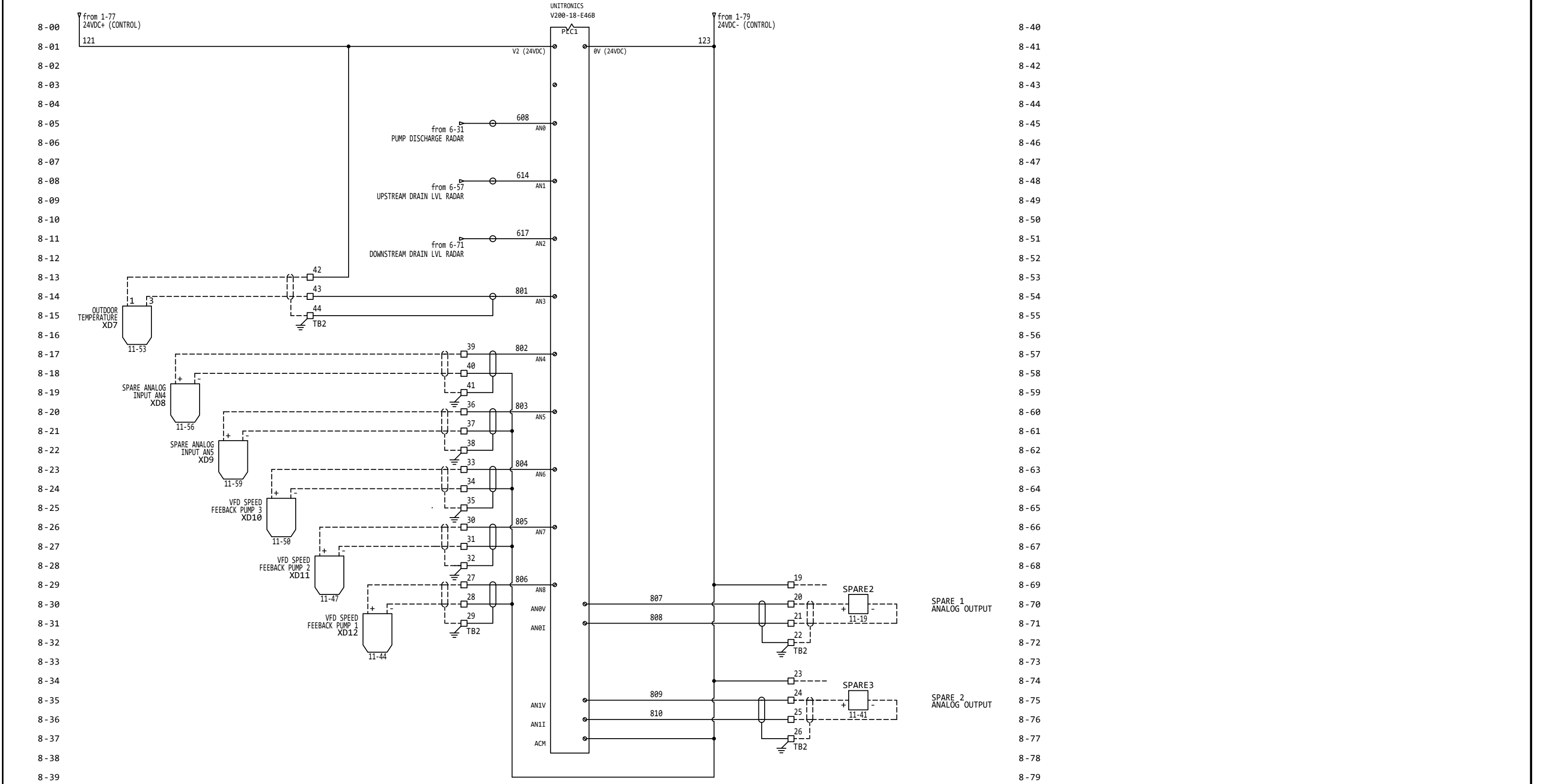
DATE
10/3/19

PANEL REQUIREMENTS	
SYM.	120 VAC
VOLTAGE	1 PHASE
PHASE	60 Hz
FREQUENCY	5 kA
SCCR	48.18
TOTAL FLA	3R
TYPE	

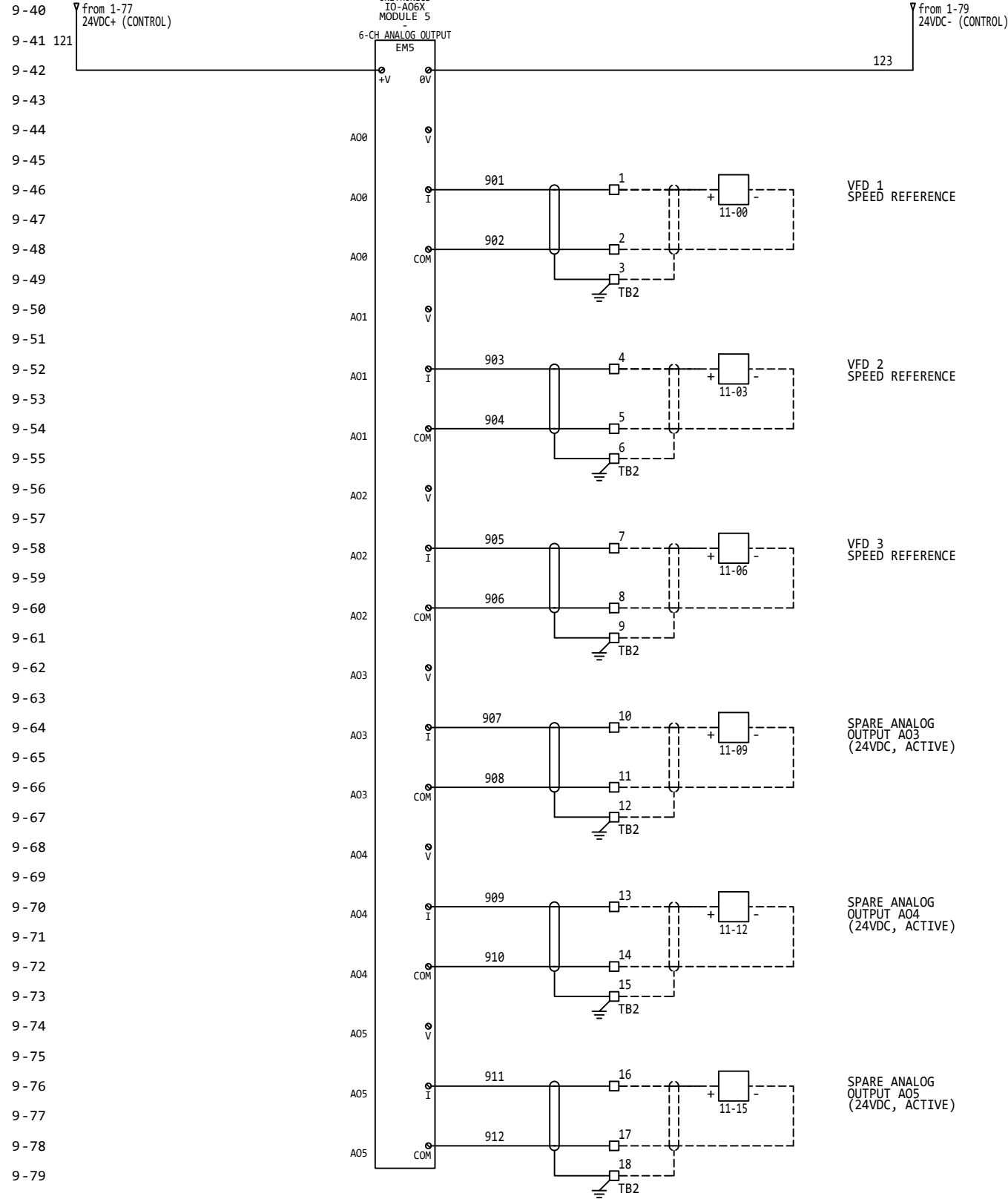
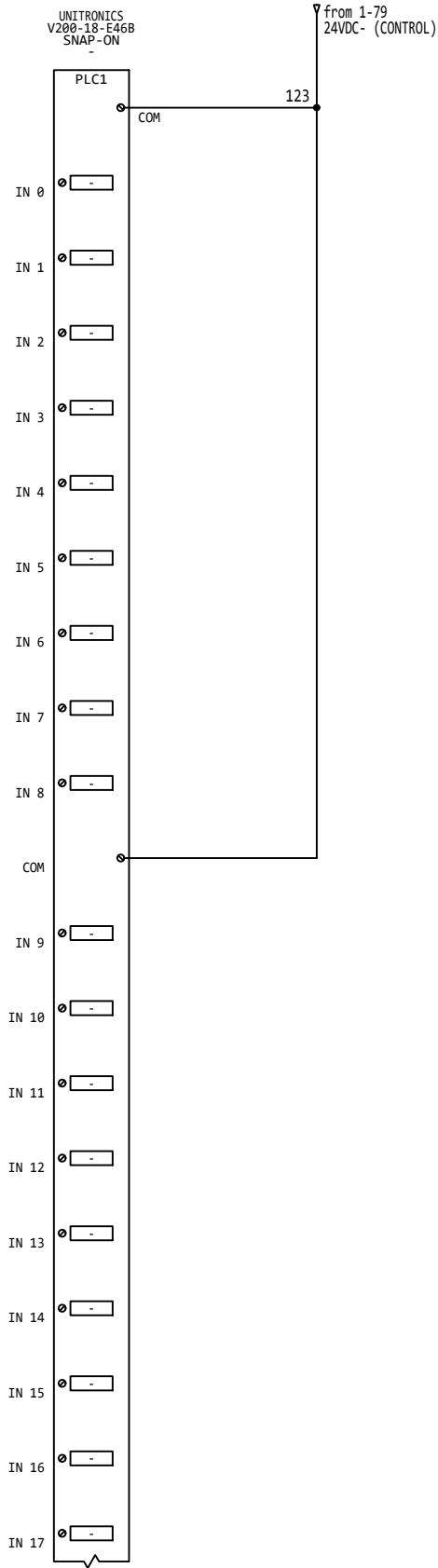
LARGEST MOTOR POWER REQUIREMENTS	
HP	N/A
FLA	N/A
PROJECT NUMBER	
4005072A	



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							SYM.		HP	N/A
							VOLTAGE	120 VAC	FLA	N/A
							PHASE	1 PHASE		
							FREQUENCY	60 Hz		
SHEET NUMBER 7 OF 14	5.0	RE-SUBMITTAL	5/26/20	ARS						
	4.0	RE-SUBMITTAL	5/12/20	ARS						
	3.0	RE-SUBMITTAL	4/17/20	NG/AS						
	2.0	RE-SUBMITTAL	2/21/20	SEL						
	1.0	INITIAL SUBMITTAL	10/14/20	SEL						
	REVISION HISTORY			DATE	BY	DRAWN BY SEL	DATE 10/3/19	PROJECT NUMBER 4005072A		



9-00
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9-39



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SHEET NUMBER
9 OF 14

5.0	RE-SUBMITTAL	5/26/20	ARS
4.0	RE-SUBMITTAL	5/12/20	ARS
3.0	RE-SUBMITTAL	4/17/20	NG/AS
2.0	RE-SUBMITTAL	2/21/20	SEL
1.0	INITIAL SUBMITTAL	10/14/20	SEL
NO.	REVISION HISTORY		DATE BY



KENNEDY INDUSTRIES INC.
SAGINAW, MI
GAGE DRAIN-SPICER ENG

DRAWN BY
SEL

DATE
10/3/19

PANEL REQUIREMENTS

SYM.	
VOLTAGE	120 VAC
PHASE	1 PHASE
FREQUENCY	60 Hz
SCCR	5 kA
TOTAL FLA	48.18
TYPE	3R

LARGEST MOTOR POWER
REQUIREMENTS

HP	N/A
FLA	N/A

PROJECT NUMBER
4005072A

FIELD WIRING SECTION

FIGURE 1
PANEL CONTROL DRAWING

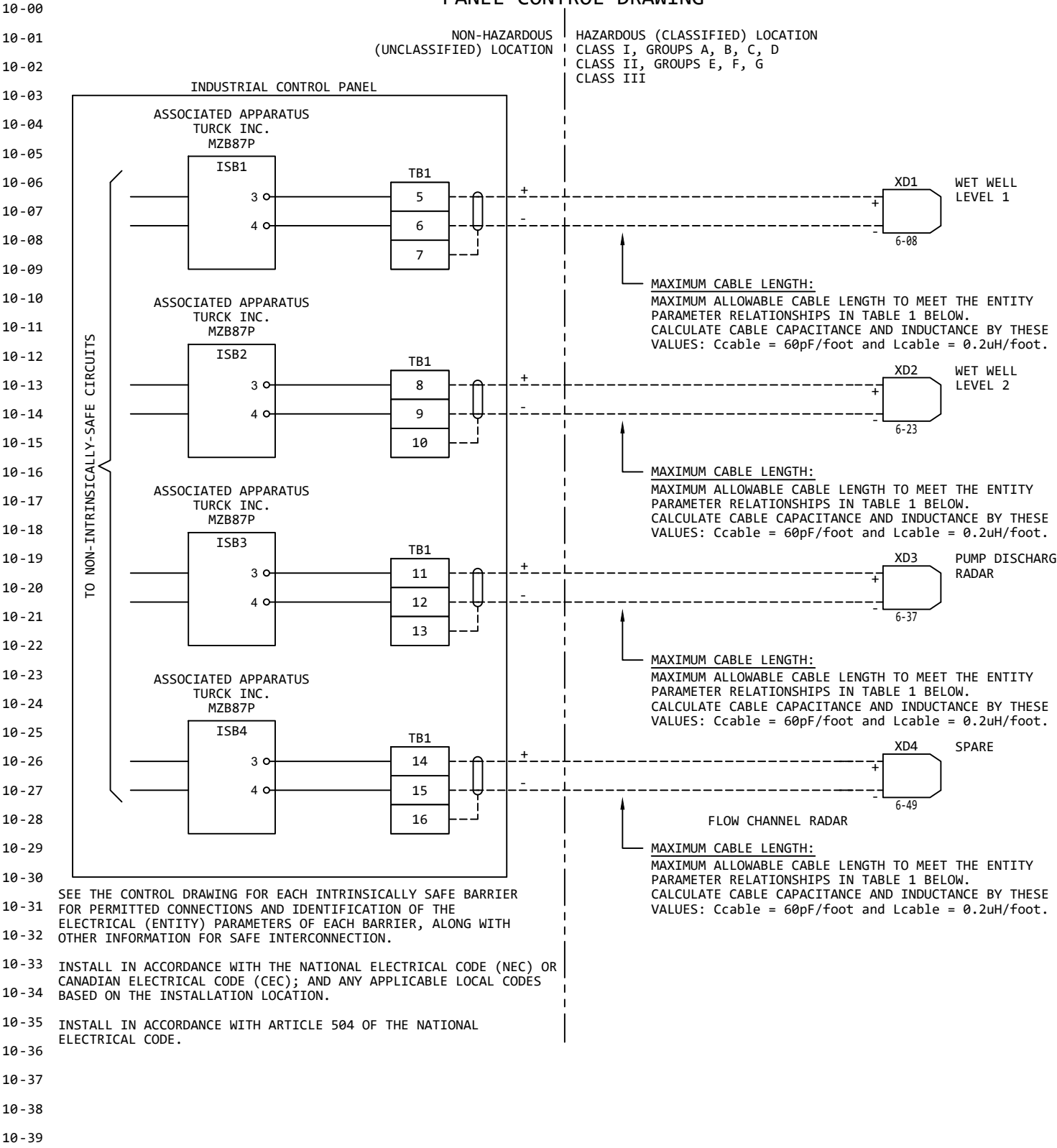


FIGURE 1
PANEL CONTROL DRAWING

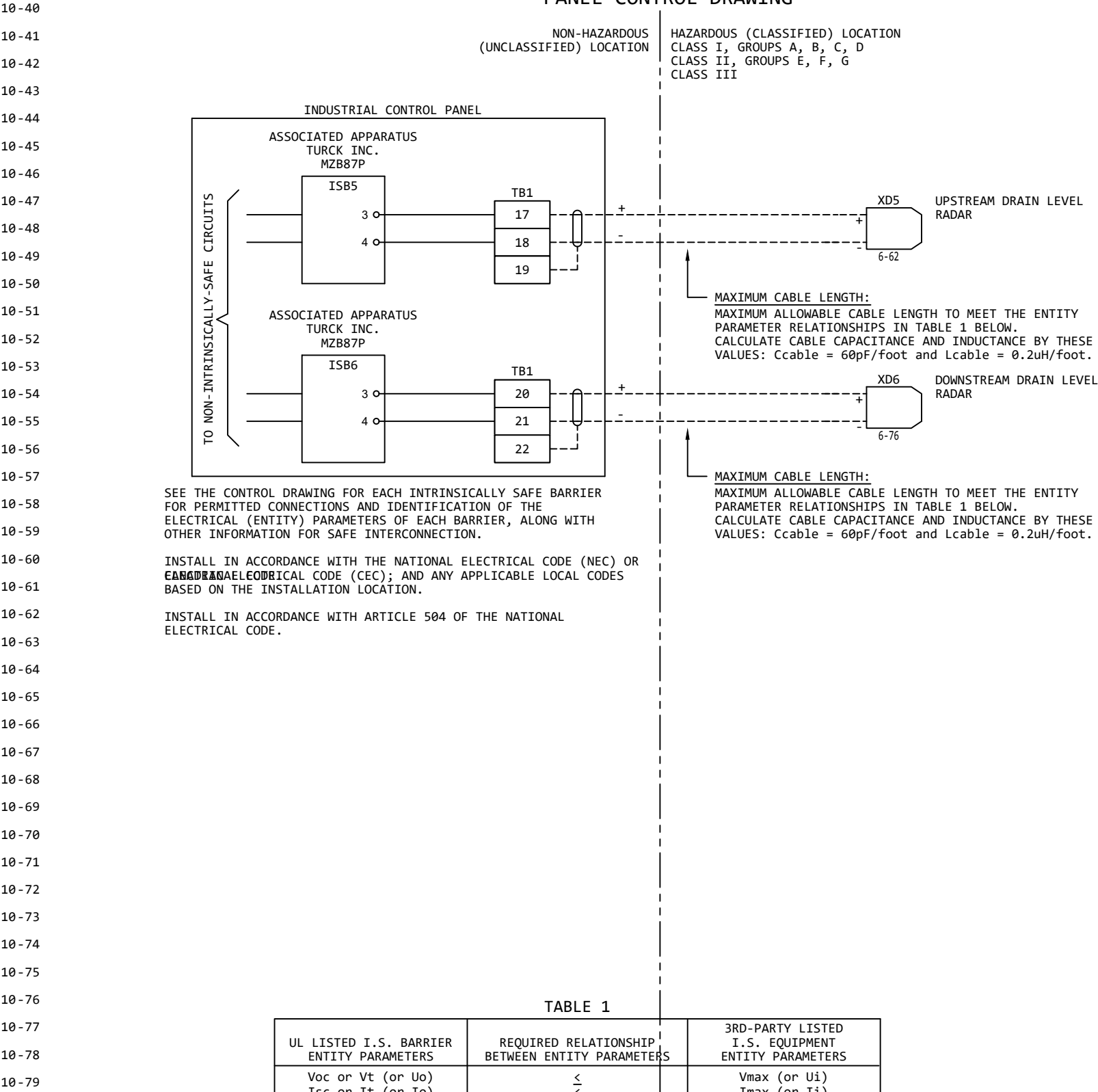


TABLE 1

UL LISTED I.S. BARRIER ENTITY PARAMETERS	REQUIRED RELATIONSHIP BETWEEN ENTITY PARAMETERS	3RD-PARTY LISTED I.S. EQUIPMENT ENTITY PARAMETERS
Voc or Vt (or Uo)	<	Vmax (or Ui)
Isc or It (or Io)	<	Imax (or Ii)
Po	<	Pmax (or Pi)
Ca (or Co)	>	Ci + Ccable
La (or Lo)	>	Li + Lcable

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SHEET NUMBER
10 OF 14

NO.	REVISION HISTORY	DATE	BY
5.0	RE-SUBMITTAL	5/26/20	ARS
4.0	RE-SUBMITTAL	5/12/20	ARS
3.0	RE-SUBMITTAL	4/17/20	NG/AS
2.0	RE-SUBMITTAL	2/21/20	SEL
1.0	INITIAL SUBMITTAL	10/14/20	SEL



KENNEDY INDUSTRIES INC.
SAGINAW, MI
GAGE DRAIN-SPICER ENG

DRAWN BY
SEL

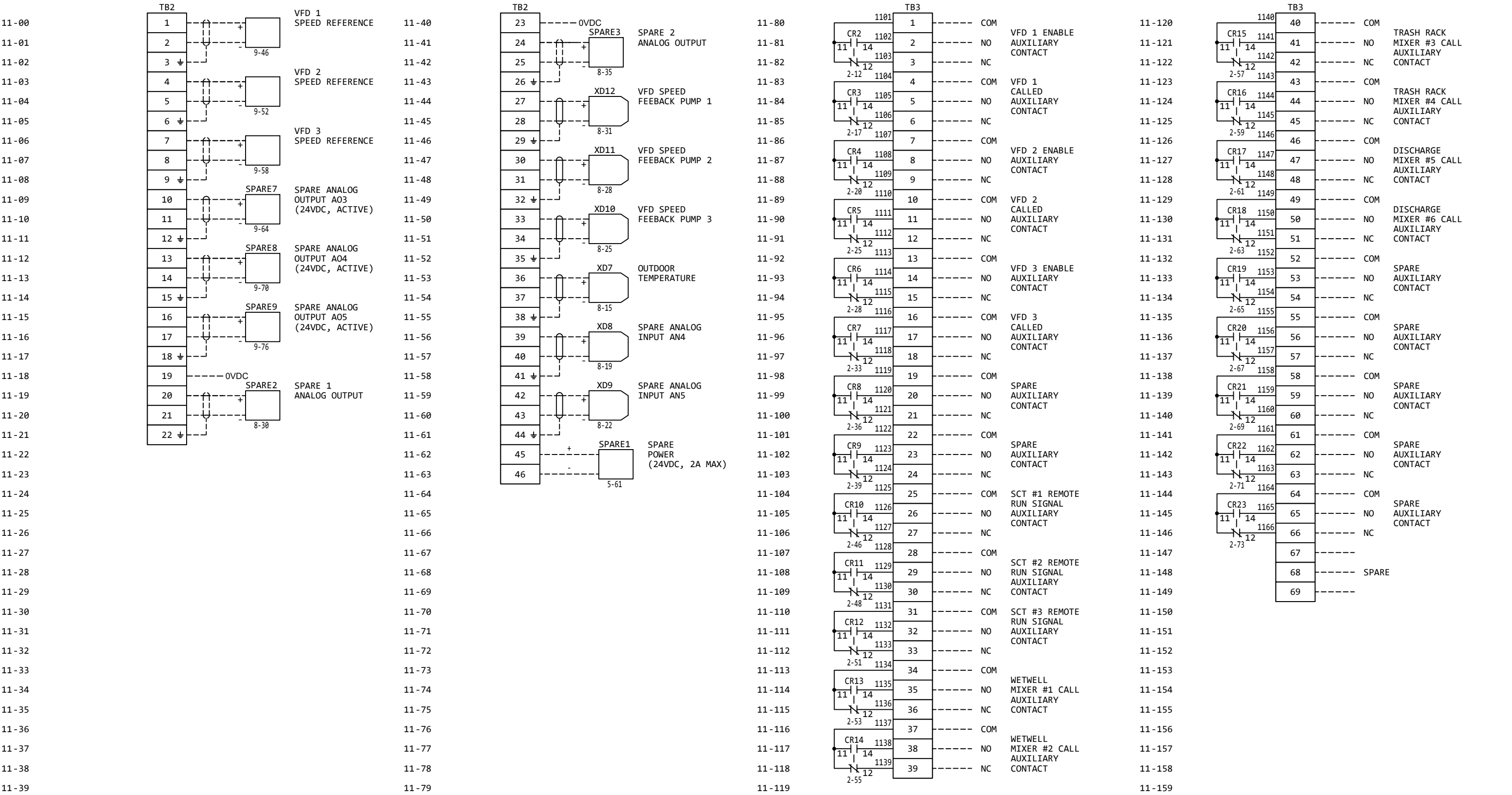
DATE
10/3/19

PANEL REQUIREMENTS
SYM.
VOLTAGE 120 VAC
PHASE 1 PHASE
FREQUENCY 60 Hz
SCCR 5 kA
TOTAL FLA 48.18
TYPE 3R

LARGEST MOTOR POWER
REQUIREMENTS
HP N/A
FLA N/A

PROJECT NUMBER
4005072A

FIELD WIRING SECTION



FIELD WIRING SECTION

12-00	TB4			12-40	TB4			12-80	TB4			12-120		
12-01	1	7-08	ATS POSITION	12-41	41	3-57	VFD 2 TRIP STATUS	12-81	81	4-27	SPARE DIGITAL INPUT (IN 9)	12-121		
12-02	2			12-42	42			12-82	82			12-122		
12-03	3	7-10	GENERATOR 1 ENERGIZED	12-43	43	SS3	VFD 2 HOA IN AUTO	12-83	83	3-02	WETWELL MIXER #1 RUNNING	12-123		
12-04	4			12-44	44	3-59		12-84	84			12-124		
12-05	5	7-12	GENERATOR 1 LOW FUEL PRESSURE	12-45	45	SS4	VFD 2 HOA IN HAND	12-85	85	3-06	WETWELL MIXER #2 RUNNING	12-125		
12-06	6			12-46	46	3-65		12-86	86			12-126		
12-07	7	7-14	GENERATOR 1 FAULT	12-47	47	3-67	VFD 2 OVERLOAD STATUS	12-87	87	3-10	TRASH RACK MIXER #3 RUNNING	12-127		
12-08	8			12-48	48			12-88	88			12-128		
12-09	9	7-16	GENERATOR 1 COOLANT	12-49	49	3-69	VFD 3 RUNNING	12-89	89	3-14	TRASH RACK MIXER #4 RUNNING	12-129		
12-10	10			12-50	50			12-90	90			12-130		
12-11	11	7-18	GENERATOR 1 BATTERY LEVEL	12-51	51	3-71	VFD 3 TRIP STATUS	12-91	91	3-18	DISCHARGE MIXER #5 RUNNING	12-131		
12-12	12			12-52	52			12-92	92			12-132		
12-13	13	7-20	GENERATOR 2 ENERGIZED	12-53	53	SS5	VFD 3 HOA IN AUTO	12-93	93	3-22	DISCHARGE MIXER #6 RUNNING	12-133		
12-14	14			12-54	54	3-73		12-94	94			12-134		
12-15	15	7-22	GENERATOR 2 LOW FUEL PRESSURE	12-55	55	SS6	VFD 3 HOA IN HAND	12-95	95	4-45	SPARE DIGITAL INPUT (IN 0)	12-135		
12-16	16			12-56	56	3-75		12-96	96			12-136		
12-17	17	7-43	GENERATOR 2 FAULT	12-57	57	3-77	VFD 3 OVERLOAD STATUS	12-97	97	4-47	SPARE DIGITAL INPUT (IN 1)	12-137		
12-18	18			12-58	58			12-98	98			12-138		
12-19	19	7-45	GENERATOR 2 COOLANT	12-59	59	3-79	SPARE DIGITAL INPUT (IN 15)	12-99	99	4-49	SPARE DIGITAL INPUT (IN 2)	12-139		
12-20	20			12-60	60			12-100	100			12-140		
12-21	21	7-47	GENERATOR 2 BATTERY LEVEL	12-61	61	4-05	SCT #1 OVERTORQUE	12-101	101	4-51	SPARE DIGITAL INPUT (IN 3)	12-141		
12-22	22			12-62	62			12-102	102			12-142		
12-23	23	7-51	SPARE DIGITAL INPUT (IN 44)	12-63	63	4-07	SCT #1 IN AUTO	12-103	103	4-53	SPARE DIGITAL INPUT (IN 4)	12-143		
12-24	24			12-64	64			12-104	104			12-144		
12-25	25	7-53	SPARE DIGITAL INPUT (IN 45)	12-65	65	4-09	SCT #1 RUNNING	12-105	105	4-55	SPARE DIGITAL INPUT (IN 5)	12-145		
12-26	26			12-66	66			12-106	106			12-146		
12-27	27	7-55	SPARE DIGITAL INPUT (IN 46)	12-67	67	4-11	SCT #2 OVERTORQUE	12-107	107	4-57	SPARE DIGITAL INPUT (IN 6)	12-147		
12-28	28			12-68	68			12-108	108			12-148		
12-29	29	3-45	VFD 1 RUNNING	12-69	69	4-13	SCT #2 IN AUTO	12-109				12-149		
12-30	30			12-70	70			12-110				12-150		
12-31	31	3-47	VFD 1 TRIP STATUS	12-71	71	4-15	SCT #2 RUNNING	12-111				12-151		
12-32	32			12-72	72			12-112				12-152		
12-33	33	SS1	VFD 1 HOA IN AUTO	12-73	73	4-17	SCT #3 OVERTORQUE	12-113				12-153		
12-34	34	3-49		12-74	74			12-114				12-154		
12-35	35	SS2	VFD 1 HOA IN HAND	12-75	75	4-19	SCT #3 IN AUTO	12-115				12-155		
12-36	36	3-51		12-76	76			12-116				12-156		
12-37	37	3-53	VFD 1 OVERLOAD STATUS	12-77	77	4-23	SCT #3 RUNNING	12-117				12-157		
12-38	38			12-78	78			12-118				12-158		
12-39	39	3-55	VFD 2 RUNNING	12-79	79	4-25	SPARE DIGITAL INPUT (IN 8)	12-119				12-159		
	40				80									

1-01

PDB1

L1

N

GND

INFEED POWER
120VAC, 60HZ
1 PHASE, 2 WIRE

1-00

NOTES:

1. FIELD WIRING IS SHOWN -----

2. TEMPERATURE RATING OF FIELD INSTALLED CONDUCTORS LESS THAN 100 AMPS MUST BE RATED 60DEG C OR ABOVE. FIELD INSTALLED CONDUCTORS GREATER THAN OR EQUAL TO 100 AMPS MUST BE RATED 75 DEG C OR ABOVE.

3. FIELD WIRING WILL ACCEPT COPPER CONDUCTORS ONLY.

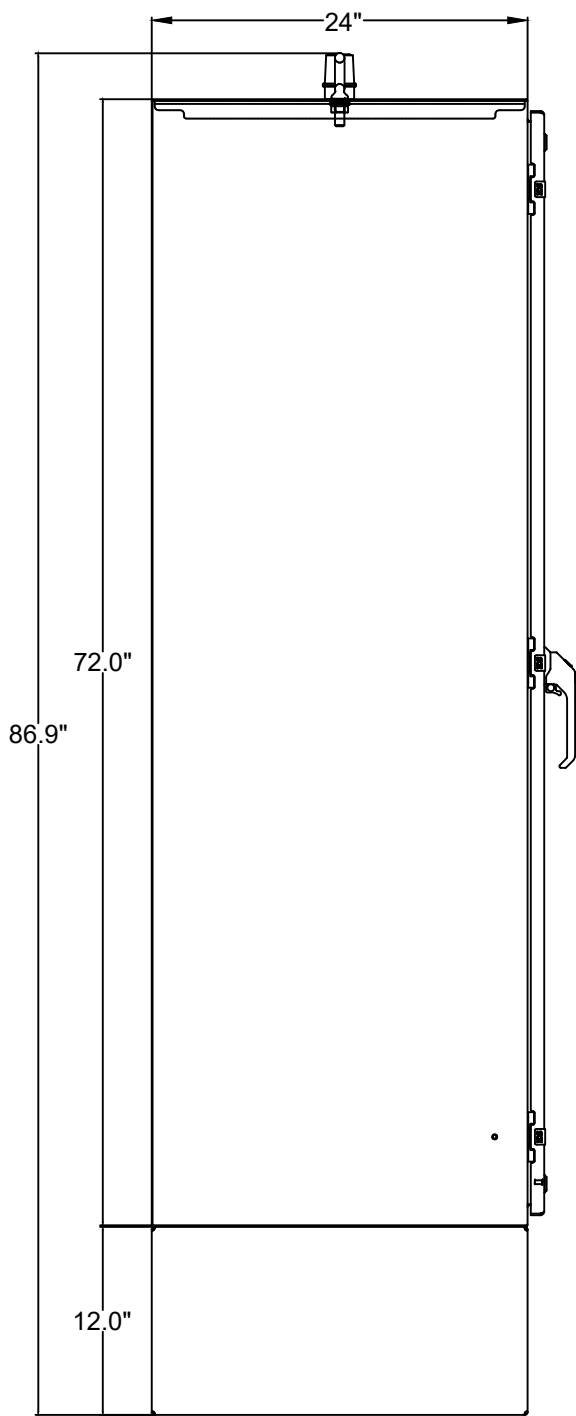
4. FOR FIELD WIRING REFER TO COMPONENT, OR TORQUE RATING DATASHEET.
13.3-15.9 IN/LBS FOR TB1-TB3
180 IN/LBS FOR GROUND LUG

5. MAIN SERVICE DISCONNECT PROVIDED BY OTHERS.

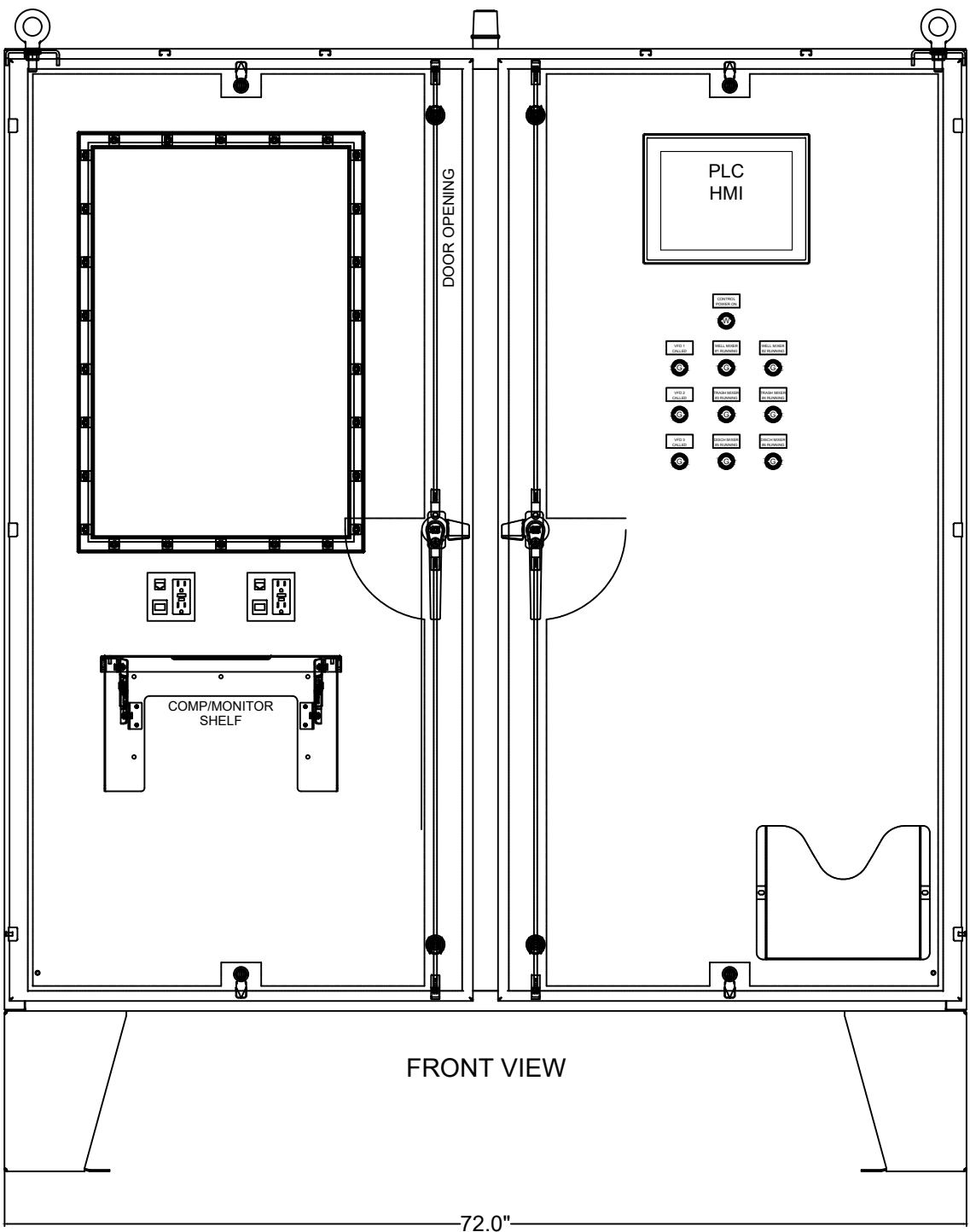
6. INSTALL IN ACCORDANCE WITH ARTICLE 504 OF THE NATIONAL ELECTRIC CODE.

ENCLOSURE LABEL SCHEMATIC

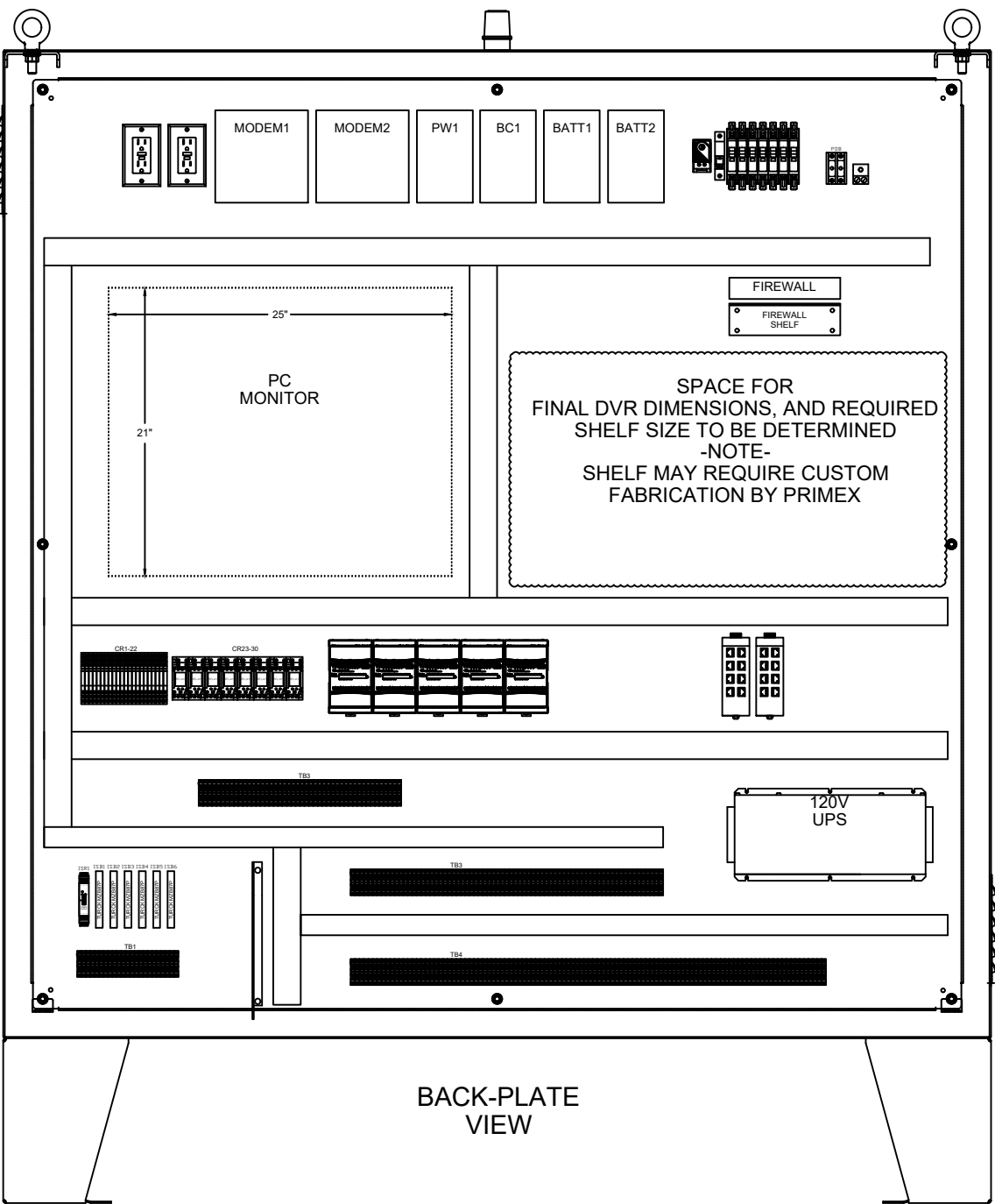
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	5.0	RE-SUBMITTAL	5/26/20	ARS			
	4.0	RE-SUBMITTAL	5/12/20	ARS			
	3.0	RE-SUBMITTAL	4/17/20	NG/AS			
	2.0	RE-SUBMITTAL	2/21/20	SEL			
SHEET NUMBER 12 OF 14	1.0	INITIAL SUBMITTAL	10/14/20	SEL	DRAWN BY SEL	DATE 10/3/19	PROJECT NUMBER 4005072A
	NO.	REVISION HISTORY		DATE	BY		



LEFT SIDE VIEW



FRONT VIEW



BACK-PLATE VIEW

ENCLOSURE: 48"Hx36"Wx12"D
NEMA 4X 304 STAINLESS STEEL

EXTERIOR/DOOR/BACKPANEL LAYOUTS

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SHEET NUMBER
13 OF 14

NO.	REVISION HISTORY	DATE	BY
5.0	RE-SUBMITTAL	5/26/20	ARS
4.0	RE-SUBMITTAL	5/12/20	ARS
3.0	RE-SUBMITTAL	4/17/20	NG/AS
2.0	RE-SUBMITTAL	2/21/20	SEL
1.0	INITIAL SUBMITTAL	10/14/20	SEL

**PRIMEX**

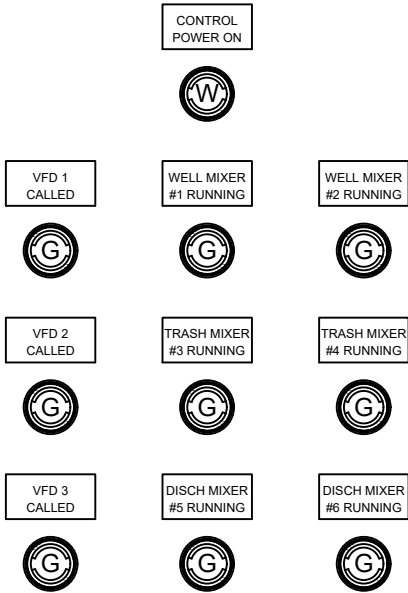
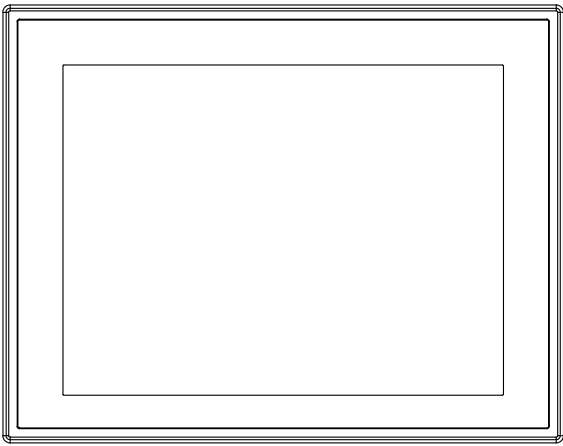
primexcontrols.com
22650 County Highway 6 - Detroit Lakes, MN 56501
888-342-5753

KENNEDY INDUSTRIES INC.
SAGINAW, MI
GAGE DRAIN-SPICER ENG

DRAWN BY
SEL

DATE
10/3/19

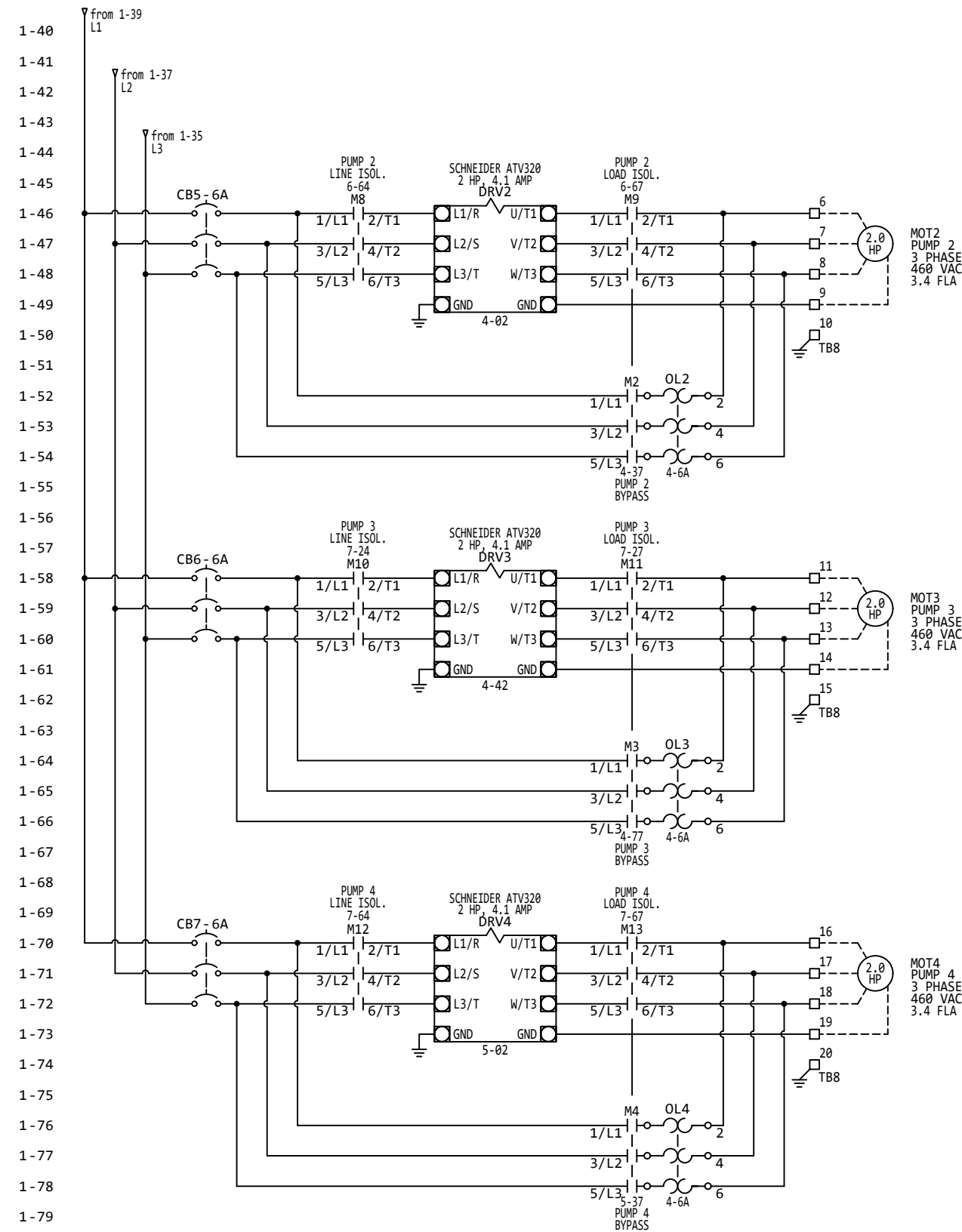
PANEL REQUIREMENTS		LARGEST MOTOR POWER REQUIREMENTS	
SYM.		HP	N/A
VOLTAGE	120 VAC	FLA	N/A
PHASE	1 PHASE		
FREQUENCY	60 Hz		
SCCR	5 kA		
TOTAL FLA	48.18		
TYPE	3R		
PROJECT NUMBER 4005072A			



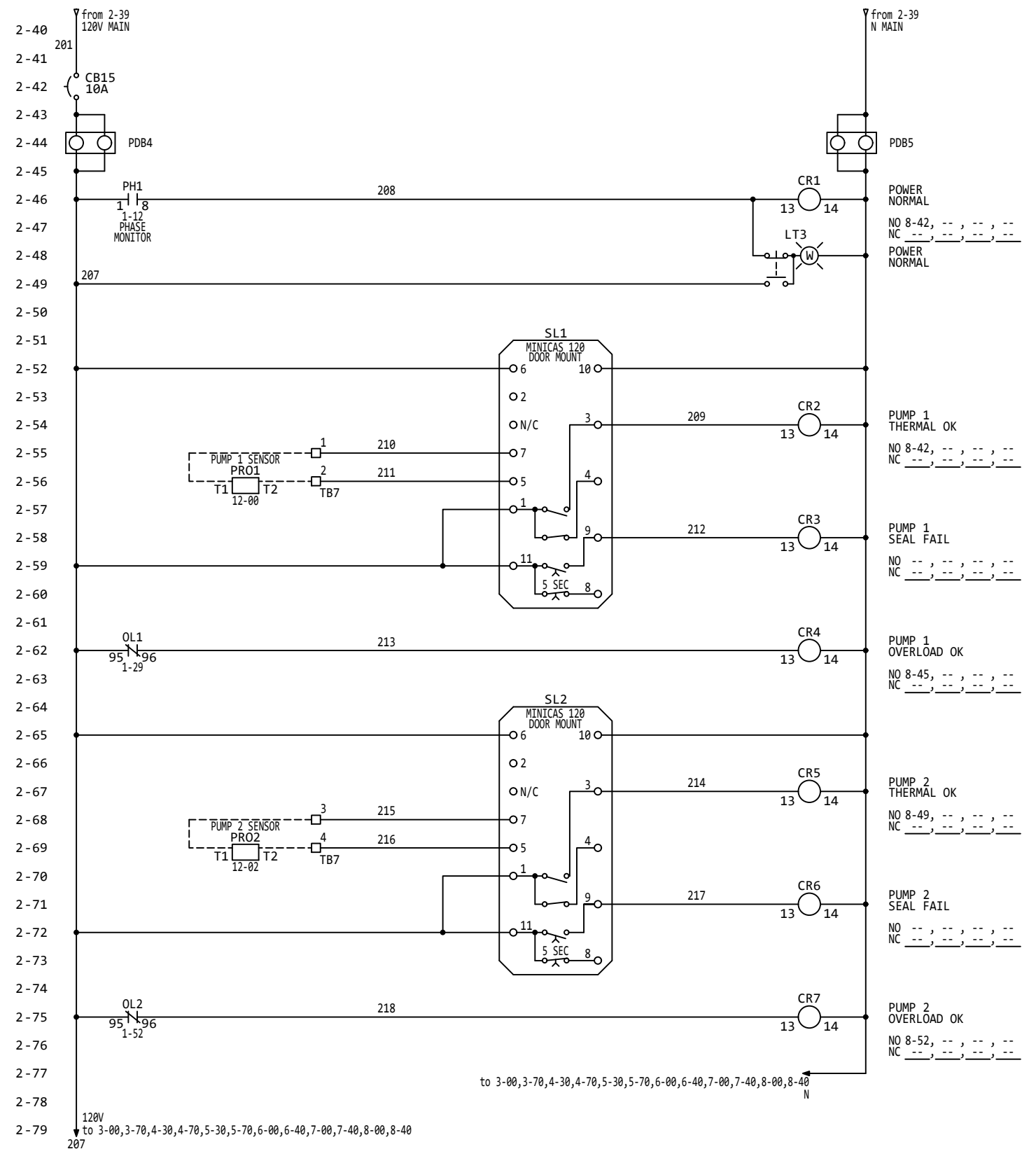
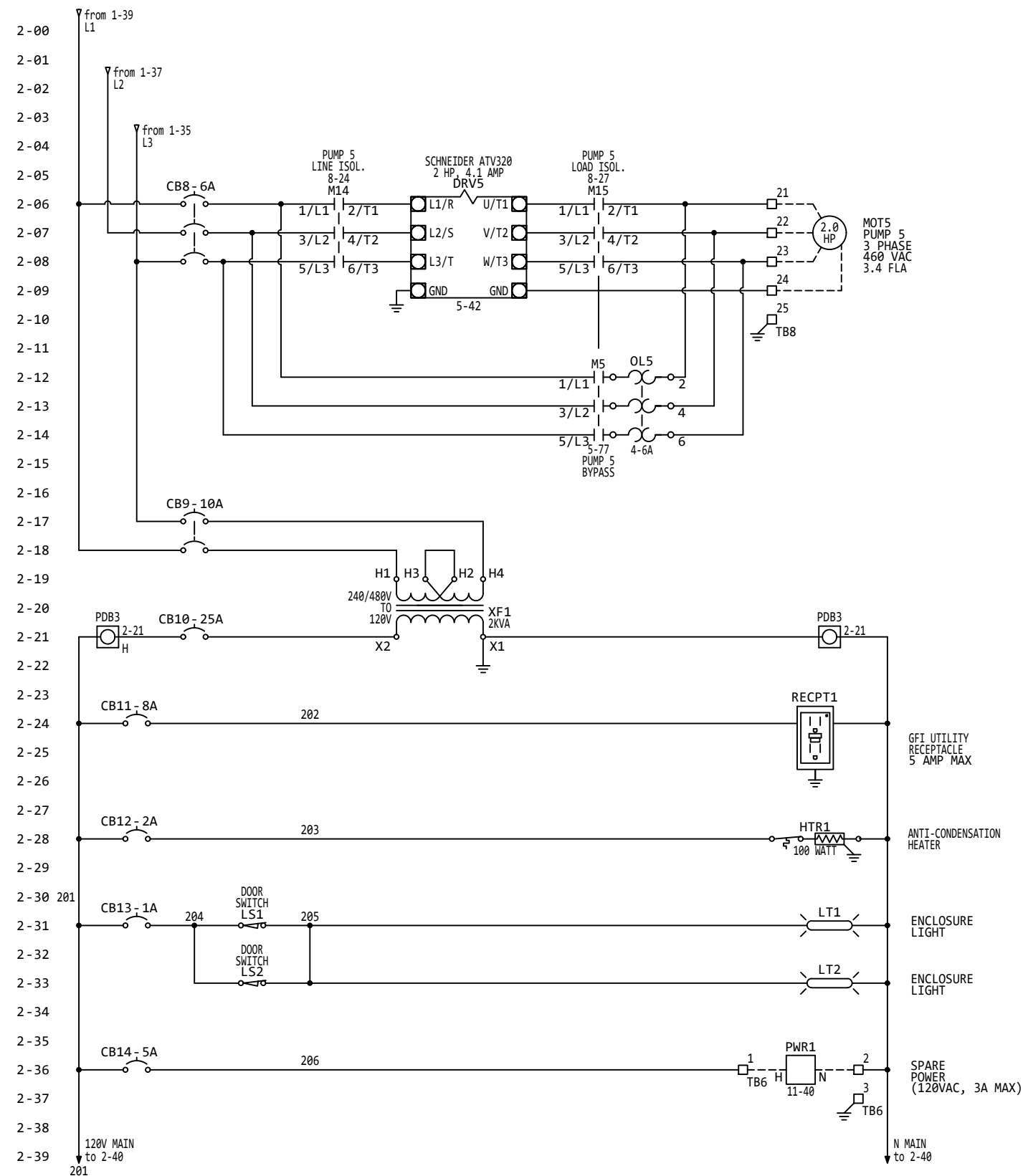
LABEL MATERIAL: PHENOLIC, ENGRAVED
STYLE: BLACK LABEL, WHITE LETTERS

LABEL SCHEDULE

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	5.0	RE-SUBMITTAL	5/26/20	ARS					
	4.0	RE-SUBMITTAL	5/12/20	ARS					
	3.0	RE-SUBMITTAL	4/17/20	NG/AS					
	2.0	RE-SUBMITTAL	2/21/20	SEL					
	1.0	INITIAL SUBMITTAL	10/14/20	SEL					
SHEET NUMBER		REVISION HISTORY		DATE	BY	DRAWN BY SEL		DATE 10/3/19	
14 OF 14								PROJECT NUMBER 4005072A	



SHEET NUMBER				
1 OF 15				
NO.	REVISION HISTORY	DATE	BY	



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SHEET NUMBER
2 OF 15

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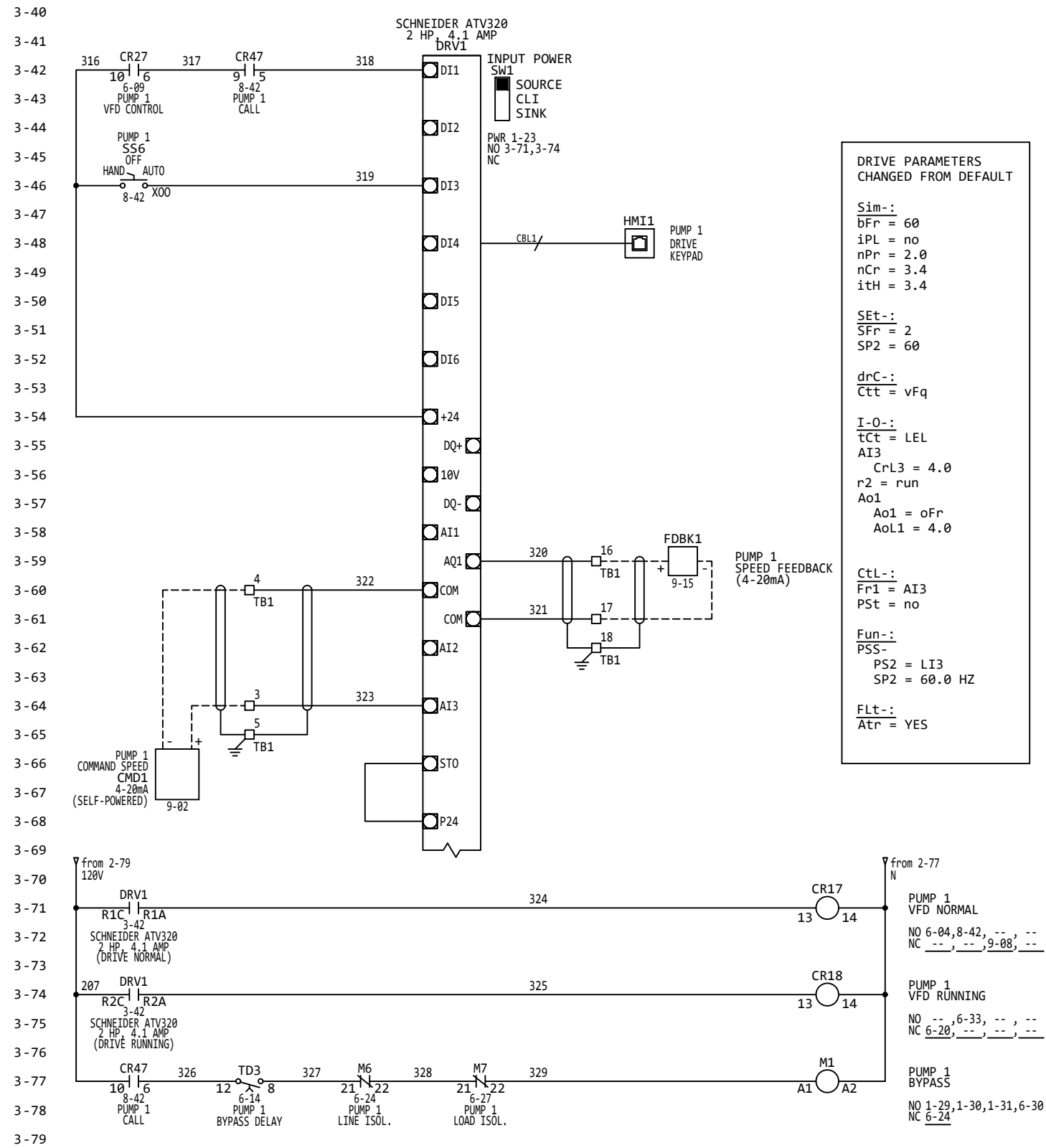
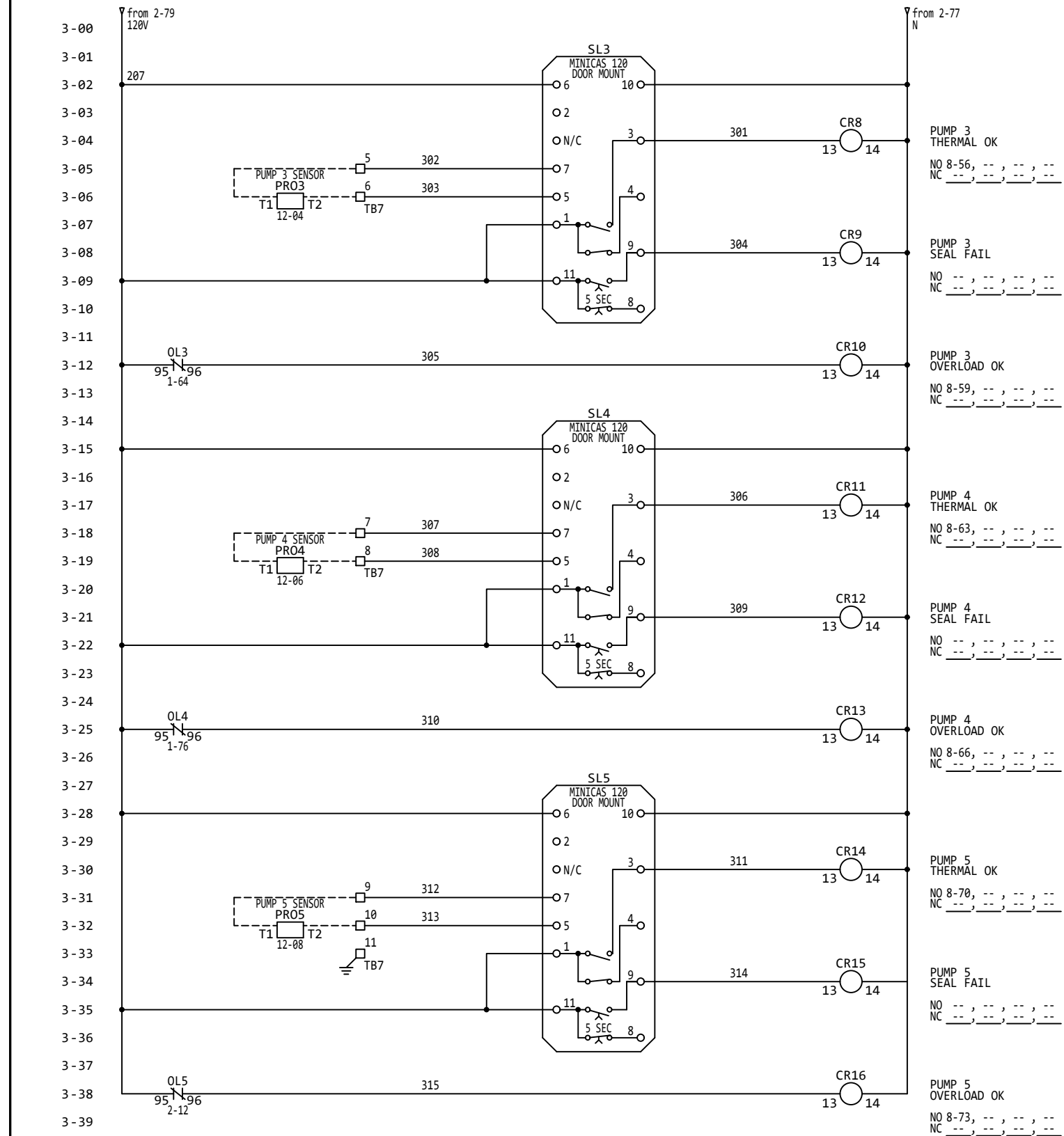
KENNEDY INDUSTRIES INC.
SAGINAW, MI
GAGE DRAIN - PENTAPLEX VFDS

DRAWN BY ARS	DATE 5/17/20
-----------------	-----------------

PANEL REQUIREMENTS	
SYM.	
VOLTAGE	480/277 VAC
PHASE	3 PHASE 4 WIRE
FREQUENCY	60 Hz
SCCR	5 kA RMS SYM
TOTAL FLA	23.8 A
TYPE	4X

LARGEST MOTOR POWER REQUIREMENTS	
A	2.0 HP 3.4 FLA

PROJECT NUMBER
4005072B



DRIVE PARAMETERS
CHANGED FROM DEFAULT

Sim--:
bFr = 60
iPL = no
nPr = 2.0
nCr = 3.4
itH = 3.4

SEt--:
SFr = 2
SP2 = 60

drC--:
Ctt = vFq

I-O--:
tCt = LEL
AI3
CrL3 = 4.0
r2 = run
Ao1
Ao1 = oFr
AoL1 = 4.0

CtL--:
Fr1 = AI3
PSt = no

Fun--:
PSS-
PS2 = LI3
SP2 = 60.0 HZ

FLt--:
Atr = YES

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SHEET NUMBER
3 OF 15

NO.	REVISION HISTORY	DATE	BY



KENNEDY INDUSTRIES INC.
SAGINAW, MI
GAGE DRAIN - PENTAPLEX VFDS

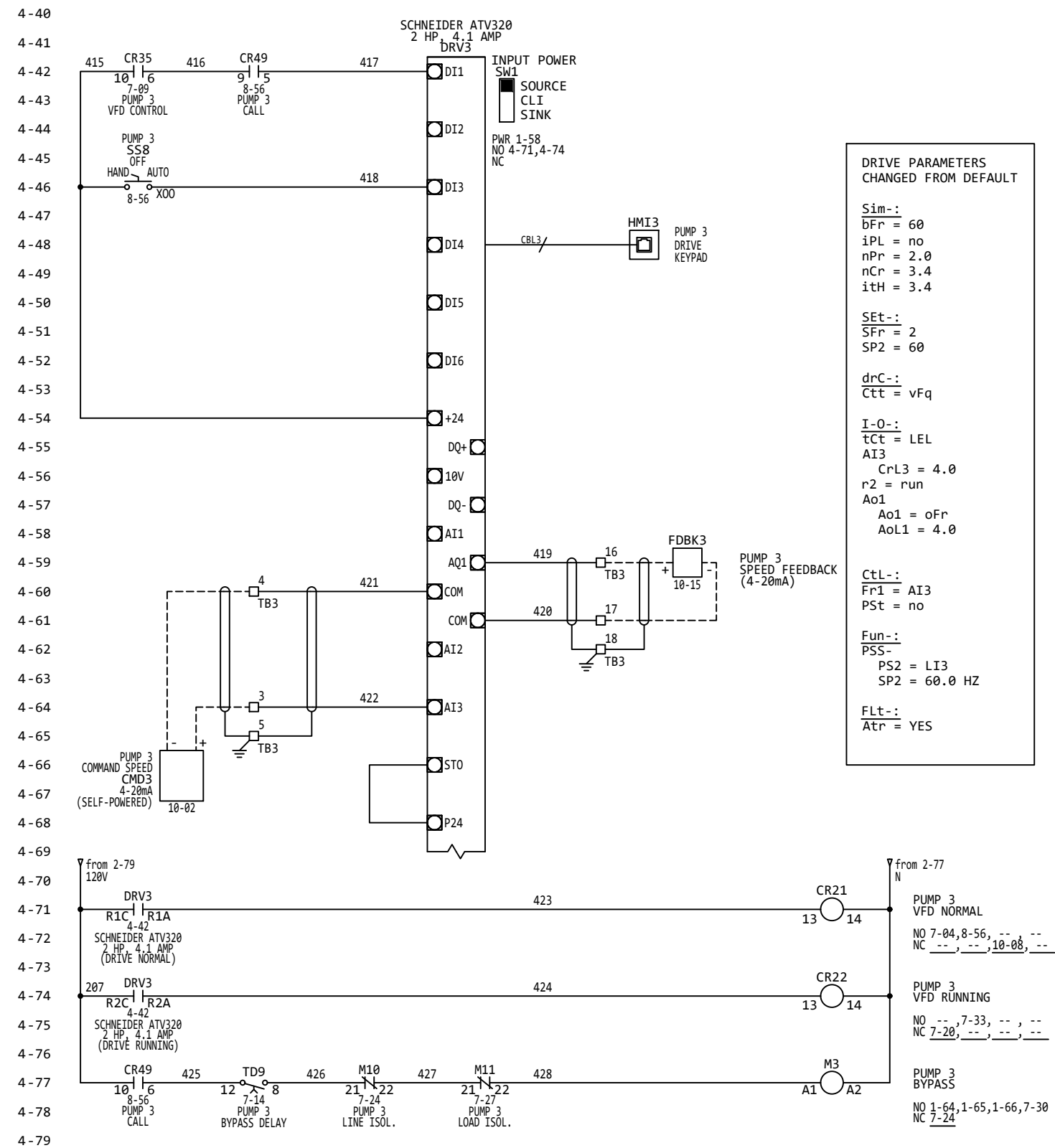
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ARS

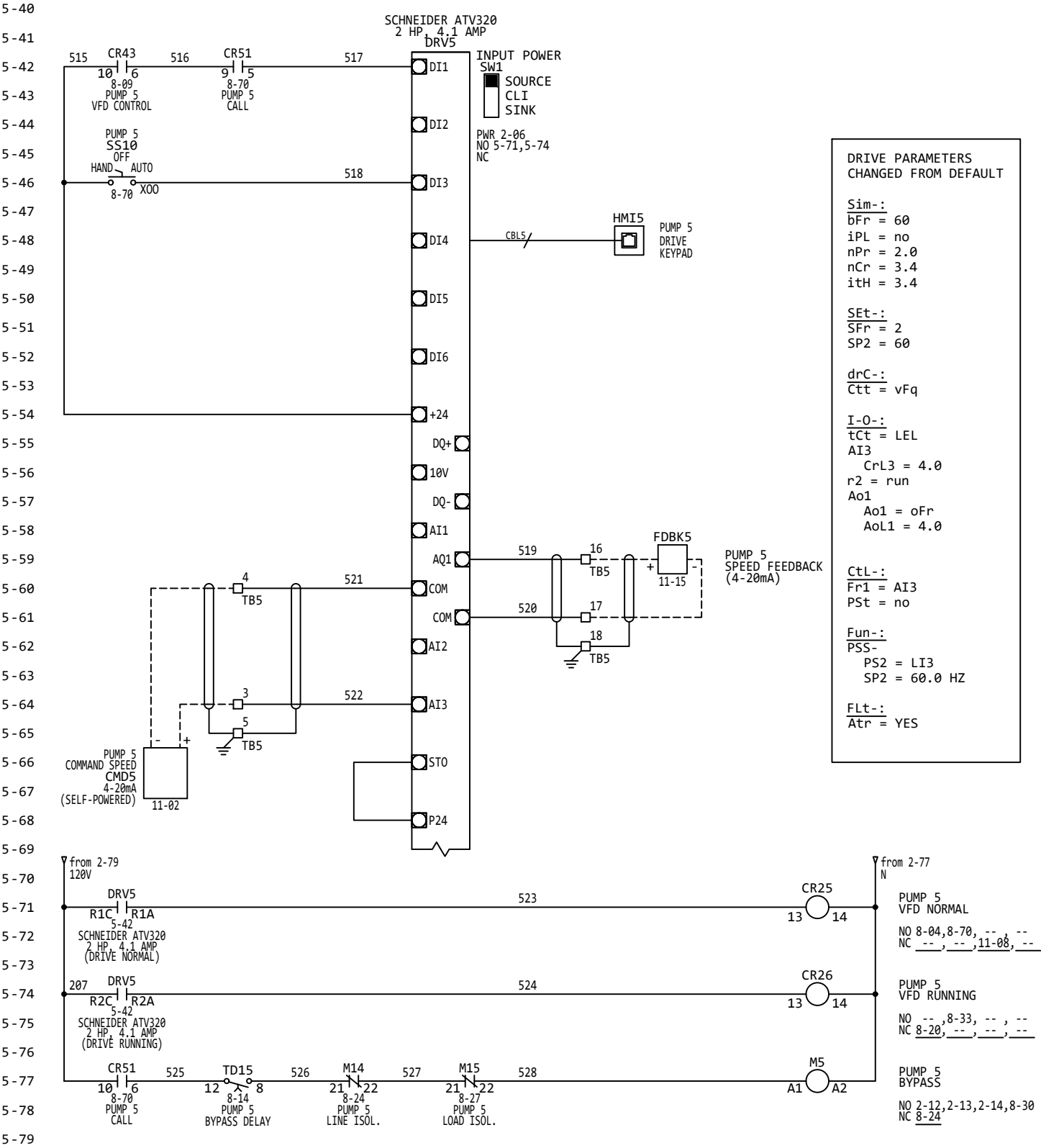
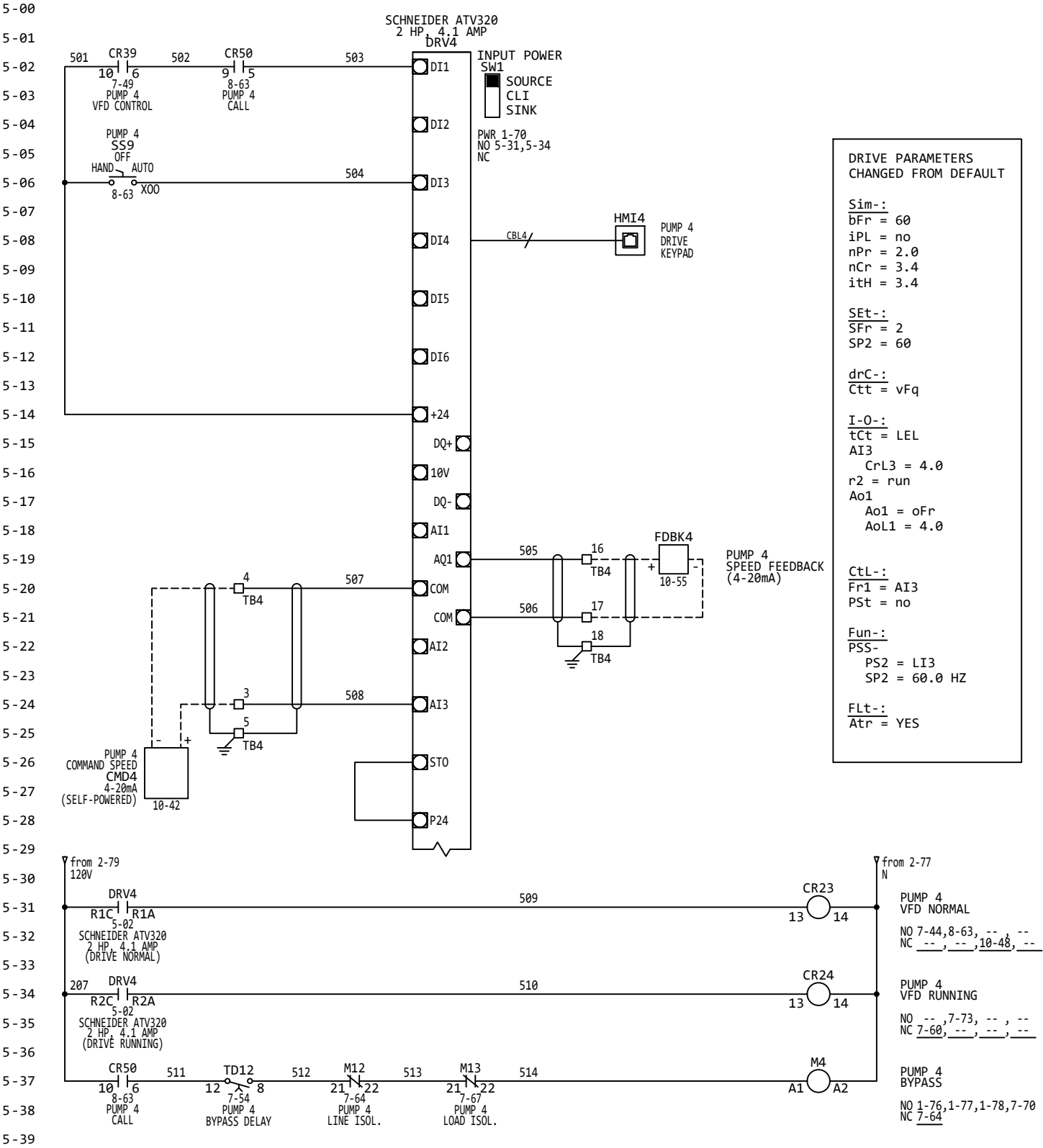
DATE
5/17/20

PANEL REQUIREMENTS
SYM.
VOLTAGE 480/277 VAC
PHASE 3 PHASE 4 WIRE
FREQUENCY 60 Hz
SCCR 5 kA RMS SYM
TOTAL FLA 23.8 A
TYPE 4X

LARGEST MOTOR POWER
REQUIREMENTS
HP 2.0 HP
FLA 3.4 FLA

PROJECT NUMBER
4005072B





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SHEET NUMBER
5 OF 15

NO.	REVISION HISTORY	DATE	BY



KENNEDY INDUSTRIES INC.
SAGINAW, MI
GAGE DRAIN - PENTAPLEX VFDS

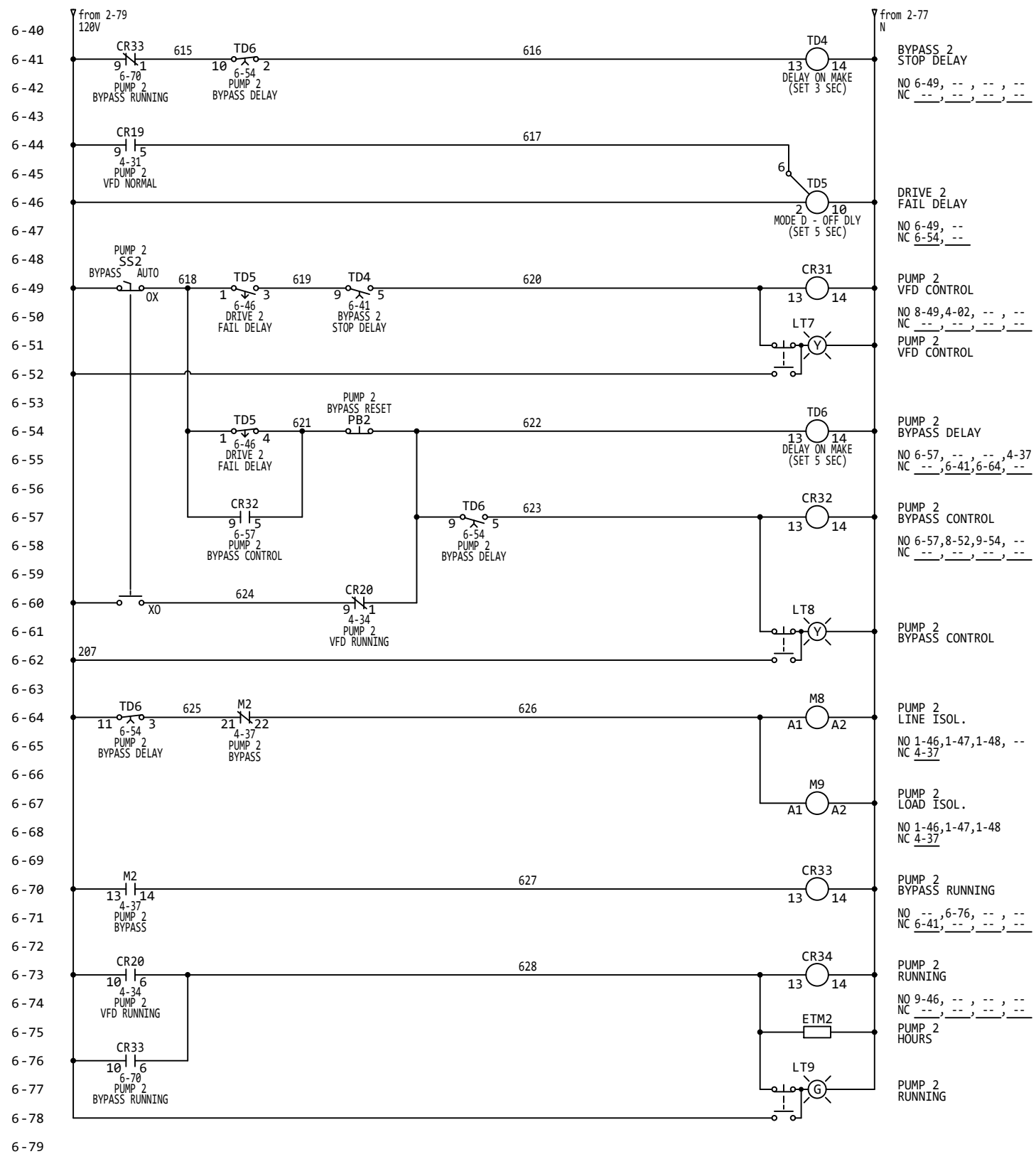
DRAWN BY
ARS

DATE
5/17/20

PANEL REQUIREMENTS
SYM.
VOLTAGE 480/277 VAC
PHASE 3 PHASE 4 WIRE
FREQUENCY 60 Hz
SCCR 5 kA RMS SYM
TOTAL FLA 23.8 A
TYPE 4X

LARGEST MOTOR POWER
REQUIREMENTS
HP 2.0 HP
FLA 3.4 FLA

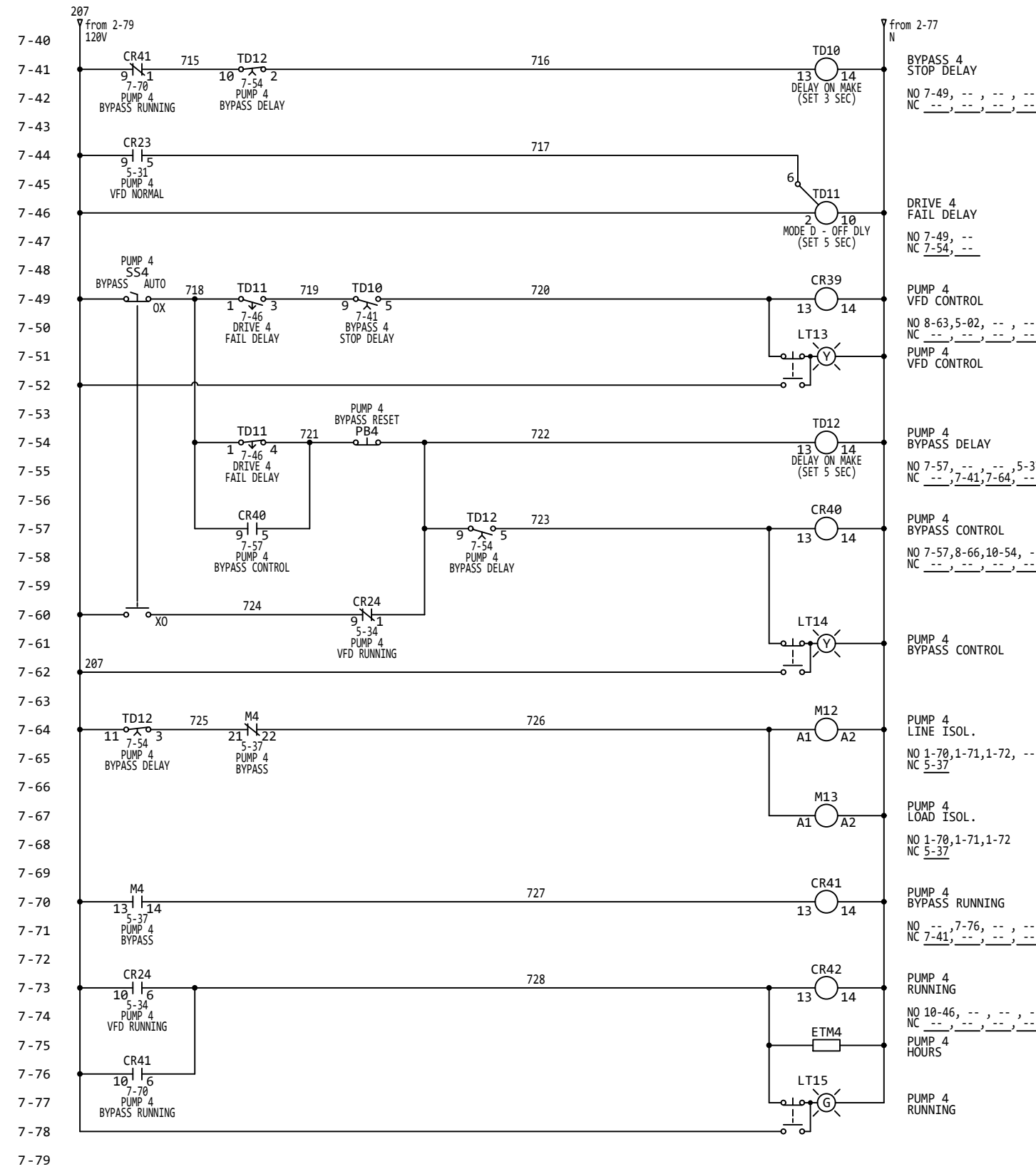
PROJECT NUMBER
4005072B



PROJECT NUMBER
4005072B

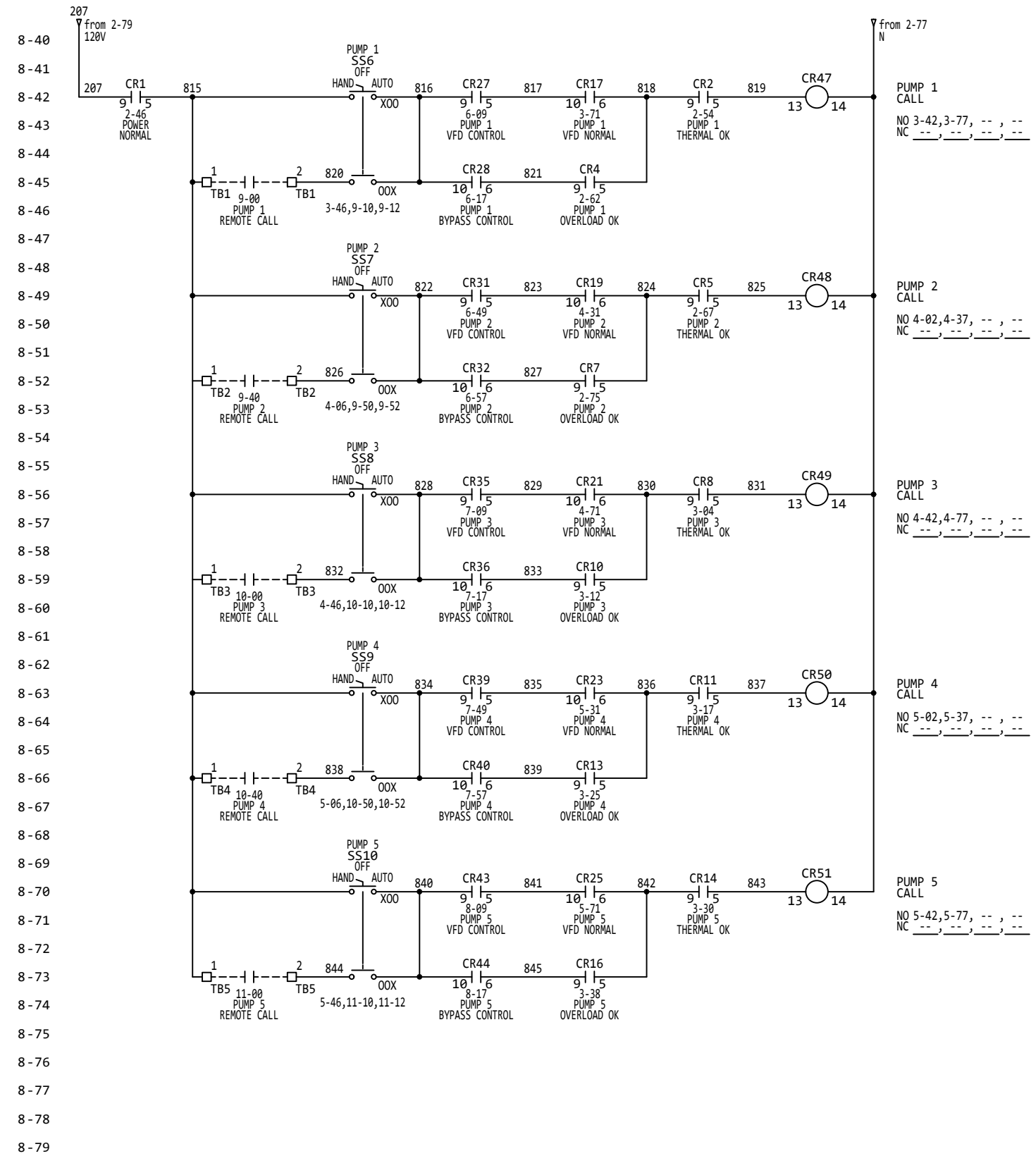
DRAWN BY
ARS

DATE
5/17/20



DRAWN BY
ARS

DATE
5/17/20



PRIMEX
primexcontrols.com
2221 Ford Drive - Ashland, Oh 44805
419-281-5767

PANEL REQUIREMENTS

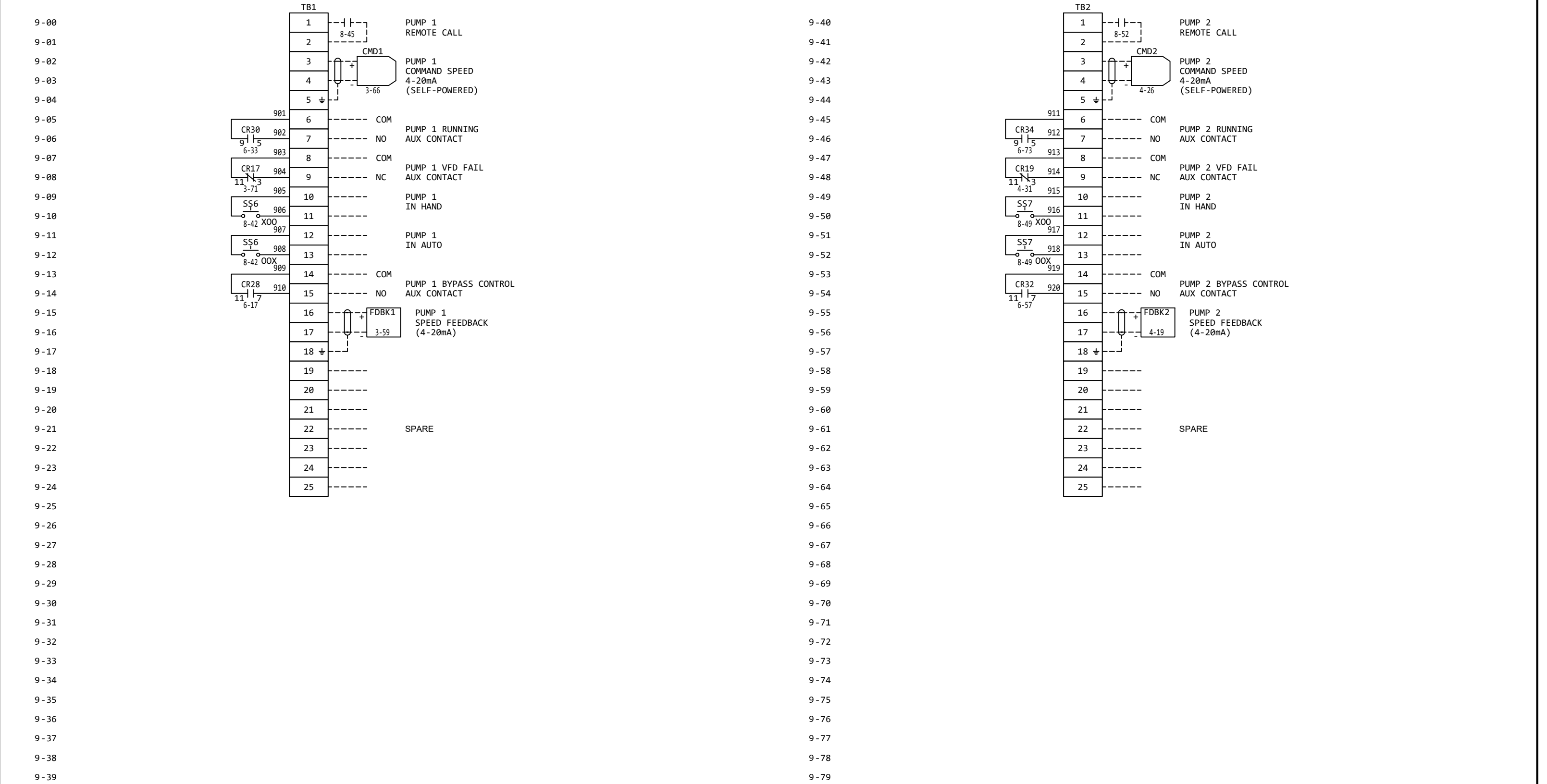
SYM.	
VOLTAGE	480/277 VAC
PHASE	3 PHASE 4 WIRE
FREQUENCY	60 Hz
SCCR	5 kA RMS SYM
TOTAL FLA	23.8 A
TYPE	4X

PROJECT NUMBER
4005072B

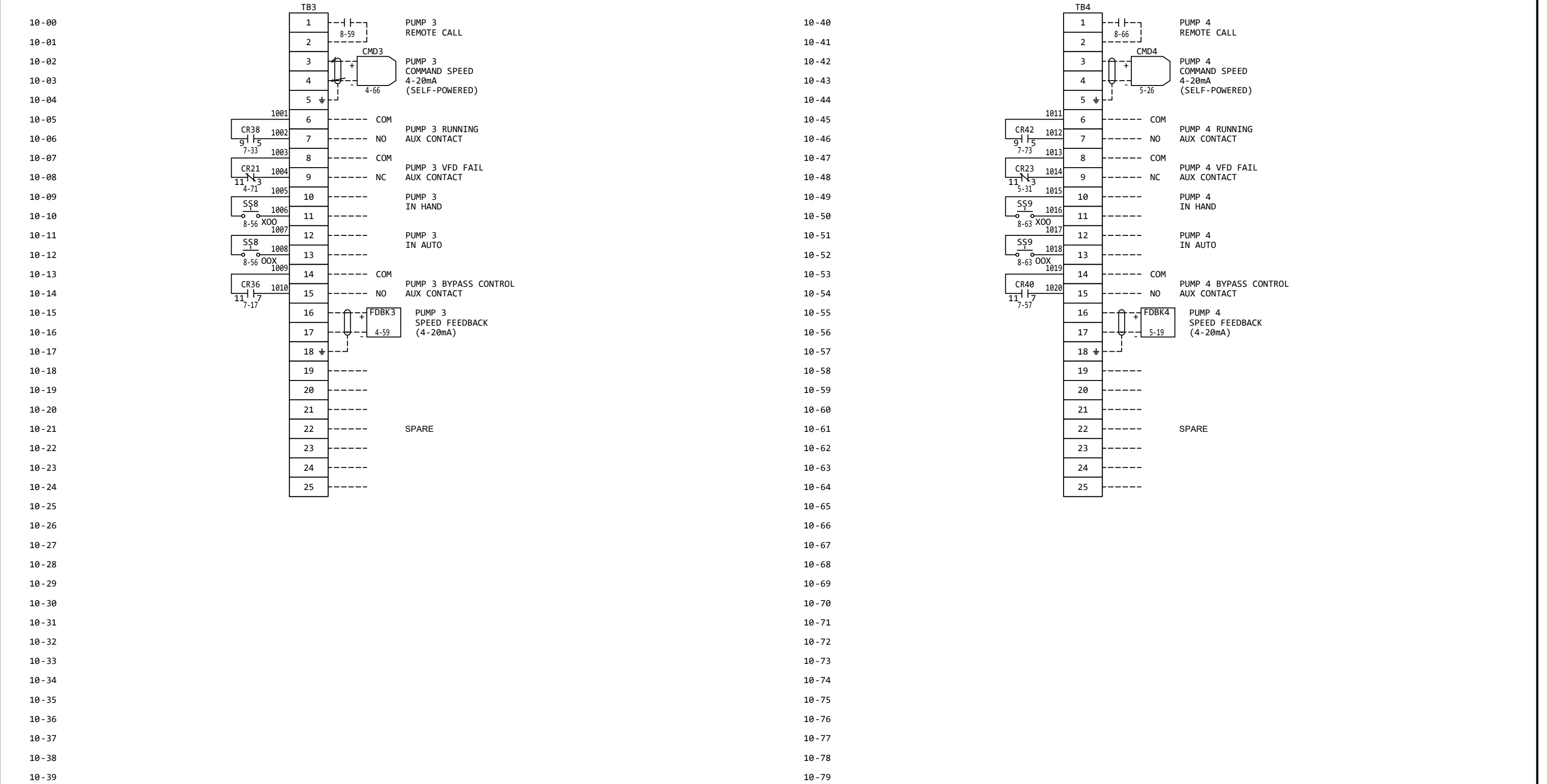
NO.	REVISION HISTORY	DATE	BY
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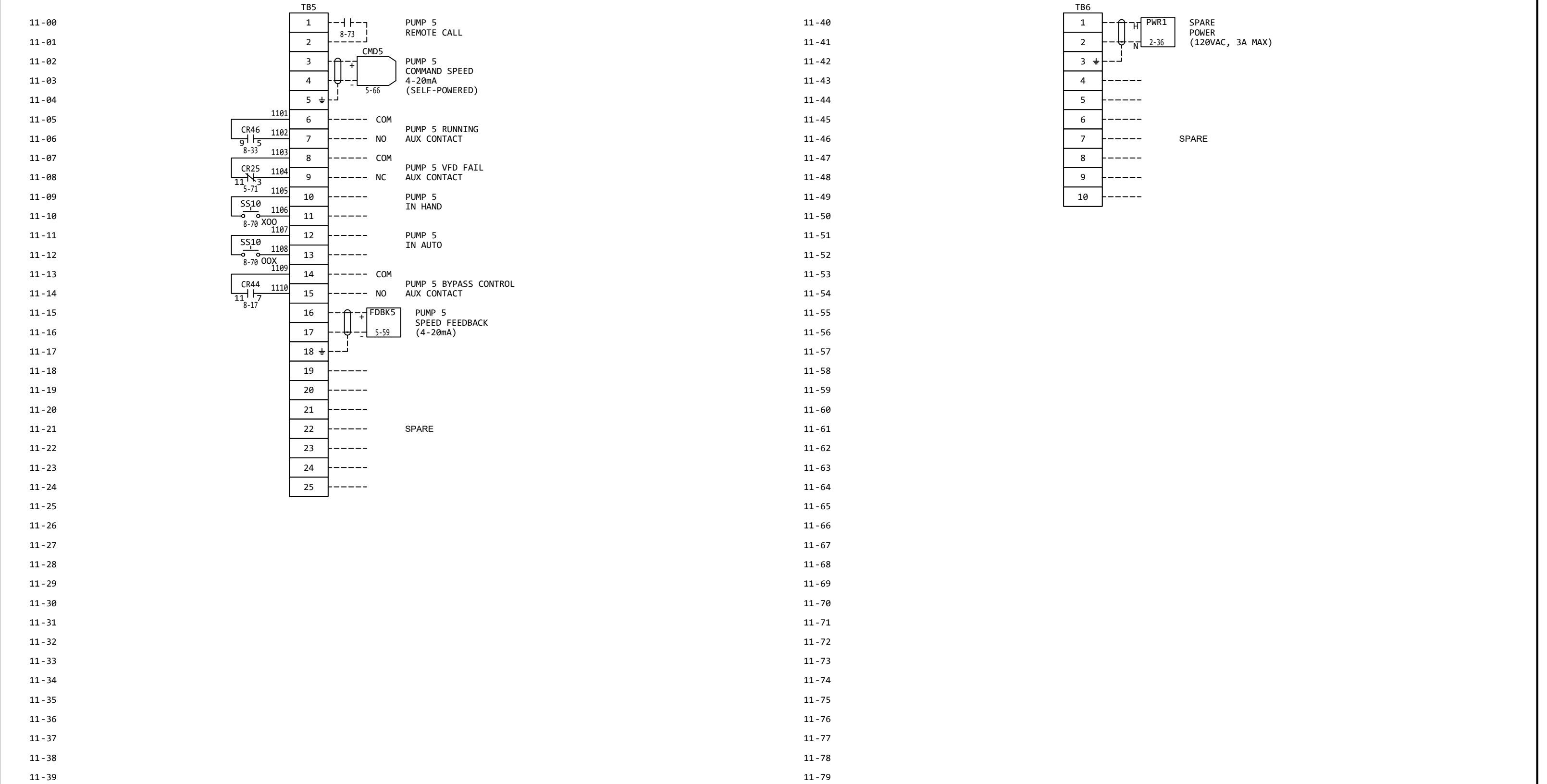
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FIELD WIRING SECTION

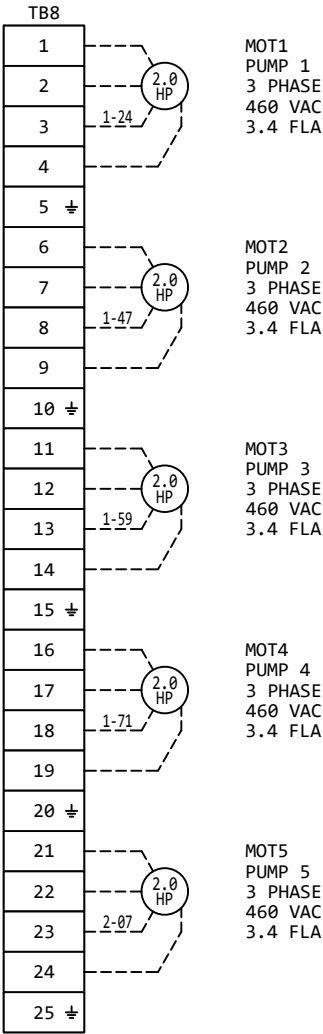
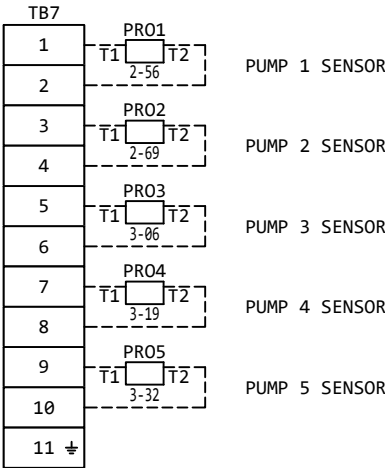


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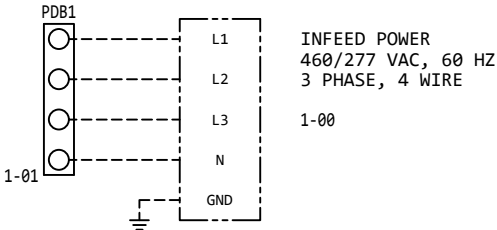


FIELD WIRING SECTION

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DEVICE ID	Tightening Torque for Wire Size (AWG)
PDB1	35 LB/IN FOR #14 - #10 AWG, 40 LB/IN FOR #8 AWG, 120 LB/IN FOR #6 - 2/0 AWG
GND1	35 LB/IN FOR #14 - #10 AWG, 40 LB/IN FOR #8 AWG, 50 LB/IN FOR #6 - 4 AWG
GND1	120 LB/IN FOR #14 - 2/0 AWG
TB1-TB6	5.5-7.0 LB/IN FOR #26 - #10 AWG
TB7	13-16 LB/IN FOR #24 - #8 AWG
TB8	13-16 LB/IN FOR #20 - #6 AWG

- NOTES:
- FIELD WIRING IS SHOWN -----
 - TEMPERATURE RATING OF FIELD INSTALLED CONDUCTORS LESS THAN 100 AMPS MUST BE RATED 60DEG C OR ABOVE. FIELD INSTALLED CONDUCTORS GREATER THAN OR EQUAL TO 100 AMPS MUST BE RATED 75 DEG C OR ABOVE.
 - FIELD WIRING WILL ACCEPT COPPER CONDUCTORS ONLY.
 - FOR FIELD WIRING REFER TO COMPONENT, OR TORQUE RATING DATASHEET.
 - MAIN SERVICE DISCONNECT PROVIDED BY OTHERS.
 - INSTALL IN ACCORDANCE WITH ARTICLE 504 OF THE NATIONAL ELECTRIC CODE.
 - MAXIMUM WIRING DISTANCE FROM INTRINSICALLY SAFE BARRIER IS 1,000 FEET.
 - IF SEAL LEAK PROBE IS ONE WIRE, B IS PANEL GROUND.

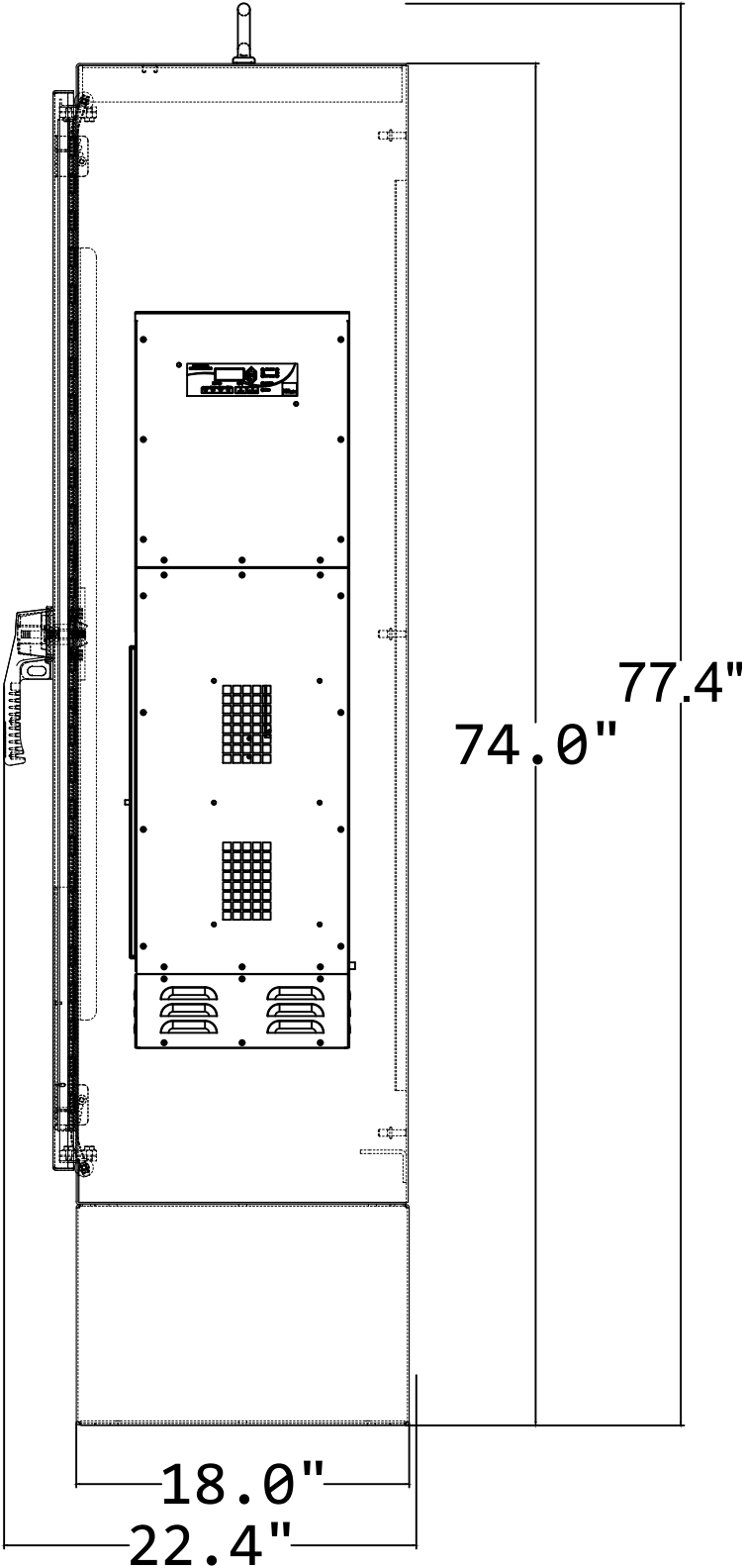
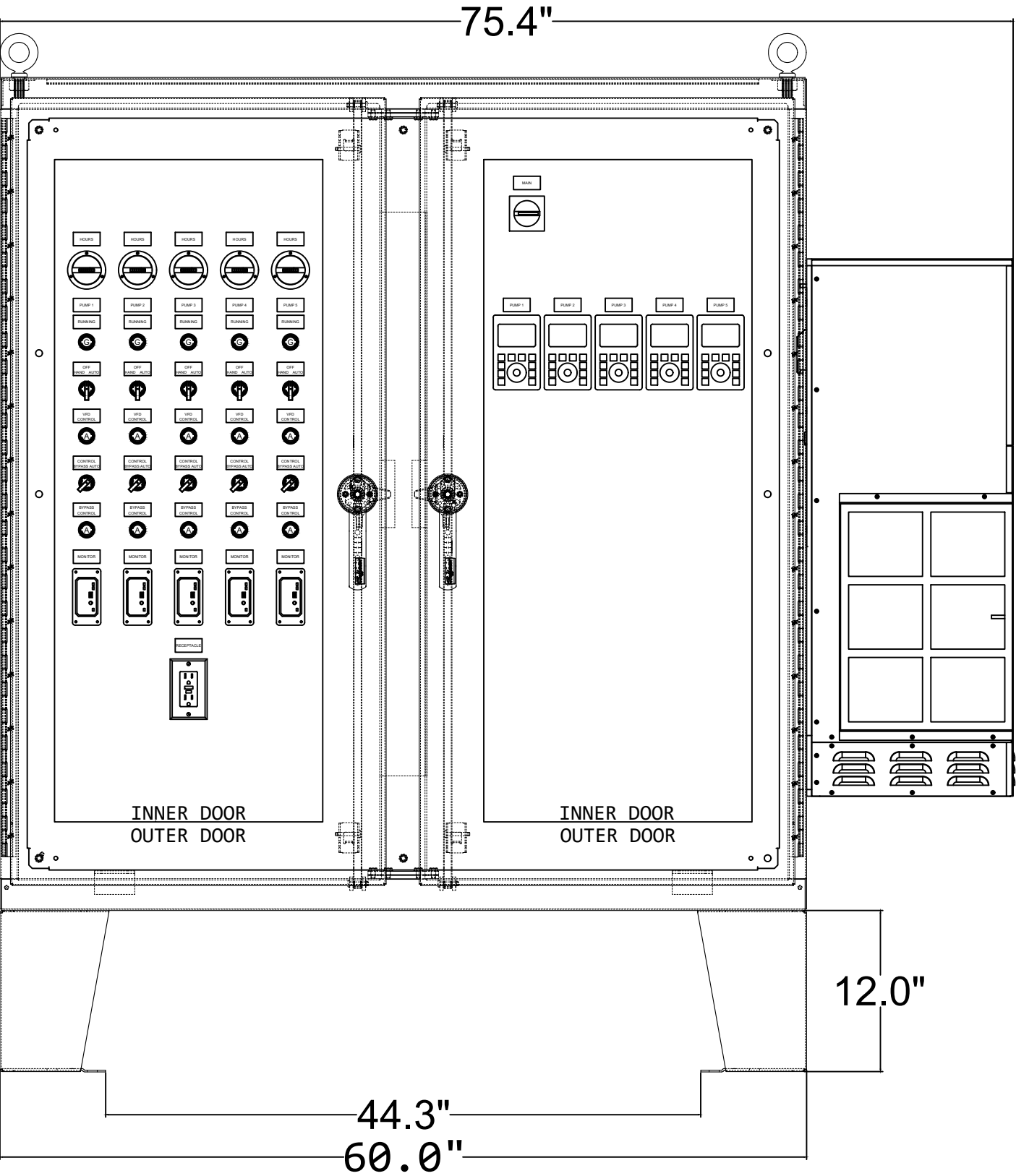
ENCLOSURE
LABEL
LITERATURE

FIELD WIRING SECTION

THIS DRAWING CONTAINS PROPRIETARY INFORMATION WHICH MUST NOT BE DUPLICATED, USED, OR DISCLOSED IN WHOLE OR IN PART WITHOUT PRIOR WRITTEN CONSENT.				
SHEET NUMBER				
12 OF 15				
NO.	REVISION HISTORY		DATE	BY



KENNEDY INDUSTRIES INC. SAGINAW, MI GAGE DRAIN - PENTAPLEX VFDS		PANEL REQUIREMENTS SYM. VOLTAGE 480/277 VAC PHASE 3 PHASE 4 WIRE FREQUENCY 60 Hz SCCR 5 kA RMS SYM TOTAL FLA 23.8 A TYPE 4X	LARGEST MOTOR POWER REQUIREMENTS HP 2.0 HP FLA 3.4 FLA
DRAWN BY ARS		DATE 5/17/20	PROJECT NUMBER 4005072B



ENCLOSURE: 62"H X 60"W X 18"D, WITH 12" LEGS
MATERIAL: NEMA 4X 304 STAINLESS STEEL

EXTERIOR/INNER DOOR LAYOUTS

THIS DRAWING CONTAINS PROPRIETARY INFORMATION WHICH MUST NOT BE DUPLICATED, USED, OR DISCLOSED IN WHOLE OR IN PART WITHOUT PRIOR WRITTEN CONSENT.

SHEET NUMBER
13 OF 15

NO.	REVISION HISTORY	DATE	BY



KENNEDY INDUSTRIES INC.
SAGINAW, MI
GAGE DRAIN - PENTAPLEX VFDS

DRAWN BY
ARS

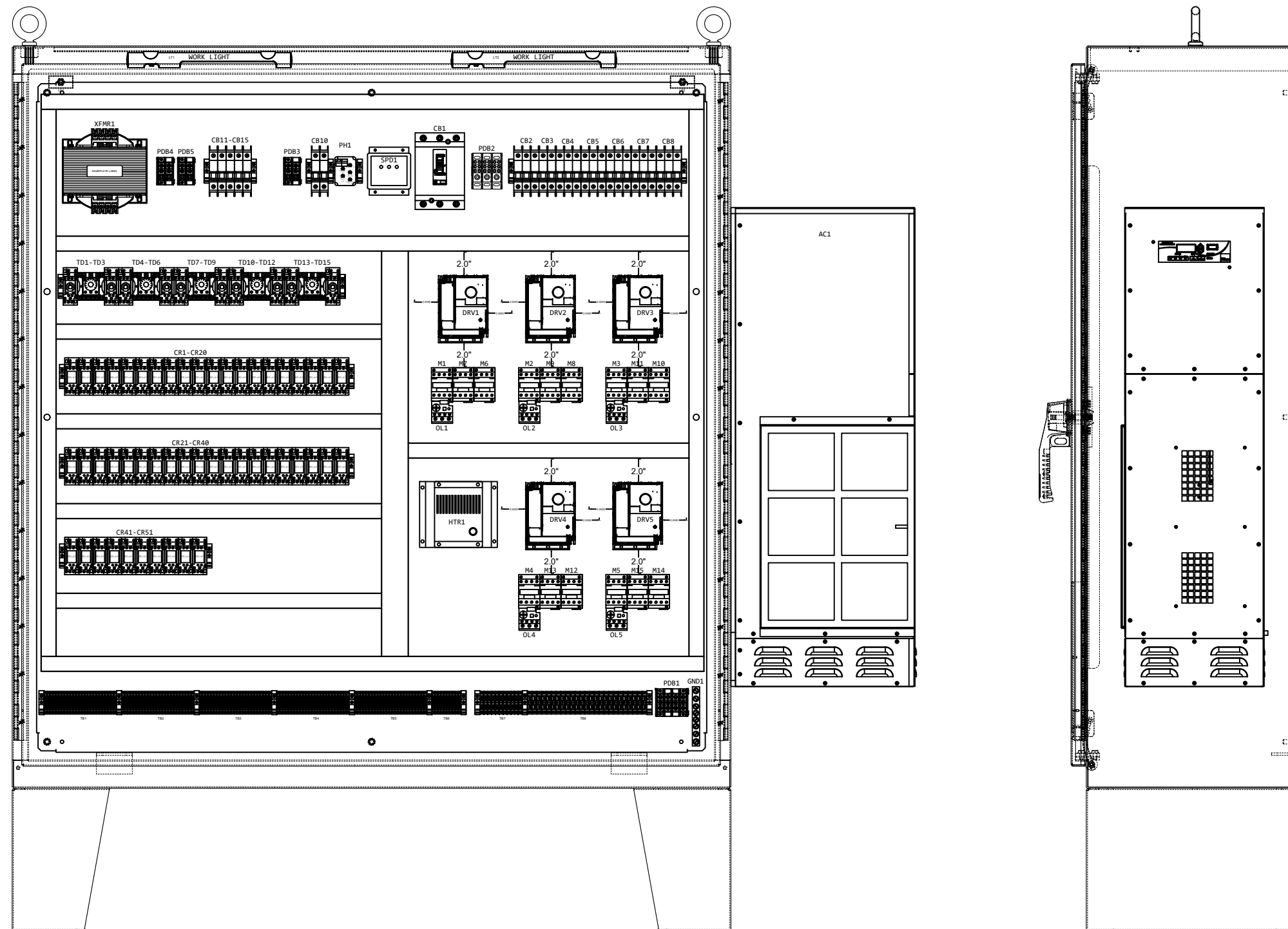
DATE
5/17/20

PANEL REQUIREMENTS
SYM.
VOLTAGE 480/277 VAC
PHASE 3 PHASE 4 WIRE
FREQUENCY 60 Hz
SCCR 5 kA RMS SYM
TOTAL FLA 23.8 A
TYPE 4X

LARGEST MOTOR POWER REQUIREMENTS
HP 2.0 HP
FLA 3.4 FLA

PROJECT NUMBER
4005072B

LAYOUT SUBJECT TO CHANGE WITHOUT NOTICE



ENCLOSURE: 62"H X 60"W X 18"D, WITH 12" LEGS
MATERIAL: NEMA 4X 304 STAINLESS STEEL

INTERIOR LAYOUT

THIS DRAWING CONTAINS PROPRIETARY INFORMATION WHICH MUST NOT BE DUPLICATED, USED, OR DISCLOSED IN WHOLE OR IN PART WITHOUT PRIOR WRITTEN CONSENT.

SHEET NUMBER
14 OF 15

NO.	REVISION HISTORY	DATE	BY



KENNEDY INDUSTRIES INC.
SAGINAW, MI
GAGE DRAIN - PENTAPLEX VFDS

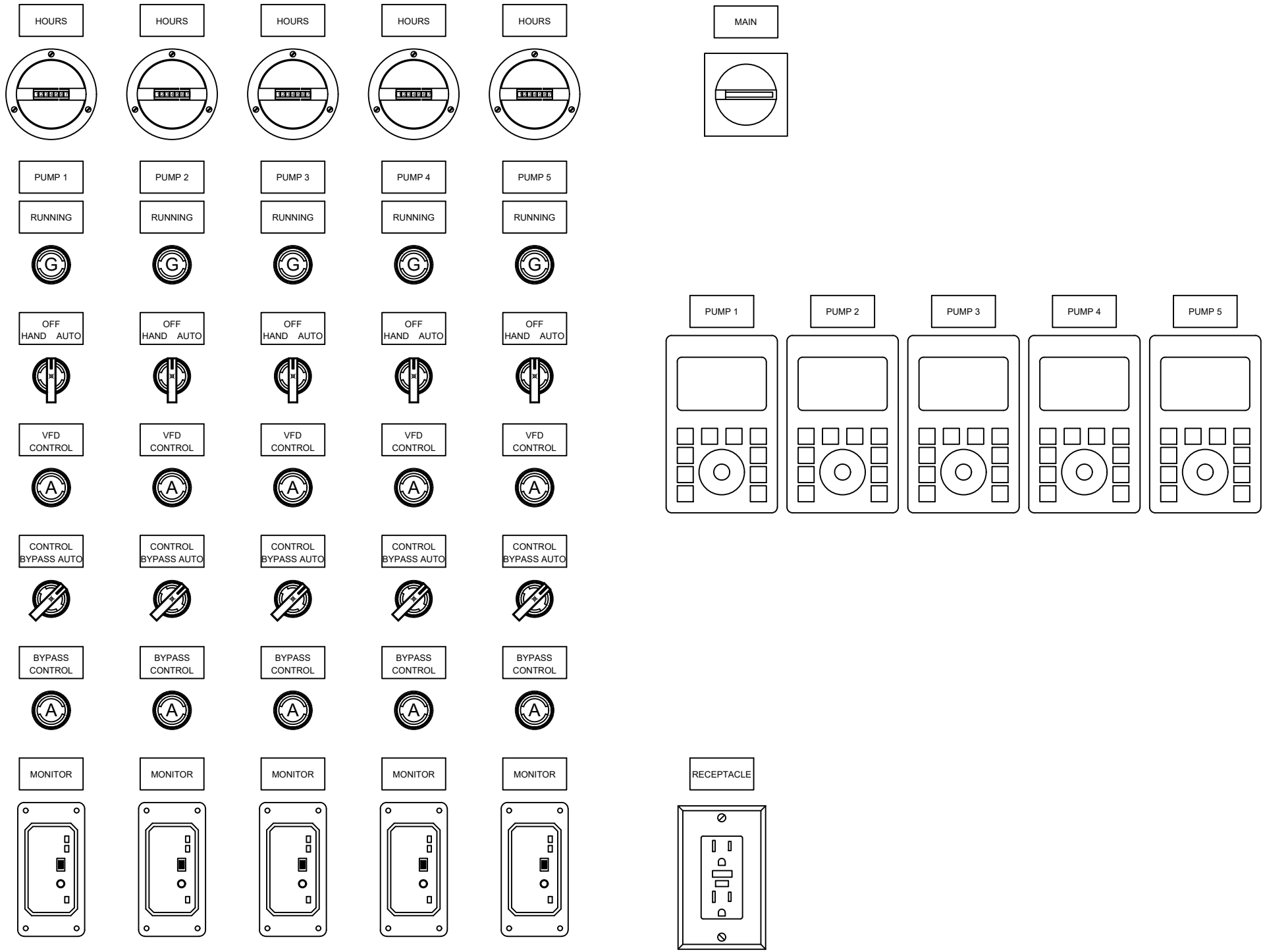
DRAWN BY
ARS

DATE
5/17/20

PANEL REQUIREMENTS	
SYM.	
VOLTAGE	480/277 VAC
PHASE	3 PHASE 4 WIRE
FREQUENCY	60 Hz
SCCR	5 kA RMS SYM
TOTAL FLA	23.8 A
TYPE	4X

LARGEST MOTOR POWER REQUIREMENTS	
HP	2.0 HP
FLA	3.4 FLA

PROJECT NUMBER
4005072B



MATERIAL: ENGRAVED PHENOLIC
STYLE: BLACK LABEL, WHITE LETTERS

LABEL SCHEDULE

THIS DRAWING CONTAINS PROPRIETARY INFORMATION WHICH MUST NOT BE DUPLICATED, USED, OR DISCLOSED IN WHOLE OR IN PART WITHOUT PRIOR WRITTEN CONSENT.					<div> primexcontrols.com 2221 Ford Drive - Ashland, Oh 44805 419-281-5767</div>	KENNEDY INDUSTRIES INC. SAGINAW, MI GAGE DRAIN - PENTAPLEX VFDS		PANEL REQUIREMENTS		LARGEST MOTOR POWER REQUIREMENTS			
SHEET NUMBER									SYM.				
15 OF 15									VOLTAGE	480/277 VAC	HP		
									PHASE	3 PHASE 4 WIRE	FLA		
									FREQUENCY	60 Hz			
									SCCR	5 kA RMS SYM			
									TOTAL FLA	23.8 A			
									TYPE	4X			
NO.	REVISION HISTORY			DATE	BY	DRAWN BY ARS		DATE 5/17/20		PROJECT NUMBER 4005072B			

Altivar™ 660 Drive Systems

The Schneider Electric Altivar™ 660 Drive Systems provides a robust, packaged, adjustable-speed solution for commercial, industrial, and municipal applications. All ratings are UL 508A listed, with selectable control and power configurations. These drives combine the reliability and ease-of-use of the Altivar drives family with proven, validated, and tested drive system designs.

- 1 - 900hp at 460V Normal Duty
- 1 - 60hp at 230V Normal Duty
- 1 - 700hp at 460V Heavy Duty
- 1 - 50hp at 230V Heavy Duty



- Pre-engineered, ready to use solutions in highly efficient designs
- Modular and compact to maximize space utilization
- Flexibility for application requirements
- UL Type 1, 12 and 3R rated enclosures
- Built in pump curves
- Embedded ethernet and web server
- Dynamic QR codes
- Real time clock

Seq #	Qty	Product Description
1	1	<p>Designation :</p> <p>Product Details 1-ATV660C13T4N2GAYAAGH-Altivar 660 ATV660C13T4N2GAYAAGH Main circuit breaker disconnect 100k AIC rated Selected for 460 Vac 3 phase motor 200 Horsepower Sized for Normal duty. Drive controller rated for 240 Max. Output Amps Max. Output Current Rating Will Be Lower Than The Continuous Output Current Rating Of The Drive When Bypass Option Is Selected. Type 1 Enclosure UL508A Label RAL7035 (Gray) Standard IEC Rated Bypass Contactors Isolation and bypass contactors (with mechanical and electrical interlocking). Isolation and bypass contactor sequencing provides true motor isolation. Remote automatic bypass operation using Auto Start contacts. Control options: AFC-Off-Bypass selector switch Hand-Off-Auto selector switch Test-Normal selector switch Speed Potentiometer Pilot light options: Auto pilot light (yellow) Bypass pilot light (yellow) Overload Trip pilot light (yellow) Power on pilot light (red) Run pilot light (green) Trip pilot light (yellow) Auxiliary contacts: 1 NO/NC run contact 1 NO/NC trip contact 1 NO/NC bypass run contact 1 NO auto mode contact Ethernet IP Communications Card A09 - 5% Line Impedance H14 - Transient voltage suppressor TYPE 2 SPD 80K This device contains selected features that require factory engineered configurations. Standard published lead times no longer apply. Enclosure dimensions are subject to change. Revision - 6/8/2020 - (20200514/20200514) 6/8/2020 6:23:49 PM</p>

LEFT VIEW

FRONT VIEW

TOP VIEW/DOOR PROJECTION AND CONDUIT ENTRY

PILOT DEVICE DETAIL

PWR ON TRIPPED AFC RUN AUTO

BYP RUN OL TRIP

HOA POT AOB T/N

NOTES:

△ REFER TO CONTROLLER NAMEPLATE TO COMPLETE P/N.

ENCLOSURE OUTLINE & GENERAL ARRANGEMENT FOR CONTROLLER P/N

△ ATV660 C13 T4 N G A Y

MAX FLA	KILOWATTS/HP	VOLTAGE/PH	DUTY TYPE	ENCLOSURE TYPE	HARMONIC MITIGATION	POWER CIRCUIT TYPE
240 AMPS	130KW/200HP	460V/3 PH	NORMAL	TYPE 1	5% REACTOR	BYPASS

JOB NAME: 660 3R drive

JOB LOCATION:

DRAWN BY: (Q2C)

ENGR:

DATE: June 09 2020

DRAWING STATUS: QUOTE

EQUIPMENT DESIGNATION:

EQUIPMENT TYPE: ALTIVAR PROCESS DRIVE

DRAWING TYPE: ELEVATION

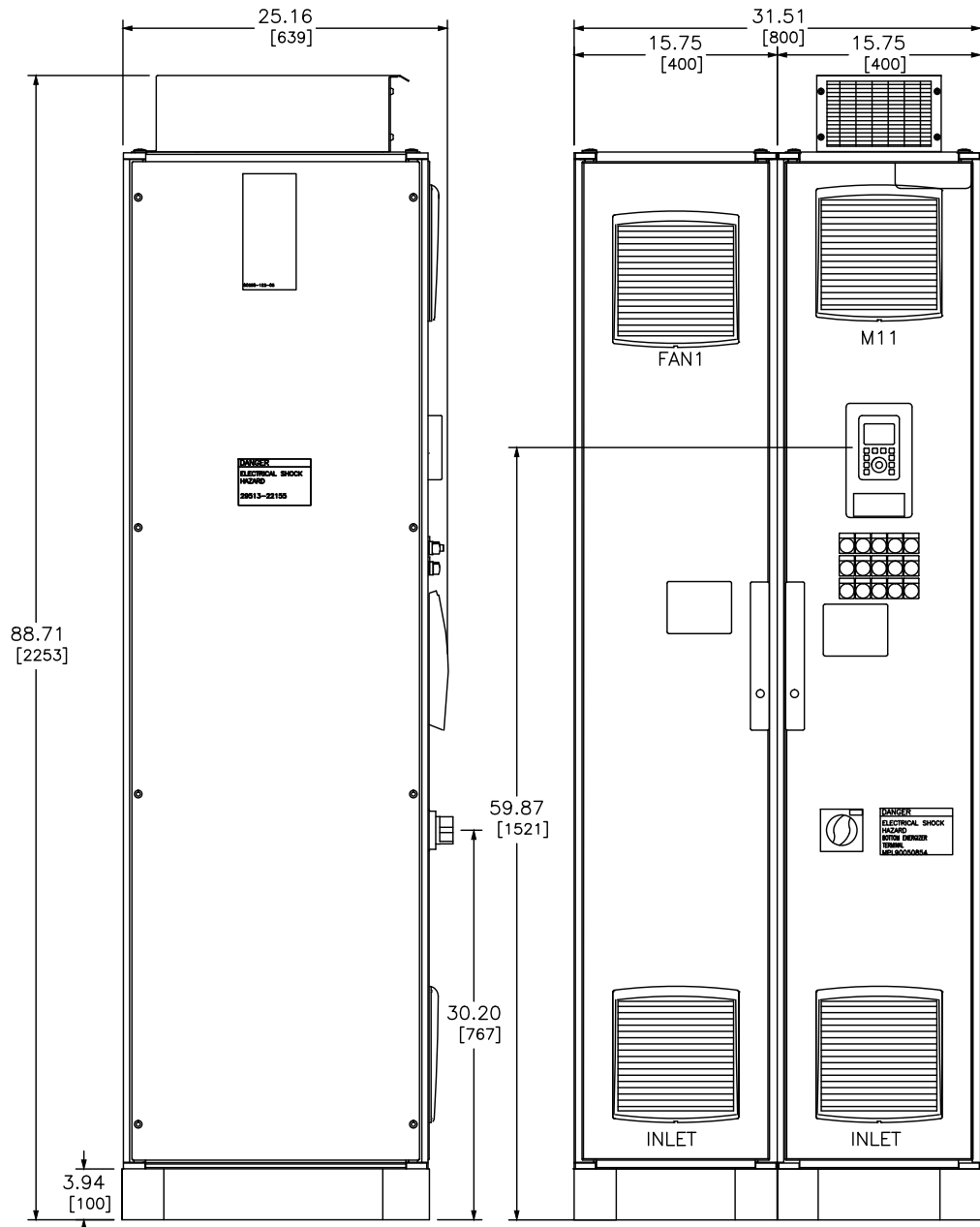
SQUARE D

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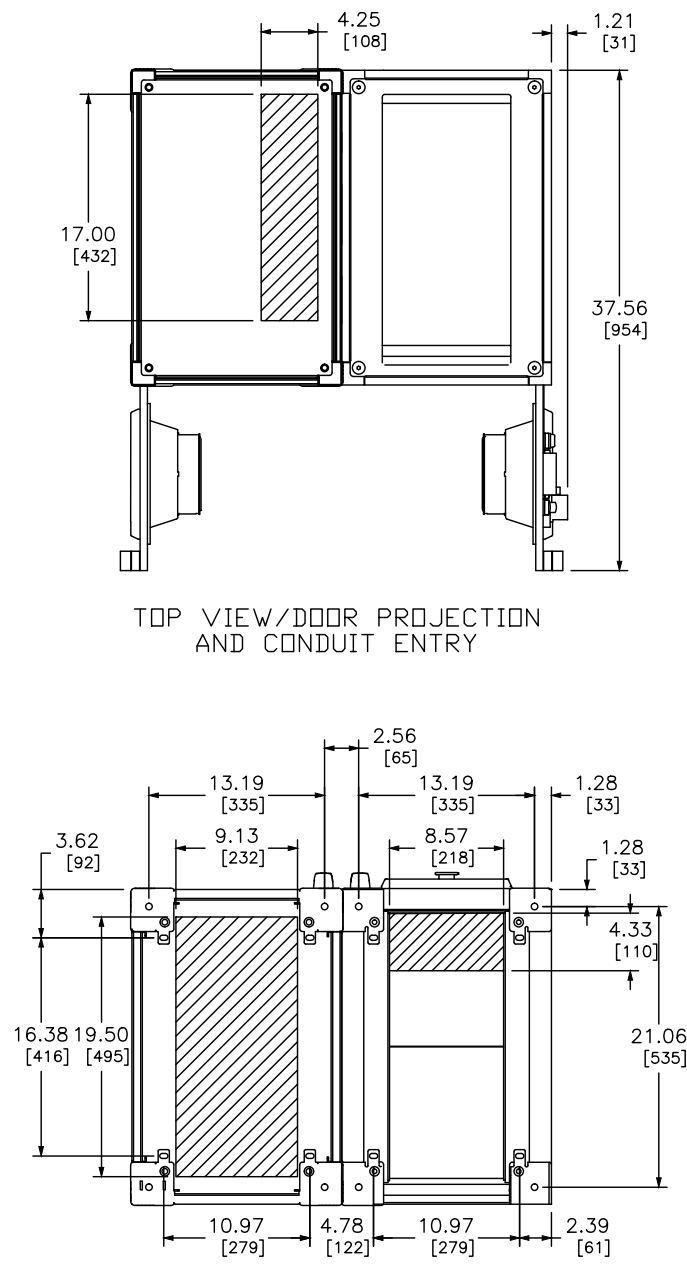
PG 1 OF 1

REV

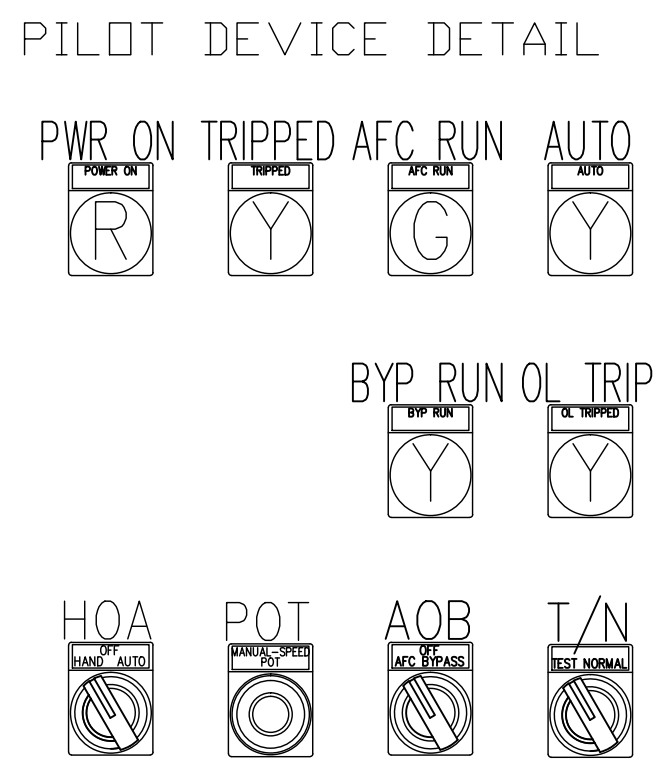
THIS ASSEMBLY MUST MEET UNDERWRITERS LABORATORIES STANDARD UL 508A.



LEFT VIEW



BOTTOM VIEW MOUNTING LOCATIONS
AND CABLE ACCESS AREAS



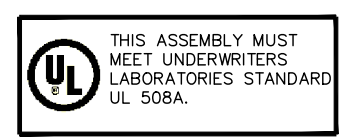
NOTES:


1 REFER TO CONTROLLER NAMEPLATE TO COMPLETE P/N.

ENCLOSURE OUTLINE & GENERAL ARRANGEMENT FOR CONTROLLER P/N

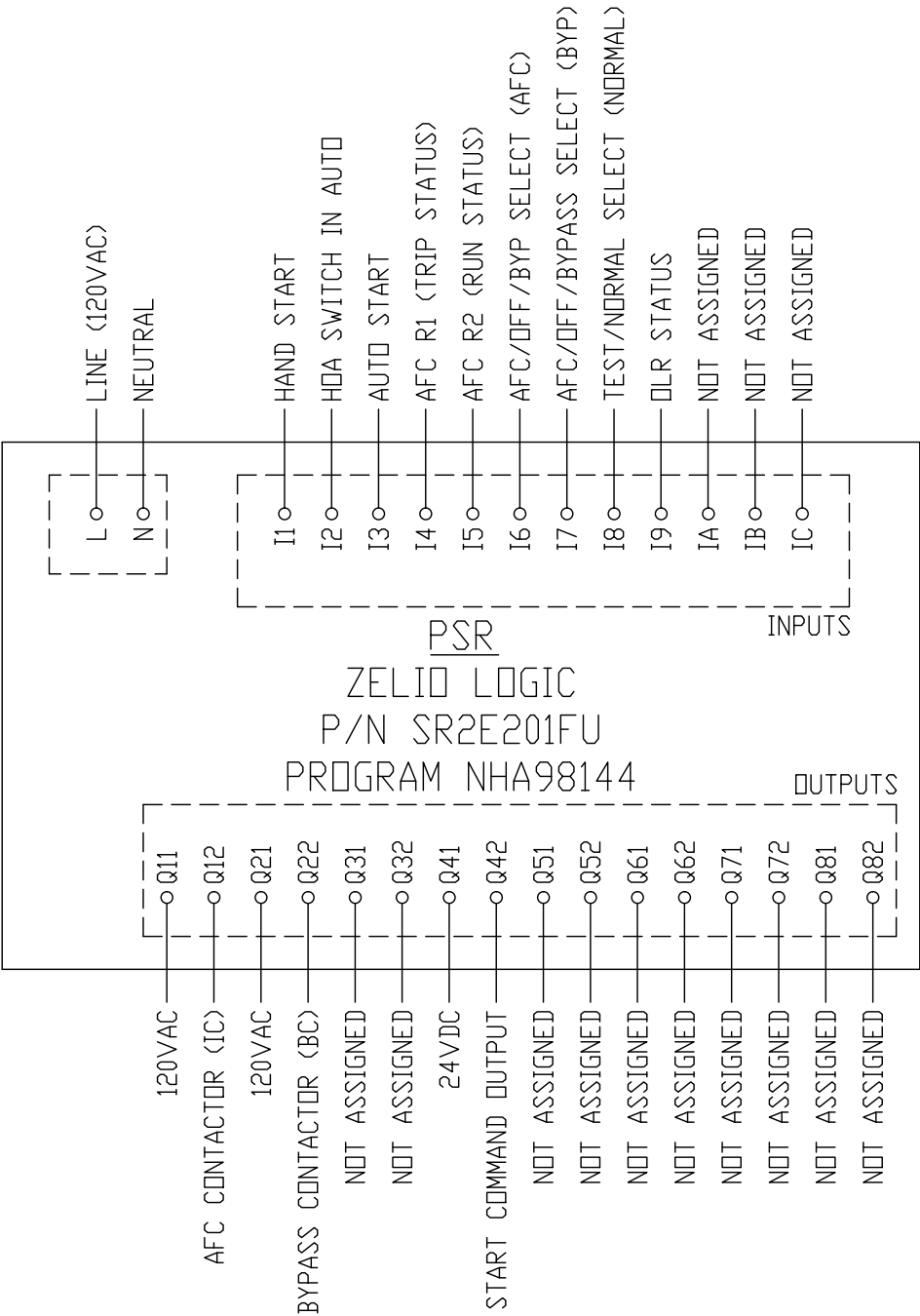
⚠ ATV660 C13 T4 N G A Y


MAX FLA	KILOWATTS/HP	VOLTAGE/PH	DUTY TYPE	ENCLOSURE TYPE	HARMONIC MITIGATION	POWER CIRCUIT TYPE
240 AMPS	130KW/200HP	460V/3 PH	NORMAL	TYPE 1	5% REACTOR	BYPASS



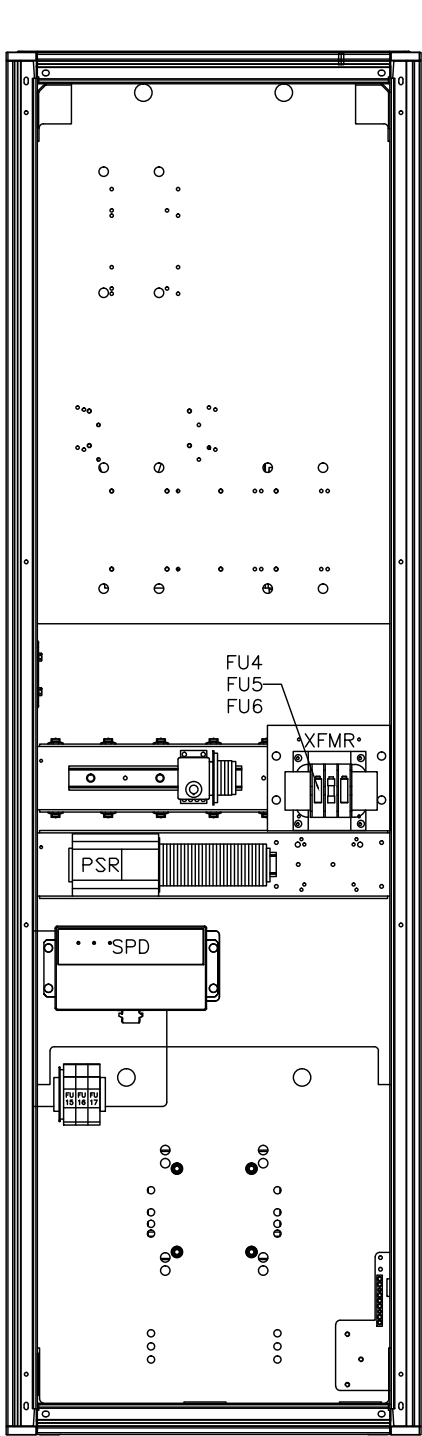
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JOB LOCATION:		EQUIPMENT TYPE:	ALTIVAR PROCESS DRIVE		
DRAWN BY:	(Q2C)	DRAWING TYPE:	ELEVATION		
ENGR:		 by Schneider Electric			
DATE:	June 09 2020	DWG#	FQ-1788575-48116441-01	PG 1	OF 1
DRAWING STATUS:	QUOTE			REV -	

REV	DESCRIPTION	BY	DATE	-	----	---	---/---/---	-	----	---	---/---/---
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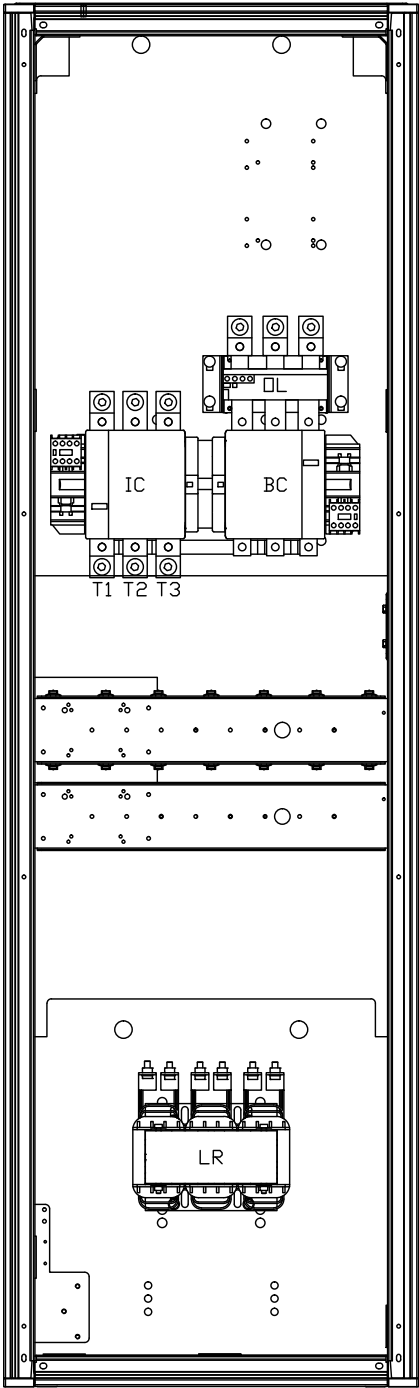


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JOB LOCATION:		EQUIPMENT TYPE:	ALTIVAR PROCESS DRIVE
DRAWN BY:	(Q2C)	DRAWING TYPE:	ELEMENTARY
ENGR:		 by Schneider Electric	
DATE:	June 09 2020		
DRAWING STATUS:	QUOTE	DWG#	EQ-1788575-48116441-01
		PG	3 OF 3
		REV	-

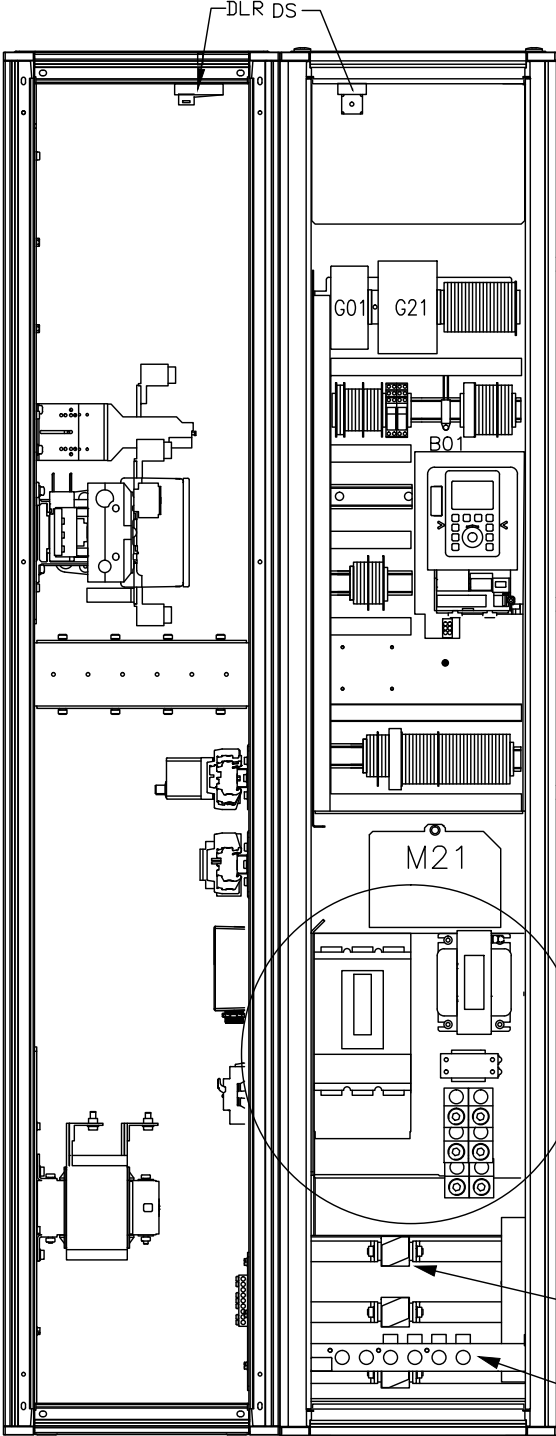
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LEFT VIEW
(OF RIGHT HAND WALL)



RIGHT VIEW
(OF LEFT HAND WALL)

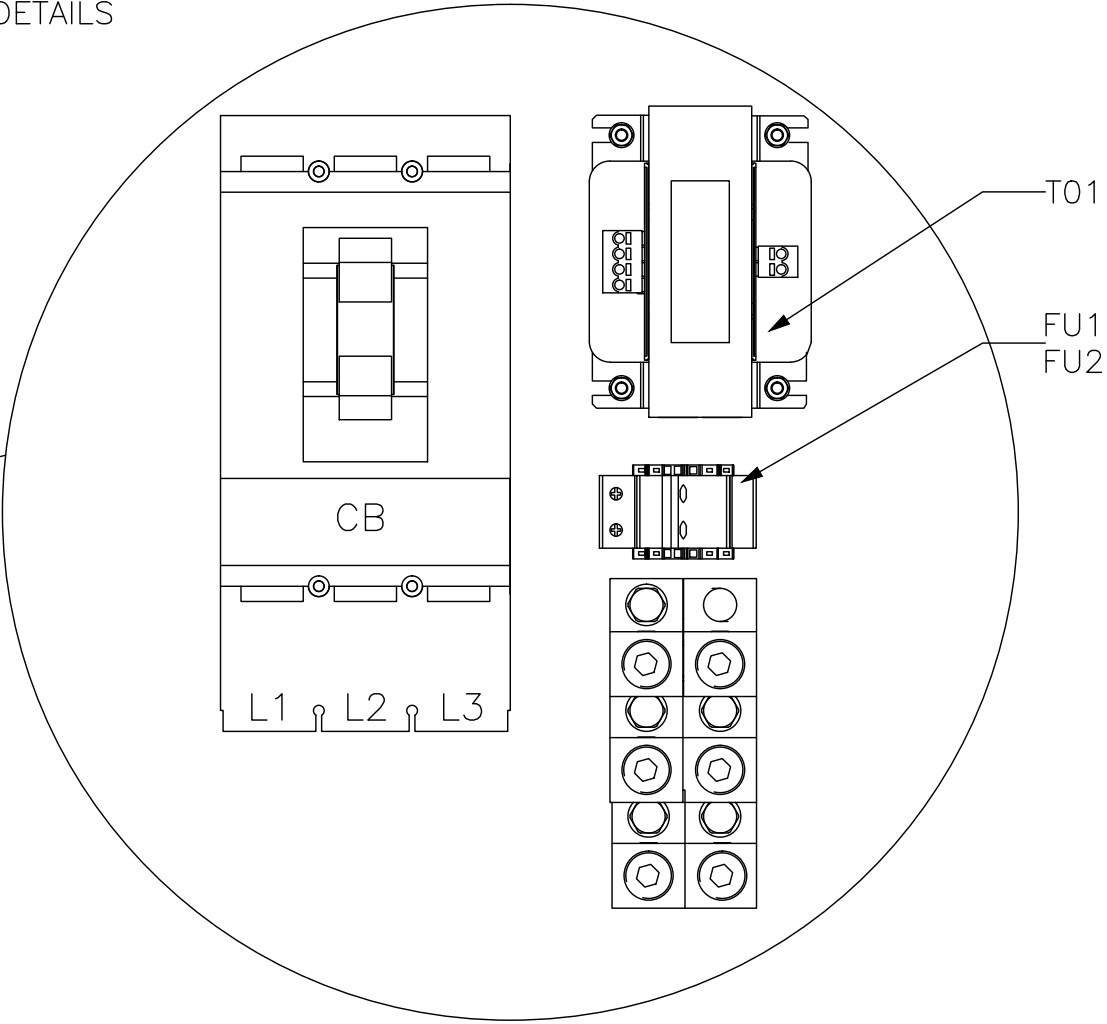


FRONT FRONT
INTERNAL VIEW

ROW 5
ROW 4
ROW 3
ROW 2
ROW 1

COMPONENT DETAILS
SEE PAGE 2

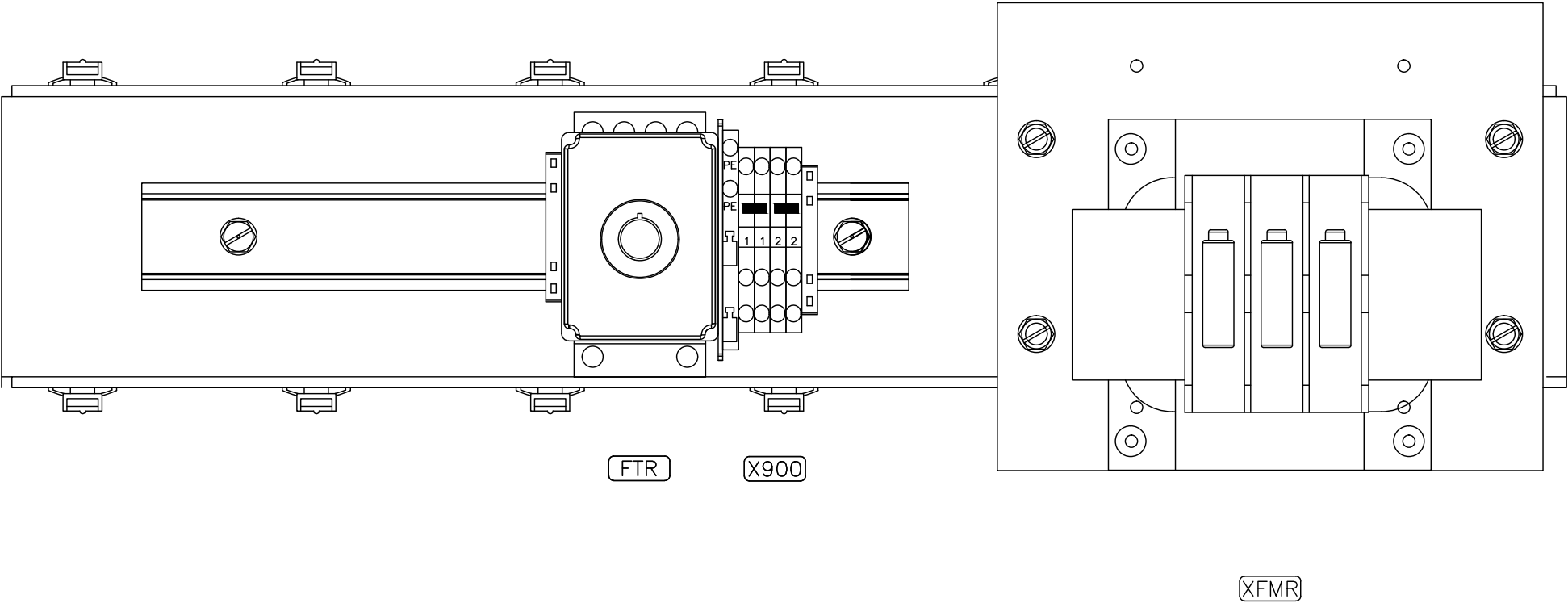
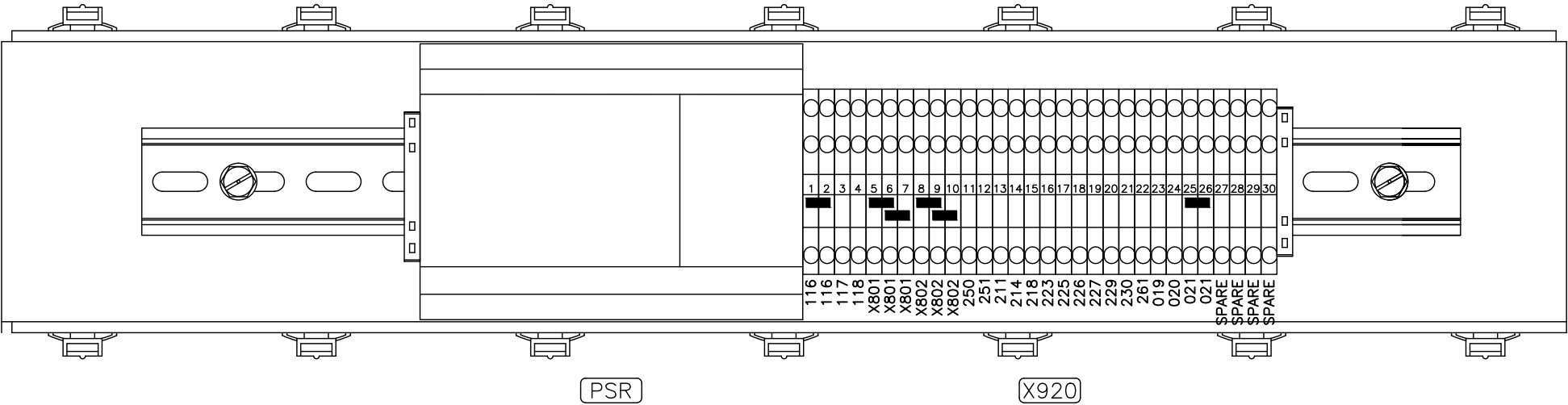
F01.1
F01.2
F01.3
GND




JOB NAME:	660 3R drive	EQUIPMENT DESIGNATION:	
JOB LOCATION:		EQUIPMENT TYPE:	ALTIVAR PROCESS DRIVE
DRAWN BY:	(Q2C)	DRAWING TYPE:	LAYOUT
ENGR:		SQUARE D by Schneider Electric	
DATE:	June 09 2020		
DRAWING STATUS:	QUOTE	DWG#	RQ-1788575-48116441-01
		PG 1	OF 3
		REV	-

REV	DESCRIPTION	BY	DATE	-	----	--	---/---/---	-	----	--	---/---/---
-	----	--	---/---/---	-	----	--	---/---/---	-	----	--	---/---/---

LOCATED IN CABINET NEAR BYPASS CONTACTORS



XFMR

JOB NAME:	660 3R drive	EQUIPMENT DESIGNATION:	
JOB LOCATION:		EQUIPMENT TYPE:	ALTIVAR PROCESS DRIVE
DRAWN BY:	(Q2C)	DRAWING TYPE:	LAYOUT
ENGR:		 by Schneider Electric	
DATE:	June 09 2020		
DRAWING STATUS:	QUOTE	DWG#	RQ-1788575-48116441-01
		PG	3 OF 3
		REV	-

Altivar™ 660 Drive Systems

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- 1 - 900hp at 460V Normal Duty
- 1 - 60hp at 230V Normal Duty
- 1 - 700hp at 460V Heavy Duty
- 1 - 50hp at 230V Heavy Duty

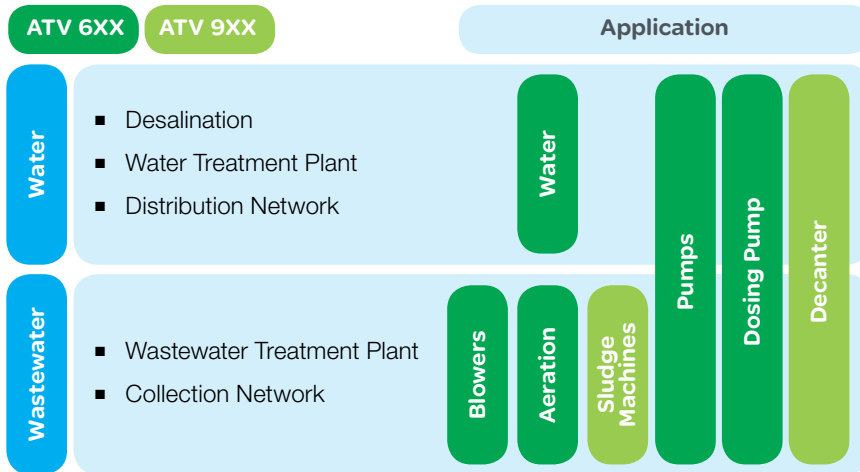


- Pre-engineered, ready to use solutions in highly efficient designs
- Modular and compact to maximize space utilization
- Flexibility for application requirements
- UL Type 1, 12 and 3R rated enclosures
- Built in pump curves
- Embedded ethernet and web server
- Dynamic QR codes
- Real time clock

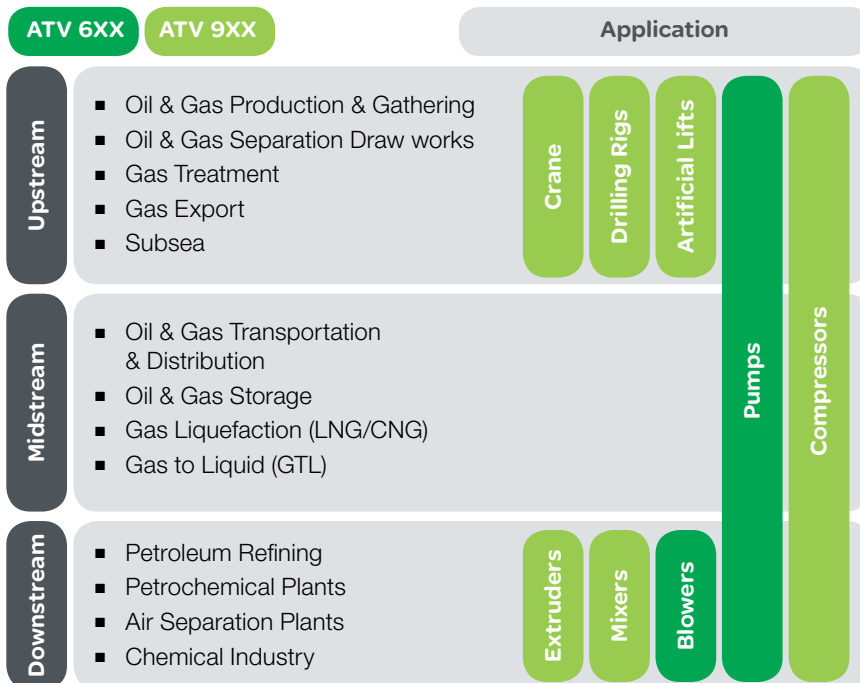
ATV660 Drive Systems

- Applications4
- 1-125hp.....6
- 150-900hp.....8
- Configured to Order10
- Make the Switch11
- Specifications12

Applications in WWW



Applications in O&G



Applications in MMM



	ATV 6XX	ATV 9XX	Application
Mining	<ul style="list-style-type: none"> Extraction Underground Processing Transportation & Logistics 	Flotation Separation Thickening Long Conveyor	Crusher, Screen, Grinder, Mill Loading/Unloading Conveying Pump/Fan/Compressor
Cement	<ul style="list-style-type: none"> Cement Aggregates 	Fan Blower	
Metal	<ul style="list-style-type: none"> Raw Material Preparation (Coke/Sinter/Pellet) Iron Making Area Rolling Finishing 	Steel Converter Tilt Crane	



Applications in F&B



	ATV 6XX	ATV 9XX	Application
Liquid Food	<ul style="list-style-type: none"> Dairy Juice 	Air Drying Cyclone Mech, Vapor Recompression Pumping Pipe Distribution	Pumps Air Blower Fan
Agri-Business	<ul style="list-style-type: none"> Sugar Oil Grain 	Mixers Conveying Mill & Crushers Centrifugal Pump	



ATV660 Drive Systems (1-125hp ND)



- 1–125hp Normal Duty at 460V, 1–100hp Heavy Duty at 460V, 1–60hp Normal Duty at 230V, 1–50hp at 230V Heavy Duty
- All four frames are 16 in wide
- All wall mount frames are 19.5 in deep
- Two additional frame enclosures available for ETO options
- UL Type 1, 12 & 3R rated enclosures
- 100,000 SCCR short circuit rating
- Energy management (integrated power measurement)
- Remote graphic keypad
- Standard 3% equivalent impedance
- Circuit breaker disconnect
- White component mounting plate
- Service entrance - 3R

75-125hp ND
@460V



40-60hp ND
@460V



20-30hp ND
@460V



1-15hp ND
@460V



ATV660 Drive Systems

ATV660 Drive Systems (1-125hp ND)

Available options:

- Bypass-utilizing Zelio Smart Relay (up to 250hp)
- Harmonic filter
- Service switch (bypass)
- DV/DT motor filter
- 50 Deg C (3R)
- Communication cards
- Control and indicator options
- 5% equivalent impedance option
- Many more to meet customer requirements



ATV660 Drive Systems (150-900hp ND)

- 150–900hp Normal Duty @ 460V, 125–700hp Heavy Duty at 460V
- UL Type 1 & Type 12 rated enclosures
- UL 508A
- 100,000 AIC short circuit rating
- Contains frequency inverter & rectifier modules, circuit breaker, line reactor, motor choke
- Remote graphic keypad
- Removable conduit entry plate

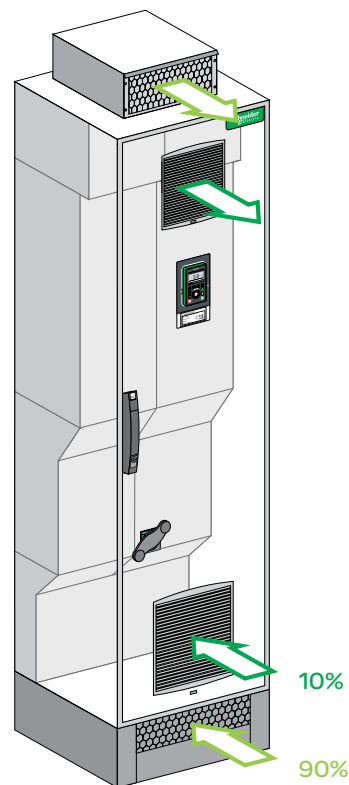
150-250hp ND
@460V



300-500hp ND
@460V

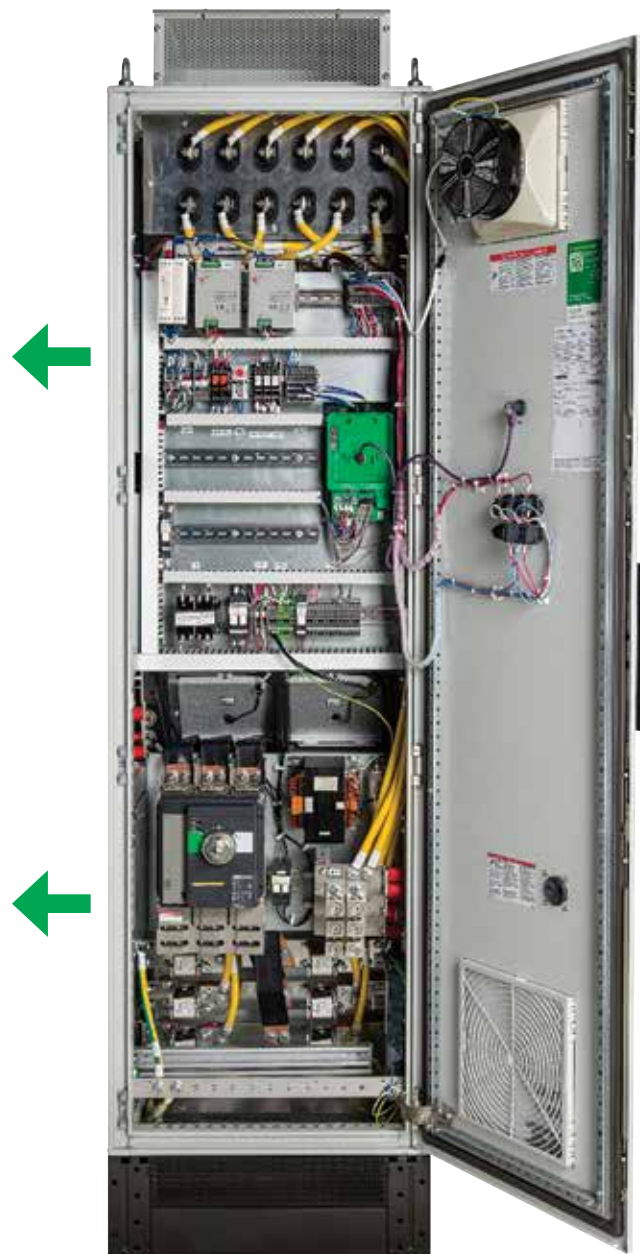
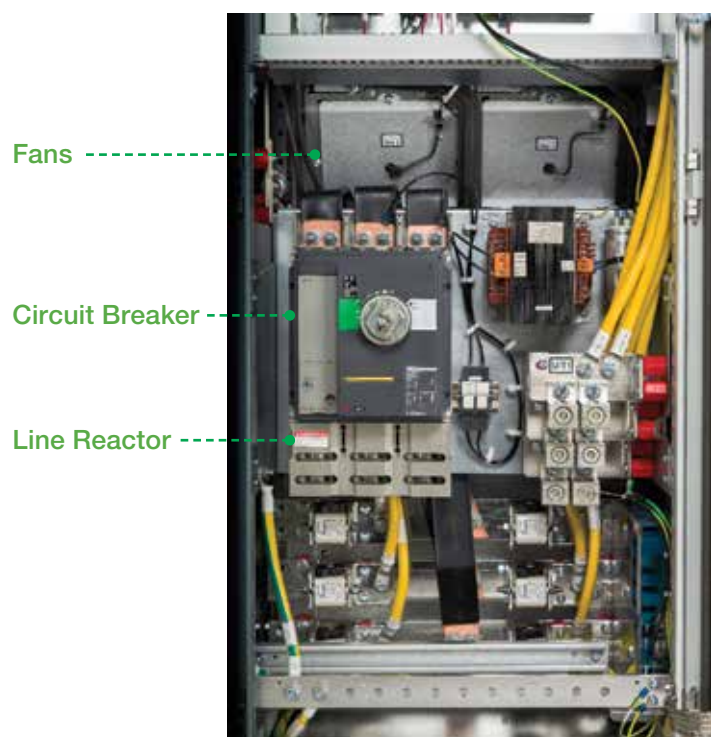
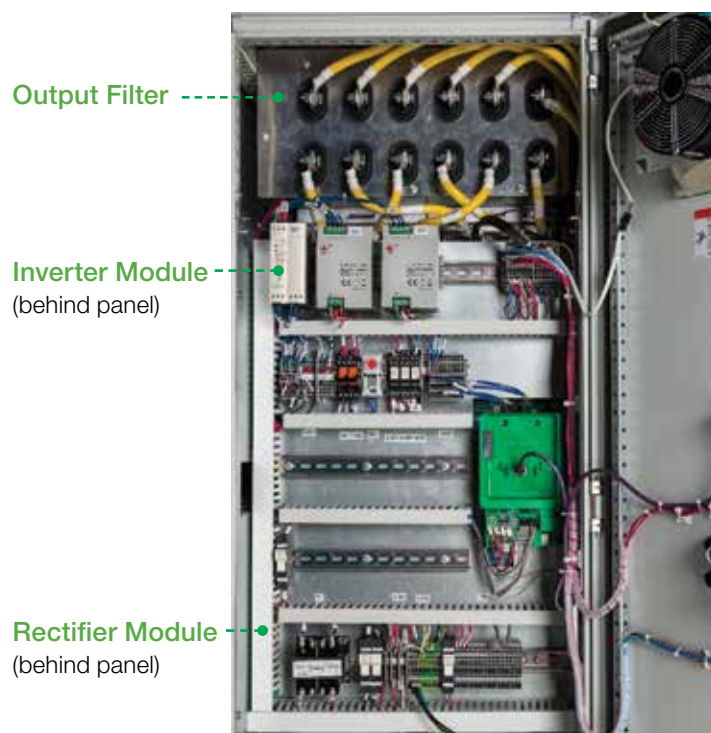


Cooling concept



ATV660 Drive Systems

ATV660 Drive Systems (150-900hp ND)



Configuration To Order

Catalog number example: ATV660D22T4N2ANWAANAGK

ATV660 **D22** **T4** **N** **2** **A** **N** **W** **A** **A** **N** **A** **G** **K**

Product line (Utility)
660 ATV660 Drive System
680 Low Harmonic

Product line (Industry)
960 ATV960 Drive System
980 Regen

Voltage
U3 230V
T4 460V

2 UL (default)
6 cUL

Power Circuit
W W/O bypass (default)
Y Bypass (<300hp)

Light Options
N None
A Red pwr on, Yell trip gr AFC run, Yell auto
B Red pwr on, Yell trip gr AFC run

Misc Options
N None
A Ethernet port on front door (PC/iPad)
B Line contactor
C Drive I/O extension
D Drive extended relay module (3 NO)
E 0-10V auto speed reference
F 1 NO auxiliary auto mode contact
G Type 1 SPD 40 k
H Type 2 SPD 80 k
J Not assigned
K Additional 150VA control power transformer
L Push-to-test pilot lights
M Not assigned
P Permanent wire markers (sleeve type)
Q Trip reset button
R Not assigned
S 50 deg C (3R only, 125hp & below)
T Service Switch
U Top entry cubical (150hp & above)
V Assembled in US (60hp & below)
W Not assigned
X DV/DT filter

Normal Duty Values

Code	HP at 460V
U07	1
U15	2
U22	3
U40	5
U55	7.5
U75	10
D11	15
D15	20
D18	25
D22	30
D30	40
D37	50
D45	60
D55	75
D75	100
D90	125
C11	150
C13	200
C16	250
C20	300
C25	400
C31	500
C40	600
C50	700
C63	900

Heavy Duty Values

Code	HP at 460V
—	—
U15	1
U22	2
U30	3
U55	5
U75	7.5
D11	10
D15	15
D18	20
D22	25
D30	30
D37	40
D45	50
D55	60
D75	75
D90	100
C11	125
C13	150
C16	200
C20	250
C25	300
C31	400
C40	500
C50	600
C63	700

Enclosure
G Type 1 (default)
A Type 12
H Type 3R (<150hp)

Control Options
N Prewired for HOA
A HOA, Speed Pot (default)
B HOA, Speed Pot, Start-Stop

Harmonic Mitigation
N None (default)
A 5% line impedance
M Harmonic filter

Comms Options
N None
A Profibus DP
B CANopen daisy chain
C Devicenet
D CANopen sub-D9
E CANopen open style
F Profinet
G Ethernet/IP-VW3A3720

Make the Switch Today

M-Flex

- Commercial
- Industrial
- WWW



ATV Plus

- Commercial
- Industrial
- WWW



E-Flex

- Industrial
- Some WWW



Smaller footprint
Advanced keypad
Option rich

Embedded pump curves
Embedded web server
Dynamic QR codes



ATV660 Drive Systems

ATV660 Drive Systems (1-900hp ND)

Electrical Specifications		Environmental Specifications	
Input mains voltage	230 Vac \pm 10%, 460 Vac \pm 10%	Storage temperature	-13 to +149 °F (-25 to +65 °C)
Short circuit current rating (AC symmetrical)	100 kA	Operating temperature	+14 to +104 °F (-10 to +40 °C) Type 1/12; +14 to +122 °F (-10 to +50 °C) Type 3R
Control voltage	24 Vdc, 115 Vac + 10%/-15% (control power transformer included)	Humidity	95% with no condensation or dripping water, conforming to IEC 60068-2-78
Displacement power factor	98% through speed range	Altitude	3,300 ft (1000 m), without derating, derating of the current by 1% for each additional 330 ft (100 m) up to 9,842 ft. (3000 m) maximum
Input frequency	50/60Hz \pm 5%	Enclosure	UL Type 1 : General indoor; UL Type 12: Indoor dust-tight (ventilated); UL Type 3R: Outdoor (ventilated)
Output voltage	Three-phase output, maximum voltage equal to input voltage	Pollution degree	Pollution degree 2 or 3 per NEMA ICS-1 Annex A and IEC 60664-1
Galvanic isolation	Galvanic isolation between power and control (inputs outputs, & power supplies)	Operational test vibration	Conforming to IEC 60721-3-3-3M3 amplitude 1.5 mm peak to peak from 3-13 Hz 1 g from 13-200Hz
Torque/Over torque	Normal Duty: 110% of nominal motor torque for 60s Heavy Duty: 150% of nominal motor torque for 60s	Transit shock test	15 g, 11 ms
Current (transient)	Normal Duty: 110% of drive rated current for 60s Heavy Duty: 150% of drive rated current for 60s	Codes and standards	UL Listed per UL 508A IEEE519 compliant (passive harmonic filter required); Conforms to applicable NEMA ICS, NFPA, and IEC standards; Manufactured under ISO 9001 standards
Switching frequency	Selectable from .5-8 kHz Factory setting: 2.5 kHz The drive reduces the switching frequency automatically in the event of excessive heat sink temperature	Cyber Security	Achilles™ Level 2 certification
Efficiency	95% (or greater) at full load typical		

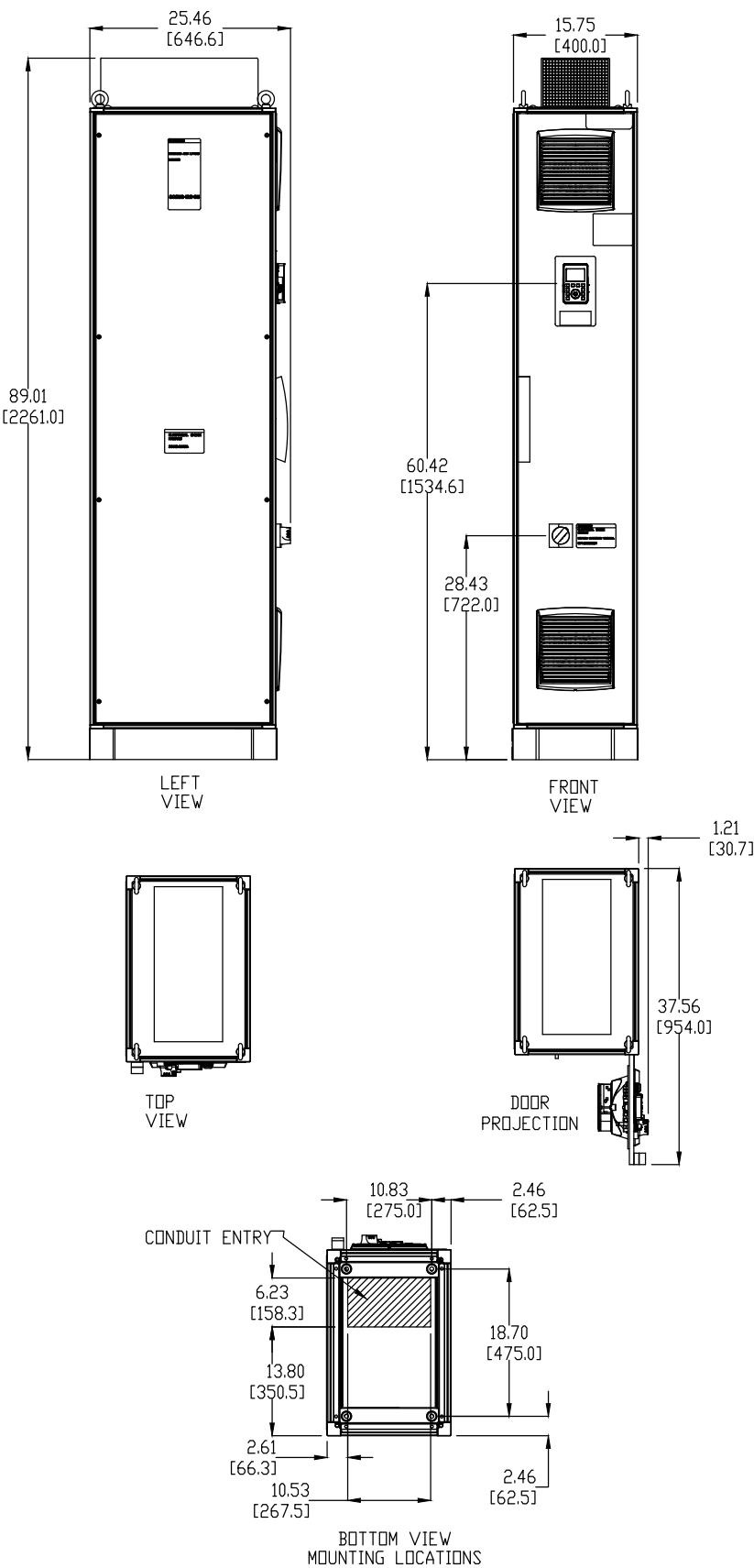
Process drives without bypass are available up to 700hp HD / 900hp ND at 460V or 50hp HD / 60hp ND at 230V. The following standard features for process drives without bypass, when no options are ordered:

- Disconnect handle with lockout/tagout provisions
- Door mounted keypad holder and display
- One form C tripped relay
- Two form A sequence relays
- Six programmable digital inputs
- Standard color RAL735
- Class 10 overload protection
- Controller programming
 - Acceleration (ACC): 10s
 - Deceleration (DEC): 10s
 - Low Speed (LSP): 3Hz

ATV660 Drive Systems

ATV660
TYPE 1 FRAME 1P
150-250HP @ 460V

ELEVATION 2000MM
TYPE 1



For additional information,
contact your local field office.



Schneider Electric USA, Inc.

Schneider Electric USA, Inc.
8001 Knightdale Blvd.
Knightdale, NC 27545

USA Customer Care Center
Tel: 888-778-2733

altivardrives.com

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Design: Schneider Electric
Photos: Schneider Electric

Life Is On



8800BR1601
April 2016 - V1.0



**FLYGT MIXER
MODEL 4610.410
1.2 HP, 3/460V**

QTY. (7)



KENNEDY INDUSTRIES PERSONNEL HAVE DONE ITS DUE DILIGENCE TO ENSURE THAT ALL PROJECT REQUIREMENTS ARE MET BY OUR SUPPLY. THE FOLLOWING DRAWINGS, SPECIFICATIONS & CUT SHEETS ARE THE OFFERINGS THAT WE SUBMIT FOR APPROVAL TO SUPPLY. KENNEDY INDUSTRIES IS A SUPPLIER AND STRIVES TO PROVIDE OUR CUSTOMERS WITH THE HIGHEST QUALITY PRODUCTS AND LEVEL OF SERVICE. IF A CHANGE OR DEVIATION FROM THE FOLLOWING IS DESIRED PLEASE ADVISE US AND WE WILL CHANGE OUR SCOPE OF SUPPLY AS REQUIRED. IF MATERIALS OF CONSTRUCTION OR SCOPE OF SUPPLY CHANGES, IT MAY IMPACT THE CONTRACT PRICE.

PROJECT:	UNIVERSAL PUMP STATION	JOB #:	96857
KI CONTACT:	JIM BAKOS / JASON WENDECKER	CUSTOMER:	JOHN E. GREEN CO.
OWNER:	SAGINAW COUNTY BOARD OF PW	ENGINEER:	SPICER GROUP
DATE:	1/8/19	SECTION:	
PUMP TYPE:	MIXER	CONDITION:	
PH/VOLT:	3/460V	PIPE DIA:	
WW DIA:		WW DEPTH:	
NOTES:			

QTY.	DESCRIPTION	COMMENTS
7	FLYGT 4610.410 MIXER, 1.2 HP, 3/460V	APPROX. WEIGHT: 36 LBS.
7	FLS	DETECTS MECHANICAL SEAL LEAKS
7	POWER AND SENSOR CABLE	50 FT. LENGTH
7	WALL MOUNT KIT	#14-589232, 20' CABLE & ONE INTERMEDIATE
7	2"X2"X3/16" SQUARE TUBING	20' LENGTH
7	LIFT CHAIN	1/4", 20' LENGTH CAPACITY = 650 LBS
7	QUICK LINKS	1/4", 304SS CAPACITY = 1,700 LBS
7	FLYGT MINI-CAS W. 11 PIN SOCKET BASE	SEAL FAIL / HIGH TEMP RELAY



ITT

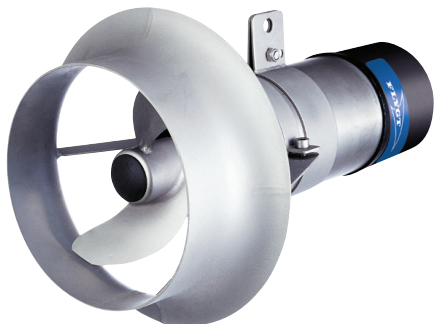
Water & Wastewater

4610

Submersible Mixer

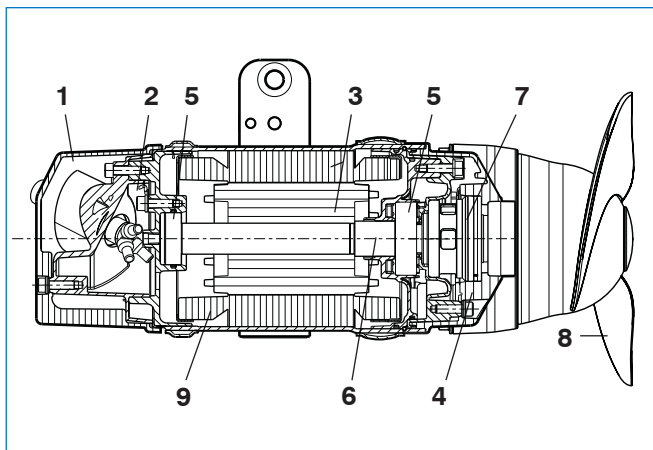
Heavy duty, direct drive mixer

Flows from 1,363 to 1,501 GPM



Applications:

4610 mixers are used in industrial processes such as Pulp & Paper, Chemicals, Food & Beverage and more. Also found in Municipal and Industrial waste treatment, Mining, Marine and Agricultural uses.



Materials of Construction:

- 316 Stainless Steel

Approvals:

CSA tested and approved to UL Standard for Safety #778.

Factory Mutual Research tested and approved. (Pending)
Suitable for use in:

Class I Div 1 groups C and D

Class II Div 1 groups E; F and G

Class III Div 1 Hazardous locations



Specifications

1. Cable Entry

Cable entry consists of a compressible rubber bushing to seal off motor area and relieve strain on the cable. Cable entry housing is constructed of vinyl ester for shock and chemical resistance.

2. Junction Box

Box is sealed off from surrounding liquid and stator casing via terminal board and an O-ring.

3. Motor

Squirrel cage, 3 phase induction shell type design NEMA B motors are specifically designed for each mixer frame size. Non-overloading for full performance range. Motor insulation is Class F with a maximum working temperature of 155°C (311°F). Combined service factor of 1.10. Motors can be run continuously or intermittently. The stator is cooled by the surrounding mixed media.

4. Oil Casing

An environmentally friendly white paraffin based, FDA approved, non-toxic oil lubricates and cools the seals and acts as an additional barrier to prevent liquid from penetrating the motor area. Pressure build-up within the casing is reduced by an inner and outer oil compartment design which transports any foreign liquids away from rotating components. Casing is constructed of vinyl ester for shock and chemical resistance.

5. Bearings

Bearings are rated in excess of 100,000 hours of operation (L-10aa rated life). Shaft is supported by a single row angular contact ball bearing and single row cylindrical roller bearing, plus a heavy duty single row angular contact ball bearing on the propeller side.

6. Shaft

Motor shaft and rotor are a single integral unit. Shaft is completely isolated and cannot come in contact with the mixed media.

7. Shaft Seals

Outer mechanical seal isolates the oil housing and surrounding liquids and is tungsten carbide lapped end faced running in oil. Inner mechanical seal operates between oil casing and stator casing. Only seal faces operate in the mixed media, all other components are within motor housing.

8. Propeller

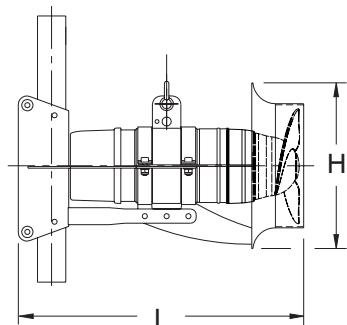
Two bladed, 316 stainless steel propeller. Blades have large width, thin profile and smooth surface with a back swept design for optimum efficiency and non clogging operation. The blades are laser cut to exacting tolerances. Propeller is available in other materials - consult Flygt.

9. Monitoring Equipment

The stator incorporates three thermal switches connected in series (one in each phase) which open at 260°F (125°C).

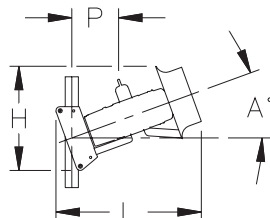
Flygt products are affiliated with the following associations:





ALL DIMENSIONS IN INCHES

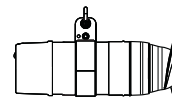
DIMENSION CHART					
A°	-20	-10	0	10	20
H	15 $\frac{1}{2}$	13 $\frac{1}{8}$	11 $\frac{1}{2}$	13 $\frac{1}{8}$	15 $\frac{5}{8}$
L	21 $\frac{3}{4}$	21	19 $\frac{7}{8}$	21 $\frac{1}{8}$	21 $\frac{3}{4}$
P	9 $\frac{3}{4}$	9 $\frac{1}{2}$	8 $\frac{1}{4}$	8 $\frac{1}{8}$	7 $\frac{5}{8}$



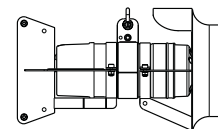
Weights

Weight of mixer without cable:

min. 24.2 lbs



max. 35.3 lbs



Power Cable for Warm Liquid Mixers HCR cable - to 195°F (90°C)

HP	Volts	Cable Size	Part No.
1.2	All	7G2.5 11.4 mm (0.45")	94 20 91

Propeller Performance

Model	Prop. Code	Ø	Poles	Max. Motor HP Rating	Shaft HP*	% Full Load	Power Input (kW)	Prop. Speed (RPM)	Prop. Dia. (inches)	Prop. Blade Angles (Degree)	Flow (GPM)
Mixer With Jet Ring	042107SJ	3	4	1.2	0.9	69	.90	1740	8-9/32"	7°	1,136
Mixer Without Jet Ring	042107SF	3	4	1.2	1.0	81	1.05	1740	8-9/32"	7°	1,501

Liquid Temperatures: Mixers constructed in 316SS are assembled using components that will withstand liquid temperatures up to 195°F. Cable sizes shown below are based on max. liquid temperature of 104°F. Refer to power cable chart above for liquid temperatures above 104°F.

Motor Data

Rated Output Power HP (kW)	Ø	Volts nom.	Full Load Amps	Locked Rotor Amps	Locked Rotor KVA	NEC Code Letter	Rated Input Power kW	Poles/RPM	Cable Size AWG	Cable Part Number	Max. Cable Length (FT.)
1.2 (0.9)	3	200	7.5	41							255
		230	7.4	37	13.5	N	1.3	4/1740	14/7	94 21 02	295
		460	3.0	17					19.0 mm (0.75")		1470
		575	2.6	14							2120

Efficiency			Power Factor			Electrical Service Specifications	
100% Load	75% Load	50% Load	100% Load	75% Load	50% Load	Voltage Tolerances: $\pm 5\%$ (Rated Output), $\pm 10\%$ (without overheating) Frequency Tolerance: $\pm 5\%$ Voltage Balance (Phase to Phase): $\pm 1\%$	
68.5	64.0	56.0	0.54	0.46	0.36		

ITT Water & Wastewater, Flygt products, reserves the right to modify performance, specifications or design without notice.

4610, 4610(X) Mixers

Outline Dimensions with Jet Ring - System 4 Mounting (2" Mixer Mast)



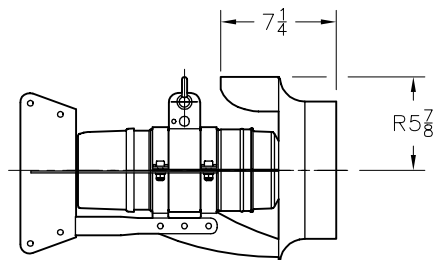
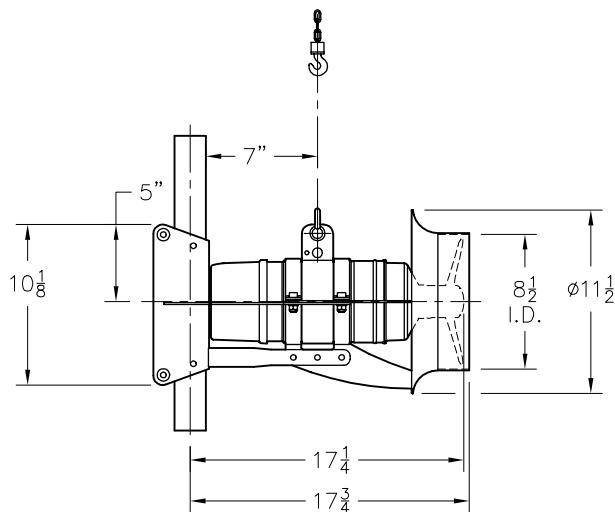
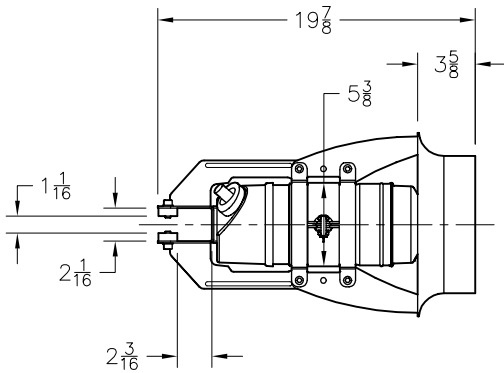
4600 Series Mixers

Issued: 2/03

Supersedes: 7/00

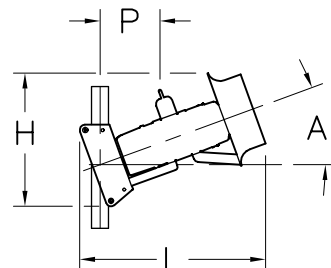
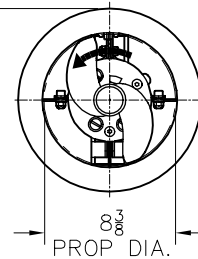
NOTE:

1. 21" MIN. SUBMERGENCE WITHOUT VORTEX SUPPRESSOR.
8" MIN. SUBMERGENCE WITH VORTEX SUPPRESSOR.



▽ WATER LEVEL

1



ALL DIMENSIONS IN INCHES

681614A

DIMENSION CHART					
A°	-20	-10	0	10	20
H	15 1/2	13 1/8	11 1/2	13 1/8	15 5/8
L	21 3/4	21	20	21 1/8	21 3/4
P	9 3/4	9 1/2	8 1/4	8 1/8	7 5/8

WEIGHT (LBS.)

TOTAL w/o GUIDE BRACKET
40

4610 MUNICIPAL SPEC

SCOPE

Furnish (7) submersible mixers. Each mixer shall be equipped with a 1.2 HP, submersible electric motor connected for operation on 460 volts, 3 phase, 60 Hertz, with 50 ft. of cable. All cables shall be oil resistant chlorinated polyethylene rubber jacketed. Each unit shall be fitted with 20 feet (40 ft. minimum) of lifting cable of adequate strength to permit raising and lowering the mixer. Mixers specified herein shall have propeller code 042107SJ.

MANUFACTURER REQUIREMENTS

The mixing equipment specified herein shall be the design and fabrication of a single manufacturer which shall have sole source responsibility for said equipment.

MIXER DESIGN

The mixers shall be capable of handling raw, screened sewage. The mixers shall be able to be raised and lowered and shall be easily removed for inspection or service without the need for personnel to enter the mixing vessel. A sliding guide bracket shall be an integral part of the mixer unit. The entire weight of the mixer unit shall be guided by a single bracket which must be able to handle all thrust created by the mixer. The standard mixer, with its appurtenances and cable, shall be capable of continuous submergence under water without loss of watertight integrity to a depth of 130 ft. FM approved mixers have a depth limit of 57 ft.

MIXER CONSTRUCTION

Each mixer shall be of the integral design, close coupled, submersible type. All components of the mixer, including motor shall be capable of continuous underwater operation. Major mixer components shall be of 316L Stainless Steel construction. The oil housing cover plate shall be of corrosion resistant composite (4610/20 utilize a vinyl ester composite motor cover). All exposed nuts and bolts shall be of stainless steel. In order to insure that the low velocity area around the motor remains impervious to low PH solids and or liquid attack, the motor housing exterior shall be made of 316 Stainless Steel. All metal surfaces coming into contact with the mixed media, other than stainless steel, shall be protected by a factory applied spray coating of acrylic dispersion zinc phosphate primer with an epoxy finish coat on the exterior of the mixer.

MOTOR (Non-explosion proof)

The motor shall be directly connected to the propeller (gearbox designs are not acceptable) to produce a propeller speed of 1740 RPM. The mixer motor shall be squirrel cage, induction, shell type design, housed in an air filled, watertight chamber. The stator winding shall be insulated with moisture resistant Class F insulation which will resist a temperature of 155°C (311°F). The stator shall be dipped and baked three times in Class F varnish. The motor shall be designed for continuous duty, capable of sustaining a maximum of at least ten (10) evenly spaced starts per hour. The rotor bars and short circuit rings shall be made of aluminum.

Thermal sensors shall be used to monitor stator temperatures. The stator shall be equipped with three (3) thermal switches embedded in the end coils of the stator winding and set for 260°F (125°C). These shall be used in conjunction with, and supplemental to, external motor overload protection, and wired to the control panel. In addition, a leakage detector be installed in the motor and connected through a Mini-CAS unit.

ELASTOMERS

All mating surfaces where watertight sealing is required shall be machined and fitted with a double set of Nitrile rubber or Viton O-rings. Fitting shall be such that sealing is accomplished by metal-to-metal contact between machined surfaces. This will result in controlled compression of the O-rings without requiring a specific torque limit. No secondary sealing compounds, rectangular gaskets, elliptical O-rings, grease or other devices shall be used.

PROPELLER

The propeller shall be of 316 stainless steel dynamically balanced, non-clogging backward curved design. Each blade shall be laser cut and welded to the hub to ensure that the propeller is properly balanced. The propeller shall be capable of handling solids, fibrous materials, heavy sludge and other matter found in normal sewage applications. The propeller shall have either two or three vanes 8-9/32" inches in diameter with a blade angle of 7 degrees.

JET RING ASSEMBLY

The mixer assembly shall incorporate a jet ring a full 360 degrees around the propeller. A maximum clearance of 1½ inches shall be maintained between the propeller tip and the shroud in order to maintain hydraulic efficiency and minimize power consumption.

CABLE ENTRY

The cable entry housing shall be an integral part of the back plate. The cable entry shall have a double set of elastomer grommets in order to ensure a redundant system in the event of a cable entry failure. Single sealing systems will not be deemed acceptable. The cable entry shall be comprised of two cylindrical elastomer grommets, each flanked by washers and a ferrule designed with close tolerance fit against the cable outside diameter and the entry inside diameter. This will provide a leak proof seal at the cable entrance without the need for specific torque requirements. The assembly shall bear against a shoulder in the stator casing opening and be compressed by a gland nut threaded into it. Interaction between the gland nut and the ferrule should move the grommet along the cable axially instead of with a rotary motion. The junction chamber and motor compartment shall be separated by a terminal board which shall protect the motor interior from foreign material gaining access into the mixer top. Connection shall be made between the threaded compressed type binder posts thus securely affixing the cable wires to the terminal board. The use of the terminal compressed type post and a terminal board O-ring shall render the motor compartment leak proof from any liquid which may enter the terminal compartment. Epoxies, silicones, or other secondary sealing systems shall not be considered acceptable.

BEARINGS

All bearings shall have a minimum B-10 or L-10aa rated life of 100,000 hours and shall have inner and outer races of metal construction. Bearings with races made of nonmetallic construction will not be deemed acceptable or meeting the load handling and environmental requirements of this application. The outboard propeller bearing shall be an angular contact bearing. The motor shaft end shall be supported by two bearings. A roller and an angular contact ball bearing shall take up the axial and radial loads while an angular contact ball bearing shall take up the axial loads. The bearings shall be pre-loaded by a bearing loading nut located on the motor end of the shaft in order to reduce shaft deflection and increase bearing life and seal life. Mixers without pre-loaded bearings will not be considered acceptable or equal.

OIL HOUSING

The oil housing shall contain two compartments consisting of an inner and an outer section with four ports to connect and facilitate oil flow. In the event that the mixed media bypasses the other seal, this design will allow the outer compartment to collect the heavier (denser) fluids by means of a simple gravity process.

MECHANICAL SEALS

Each mixer shall be provided with two sets of lapped end face type mechanical seals running in oil reservoirs for cooling and lubrication. The mechanical seals shall contain positively driven rotary, corrosion resistant, Tungsten Carbide/Tungsten Carbide face rings for the outer seal assembly and Tungsten Carbide/Aluminum Oxide seal faces for the inner seal assembly or optional Silicon Carbide rings (select appropriate materials). In order to avoid seal failure due to sticking, clogging, and misalignment from elements contained in the mixed media, only the seal faces of the outer seal assembly and its retaining clips shall be exposed to the mixed media. All other components shall be contained in the oil housing.

The seals shall require neither maintenance nor adjustment, but shall be easy to check and replace. Shaft seals without positively driven rotating members shall not be considered acceptable or equal.

MIXER TEST

The mixer manufacturer shall perform the following inspections and tests on each mixer before shipment from the factory:

1. Propeller, motor rating, and electrical connections shall first be checked for compliance to the customer's purchase order.
2. A dielectric test shall be carried out in accordance to IEC 60034-1 (two times rated voltage plus 1000 V). This test shall be done after assembly but before any performance tests. No records shall normally be provided.
3. Prior to shipment, the mixer shall be run dry to establish correct rotation and mechanical integrity.

A written report stating the foregoing steps have been done may be supplied with each mixer at the time of shipment (upon request).

**ITT**

Water & Wastewater

4600 Propeller Performance

Mixers with Jet Ring

4600 Series Mixers

Issued: 2/08

Supersedes: 7/07

Mixer	Prop. Code	Ø	Poles	Max. Motor HP Rating	Shaft HP*	% Full Load	Power Input (kW)	Prop. Speed (RPM)	Prop. Dia. (inches)	Prop. Blade Angles (Degree)	Flow (GPM)
4610	042107SJ	3	4	1.2	0.90	69	0.90	1740	8 9/32	7°	1,430
4620	042107SJ	3	4	2.3	0.90	38	0.90	1675	8 9/32	7°	1,430
	042113SJ	3	4	2.3	1.20	58	1.40	1675	8 9/32	13°	1,950
	042115SJ	3	4	2.3	1.60	75	1.80	1675	8 9/32	15°	2,170
	042107SJ	1	4	1.2	1.00	69	0.90	1710	8 9/32	7°	1,390
4630	083705SJ	3	8	2.5	1.7	68	1.65	855	14 7/16	5°	4,010
	083706SJ	3	8	2.5	1.9	76	1.80	855	14 7/16	6°	4,240
	083707SJ	3	8	2.5	2.0	80	1.95	855	14 7/16	7°	4,470
	083708SJ	3	8	2.5	2.1	84	2.15	855	14 7/16	8°	4,650
4640	083705SJ	3	8	4.0	1.7	43	1.70	855	14 7/16	5°	4,030
	083706SJ	3	8	4.0	1.9	48	1.85	855	14 7/16	6°	4,260
	083707SJ	3	8	4.0	2.0	50	2.00	855	14 7/16	7°	4,490
	083708SJ	3	8	4.0	2.2	55	2.20	855	14 7/16	8°	4,680
	083709SJ	3	8	4.0	2.6	65	2.40	855	14 7/16	9°	4,840
	083711SJ	3	8	4.0	3.0	75	2.90	855	14 7/16	11°	5,300
	083712SJ	3	8	4.0	3.3	83	3.20	855	14 7/16	12°	5,530

* Horsepower consumed in clear water.

NOTES:

Liquid Temperature: Mixers constructed in 316SS are assembled using components that will withstand liquid temperatures up to 195°F. Refer to Warm Liquid Cable chart on Individual product specification sheet for required cable.

Consult your Flygt Regional Applications Engineer or Regional Sales Office for specific model and propeller selection.

Important: Please provide Specific Gravity with applications details.

All of the above versions are available in Stainless Steel 304 or 316.
All versions can be equipped with Seal Flush Device.
Explosion-proof mixers are available.



Water & Wastewater

Flygt System 4 Mixer Mounting System (with 2" Mast)

Accessories

Issued: 8/05

Supersedes: 2/04

FLYGT SYSTEM 4 (2" Mixer Mast)

This system was designed to mount mixer models **4610, 4620, 4630 and 4640**.

The System 4 is a corrosion resistant 316 stainless steel mixer mounting system designed by FLYGT to be used with our standard and explosion-proof mixers.

Construction of the System 4 enables the operator to position and lock the 2" x 2" mounting mast and mixer at different operating angles along the horizontal and vertical planes respectively.

The System 4 is an extremely versatile mixer mounting system designed and tested to meet and exceed a variety of customer requirements, such as:

1. **Tanks with sloped walls and floors**

The mast mounting brackets are designed for stepless adjustment, and as a result they can be fastened to straight or sloping surfaces.

2. **Deep tanks**

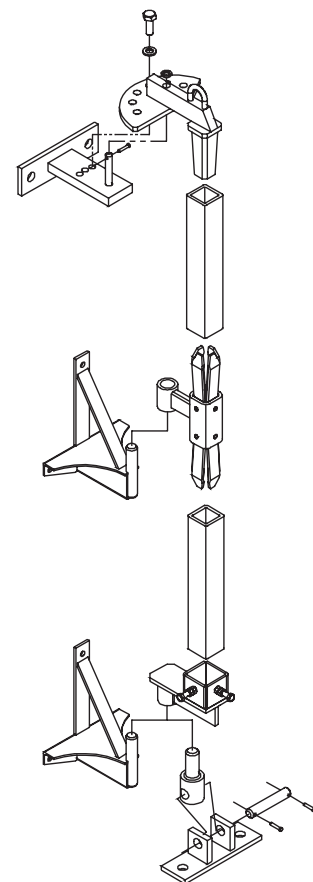
Lengthy mixer mounting masts will include the use of additional intermediate mast mounting brackets, there fore permitting mixer installation in deep tanks by pre venting mast deflection.

3. **Closed tanks**

By utilizing the adjustable 316 stainless steel cable, the mixer can be supported at the desired operating level, thus allowing the davit's lifting cable to be slackened and removed from the winch. This feature enables the **portable davit** to be removed from it's mounting socket and stored, while the davit's lifting cable may be secured below the roof of the tank. This in turn permits the tank roof doors to be closed during mixer operation.

4. **Mast length flexibility**

The System 4 mast length is currently limited only by the depth at which a particular Flygt mixer may be installed and retrieved. Please consult **Operating Guidelines** in the **Mixer Applications** section for data applicable to your installation.



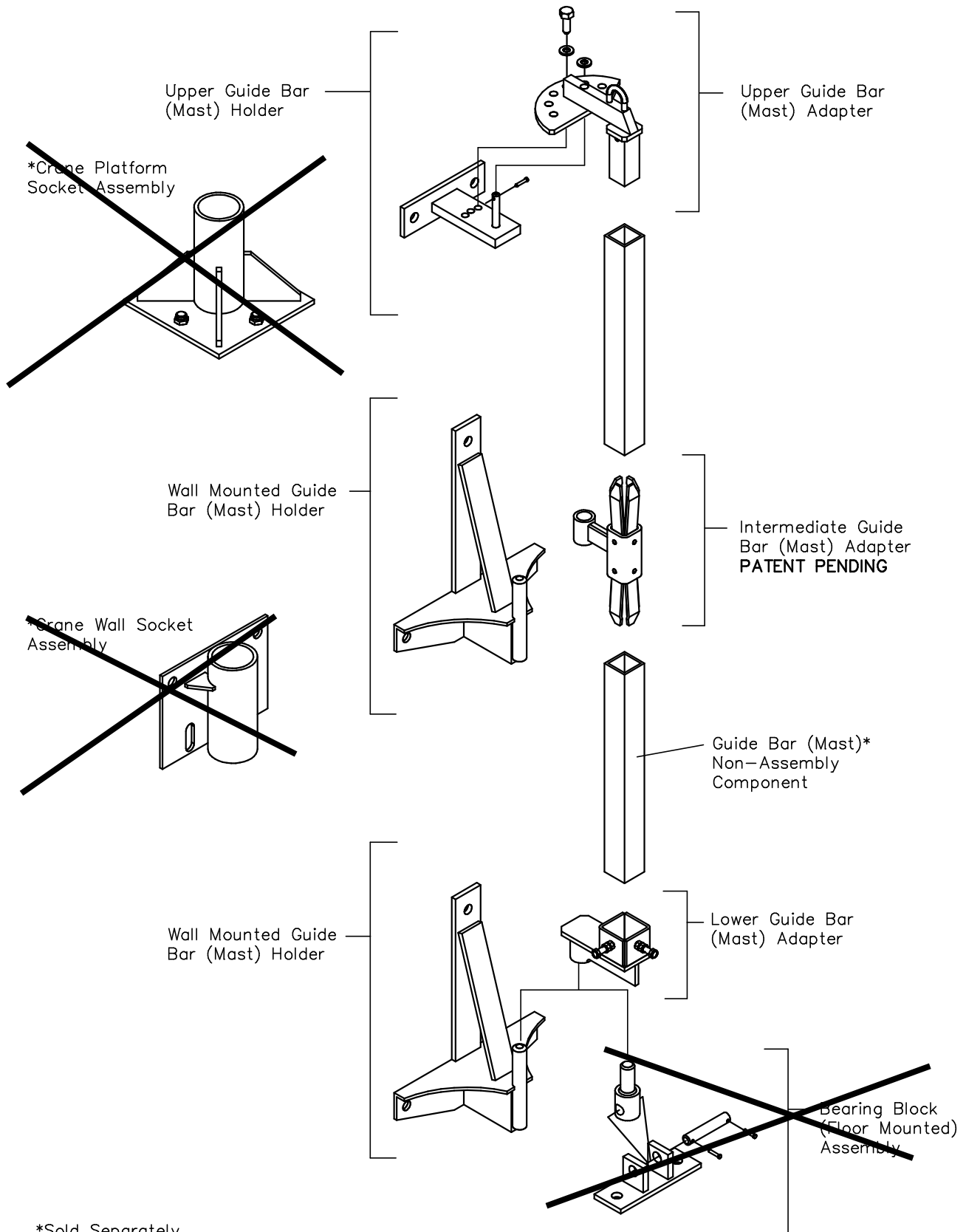
Floor or Wall Mounted 2" System 4 Mixer Mast Assembly (without Provision for Crane Mounting)

FLYGT

Accessories

Issued: 3/99

Supersedes: 9/93



*Sold Separately

**ITT****Flygt**

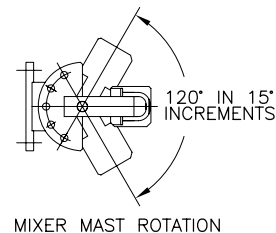
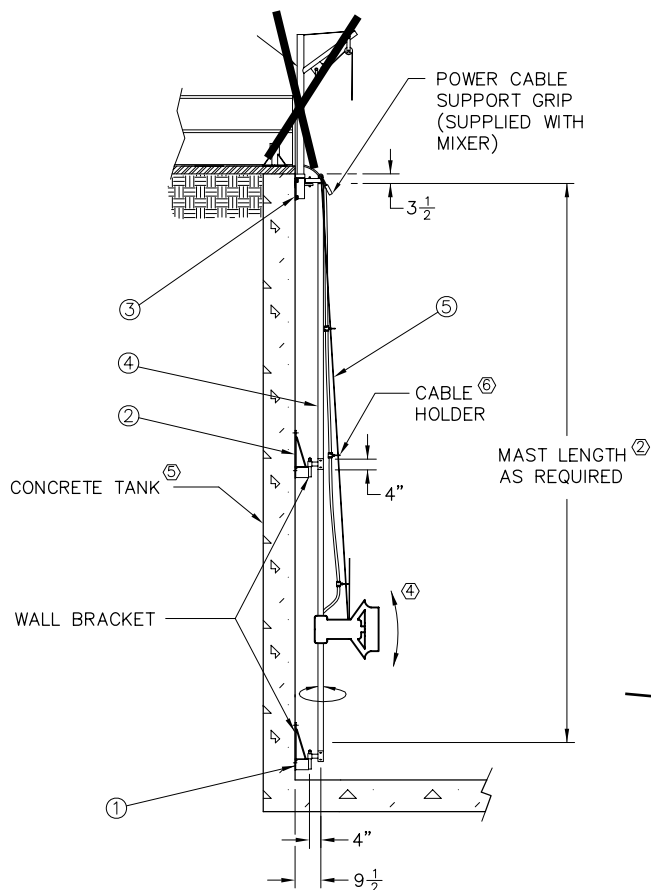
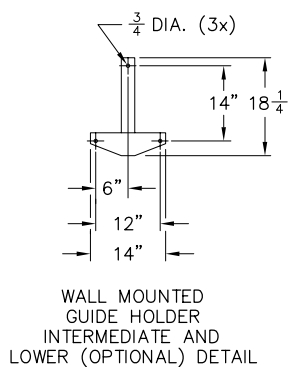
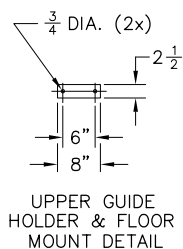
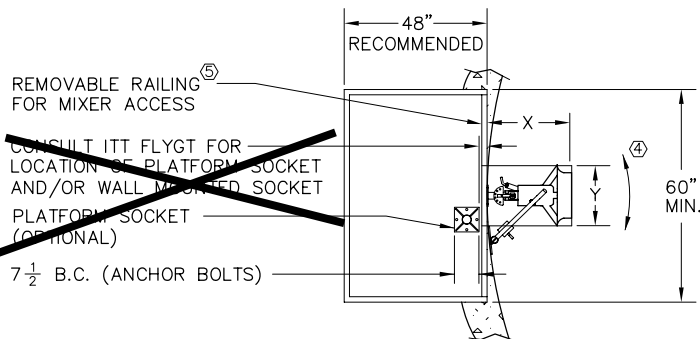
Installation and Platform Requirements

Wall Mounted 2" System 4

Accessories

Issued: 5/08

Supersedes: 11/05

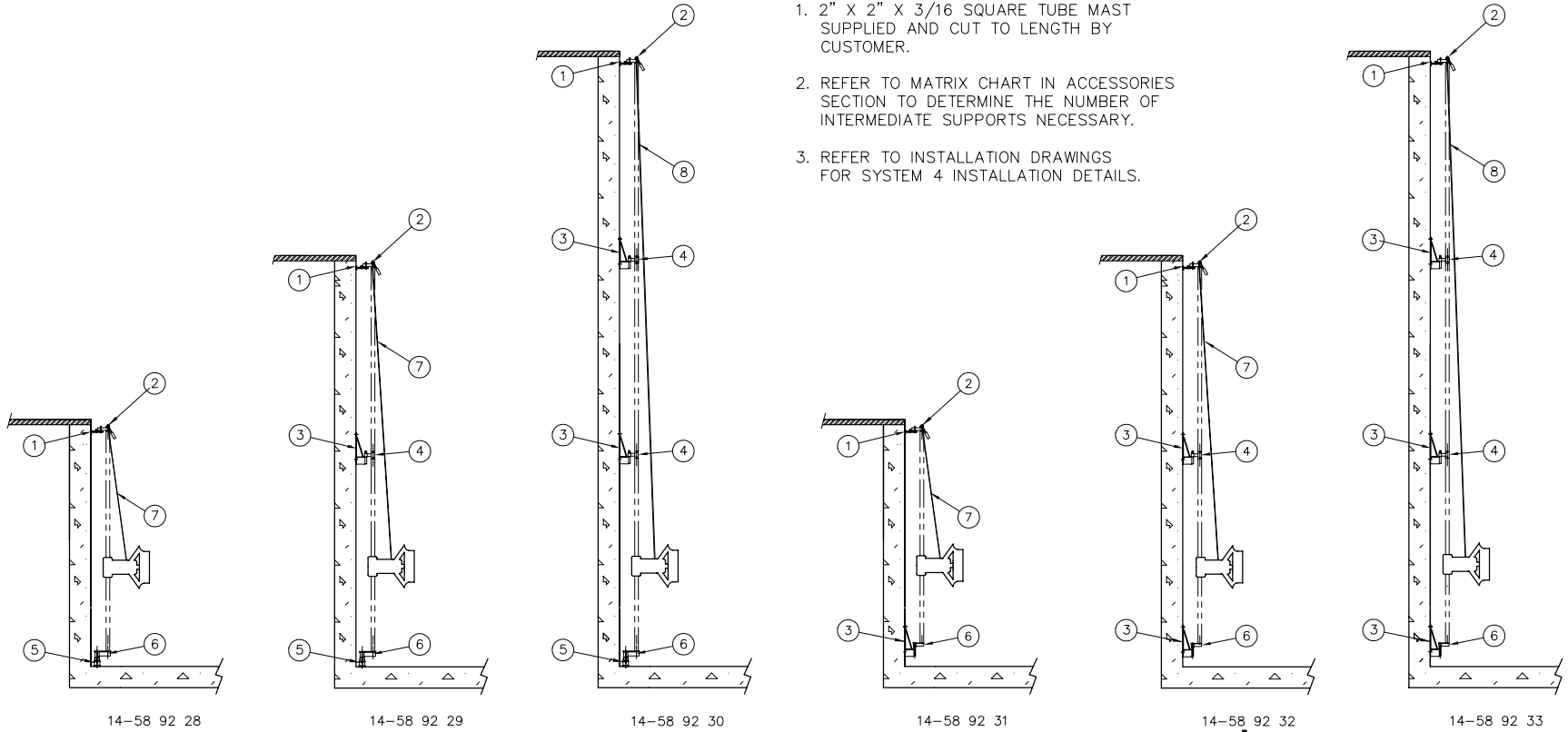


MINIMUM REQUIRED CLEARANCE (ACCESS COVER DESIGN MUST CONSIDER THESE MINIMUM CLEARANCES)		
MODEL	X	Y
4610	27"	12"
4620	27"	12"
4630	32"	27"
4640	34"	29"

NOTES:

1. MAST TUBING 2" x 2" x 3/16 WALL THICKNESS TO BE SUPPLIED AND CUT TO APPROPRIATE LENGTH BY CONTRACTOR.
2. CONSULT MIXER MATRIX CHART IN ACCESSORY SECTION TO DETERMINE HOW MANY INTERMEDIATE SUPPORTS ARE NECESSARY, DEPENDING UPON LENGTH AND MIXER SELECTED.
3. POWER CABLE TO BE CLEAR OF ALL SHARP SURFACES.
4. SEE MIXER DRAWINGS FOR WEIGHTS, DIMENSIONS, AND ANGLE SETTINGS.
5. PARTS AND DESIGN DETAIL BY OTHERS.
- ~~6. PLACE CABLE HOLDERS EVERY 6 FT.~~
- ~~7. SEE ACCESSORY SECTION FOR CRANE SELECTION.~~

6	MANUAL CRANE	1
5	CABLE ASSEMBLY (LOAD CARRYING)	1
4	MAST 2" X 2" X 3/16	AS REQ.
3	GUIDE HOLDER (UPPER)	1
2	GUIDE HOLDER (MIDDLE)	1
1	GUIDE HOLDER (LOWER)	1
ITEM NO.	DESCRIPTION	QUANTITY



NOTES:

1. 2" X 2" X 3/16 SQUARE TUBE MAST SUPPLIED AND CUT TO LENGTH BY CUSTOMER.
2. REFER TO MATRIX CHART IN ACCESSORIES SECTION TO DETERMINE THE NUMBER OF INTERMEDIATE SUPPORTS NECESSARY.
3. REFER TO INSTALLATION DRAWINGS FOR SYSTEM 4 INSTALLATION DETAILS.

MIXER MOUNTING KITS – 2" SYSTEM 4 STAINLESS STEEL 316							
		14-58 92 28	14-58 92 29	14-58 92 30	14-58 92 31	14-58 92 32	14-58 92 33
		KIT, FLOOR MOUNTED (W/O INTER. SUPPORT)	KIT, FLOOR MOUNTED (W/1 INTER. SUPPORT)	KIT, FLOOR MOUNTED (W/2 INTER. SUPPORT)	KIT, WALL MOUNTED (W/O INTER. SUPPORT)	KIT, WALL MOUNTED (W/1 INTER. SUPPORT)	KIT, WALL MOUNTED (W/2 INTER. SUPPORT)
ITEM	DESCRIPTION	QUANTITY	QUANTITY	QUANTITY	QUANTITY	QUANTITY	QUANTITY
1	UPPER GUIDE BAR HOLDER	1	1	1	1	1	1
2	UPPER GUIDE BAR ADAPTOR	1	1	1	1	1	1
3	WALL MOUNTED GUIDE BAR HOLDER	0	1	2	1	2	3
* 4	INTERMEDIATE GUIDE BAR ADAPTOR	0	1	2	0	1	2
5	BEARING BLOCK ASSEMBLY	1	1	1	0	0	0
6	LOWER GUIDE BAR ADAPTOR	1	1	1	1	1	1
7	WIRE ROPE ASSY 20 FT 316 SST	1	1	0	1	1	0
8	WIRE ROPE ASSY 40 FT 316 SST	0	0	1	0	0	1

ANCHOR BOLTS NOT INCLUDED
* PATENT PENDING

MiniCAS

Features

- 120 VAC, 24 VAC, or 24 VDC Powered
- Durable Plastic Enclosure with Flange for Mounting
- Leakage & Temperature Alarm Indication
- Power Applied Indication
- Temperature Alarm Reset Mode Select Switch
- Temperature Alarm Reset Push-button
- Sensor Input Transient & Short Circuit Protection

Operation

The MiniCAS provides Motor Over Temperature and Seal Leakage protection for Flygt Submersible Pumps equipped with FLS or CLS sensors. The unit supplies 12 VDC to the sensor and measures the current through the sensor using protected, noise-filtered electronic circuitry. When sensor current is in the normal range, the Temperature Alarm Relay activated to allow normal pump operation.

High Temperature Condition

In a motor High Temperature condition, the pump thermal contacts open and the current becomes zero. The Overtemp Indication is turned on and the Temperature Alarm Relay is deactivated, preventing pump operation. When the motor High Temperature condition has cleared, the unit will reset based on the position of the Alarm Reset Mode Select Switch (Auto or Manual). In the Auto position, the Overtemp Alarm resets automatically. In the Manual position, the Overtemp Reset Push-button must be pushed to clear the alarm.

Seal Leakage Condition

In a Seal Leakage condition, the Flygt FLS or CLS sensor decreases its internal resistance. The increased current is sensed, the Leakage Indication is turned on, and the Leakage Alarm Relay is activated.

Shorted Sensor Condition

If the sensor wires are shorted, a Shorted Sensor condition is indicated by activating the Leakage Alarm Relay and alternately flashing both the Leakage and Overtemp LED together with the Power LED. If the short is removed, the fault will automatically reset within 30 seconds.

Cleared Fault Indication

For both Overtemp and Seal Leakage conditions, a cleared fault indication is provided. If either condition has occurred, but has been automatically cleared, then the corresponding Indication will slowly flash. The flashing indication may be manually removed by pressing the Overtemp Reset Push-button.

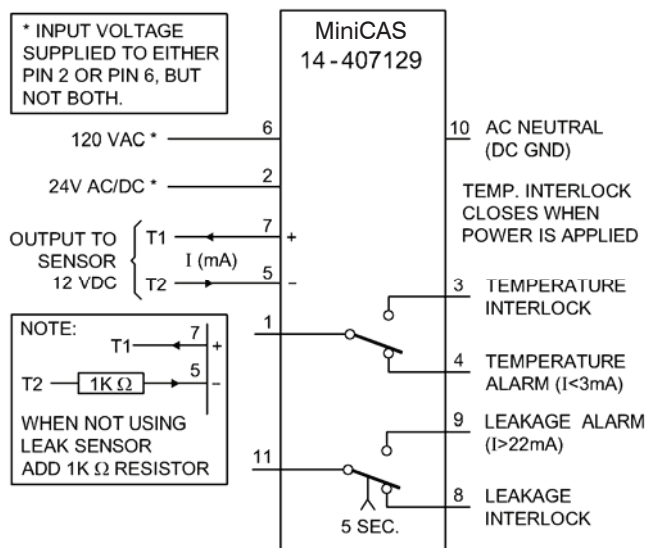
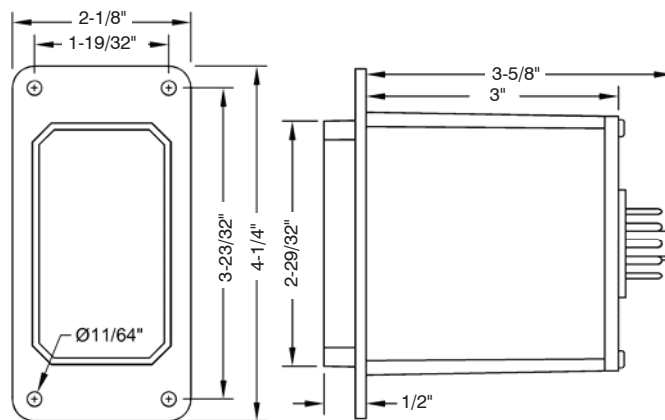
Specifications

Input Power:	120 VAC \pm 10% 3.5 VA max. 24 VAC \pm 10% 3.5 VA max. 24 VDC \pm 10% 125 mA max.
Output Rating:	NEMA B300 Pilot Duty, 1/6th HP, 3A @ 240 VAC Form C
Operating Temp:	-20°C to 60°C
Storage Temp:	-40°C to 80°C
Sensor Voltage:	12 VDC \pm 10%
Temp. Alarm Trip Point:	<3.0 mA \pm 5%
Leak Alarm Trip Point:	>22 mA \pm 5%
Shorted Sensor Trip Point:	>64 mA \pm 5%
Enclosure:	Lexan
Base:	Phenolic



UL FILE # 222351

**MADE IN THE
U.S.A.**



ORDERING INFORMATION

Part Number – **14-407129**

APPENDIX B

GEOTECHNICAL

GEOTECHNICAL EXPLORATION

Report on:

**Geotechnical Exploration
Gage Drain Pump Station Improvements
Saginaw County, Michigan**

Prepared For:

Spicer Group, Inc.
230 South Washington Avenue
Saginaw, Michigan 48607

GeoTran Project No.: 17-11001G-10
August 23, 2019

GeoTran

10315 E. Grand River
Suite 201
Brighton, Michigan 48116

Mr. Nicholas Czerwinski, PE
Spicer Group, Inc.
230 S. Washington Avenue
Saginaw, Michigan 48607

August 23, 2019
GeoTran Project No. 17-11001G-10

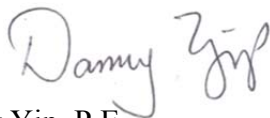
**RE: Report on Geotechnical Exploration
Gage Drain Pump Station Improvements
Saginaw County, Michigan**

Dear Mr. Czerwinski:

We are pleased to submit this report of our geotechnical exploration completed for the above referenced project in Saginaw County, Michigan. The investigation was performed in accordance with the authorization of our services provided in your E-mail correspondence dated November 17, 2017 and supplemental authorization for additional services provided in your E-mail correspondence dated August 2, 2019.

The data obtained during the investigation, along with our evaluations and recommendations are presented in the subsequent sections of this report. We appreciate the opportunity to be of service to you on this project. If you have any questions regarding this report or if we can be of further assistance, please feel free to contact us at (810) 229-6805.

Sincerely,
GeoTran Consultants, LLC



Danny Yip, P.E.
Project Engineer



Tanweer Shah, P.E.
Senior Project Manager

DY/TS/dy
Attachments

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APPENDIX

BORING LOCATION PLAN	FIGURE NO. 1
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GRAIN SIZE ANALYSIS	FIGURE NO. 9

1.0 INTRODUCTION

This report presents the results of our geotechnical exploration completed for the proposed improvements to Gage Drain Pump Station in Saginaw County, Michigan. The site location, relative to existing streets and topographic features, is shown on the Boring Location Plan, Figure No. 1 of the Appendix.

The purpose of the investigation was to explore and evaluate the general subsurface conditions at the site and to develop foundation and related site preparation recommendations for the proposed project. Conclusions and recommendations presented in this report are based on the subsurface conditions encountered at the locations of our explorations and our current understanding of the proposed project. Conditions may vary between boring locations, and should not be extrapolated to other areas without our prior review.

2.0 SITE AND PROJECT CHARACTERISTICS

The site of the proposed project is located on the premises of the Gage Drain Pump Station that is located at the Gage Drain's outlet into Saginaw River. This location is on the east side of Veterans Memorial Parkway (M-13), roughly less than ¼ mile south and west of the intersection of M-13 with Crow Island Road in Saginaw County. The approximate layout of the site is presented on the Boring Location Plan, Figure No. 1.

Based on the review of historical drawings (dated 1946) and related project information provided to us by Spicer Group, Inc. (Spicer), the site of the existing pump station is generally level and includes a small rectangular-shaped pump house building constructed circa 1947. The pump station was reportedly constructed for flood protection. The existing pump station building which consists of upper and lower floors houses the pumps and associated electric equipment. The first or the upper floor of the pump house building has a finished floor elevation of about 590 feet, with the lower floor or base slab finished floor elevation ranging from 572½ to 568½ feet. The existing building is generally masonry (concrete and brick) and steel construction and is supported on timber piling with capacities and tip elevations not currently known to us. A discharge basin is located on the west side of the building, with a concrete culvert beyond that extends under the M-13 roadway and spills into Saginaw River. The discharge basin is contained by steel sheet pile walls on the north and south sides, with cutoff elevation of 587 feet. The east side of the pump house building features a concrete culvert with a mechanically fastened metal trash rack containing an inclined bar screen that extends down to the base slab of the pump house (Elevation 572 feet) at the entrance to Gage Drain flowing into the pump station. The maintenance bulkhead slot at the upstream (u/s) drain entrance to the pump house features steel sheet pile wall sections on the north, south and west sides, with cutoff elevation of about 588 feet. Asphalt-paved surface parking areas are located on the south side of the pump house building. Access to the pump station is via a gated asphalt driveway on the east side off

M-13. In addition, the site contains small grass-covered areas on the north side of the pump house building and directly to the east and west of the on-site surface parking area.

Several upgrades have been previously performed to the existing pump station since its original construction including mechanical and electric upgrades in 1983, addition of a self-cleaning trash rack circa 1985 to replace the original bar screen and addition of metal sheeting to the exterior of the pump house building in mid 1990's. The u/s bottom of the ditch (Gage Drain) was reported at Elevation 572½ on the historical plans. Based on the recent topographic survey provided by Spicer, the u/s water surface in the Gage Drain that runs through the site was reported at about Elevation 576 feet as of August 22, 2017, with the average water depth in the drain ranging from about 3½ to 4 feet.

According to the preliminary improvement plans (dated March 2019) provided to us, the proposed project calls for box culvert expansion on the upstream (u/s) or the east side of the existing pump house building. The culvert expansion will have plan dimensions of 40 feet by 30 feet and will consist of a box culvert spanning over the 30-foot wide u/s Gage Drain channel. The box culvert will have a width of 25 feet and a rise of 12 feet and will consist of precast concrete walls (top of wall elevation at about 587½ feet) with upper and lower top slabs each 1-foot thick and a 1-foot thick bottom slab. The space between the upper and lower top slabs will be filled with a 3-foot thick layer of sand. The upper top slab will function as a maintenance platform and provide space for a roll away dumpster. The bottom slab will be extended 18 feet u/s for providing bottom support for the new trash rake, while the upper part of the rake will derive its support from the upper top slab of the culvert. The bottom slab will have finished elevation of about 571½ feet. It is anticipated that the box culvert expansion loads will be supported on deep foundations, presumably driven 12x53 steel H-piles with 2-foot thick and 4-foot wide pile caps. The pile caps will have a bottom elevation of about 567¼ feet. The foundation loads associated with the box culvert are anticipated to range from 216 to 507 kips along the north and south walls of the culvert. It is anticipated that new AZ22 sheet pile wall sections with tip elevation of 552 feet will be installed on the north and south sides of the new trash rack and behind its u/s end.

Additionally, it is anticipated that a slab-on-grade building addition roughly 19 feet by 16 feet in plan dimensions is planned to house the new electrical and computer equipment. The new addition will be built on the south side of the existing pump house building and is anticipated to be supported on shallow foundations. The finished floor of the new addition will be at about Elevation 589½ feet, close to the upper finished floor of the existing pump house building. Wall loads of less than 2 kips/foot are anticipated for the building addition. We understand Spicer is preparing the design plans for the project.

Based on our visual field observations and MISS DIG markings as well as historical drawings reviewed, several underground and overhead utilities including gas, electric, telecommunication,

underground storm piping are known to exist at or near the site, but were not encountered during this investigation. Locations of all utilities, existing timber and sheet piling and related features must be defined accurately prior to construction of the proposed project in order to avoid potential conflicts.

3.0 CURRENT FIELD EXPLORATION

Geotechnical field exploration for the proposed project was conducted on November 13 and 14, 2017 and on August 8, 2019. Subsurface conditions at the site were explored by completing a total of five soil borings designated as TB-1 through TB-5 at the approximate locations shown on the Boring Location Plan, Figure No. 1. The number and locations of the soil borings were selected in consultation with Spicer and marked in the field by our representative. The boring locations were marked using unsophisticated methods, and are, therefore, considered to be approximate. The as-drilled borings were not surveyed by a licensed land surveyor for horizontal or vertical control. The site ground surface elevations at the as-drilled boring locations were estimated based on topographic survey provided to us by Spicer and should be considered approximate.

The borings were advanced by our drilling subcontractor under the full-time technical observation of a geotechnical engineer with our firm. Borings TB-1 to TB-3 were drilled using an All-Terrain Vehicle (ATV)-mounted CME 75 drilling rig and extended to depths ranging from about 45 to 80 feet below ground surface (bgs), whereas, borings TB-4 and TB-5 were drilled using a CME 45 truck-mounted drilling rig and each extended to 15 feet bgs. At locations TB-1, TB-2, TB-4 and TB-5, continuous flight, hollow-stem augers having an inside diameter of 2¼ inches were used to advance the borings to the explored depths. At location TB-3, hollow-stem augers having an inside-diameter of 2¼ inches were used to advance the boring to 10 feet depth. Upon achieving an adequate seal of the hollow-stem augers, wash rotary drilling method with 2-7/8 inch tri-cone bit was used to advance the boring to its explored depth of 80 feet. Soil samples within the borings were typically obtained at 2½- to 5-foot intervals using a 1⅜-inch inside-diameter split-barrel sampler and the Standard Penetration Test (SPT) method (ASTM D 1586), described on the appended General Notes, Figure No. 2.

Soil samples obtained from the borings were visually classified in the field by our representative using Unified Soil Classification System (USCS), sealed in containers and transported to geotechnical laboratory for further classification and testing. We will retain these samples for 30 days after the date of this report, at which time we will dispose of the samples unless we are otherwise instructed. Upon completion of drilling and sampling operations, and following subsequent groundwater observations, the borings were backfilled using excavated materials (soil cuttings).

4.0 LABORATORY TESTING

Representative soil samples obtained from the borings were subjected to limited laboratory testing for further classification and to determine the pertinent engineering characteristics of the site soils. The laboratory testing included moisture content determination, unconfined compressive strength tests and grain size analysis (hydrometer) of selected soil samples using applicable ASTM methods. The results are included as Summary of Laboratory Test Data, Figure No. 8 and Grain Size Analysis, Figure No. 9 in the Appendix.

In addition to laboratory testing, field pocket penetrometer measurements were made as appropriate on representative cohesive soil samples obtained from the borings as an aid in evaluating their unconfined compressive strengths. The pocket penetrometer values are indicated on the boring logs.

5.0 GENERAL SUBSURFACE CONDITIONS

We have evaluated the soil and groundwater conditions encountered in the borings and have presented these conditions in the form of appended individual Logs of Soil Boring, Figure Nos. 3 to 7. In addition to subsoil stratification, the boring logs present SPT results or N-values, observed groundwater levels, drilling and sampling information and other pertinent data. General notes defining the nomenclature used on the logs and within the text of this report are presented on Figure No. 2. We have prepared the boring logs on the basis of visual classification and limited laboratory testing.

The stratification indicated on the boring logs represents the subsurface conditions at the actual explored locations. Variations in subsurface conditions may occur between these locations. In addition, the stratigraphic lines represent the approximate boundary between material types. The transition from one material type to another may be more gradual than indicated.

Subsoil Conditions and Evaluations

Borings TB-1, TB-2 and TB-3: A layer of topsoil amounting to about 12 inches in thickness was encountered at the as-drilled soil boring locations TB-1 through TB-3. The topsoil layer consists of dark brown clayey sand and dark brown sand, with organic matter. Underlying the topsoil layer, existing fill soils were encountered within the borings to approximate depths of 5½ to 8 feet (about Elevation 581½ to 579). The fill soils consist of cohesive and granular materials including brown to dark brown sandy clay and black and dark brown clayey sand with trace amounts of silt and roots.

Underlying the existing fills, native granular soil deposits were encountered to approximate Elevation of 577 to 575 within the borings. The granular soils consist of dark brown sand with trace amounts of clay, silt and roots as well as dark brown to gray silty sand with trace amounts of gravel. The SPT or N-values for the granular soils ranged from 2 to 5 blows per foot (bpf), indicative of very loose to loose conditions.

The granular soils are, in turn, generally underlain by native cohesive soil deposits to the termination depths of 45 feet and 70 feet (Elevation 542 and 517) within TB-1 and TB-2, and to an approximate depth of 77 feet (Elevation 510) within TB-3. The native cohesive soil deposits underlying the upper granular soils generally consisted of brown to gray silty clay with variable amounts of sand and trace amounts of gravel. Pocket penetrometer (PP) unconfined compressive strength measurements for the native silty clay soils ranged generally from less than 500 pounds per square foot (psf) to 7,500 psf, indicative of soft to very stiff consistency. Within TB-3, beyond about Elevation 514, an approximately 4-foot thick layer of hard gray sandy clay and silt deposit extending to about Elevation 510 was encountered underlying the soft silty clay soil deposits in this boring. Beyond about Elevation 510, TB-3 encountered a very dense granular deposit of gray sand (N-value of 88 bpf) which extended to the boring termination depth of 80 feet (Elevation 507).

Results of the laboratory testing for three representative native cohesive soil samples obtained at 25-foot depth in TB-2 and from 15-foot and 75-foot depths in TB-3 showed moisture content values for the native cohesive soils ranged from 11 to 14 percent. Laboratory unconfined compressive strength test values for the 25-foot silty clay sample (SS-7) at TB-2 and for the 15-foot (SS-5) and 75-foot (SS-13) silty clay and sandy clay samples at TB-3 were reported at 2,760 psf, 4,280 psf and 8,580 psf, respectively. Overall, the PP and laboratory test results for the native silty clay soils indicated that these cohesive soils vary in consistency, with the consistency generally decreasing downward. The laboratory unconfined strength test data for the native sandy clay soils underlying the silty clay soils at TB-3 showed the sandy clay soils to be of hard consistency.

Borings TB-4 and TB-5: A layer of sand and gravel fill amounting to about 12 inches in thickness was encountered at TB-4. At location TB-5, an approximately 18-inch thick layer of topsoil consisting of dark brown clayey sand with organic matter was encountered at the surface. Underlying the sand and gravel fill layer at TB-4 or topsoil layer at TB-5, existing fill materials were encountered within the borings to approximate depths of 3 to 5½ feet (Elevation 585 to 582). The fills consist of cohesive and granular materials including gray sandy clay, brown sand and dark gray clayey sand with trace amounts of silt and gravel.

Underlying the existing fills at TB-4, native cohesive soil deposits consisting of stiff to very stiff native brown silty clay over stiff brown sandy clay was encountered to about 9½ feet depth (about Elevation 578½) in this boring. PP readings of 4,000 psf and 3,000 psf were estimated for the silty clay and sandy clay soils, respectively. Beyond about 9½ feet depth, granular soil deposits consisting of very loose brown and gray clayey sand (N-value of 3bpf) with trace amounts of silt and gravel were encountered to an approximate depth of 14 feet (Elevation 574) within TB-4. Underlying this clayey sand layer, a cohesive layer of stiff silty clay with trace amounts of sand and gravel with PP reading of 3,500 psf was encountered to the boring termination depth of 15 feet (Elevation 573).

Underlying the existing fills at TB-5, a granular soil deposit consisting of an approximately 1½-foot thick layer of dark gray silty sand with little clay over an approximately 5-foot thick layer of very loose to loose gray silty sand (N-values of 3 to 5 bpf) was encountered to about 12 feet depth (Elevation 575 ½) within the boring. Beyond about 12 feet depth, a cohesive deposit of hard gray silty clay with trace amounts of sand and gravel was encountered to boring termination depth of 15 feet (Elevation 572½). PP readings in excess of 9,000 psf were measured for the silty clay deposit.

The existing topsoil layer contains appreciable amounts of organic matter and is, therefore, susceptible to decomposition. Accordingly, we do not consider the existing topsoil layer to be suitable for the support of foundations or for use as engineered fill material. The topsoil layer should be removed in its entirety from within the proposed construction areas. However, clean topsoil material can be used for landscaping in non-structural areas.

Existing fill materials were encountered within all borings to approximate depths of 3 to 8 feet and the fills vary in strength and composition. We have not reviewed any documentation confirming that the fills were placed in an engineered manner. Due to the lack of documentation that the fills had been placed in an engineered manner, the existing fill materials are prone to settlements and are not considered suitable for the support of structural foundations associated with the proposed pump house addition and box culvert expansion u/s of the existing pump house building. However, following proper subgrade preparation and provided some settlement can be tolerated, most of the existing fills may remain in place beneath the floor slab of the proposed building addition. Furthermore, the existing fills that are granular in character are expected to be suitable for reuse as engineered fill, provided the soils are free of organic matter, non-soil debris or other undesirable materials.

At locations TB-1 through TB-3, the very loose to loose native granular soils underlying the fill deposits, upon proper conditioning, are considered suitable for the support of light foundation loads, but are not considered suitable for the support of anticipated moderate to heavy foundation loads associated with the proposed box culvert expansion due to the influence of underlying thick native cohesive soil deposits of highly variable strength characteristics on the performance of structures with such heavy loads. The native cohesive soil deposit generally consisting of gray silty clay showed consistency that varies from soft to very stiff, with the consistency generally showing a downward decreasing trend. Due to their low strength and high compression characteristics, the native cohesive soils encountered at boring locations TB-1 through TB-3 to about Elevation 542 to 514 will experience consolidation when subjected to increased loads resulting from the proposed box culvert expansion over an extended period of time. This consolidation will result in settlement of overlying structure. As such, we do not consider the native silty clay soil deposits underlying the site to be suitable for the direct support of moderate to heavy structural loads anticipated for the box culvert expansion.

Hard native sandy clay and very dense sand deposits were encountered below an approximate depth of 73 feet (about Elevation 514) at boring location TB-3. The results of the laboratory testing indicated an unconfined compressive strength of more than 8,500 psf for the hard sandy clay layer, whereas, the underlying very dense layer sand deposit present below about Elevation 510 showed an N-value of 88. Based on our evaluation, the native hard sandy clay and underlying very dense sand deposits encountered below about Elevation 514 and 510 within boring TB-3 are generally considered suitable for the support of anticipated moderate to heavy loads associated with the proposed box culvert expansion structure.

The native cohesive and granular soils underlying the existing fills and topsoil materials at boring locations TB-4 and TB-5 are generally considered suitable for the support of shallow footings anticipated for the proposed building addition. Please refer to the Site Preparation section of this report for additional discussion regarding site and subgrade conditioning measures recommended for the building addition improvements.

Groundwater Conditions

Groundwater level observations were made at each boring location during and upon completion of the drilling operations. Groundwater was encountered at depths ranging from about 7½ to 9½ feet (about Elevation 579½ to 577½) during drilling. Upon completion of drilling (end of drilling), groundwater was observed at an approximate depth of 12 feet at TB-1 and TB-5 (corresponding to about Elevation 575), with dry conditions observed at TB-2 and TB-4. No groundwater measurement was made upon completion in TB-3 due to the use of wash rotary drilling method. Further, caving was observed within TB-1 and TB-2 at approximate depths of 12½ feet (about Elevation 574½) and 14 feet (about Elevation 573), respectively.

Fluctuations in the groundwater levels at the site should be anticipated with the raising or lowering of water levels in the Gage Drain and nearby Saginaw River along with seasonal variations following periods of prolonged precipitation or drought and variations in infiltration rates. The observations at the borings represent conditions at the time the readings were taken. The actual groundwater levels at the time of construction may vary. We expect the groundwater levels at the site will be close to or slightly higher than the water levels in the adjacent drainage channels. Further, volume and rate of groundwater seepage or inflow may be different at other times and locations than those indicated in this report. Long-term groundwater levels including fluctuations in groundwater levels can best be determined through measurements made in cased boreholes or observation wells over a prolonged period of time. The installation of cased boreholes was beyond the scope of the current exploration.

6.0 SITE PREPARATION

Site preparation, excavations, backfilling, fill placement and compaction and construction of slopes, as well as selection of materials for the project should be performed in strict accordance with the project requirements and specifications. We have assumed that the finished floor elevation for the building addition will be generally close to the existing upper floor level (about Elevation 590 feet) for the existing pump house building and, as such, will be relatively close to existing grade. Due to the presence of fill materials encountered within the building addition borings (TB-4 and TB-5), an engineering evaluation in the field will be necessary prior to the installation of foundations for the proposed addition. Regardless of the amount of earthwork required to achieve final grades, it is recommended that all site and subgrade preparation activities be properly observed and controlled in the field.

Prior to initiating site preparation or other construction activities, the contractor should be required to identify/establish the accurate locations of all existing underground and aboveground utilities, sewer/culvert piping, piling and other below-grade structures within the project construction limits. Active and in-active utilities and associated structures such as manholes, vaults and piping within or immediately adjacent to the construction areas should be identified for protection, relocation or abandonment prior to grading. Utilities that are to be left in place should be evaluated for their effect on the proposed project and vice versa. Existing backfill around utilities that are to remain should be checked for compaction and suitability to meet the project requirements and should be improved, if necessary. Excavations or voids resulting from site stripping, clearing and removal of existing fill materials and/or buried obstructions should be backfilled to surrounding grade or design subgrade level with approved and compacted granular engineered fill.

All areas intended to support new building addition foundations or grade raise fill must be properly prepared before proceeding with new construction. At the start of earthwork operations, existing grass cover, topsoil and/or other unsuitable materials including organic matter, refuse and deleterious non-soil debris, as well as any other exposed soil containing obvious amounts of organic matter should be stripped in their entirety from within the proposed construction areas. The stripping should typically extend a horizontal distance of at least 5 feet beyond planned construction lines, where practical. All underlying existing fill materials or other unsuitable materials such as yielding soils should be removed in their entirety, where they exist below the proposed footing locations. All debris and materials resulting from the stripping operations and removal of existing fill from footing areas should be disposed of outside the proposed construction limits.

The information from the soil borings indicates that existing fill materials are present within the proposed building addition area to a depth of about 5½ feet. The fill materials are evaluated to be unsuitable for the support of structural foundations. Therefore, the existing fill materials and/or any unsuitable materials such as yielding or unstable soils should be removed in their entirety, where they exist at the new building addition footing locations.

As mentioned above, within the shallow footings excavations for the proposed building addition, we recommend that all of the existing fill materials or any other yielding or unstable soils be removed in their entirety, where they exist at the proposed footing locations, and replaced with well-compacted granular engineered fill. Based on the soil boring data, it is anticipated that removal of existing fills from footing locations for the new addition will extend up to a depth of about 5½ feet below ground surface. The exact depth and lateral extent of the fill materials within the building addition area should be expected to vary. Evaluation of the required depth of removal must be performed by a qualified person at the time of construction.

After rough grade has been established in cut areas and prior to placement of new grade raise fill in all fill areas, the exposed subgrade should be carefully observed by probing and testing as needed. All organic material (if any) still in place as well as frozen, wet, soft or loose soils and non-soil debris should be removed. The subgrade resulting from the removal of such materials is expected to consist primarily of existing granular and cohesive fills or native cohesive soils. Therefore, areas of exposed granular subgrade soils including those underlying the proposed building addition floor slab area should be thoroughly proof-compacted using a medium weight, smooth drum vibratory roller making a sufficient number of passes in each of two perpendicular directions. This is intended to densify any loose granular soils or granular soils that have been disturbed by site clearing and grading operations, thereby improving their load supporting capability. If the operation of the vibratory roller is observed to decrease the stability of the subgrade soils by drawing water towards the subgrade surface, vibration should be discontinued and the roller should be operated in the static mode. The smooth drum roller should be kept a minimum distance of 10 feet from any existing structures and only light-weight compaction equipment such as a plate compactor or hoe-pak should be used to achieve the required compaction in these areas. The use of light weight compaction equipment will be more practical than use of a vibratory roller in areas adjacent to the existing facilities or in areas with limited space available for the heavier equipment to perform proof-compaction operations.

Areas that exhibit excessive movement or pumping during proof-compaction operations should be re-compacted or undercut and replaced with engineered granular fill or improved by using other methods depending upon site conditions at the time of construction. If undercutting is used, the undercut should be a minimum depth of 12 inches and the resulting excavation properly backfilled with engineered MDOT Class II or 21AA materials.

In addition to proof-compaction operations, areas where the exposed subgrade consists of cohesive soils, the subgrade should be thoroughly proof-rolled using heavy rubber tired roller or earthmoving equipment such as a loaded dump truck or loaded scarper. Any areas of cohesive subgrade soils that exhibit excessive movement or instability during proof-rolling operation should be stabilized by aeration, drying and re-compaction, if weather conditions are favorable, or by removal of the yielding soils and their replacement with engineered granular fill.

Grading and fill placement operations should be conducted with utmost care. The traffic of heavy construction equipment, including heavy cranes or heavy compaction equipment may create pumping and general deterioration of the on-site subgrade soils, and in particular where cohesive or other fine-grained soils are present (these soils are expected to be sensitive to softening when wet or when disturbed by construction traffic), if excess surface water is present due to ponding or freeze-thaw cycles. We recommend that site grading be performed so as to provide for rapid runoff of precipitation to reduce the potential for water infiltration. The grading, if at all possible, should be performed during dry season. The contractor should exercise discretion when selecting equipment sizes and should control surface runoff while the subgrade soils are exposed. In any event, positive surface drainage should be established as soon as possible. Additionally, it is recommended that the contractor avoid trafficking the new construction areas with heavy trucks. Rather, transported materials should be unloaded away from the construction areas and pushed where needed with light weight equipment. Therefore, depending upon weather conditions and the type of equipment and construction procedures used, surface instability may develop in parts of the site. If this occurs, the in-place stabilization and/or undercutting procedures outlined above may become necessary. Furthermore, if site conditioning and earthwork operations are to be performed during wet or cold weather months, significant difficulty should be anticipated in drying or stabilizing the on-site fine-grained soils. Under such circumstances, it may become necessary to undercut the wet soils and place a layer of coarse aggregate or crushed stone to achieve proper stabilization.

Where old construction debris (i.e., concrete, rubble, abandoned piping or utility lines, etc.) is encountered during excavations, it must be removed in its entirety or at least where it is encountered below the new footings and replaced with compacted granular engineered fill. If old construction debris is encountered within the proposed on-grade slab area of the new addition, it should be removed to a depth of at least 18 inches below the final subgrade elevation; any slabs or pads encountered below this depth should be thoroughly broken up prior to the placement of new engineered fill to allow for passage of water.

Material for backfill or engineered fill required to achieve design grades should preferably consist of free-draining and well-graded non-organic granular soils, such as soils meeting the requirements of Michigan Department of Transportation (MDOT) Class II or equivalent granular material. The on-site granular soils that are free of organic matter and other deleterious materials may be used for engineered fill materials provided they are approved by a qualified representative of the project owner and placed under favorable weather conditions to control moisture. The fill materials should not contain rock fragments larger than 3 inches in diameter.

Engineered fill should be placed in uniform horizontal lifts, the thickness of which is compatible with the type and condition of material being placed, area of placement and type of compaction equipment being used. In general, we recommend that lifts be placed in 12 inches (or less) in loose thickness for materials being compacted with a medium smooth non-vibratory roller for granular

soils. Other types of compaction equipment may require reducing lift thickness in order to achieve suitable compaction. Within structural areas, the fill should be compacted to achieve a density of at least 95 percent of Maximum Dry Density (MDD) as determined by the Modified Proctor compaction test (ASTM D 1557). All fill material should be placed and compacted at or near optimum moisture content. In-situ density tests should be performed to verify that proper compaction is achieved. Frozen material should not be used as fill, nor should fill be placed on a frozen subgrade.

Extreme care must be exercised when making excavations close to existing facilities including below grade utilities, vaults, tunnels, conduits, drains, influent or other piping and/or other nearby facilities to prevent undermining or damage to the supported facilities. Open excavations for new footings or pipe trenches should not extend below the bearing level of any adjacent footings or pipe inverts. If excavations must be extended deeper than any existing footings or pipe/tunnel inverts, provisions should be made either to underpin the existing footings and inverts or to provide lateral support system to prevent movement of existing structures during the time the nearby excavations are open. For conventional footings, the support measures may include temporary support systems or underpinning of any existing footings or inverts adjacent to open excavations. Furthermore, if the new footings are located within the zone of influence of the existing footings or other below grade structural elements such as pipe inverts and floor slabs, it will also be necessary to account for the loading of the existing footings or these other below grade structures on the support systems as well as the new foundations. The zone of influence of a footing may be considered to extend from the edge of the footing bottom in a downward direction away from the footing at a slope of 1 unit horizontal to 1 unit vertical (1H: 1V).

7.0 FOUNDATION RECOMMENDATIONS

The following recommendations have been developed on the basis of the previously described project characteristics and our evaluation of the subsurface conditions encountered during the current investigation. If there is a change in the project characteristics, including anticipated loads and proposed structure locations at the site, a review should be made by our office.

Box Culvert Expansion

Based on the subsurface data developed during the course of this investigation, anticipated structure loads along the culvert walls and overall project understanding, the proposed box culvert expansion may be supported on deep foundations. We recommend the use of driven steel H-pile foundations to be suitable for the support of the proposed culvert expansion structure. AASHTO M270 Grade 50 steel H-piles may be used to provide a feasible foundation for the support of the proposed structure. Based on our analysis, HP 12x53 driven steel piles bearing at about Elevation 509 feet will provide an allowable vertical capacity of 65 tons per pile. The driven H-piles will be designed for end bearing together with skin friction. The allowable pile capacity is based on a factor of safety of 3 on the ultimate capacity and assumes that there are no scour-related effects and that the pile cap bottom

will be located at about Elevation 567 feet. The actual load carrying capacity of the foundation piles will be a function of the pile diameter and the driven length of the pile. We recommend that H-piles be driven into suitable native soils along the proposed walls of the proposed culvert expansion structure. The piles should extend at least 1 to 2 feet below the native cohesive deposits and into the very dense granular soils anticipated at about Elevation 509 feet within boring TB-3 completed for this investigation. The table below provides recommended allowable capacities and estimated pile tip bearing elevations for driven 12-inch and 14-inch steel H-pile options.

Table 2: Recommended Allowable Capacities and Tip Elevations for Driven H-Piles

Box Culvert Expansion	H-Pile Section	Estimated Pile Tip Elevation (feet)	Allowable Axial Pile Capacity (Tons)	Allowable Uplift Capacity (Tons)
North Side	HP 12x53	509	65	6
	HP 14x73	509	75	8
South Side	HP 12x53	509	65	6
	HP 14x73	509	75	8

The allowable capacities presented above may be increased by one-third for short-term, transient loading conditions such as seismic, wind, etc. The above estimated pile tip elevation is based on the subsoil conditions encountered at the as-drilled boring location TB-3. As indicated earlier, the driven piles for the box culvert expansion should bear in the very dense native granular soil deposits encountered below the cohesive deposits in order to attain the required load bearing capacities. As such, pile lengths are expected to vary accordingly. It is important to note that subsoil conditions may vary at the exact pile locations and the pile driving operations may be less than ideal. These or other factors could necessitate the actual required pile lengths to be more or less than the estimated pile tip elevation provided above. The actual required lengths can best be determined in the field by the contractor based on the actual driving performance. We recommend the project specifications or contract documents allow for slightly longer piles to accommodate possible variations in the depth of bearing stratum at various pile locations and to achieve the driving criteria. To avoid protection against uplift due to frost heave, pile caps should be embedded a minimum of 42 inches below final site grade.

We do not anticipate any significant settlement of the proposed culvert expansion supported on driven H-pile foundations bearing on the very dense native granular soils at the site. Total settlement for the driven H-pile foundations bearing in very dense native granular soils is estimated to be on the order of 1 inch or less, including elastic compression of the piles under design loads. Differential settlements between adjacent piles should be negligible. To avoid interference with adjacent piles, piles should be spaced minimum of 3 pile diameters center to center for achieving the recommended

vertical capacity. However, greater pile spacing is recommended to ensure piles behave independently under lateral loads. For the minimum pile spacing, it will not be necessary to reduce vertical capacities for group action.

Boring TB-3 encountered hard cohesive soils at an approximate depth of 73 feet (about Elevation 514) and very dense sandy soils below an approximate depth of 77 feet (about Elevation 510). Based on the hard or dense nature of the native soil deposits and the potential for encountering obstructions such as cobbles and/or boulders in the type of glacial soil deposits present at the site locations, hard pile driving conditions may be experienced and should be anticipated by the contractor. Accordingly, we recommend consideration be given the use of pile points in conjunction with the steel H-piles to protect the piles from damage during driving and to avoid compromising the integrity of pile tips.

The lateral load capacity of driven H-piles is dependent on specific soil profile and the amount of lateral deflection allowed. For a typical vertical H-pile installation, with a limit of ½-inch of lateral deflection, an allowable lateral capacity of 2 kips per pile may be used for transient loads including wind loads. Sustained lateral loads, such as earth pressure loads, should be resisted by battered piles that will provide higher lateral capacities and not by the lateral load resistance of vertical piles.

Uplift forces may be imparted permanently or intermittently on a pile system. Such forces may result from hydrostatic uplift, lateral loads or other factors. The uplift capacity of individual piles is determined by the length of pile embedment in native soils, the equivalent perimeter of the pile and the specific soil strength profile. Allowable uplift capacities are provided in the table above and are based on a factor of safety of 3 on the ultimate capacity.

Obstructions to pile penetration could be encountered above the design pile tip elevation. For piles where refusal is encountered at elevations significantly above the estimated tip elevation, the pile should be presumed to have stopped on a cobble, boulder or other material and should be evaluated to determine its load carrying capacity. If the piles are damaged or bent, replacement piles may become necessary. If obstructions such as existing piling or abandoned foundations or other buried structures are encountered within the upper fill or native soils while driving the H-piles, then it may become necessary to make changes to the new structure pile layout as appropriate or excavate and remove the obstructions.

It should be noted that the pile capacity considerations outlined in this report are based on static analysis. Whether the required dynamic resistance of the driven piles is developed at the anticipated depths will depend on the specific characteristics of the piles and the pile driving equipment. Actual pile capacities in the field should be verified by dynamic pile driving formula and wave equation analyses. Since information of the pile driving equipment to be used by the contractor is not known at this time, we recommend the contractor be required to submit a wave equation analysis prior to

the pile driving operations to determine the final driving criteria and to verify that the proposed pile driving equipment is capable of achieving the design pile capacities. The wave equation analysis should be required as part of the submittals for review by a qualified engineer registered in the State of Michigan. Review of this submittal may identify inconsistencies between the contractor's means and methods and the geotechnical interpretation of the subsurface data prior to construction.

All pile driving should be observed on a full time basis by a qualified pile-driving inspector. Complete records of each pile should be maintained so timely decisions can be made regarding the acceptability of each pile. It is important to have an experienced pile driving contractor with sufficient experience in installing pile foundations and submit proof of similar projects. In addition, it is recommended that at least one full-scale pile load test be performed to verify allowable load capacities. The test should be performed in accordance with ASTM 1143 specifications.

The selection of the location of the new foundation elements for the proposed improvements will be influenced by factors including prevailing subsurface conditions at the locations of the proposed shallow and deep foundation elements, presence of utilities and proximity to other above or below-grade facilities that are to remain. Based on our site observations and the MISS DIG markings noted at the time of our field explorations as well as the presence of existing facilities anticipated within or near the proposed construction areas at the site, extreme care must be exercised by the contractor when performing excavations near the existing facilities that are to remain in order to protect them from potential damage. The contractor should be fully aware of the locations of all on-site existing above- or below-grade facilities such as the pump house building and timber pile foundations, culverts, sheet pile walls, utilities, piping, etc. before excavating for the new foundations and be prepared to support or brace the excavations as required so that these existing facilities are not impacted by the construction and they also do not impede the construction operations. As an added precaution, we recommend that the contractor be required to review readily available historical utility maps and as-built drawings for all nearby structures at the local city or county offices in addition to any utility plans and as-built drawings made available by the project owner prior to approval of the final layout of the new foundation locations. Furthermore, detailed construction procedures should be submitted by the contractor for review and approval by the engineer.

Building Addition

Based on our understanding of the proposed building addition, the anticipated subsoil conditions and projected wall loads, the proposed addition may be supported on a system of strip and/or spread footings. The footings should be extended through the existing fills to be founded on suitable native soils or upon properly compacted granular engineered fill established upon suitable native soils to achieve design grades in accordance with the recommendations presented herein. Footings that bear upon suitable native soils or upon well-compacted engineered fill may be designed for a maximum net allowable soil bearing pressure of 2,000 pounds per square foot (psf). The allowable bearing pressure above may be increased by 33 percent for short term loading due to wind or seismic forces.

If footings are placed on compacted granular engineered fill, the excavations centered on the footings should be made such that the width of the excavation is equal to the width of the footing plus twice the depth of the compacted fill below the footing.

Where very loose to loose granular subgrade soils are encountered at the proposed foundation bearing levels, such soils must be improved to increase their load supporting capability by proof-compaction or densifying them in-place prior to the placement of foundation concrete or reinforcing steel. Alternatively, loose soils can be removed in their entirety and replaced with engineered fill or undercut until suitable soils are present upon which the foundations can be supported.

Existing fills were encountered to approximate depths of 3 to 5½ feet within the building addition footprint borings (TB-4 and TB-5). Further, it is noted that the depth of existing fill materials may vary significantly between or away from the borings completed for the current investigation. The fill materials are prone to settlement upon application of additional loads, and therefore, are not considered suitable for the support of conventional shallow foundations. We recommend that building addition footings not be supported on the existing fills. It is recommended the existing fill materials be undercut in their entirety where they are encountered at the building footing locations and replaced with structural or engineered fill consisting of new compacted granular materials placed over suitable native soils. The intent of undercutting is to minimize the risk of settlements and to provide a uniform bearing surface for foundation support via a uniform thickness of compacted fill beneath load bearing elements. Engineered fill placement should be performed in strict accordance with the Site Preparation recommendations discussed above in Section 6.0 of this report. Lean concrete (2,000 pounds per square inch mix or better) may be used as an alternative to compacted granular fill, if approved by the structural engineer.

All strip footings should be at least 18 inches in width and all isolated spread footings should be at least 30 inches in their least plan dimension regardless of the resultant bearing pressure. The footings should be established at a depth of at least 3½ feet below exposed finished grade for protection against frost penetration. The determination of the required depth of excavation at each footing location should be performed by a qualified representative of the project owner. We recommend that all foundation excavations should be checked and tested in the field to verify that adequate in-situ soil bearing pressures, compatible with the recommendations outlined in this report, are achieved. As indicated above, if loose soils are present at the base of footing excavations, these soils should be densified in place using a plate compactor or hoe-pak in order to compact the soils and improve their bearing capability, or the loose soils must be removed until suitable bearing soils are achieved or should be replaced with engineered fill.

It is imperative that the sidewalls of the building addition footing be maintained vertical during the concrete pour. If footings for the new structure are constructed by directly placing concrete in unformed excavations (trench footings), the footing may become wider at the top as sloughing of upper surrounding granular fill occurs and will develop a “lip” or flare outward. Such condition may cause the footing to heave despite the bottom of the footing being below the frost depth, due to the frozen soils lifting the upper (wider) portions of the footing. As such, if the footing excavations cannot be maintained with vertical sides, we recommend the use of formwork to construct the footing under these conditions.

Soils exposed in the bases of all satisfactory foundation excavations should be protected against detrimental change in condition such as from disturbance, precipitation and freezing. Surface runoff water should be drained away from the excavations and not allowed to pond. Foundation excavations should be concreted as soon as practical after they are excavated. If possible, all footing concrete should be poured the same day of the excavation. If an excavation is left open for an extended period, a thin mat of lean concrete should be placed over the bottom to minimize damage to the bearing surface from weather or construction activities. Foundation concrete should not be placed on frozen or saturated subgrades.

As discussed earlier, extreme care must be exercised when excavating close to existing facilities including piping, drains, culverts, conduits, foundations, utilities, on-grade equipment or other nearby surface/below-grade structures to prevent undermining or damage to the supported facilities. Open excavations for new shallow footings should not extend below the bearing level of any adjacent footings or pipe/culvert inverts. If excavations must be extended deeper than any existing footings or inverts, provisions should be made either to underpin these below-grade structural elements or to provide lateral support system to prevent movement of existing structures during the time the nearby excavations are open. For conventional shallow footings, the support measures may include temporary support systems or underpinning of any existing footings, floor slabs or pipe/culvert inverts adjacent to open excavations. Furthermore, if the new building addition foundations are located within the zone of influence of any existing footings or other below-grade structural elements, it will also be necessary to account for the loading of existing structural elements on the support systems as well as the new foundations. The zone of influence of a footing may be considered to extend from the edge of the footing bottom in a downward direction away from the footing at a slope of 1H: 1V.

Nearby foundation elements bearing at different levels should be designed and constructed so that the least lateral distance between them is equivalent to or greater than the difference in their bearing levels. To achieve a change in the level of a strip footing, we recommend the footing be gradually stepped at a grade no steeper than two units horizontal to one unit vertical (2H: 1V).

Resistance to lateral loads may be provided by frictional resistance between the bottom of concrete footings and the underlying soils and by passive soil pressure against the sides of the footings. The coefficient of friction between poured-in-place concrete footings and underlying soils may be taken as 0.30. Passive pressure available in compacted fill or undisturbed native soils may be taken as equivalent to the pressure exerted by a fluid weighing 200 pounds per cubic foot (pcf). The above recommended values include a factor of safety of 1.5; therefore, frictional and passive resistance may be used in combination without reduction.

Total settlements of spread and strip footings will vary, depending on the size of the footing and the actual load supported. Footing settlements have been estimated based on anticipated loading conditions. If the recommendations outlined in this report are followed, total and differential settlements of the new building supported on shallow foundations are anticipated to be within approximately 1 inch and ½ inch, respectively. As a precaution, structural and utility connections to new construction supported on shallow foundations should be deferred until a majority of the dead load resulting from construction has been applied. Careful field control during construction will substantially reduce the actual settlements that occur. It is imperative that all fill and backfill materials placed beneath, above and against the sides of the foundations be thoroughly compacted at appropriate moisture content and density as described in the Site Preparation section of this report. We recommend that all footings be suitably reinforced to reduce the effects of normal differential settlements associated with local variations in subsoil conditions.

8.0 SUPPORT OF FLOOR SLABS

The subgrade resulting from the satisfactory completion of site preparation activities recommended in Section 6.0 above can be used for the support of concrete floor slabs-on-grade anticipated for the proposed building addition. However, due to existing underlying fill materials and other variations within subsoils at the proposed addition location, the possibility of some floor slab settlement cannot be precluded. Accordingly, we recommend that all ground-supported concrete floor slabs be suitably reinforced and separated from the foundation system to allow for independent movement. Further, in order to protect the subgrade soils from construction-related disturbances, reduce differential settlements of the existing fill materials and equalize moisture conditions beneath the slab as well as provide a stable working platform, it is recommended that the floor slab be supported on a minimum 6-inch well-compacted layer of free draining granular base course material such as MDOT 6AA (coarse aggregate). If no floor slab settlement can be tolerated, alternate measures such as complete removal of existing fill materials or structural support of floor slabs using grade beams will be necessary. Provided that the site conditioning recommendations outlined in the Site Preparation section of this report are followed and a minimum of 6-inch aggregate base course is placed beneath the floor slabs, a modulus of subgrade reaction value of 100 pounds per cubic inch (pci) may be used for the design of floor slabs supported on existing fill at the site. This estimated value corresponds to a 1 foot by 1 foot plate load test.

Based on our past experience from other projects involving construction of on-grade concrete slabs, there is sometimes substantial time lag between initial grading and the time when the contractor is ready to construct the slab-on-grade. Even though the subgrade soils may have been prepared and compacted adequately during initial grading, exposure to weather and construction traffic can impact the integrity of subgrade soils. Therefore, prior to the construction of on-grade concrete slabs for the new addition, the floor slab subgrade should be closely evaluated by a qualified representative of the testing agency. We suggest that provisions be included in the project specifications for the contractor to restore the subgrade soils to an acceptable condition prior to construction of slabs. Such restoration may include moisture conditioning of the surficial soils and re-compaction to the project requirements.

If the building addition floor slab is to be covered with moisture sensitive flooring or coatings, consideration should be given to the use of a 4-inch thick layer of sand underlain by a no less than 15-mil thick plastic sheet vapor retarder/barrier membrane beneath the floor slab. The placement of this plastic membrane should be in accordance with the project specific needs, current version of the American Concrete Institute (ACI) 302.1 guidelines, local building codes and the recommendations of the flooring manufacturer. Special care should be exercised during construction activities to prevent damage to the membrane.

9.0 TEMPORARY EXCAVATIONS

Excavations for the project should comply with the current Michigan Department of Labor and Regulatory Affairs (LARA) requirements, *i.e.*, the Michigan Occupational Safety and Health Act (known as MIOSHA) and related Federal OSHA regulations, as well as any additional local regulations or owner requirements must be strictly followed and adequate protection provided for workers and adjacent structures. We are providing the information below solely as a service to our client. Under no circumstances should the information provided herein be inferred to mean that GeoTran is assuming responsibility for temporary excavations, construction site safety, activities of the contractor, or for design, installation, maintenance and performance of any shoring, bracing, underpinning, or other similar systems. Such responsibility is not implied and should not be inferred.

All cuts deeper than 4 feet should be properly sloped or otherwise structurally retained to provide stable and safe working conditions. Construction site safety generally is the sole responsibility of the contractor. The contractor is also solely responsible for designing and constructing stable, temporary excavations and must shore, slope, or bench the sides of the excavations as required to maintain stability of both excavation sides and bottom. The contractor should be aware that slope height, slope inclination, and excavation depths should in no case exceed those specified in the local, state, or federal safety regulations including OSHA Health and Safety Standards for Excavations, 29CFR Part 1926, or successor regulations. Excavations must be performed and evaluated under the supervision of the contractor's designated competent person. The competent person must verify the

soil conditions based on actual materials encountered during excavation activities and field conditions at the time of excavation in order to determine the permissible temporary slope inclinations. In areas, where there is insufficient space to allow for proper side slopes for excavations due to adjacent structures, utilities or other surface or below-grade facilities, vertical walls with properly designed and installed lateral bracing, or a combination of slopes and braced vertical walls may be used. The contractor should thoroughly review the site conditions and available as-built drawings for all existing facilities located within or directly adjacent to the construction area, be aware of existing utility locations, culverts, piping, vaults, and adjacent buildings before initiating excavation activities; and be prepared to support or brace the existing facilities, as appropriate.

With time and the presence of seepage and/or wet weather, the stability of temporary cuts can be significantly reduced. Therefore, construction should proceed as quickly as possible to limit the time the excavations are left open. In addition, runoff water should be prevented from entering the excavations, by collecting and disposing of outside the construction limits. To prevent runoff from adjacent areas from entering the excavation, a perimeter berm may be constructed at the top of the excavation or slope. Additionally, temporary cut slopes, where utilized, should be covered with plastic sheeting to help minimize erosion during wet weather and closely observed in the field until the foundation installation and backfilling activities are complete.

Construction traffic and excavated material stockpiles should be kept away from excavations a minimum distance equal to the full depth of the excavation, unless the resulting surcharge loads are accounted for in the design of the lateral bracing system. In addition, the effect of the existing building foundations, culverts, buried piping or any other nearby structures must also be considered in the design of the bracing system. The contractor's proposed excavation plan, support systems and sequence of construction should be reviewed by a qualified engineer prior to allowing the contractor to commence work.

A pre-construction survey for the project should be considered owing to the close proximity of the site or construction area to existing nearby facilities. The survey should record the elevation and horizontal position of all existing installations directly bordering the construction area and may consist of photographs, videotaping, etc. Vibration monitoring may be considered if heavy construction equipment capable of producing substantial vibrations is utilized on the project. Furthermore, if shallow conventional footings that will require significant amounts of undercutting and replacement with engineered fill are selected for the new building addition, a settlement survey should be performed on a weekly basis during excavation and on a monthly basis, approximately one month after the excavations have been completed, at a minimum.

10.0 GROUNDWATER CONTROL

Groundwater was encountered within borings TB-1 through TB-3 and TB-5 at approximate Elevations of 579½ to 577½ during drilling and at about Elevation 575½ in TB-1 and TB-5 upon completion of the drilling. Note that groundwater levels are subject to seasonal, climatic and other variations and may be different at other times and locations than those stated in this report.

Water control measures during construction will depend on the final depths of excavations, time of the year and the presence of water bearing strata encountered during construction. Based on the water level data obtained in the borings, assumed water surface elevation of 576 feet in Gage Drain and proposed pile cap/footing bottom elevation of about 567 feet, the construction excavations for the pile caps are anticipated to extend below the water levels encountered within the borings. Therefore, it is anticipated that groundwater will be encountered as pile cap/footing excavations are extended below the groundwater levels. In addition, a “quick” condition could develop in granular soils as groundwater migrates towards the excavation, resulting in the disturbance of the soils and in reduction of their load carrying capacity, as well as localized sloughing and surface instability in some soil slopes. Based on these considerations, positive groundwater control measures will become necessary to lower the water level before extending excavations below the water level. Groundwater produced by cohesive soil strata should generally be limited to that contained within lenses, seams or pockets of granular materials embedded within the cohesive deposits.

We expect the use of hot-rolled steel sheeting would be effective to cutoff the upper groundwater and surface water from the Gage Drain channel and would allow for less maintenance of the side slopes and dewatering operations. Depending on the arrangement of such sheeting, it could be cantilevered or braced if a cofferdam type arrangement is used during pile driving and construction of the pile caps. Excavations near the channel should also be protected from stream and surface storm water runoff. To maintain stable base on which to construct foundation elements, the groundwater levels should be maintained a minimum of 2 feet below the bottom of all excavations. Because the water levels in the channel are expected to vary, consideration should be given to performing construction excavations preferably during the period of low water surface elevation in Gage Drain. Where excavations extend only 1 to 2 feet below the groundwater level, it may be feasible to control groundwater by pumping from properly constructed sumps; however, excavations should be left open for as little time as possible to protect subgrade soils from disturbance by ponded water or construction traffic.

Excavations that terminate more than one or two feet below groundwater level are expected to encounter moderate to heavy volumes of groundwater. In addition, a “quick” condition referenced earlier may develop as groundwater migrates towards excavations, resulting in the disturbance of soils, and a reduction in their supporting capabilities. Based on these considerations and because standard sump and pump methods may not be adequate, more rigorous or special groundwater control measures, such as fully enclosed cofferdams and/or dewatering wells or well points will be

required before making excavations below the groundwater level and for effective groundwater control.

Dewatering systems, where utilized, should be properly designed to prevent soil fines from being pumped out of the subsurface soil layers. The discharge water from the dewatering system should be monitored to verify that this condition does not develop. In addition, consideration should be given in the design of the dewatering system such that the groundwater levels are not drawn down too deep so as to affect the existing structures. The contractor should be prepared to provide a dewatering system during construction that is capable of maintaining dry and stable excavations. The dewatering system should have a filter media around the well screens in order to prevent soil particles from being pumped out of the surface. The discharge water should be monitored to verify that this condition does not develop. Deposits of silt or other fine-grained soils that contain appreciable amounts of silt and clay will be difficult to effectively dewater. Even following dewatering, a “quick” condition may still develop at the base of excavations. Under these conditions, it may be necessary to open only short sections of the excavation and replace some of the wet soils with a stabilizing layer of coarse aggregate or concrete mud mat. The subject site is located in an area where local residents may rely on private wells for their everyday water supply. Dewatering of excavations using wells points or dewatering wells for groundwater control measures may impact the local water supply wells. Accordingly, special care should be exercised in planning, designing and installation of groundwater control measures during construction.

We anticipate that accumulations of surface water runoff or groundwater seepage in shallow foundation excavations for the new addition can be controlled by conventional dewatering methods such as standard pumping from small dug sumps formed at the base of the excavations and located outside of the zone of influence of footings, and provided that inflows from any overlying saturated granular seams and layers are controlled. In addition, a layer of crushed concrete, coarse aggregate or mud mat may be required to stabilize wet soils at the bottom of excavations.

In order to provide adequate and safe working conditions, means and methods of dewatering are the sole responsibility of the contractor. The contractor should control groundwater, surface water infiltration and soil erosion during construction and be prepared to provide a dewatering system during construction capable of maintaining dry and stable excavations. Detailed construction procedures should be submitted by the contractor for review and approval by the engineer.

To prevent accumulation of hydraulic pressures against the culvert walls or other retaining wall units that may be utilized on the project, a system of perforated foundation under-drains should be provided at the back of the walls and free-draining granular materials should be used for backfilling the back of the walls. The under-drains should be protected with filter fabric and coarse aggregates to reduce the migration of fine soils into the system.

11.0 OTHER CONSTRUCTION CONSIDERATIONS

It is anticipated that project construction will involve activities such as removal and relocation of the existing trash rack, foundation and sheet pile driving, excavations for pile caps and footings and compaction of soils as well as other construction or demolition activities that could induce vibrations. Accordingly, the effects of vibrations during the performance of demolition or new construction activities on nearby existing facilities (that are to remain) including below-grade utilities, pump house building and culvert piping should be thoroughly reviewed prior to construction. Construction methods should be chosen to prevent the risk of any damage resulting from excessive vibrations to existing facilities. Consideration may be given to including provisions in the construction documents for vibration restrictions, which will require the contractor to limit construction methods, operations and equipment used to comply with these provisions. Vibration restrictions should be indicated in the project specifications related to demolition activities, foundation installation, temporary earth support systems and earthwork section (to limit vibrations produced by pile driving and heavy equipment operations, etc.). Furthermore, it is recommended that prior to the start of demolition or new construction activities, the utility owners and other stakeholders should be contacted to jointly discuss and review provisions for their facility's vibration restrictions, including acceptable peak particle velocities associated with construction vibrations produced on the project.

The foundations for the new structural upgrades at the pump station should not be installed where existing timber pile foundations and/or remnants of old construction debris will obstruct the new construction or adversely interfere with the long-term performance of the new structural upgrades. During the installation of new temporary or permanent sheet piling and/or cofferdams, the contractor should be adequately prepared to address utility conflicts and/or other potential obstructions including remnants of previous foundations, riprap or construction debris. If encountered it may become necessary to excavate such obstructions from construction areas prior to attempting to install new foundations or sheet piling elements. Provisions should be included in the construction documents such that removal of old construction, riprap and/or other debris is considered incidental to installation of new foundations and steel sheeting. Furthermore, the contractor should be prepared to manage run-off infiltration and seepage from any wet granular strata or seams that may be present above the bottom of new footing or pile cap elevations. If unstable or wet cohesive soils are encountered at the footing bottom elevations, we recommend specifying a concrete mud mat in the bottoms of these excavations to establish a suitable working platform for construction of new footings or pile caps.

If cofferdams are used on the project, they should be designed by an experienced licensed engineer employed by the contractor. The cofferdam design should be based on anticipated high water elevation during construction. The sheeting should be driven into the underlying native cohesive soils at the site and embedded a sufficient depth below the bottom of the excavation to minimize flow below the sheet piles and to reduce potential for "quick" condition. If the cofferdam requires

temporary bracing, the top elevation, tip elevation and alignment of the sheet piling must be designed to prevent interference with new foundation locations. The contractor and cofferdam designer should be provided with historical information for the site such as locations of existing and/or previous structures and utilities that may influence the design and construction of cofferdams. The removal of old construction elements may require the replacement of excavated soils with compacted granular fill prior to pile driving.

As indicated above, care should be exercised to make certain that the installation of foundations for the new construction will not interfere with the locations of previously placed subsurface utilities which are to remain in place and will not be relocated or abandoned. Where necessary, the new piling should be pre-drilled to 5 feet depth below the invert elevation of the lowest existing utility. Pile driving equipment should be equipped with a drill rig for pre-drilling purposes. Although not encountered during the current investigation, it is not uncommon to encounter obstructions including cobbles or boulders in the type of glacial overburden soil deposits underlying the site. It is recommended that construction documents have provisions for pre-drilling in the event it becomes necessary to extend the new piles below the utility inverts and/or through obstructions.

12.0 DATA REVIEW AND FIELD VERIFICATION

We should be provided the opportunity to review geotechnical portions of the final plans and specifications. The purpose of the review will be to verify that the intent of our recommendations set forth in this report have been correctly interpreted and included in the design of the project.

We recommend that a qualified firm be retained to provide observation and testing services during the earthwork and foundation construction phases of the proposed project. This is to verify the anticipated subsurface conditions are present and observe compliance with the design concepts, specifications and recommendations. Also, field verification allows appropriate design or construction changes to be made in a timely manner if conditions differ from those anticipated prior to the start of construction.

13.0 LIMITATIONS

We have prepared this report exclusively for Spicer Group, Inc. for the project specifically described in this report. Our professional services have been performed, our findings obtained and our recommendations prepared in accordance with the generally accepted geotechnical engineering practice, as it exists in the project area at the time of our study. No other warranty or representation, expressed or implied, is included or intended in this report.

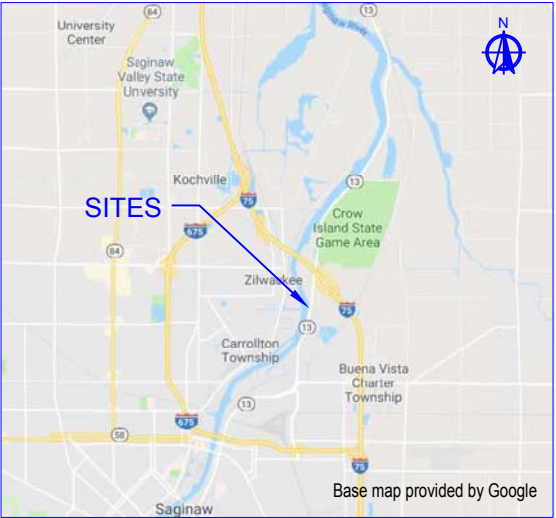
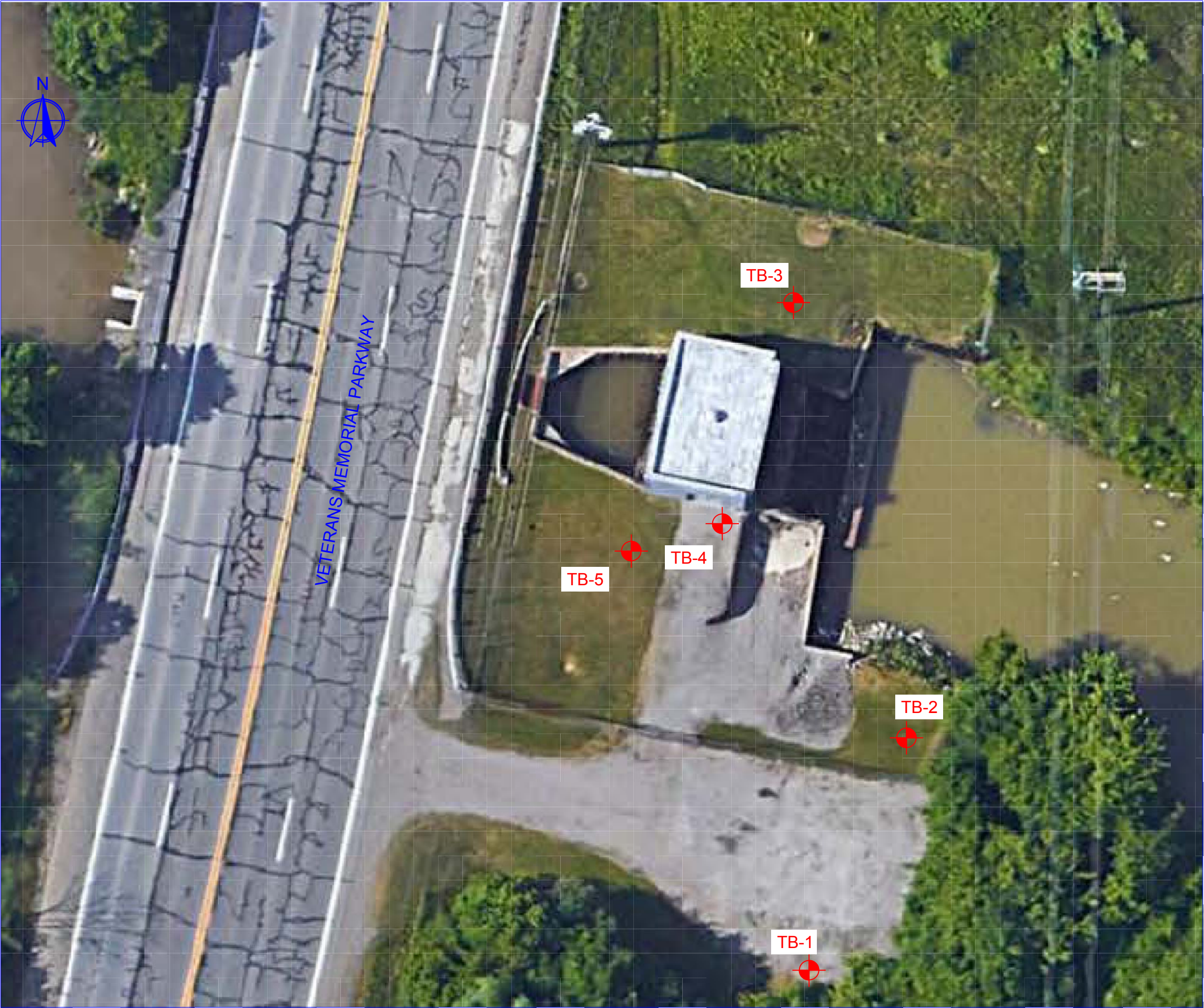
Our recommendations for this project were developed utilizing subsurface information from the soil borings performed at the site. At this time, we would like to note that borings only depict the subsurface conditions at the specific locations and time at which they were made. The subsurface conditions at other locations on the site may vary from those occurring at the boring locations that

we have explored to date. If significant variations are exposed during construction, they should be brought to our attention as it may be necessary for us to reevaluate the recommendations of this report.

The conclusions and recommendations presented in this report have been developed based upon the data obtained from the borings and our current understanding of the proposed construction. Any revision in the plans for the proposed construction from those anticipated in this report should be brought to our attention to determine whether any changes in the foundation or site preparation recommendations are necessary. This report reflects our opinion as of this date, based on the results of the study described herein and on the information provided during the course of the study. The results of this study may not be relied upon by entities other than those identified above without the prior knowledge and written consent of GeoTran.

The scope of the current study was limited to geotechnical exploration of the subsurface conditions for the support of the proposed pump station improvements and other related aspects of construction. No chemical, environmental, or hydrologic testing or analyses were performed as part of this study.

APPENDIX



SITE LOCATION MAP
NOT TO SCALE

BORING LOCATION PLAN
GAGE DRAIN PUMP STATION IMPROVEMENTS
SAGINAW COUNTY, MICHIGAN

LEGEND:

TB-1 AS DRILLED BORING
LOCATION

TEST BORINGS WERE
PERFORMED BY BRAX
DRILLING ON NOVEMBER 13
AND 14, 2017 AND BY TRIPLE
R DRILLING ON AUGUST 8,
2019 UNDER THE
OBSERVATION OF GEOTRAN
CONSULTANTS, LLC.

DRAWING REFERENCE:
BASE PLAN FROM GOOGLE
MAP

PROJECT NO.:
17-11001G-10

DRAWN BY:
D. YIP

DATE:
08-13-2019

REVIEWED BY:
M. LUCKHAM

DATE:
08-15-2019

FILE:
17-11001G-10-001.dwg

SCALE:
1 IN = 20 FT

FIGURE NO.:

1

GENERAL NOTES

TERMINOLOGY

Unless otherwise noted, all terms utilized herein refer to the Standard Definitions presented in ASTM D 653.

SAMPLE DESIGNATIONS

AS - Auger Sample - directly from auger flight	RC - Rock Core - NX core unless otherwise noted
BS - Miscellaneous Sample - bottle or bag	CS - Continuous Sample - from rock core barrel or Continuous sampling device
SS - Split Spoon Sample - ASTM D 1586	VS - Vane Shear
LS - Split Spoon Sample S with Liner Insert 3 inches in length	HA - Hand Auger Sample
ST - Shelby Tube Sample - 3 inch diameter unless otherwise noted	PID - Photo Ionizataion Detector
PS - Piston Sample - 3 inch diameter unless otherwise noted	

PARTICLE SIZES

Boulders - Greater than 12 inches (305 mm)
Cobbles - 3 inches (76.2 mm) to 12 inches (305 mm)
Gravel - Coarse - 3/4 inches (19.05 mm) to 3 inches (76.2 mm)
Fine - No. 4 - 3/16 inches (4.75 mm) to 3/4 inches (19.05 mm)
Sand - Coarse - No. 10 (2.00 mm) to No. 4 (4.75 mm)
Medium - No. 40 (0.425 mm) to No. 10 (2.00 mm)
Fine - No. 200 (0.074 mm) to No. 40 (0.425 mm)

CLASSIFICATION

The major soil constituent is the principal noun, i.e., clay, silt, sand, gravel. The second major soil constituent and other minor constituents are reported as follows:

Second Major Constituent (percent by weight)	Minor Constituent (percent by weight)
Trace - 1 to 12%	Trace - 1 to 12%
Adjective - 12 to 35% (clayey, silty, etc.)	Little - 12 to 23%
And - Over 35%	Some - 23 to 33%

COHESIVE SOILS

<u>Consistency</u>	<u>Unconfined Compressive Strength (psf)</u>	<u>Approximate Range of (N)</u>
Very Soft	Below 500	0 - 2
Soft	500 - 1000	3 - 4
Medium Stiff	1000 - 2000	5 - 8
Stiff	2000 - 4000	9 - 15
Very Stiff	4000 - 8000	16 - 30
Hard	8000 - 16000	31 - 50
Very Hard	Over 16000	Over 50

Consistency of cohesive soils is based upon an evaluation of the observed resistance to deformation under load and not upon the Standard Penetration Resistance (N).

If clay content is sufficient so that clay dominates soil properties, clay becomes the principal noun with the other major soil constituent as modified; i.e., silty clay. Other minor soil constituents may be included in accordance with the classification breakdown for cohesionless soils; i.e., silty clay, trace of sand, little gravel.

COHESIONLESS SOILS

<u>Density Classification</u>	<u>Relative Density %</u>	<u>Approximate Range of (N)</u>
Very Loose	0 - 15	0 - 4
Loose	16 - 35	5 - 10
Medium Dense	36 - 65	11 - 30
Dense	66 - 85	31 - 50
Very Dense	86 - 100	Over 50

Relative density of cohesionless soils is based upon the evaluation of the Standard Penetration Resistance (N), modified as required for depth effects, sampling effects, etc.

DEPOSITIONAL FEATURES

Parting - as much as 1/16 inch thick	Varved - alternating seams or layers of silt and/or clay and sometimes fine sand
Seam - 1/16 inch to 1/2 inch thick	Occasional - one or less per foot of thickness
Layer - 1/2 inch to 12 inches thick	Frequent - more than one per foot of thickness
Stratum - greater than 12 inches thick	Interbedded - applied to strata of soil or beds of rock lying between or alternating with other strata of different nature
Pocket - small, erratic deposit of limited lateral extent	
Lens - lenticular deposit	

STANDARD PENETRATION TEST (ASTM D 1586) - A 2.0" outside-diameter, 1-3/8" inside-diameter, split barrel sampler is driven into undisturbed soil by means of a 140-pound weight falling freely through a vertical distance of 30 inches. The sampler is normally driven three successive 6-inch increments. The total number of blows required for the final 12 inches of penetration is the Standard Penetration Resistance (N).

Project Name: Gage Drain Pump Station Improvements















Project Location: Saginaw County, Michigan

Project Number: 17-11001G-10

Client: Spicer Group

Date: 11/13/2017

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SAMPLE DATA						PROFILE DESCRIPTION			LABORATORY DATA					
ELEV. (ft)	SAMPLE TYPE/ NUMBER	REC. (in.)	BLOWS/ 6 INCHES	STD. PEN. RESIST. N-VALUE	POCKET PEN. (psf)	GRAPHIC LOG	GROUND SURFACE ELEVATION: 587.0 ft ±	DEPTH (ft)	MOIST. CONT. (%)	DRY DENSITY (pcf)	UNCONF. COMP. ST. (psf)	ATTERBERG LIMITS		Loss on Ignition (%)
								0				LIQUID LIMIT	PLASTICITY INDEX	
585	SS-1	18	3 2 2	4			586.0	TOPSOIL: Dark Brown CLAYEY SAND with Organic Matter	1.0					
	SS-2	18	2 1 3	4				FILL: Dark Brown SANDY CLAY with Trace of Silt and Roots	5					
580	SS-3	18	1 2 2	4			581.5	Very Loose Dark Brown SAND with Trace of Clay, Silt and Roots	5.5					
	SS-4	18	2 2 3	5			579.0	Loose Gray SILTY SAND with Trace of Gravel	8.0					
575									10					
	SS-5	18	2 5 6	11	7500		575.0		12.0					
570									15					
	SS-6	18	3 6 9	15	7500				20					
565														
	SS-7	18	3 4 6	10	4000			Medium Stiff to Very Stiff Brown to Gray SILTY CLAY with Trace of Sand and Gravel	25					
560														
	SS-8	18	2 4 5	9	3000				30					
555														
	SS-9	18	3 3 4	7	2500				35					

Stratification lines represent approximate boundaries; In-situ, transition may be gradual.

Total Drilling Depth: 45 ft

Drilling Contractor: Brax Drilling

Driller: K. Gourassa

Drilling Method:
CME 75 ATV Mounted Drilling Rig, Using 2-1/4-inch I.D. Hollow Stem
Auger to End of Boring.

Backfill Procedure:
Borehole backfilled with excavated materials.

Groundwater Levels:

At Time of Drilling: 9.5 ft

End of Drilling: 12 ft ; Caved at 12.5 ft

Notes:
WOH - Weight of Hammer

Logged By: D. Yip

Reviewed By: M. Luckham


Figure No.: 3

Project Name: Gage Drain Pump Station Improvements

Project Location: Saginaw County, Michigan

Project Number: 17-11001G-10

Date: 11/13/2017

SAMPLE DATA						PROFILE DESCRIPTION			LABORATORY DATA						
ELEV. (ft)	SAMPLE TYPE/ NUMBER	REC. (in.)	BLOWS/ 6 INCHES	STD. PEN. RESIST. N-VALUE	POCKET PEN. (psf)	GRAPHIC LOG	GROUND SURFACE ELEVATION: 587.0 ft ±	DEPTH (ft)	MOIST. CONT. (%)	DRY DENSITY (pcf)	UNCONF. COMP. ST. (psf)	ATTERBERG LIMITS		Loss on Ignition (%)	
550							Medium Stiff to Very Stiff Brown to Gray SILTY CLAY with Trace of Sand and Gravel								
	SS-10	18	WOH 3 4	7	1500			40							
545															
	SS-11	18	2 3 4	7	2000			542.0	45						
End of Boring at 45.0 ft.															
540															
535															
530															
525															
520															
515															
510															

Project Name: Gage Drain Pump Station Improvements










Project Location: Saginaw County, Michigan

Project Number: 17-11001G-10

Client: Spicer Group

Date: 11/13/2017

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SAMPLE DATA						PROFILE DESCRIPTION			LABORATORY DATA					
ELEV. (ft)	SAMPLE TYPE/ NUMBER	REC. (in.)	BLOWS/ 6 INCHES	STD. PEN. RESIST. N-VALUE	POCKET PEN. (psf)	GRAPHIC LOG	GROUND SURFACE ELEVATION: 587.0 ft ±	DEPTH (ft)	MOIST. CONT. (%)	DRY DENSITY (pcf)	UNCONF. COMP. ST. (psf)	ATTERBERG LIMITS		Loss on Ignition (%)
												LIQUID LIMIT	PLASTICITY INDEX	
585	SS-1	18	2	6			586.0 TOPSOIL: Dark Brown SAND with Trace of Organic Matter	0						
			3			585.0 FILL: Brown SANDY CLAY with Trace of Silt	1.0							
	SS-2	18	3	8			FILL: Black and Dark Brown CLAYEY SAND with Trace of Silt	5						
			4											
580	SS-3	18	2	3			580.0	7.0						
			1											
	SS-4	18	2	3			Very Loose Dark Brown To Gray SILTY SAND with Trace of Gravel	10						
			1											
575	SS-5	18	3	14	6500			15						
			6											
570	SS-6	18	3	11	5000			20						
			5											
565	SS-7	18	3	10			Stiff to Very Stiff Brown to Gray SILTY CLAY with Trace of Sand and Gravel	25	14		2760			
			4											
560	SS-8	18	2	9	3000			30						
			3											
555	SS-9	18	3	11	2500			35						
			4											
			7											

Stratification lines represent approximate boundaries; In-situ, transition may be gradual.

Total Drilling Depth: 70 ft

Drilling Contractor: Brax Drilling

Driller: K. Gourassa

Drilling Method:

CME 75 ATV Mounted Drilling Rig, Using 2-1/4-inch I.D. Hollow Stem Auger to End of Boring.

Backfill Procedure:

Borehole backfilled with excavated materials.

Groundwater Levels:

At Time of Drilling: 7.5 ft

End of Drilling: Dry ; Caved at 14 ft

Notes:

WOH - Weight of Hammer

Logged By: D. Yip

Reviewed By: M. Luckham

Figure No.: 4

Project Name: Gage Drain Pump Station Improvements

Project Location: Saginaw County, Michigan

Project Number: 17-11001G-10

Client: Spicer Group

Date: 11/13/2017

[illegible]

Project Name: Gage Drain Pump Station Improvements





Project Location: Saginaw County, Michigan

Project Number: 17-11001G-10

Client: Spicer Group

Date: 11/14/2017

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SAMPLE DATA						PROFILE DESCRIPTION			LABORATORY DATA					
ELEV. (ft)	SAMPLE TYPE/ NUMBER	REC. (in.)	BLOWS/ 6 INCHES	STD. PEN. RESIST. N-VALUE	POCKET PEN. (psf)	GRAPHIC LOG	GROUND SURFACE ELEVATION: 587.0 ft ±	DEPTH (ft)	MOIST. CONT. (%)	DRY DENSITY (pcf)	UNCONF. COMP. ST. (psf)	ATTERBERG LIMITS		Loss on Ignition (%)
												LIQUID LIMIT	PLASTICITY INDEX	
585	SS-1	18	2	7			586.0	0						
			TOPSOIL: Dark Brown SAND with Trace of Organic Matter				1.0							
			3											
			FILL: Brown SANDY CLAY with Trace of Silt				3.0							
	SS-2	18	4	7				5						
580	SS-3	18	2	2										
			FILL: Black and Dark Brown CLAYEY SAND with Trace of Silt											
			3											
	SS-4	18	4	2				10						
575			6											
	SS-5	18	3	10				15	14		4280			
570			4											
	SS-6	18	6	12	5500			20						
565			6											
	SS-7	18	5	11	3500									
560			6					25						
	SS-8	18	3	7	2500									
555			4					30						
			5											
	SS-9	18	2	8	1500									
			3											
			5					35						

Stratification lines represent approximate boundaries; In-situ, transition may be gradual.

Total Drilling Depth: 80 ft

Drilling Contractor: Brax Drilling

Driller: K. Gourassa

Drilling Method:

CME 75 ATV Mounted Drilling Rig, Using 2-1/4-inch I.D. Solid Stem Auger to 10 feet. 2-7/8 in. Tri -Cone Rotary Wash to End of Boring.

Backfill Procedure:

Borehole backfilled with excavated materials.

Groundwater Levels:

At Time of Drilling: 9 ft

End of Drilling: Not Measured

Notes:

No groundwater measurement upon completion of drilling due to the use of wash rotary drilling method.

WOH - Weight of Hammer

Logged By: D. Yip

Reviewed By: M. Luckham

Figure No.: 5

Project Name: Gage Drain Pump Station Improvements



Project Location: Saginaw County, Michigan

Project Number: 17-11001G-10

Client: Spicer Group

Date: 11/14/2017

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SAMPLE DATA						PROFILE DESCRIPTION			LABORATORY DATA					
ELEV. (ft)	SAMPLE TYPE/ NUMBER	REC. (in.)	BLOWS/ 6 INCHES	STD. PEN. RESIST. N-VALUE	POCKET PEN. (psf)	GRAPHIC LOG	GROUND SURFACE ELEVATION: 587.0 ft ±	DEPTH (ft)	MOIST. CONT. (%)	DRY DENSITY (pcf)	UNCONF. COMP. ST. (psf)	ATTERBERG LIMITS		Loss on Ignition (%)
												LIQUID LIMIT	PLASTICITY INDEX	
550							GROUND SURFACE ELEVATION: 587.0 ft ±							
								40						
545														
	SS-10	18	4 4 7	11	1500			45						
540														
								50						
535														
	SS-11	18	WOH WOH 1	1	<500			55						
530														
								60						
525							Soft to Very Stiff Brown to Gray SILTY CLAY with Trace to Little Sand and Trace of Gravel							
	SS-12	18	WOH 1 3	4	<500			65						
520														
								70						
515														
	SS-13	18	7 25 37	62				75	11		8580			
510														
								77.0						
	SS-14	18	33 44 44	88				80						
								80.0						
							End of Boring at 80.0 ft.							

Project Name: Gage Drain Pump Station Improvements



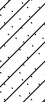
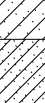
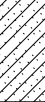
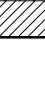
Project Location: Saginaw County, Michigan

Project Number: 17-11001G-10

Client: Spicer Group

Date: 8/8/2019

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SAMPLE DATA						PROFILE DESCRIPTION			LABORATORY DATA					
ELEV. (ft)	SAMPLE TYPE/ NUMBER	REC. (in.)	BLOWS/ 6 INCHES	STD. PEN. RESIST. N-VALUE	POCKET PEN. (psf)	GRAPHIC LOG	GROUND SURFACE ELEVATION: 588.0 ft ±	DEPTH (ft)	MOIST. CONT. (%)	DRY DENSITY (pcf)	UNCONF. COMP. ST. (psf)	ATTERBERG LIMITS		Loss on Ignition (%)
								0				LIQUID LIMIT	PLASTICITY INDEX	
585	SS-1	18	3	6			587.0	FILL: SAND AND GRAVEL	1.0					
							FILL: Gray SANDY CLAY with Trace of Silt and Gravel							
	SS-2	18	2	4	4000		585.0		3.0					
							Stiff to Very Stiff Brown SILTY CLAY with Trace of Sand and Gravel							
580	SS-3	18	3	6	3000		582.5		5.5					
							Stiff Brown SANDY CLAY with Trace of Silt and Gravel							
	SS-4	18	1	3			578.5		9.5	10				
575								Very Loose Brown and Gray CLAYEY SAND with Trace of Silt and Gravel						
	SS-5	18	5	11	3500		574.0		14.0					
			6				Stiff Gray SILTY CLAY with Trace of Sand and Gravel							
570									15.0					
								End of Boring at 15.0 ft.						
565														
560														
555														

Stratification lines represent approximate boundaries; In-situ, transition may be gradual.

Total Drilling Depth: 15 ft

Drilling Contractor: Triple R Drilling, LLC

Driller: R. Rau

Drilling Method:

CME 45 Truck Mounted Drilling Rig, Using 2-1/4-inch I.D. Hollow Stem Auger to End of Boring.

Backfill Procedure:

Borehole backfilled with excavated materials.

Groundwater Levels:

At Time of Drilling: Dry

End of Drilling: Dry

Notes:

Logged By: D. Yip

Reviewed By: M. Luckham

Figure No.: 6

Project Name: Gage Drain Pump Station Improvements








Project Location: Saginaw County, Michigan

Project Number: 17-11001G-10

Client: Spicer Group

Date: 8/8/2019

GEOTRAN LOG OF SOIL BORING - GEOTRAN STD-2012.GDT - 8/23/19 10:30 - F:\MY DRIVE\GEOTRAN - MAIN\PROPOSALS - PROJECTS\2017\17-11001G - GAGE PUMP STATION\REPORT\17-11001G-10.GPJ

SAMPLE DATA						PROFILE DESCRIPTION			LABORATORY DATA						
ELEV. (ft)	SAMPLE TYPE/ NUMBER	REC. (in.)	BLOWS/ 6 INCHES	STD. PEN. RESIST. N-VALUE	POCKET PEN. (psf)	GRAPHIC LOG	GROUND SURFACE ELEVATION: 587.5 ft ±	DEPTH (ft)	MOIST. CONT. (%)	DRY DENSITY (pcf)	UNCONF. COMP. ST. (psf)	ATTERBERG LIMITS		Loss on Ignition (%)	
								0				LIQUID LIMIT	PLASTICITY INDEX		
585	SS-1	18	4	15			TOPSOIL: Dark Brown CLAYEY SAND with Organic Matter								
			586.0												
			585.5				FILL: Brown SAND with Trace of Gravel	1.5	2.0						
	SS-2	18	3				FILL: Dark Gray CLAYEY SAND with Trace of Silt and Gravel								
			2												
			1				3								
580	SS-3	18	2				582.0	5							
			2												
			1				3								
	SS-4	18	3				580.5	7.0							
			3												
			2				5								
575			3												
			3												
			2												
	SS-5	18	4				575.5	10							
			8												
			11				19	>9000	Hard Gray SILTY CLAY with Trace of Sand and Gravel	12.0					
							572.5	15							
570							End of Boring at 15.0 ft.	15.0							
565															
560															
555															

Stratification lines represent approximate boundaries; In-situ, transition may be gradual.

Total Drilling Depth: 15 ft

Drilling Contractor: Triple R Drilling, LLC

Driller: R. Rau

Drilling Method:
CME 45 Truck Mounted Drilling Rig, Using 2-1/4-inch I.D. Hollow Stem
Auger to End of Boring.

Backfill Procedure:
Borehole backfilled with excavated materials.

Groundwater Levels:

At Time of Drilling: 8.5 ft

End of Drilling: 12 ft

Notes:

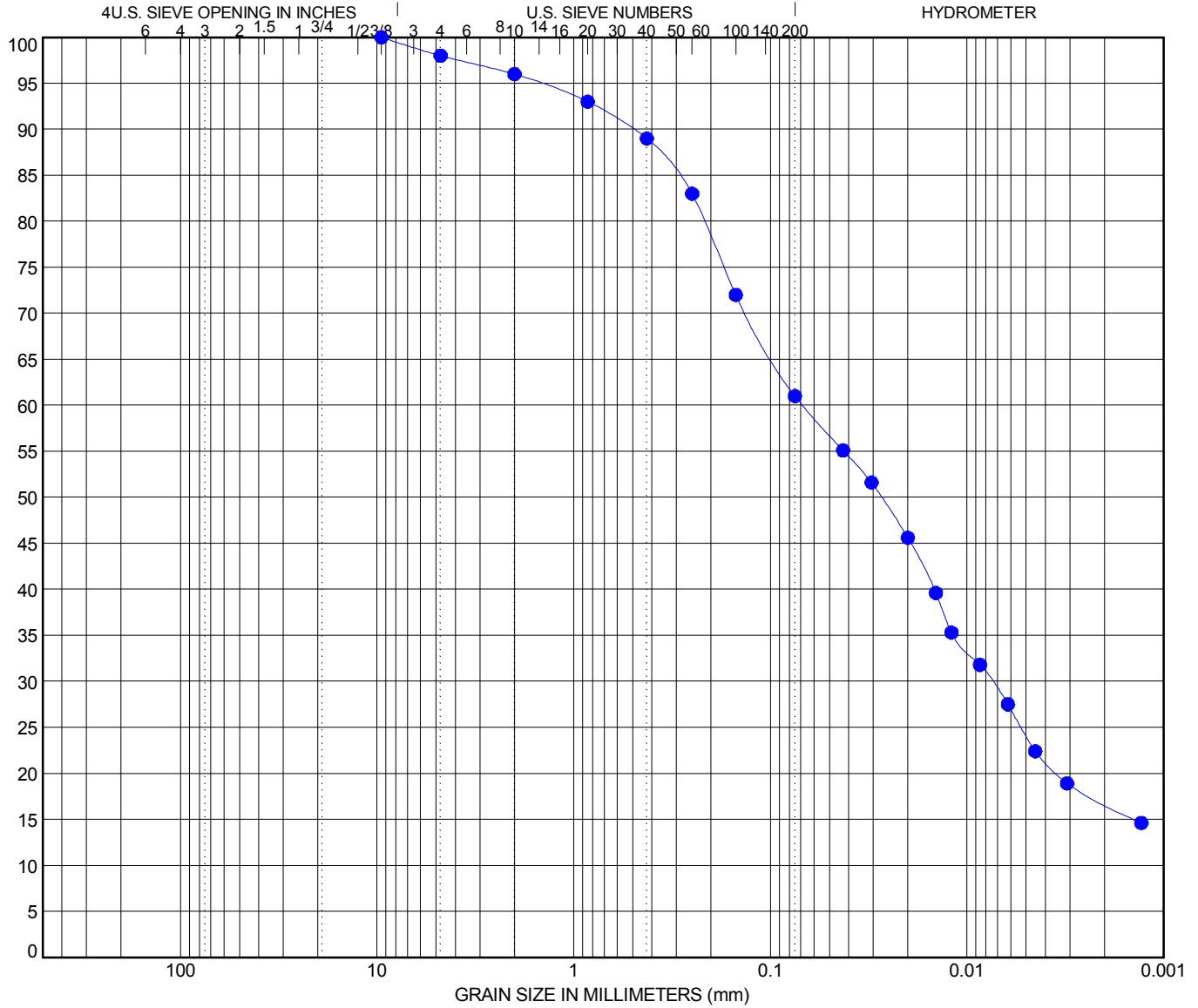
Logged By: D. Yip

Reviewed By: M. Luckham

Figure No.: 7

GRAIN SIZE ANALYSIS

Soil Boring No.	Sample No.	Sample Depth	Sample Elev.	Description
TB-3	SS-13	75.0 ft	512.0 ft	Gray SANDY CLAY and SILT with Trace of Gravel



ASTM Method D422

% COBBLES	% GRAVEL		% SAND			% SILT	% CLAY
	Coarse	Fine	Coarse	Medium	Fine		
0.0	0.0	2.0	2.0	7.0	28.0	36.9	24.1

D ₈₅	D ₆₀	D ₅₀	D ₃₀	D ₁₀	COEFFICIENTS	
					C _c	C _u
0.2984	0.0682	0.0273	0.007	--	--	--

ATTERBERG LIMITS		
LL	PL	PI
--	--	--

REMARKS:

Sampled By: D. Yip

Checked By: M. Luckham



Project Name: Gage Drain Pump Station Improvements
Project Location: Saginaw County, Michigan
Client: Spicer Group

Project Number: 17-11001G-10
Date: 11/14/2017

Figure No.: 9

APPENDIX C

EQUIPMENT PROCUREMENT

BIDDING DOCUMENTS & BID

TABULATIONS

*Note: The documents in this appendix are being provided in combination with the documents in Appendix A for Bidders to use in preparing their bid for installing the equipment procured by the Owner. The Bidder need not include the material costs of these items in their bid, but the costs are being disclosed to Bidders for the purposes of calculating any "Use Tax" that may need to be paid on this equipment.

SAGINAW COUNTY PUBLIC WORKS COMMISSIONER
SAGINAW COUNTY, MICHIGAN
GAGE DRAIN PUMP STATION EQUIPMENT PROCUREMENT

ADVERTISEMENT FOR BIDS

Sealed Bids for the procurement of axial flow pumps, submersible mixers, pump stations controls, SCADA, security, a self-cleaning trash rack, and a backup generator for use on the Gage Drain Pump Station will be received by **the Saginaw County Public Works Commissioner**, at the office of **Spicer Group, Inc., 230 S. Washington Avenue, Saginaw, Michigan, 48607**, until **10 AM** local time on **December 28, 2020**, at which time the Bids received will be **publicly** opened and read. The equipment includes three axial flow pumps rated for a capacity of 35,000 gallons per minute (gpm), three submersible mixers, a self-cleaning trash rack approximately 20 feet in width and 26 feet in height, a backup generator, as well as electrical controls, SCADA, and security as necessary for the operation of the pump station.

The Issuing Office for the Bidding Documents is: **Spicer Group, Inc., 230 S. Washington Avenue, Saginaw, Michigan, 48607**. Prospective Bidders may obtain bidding documents by contacting Nicholas Czerwinski, P.E. by email at nickc@spicergroup.com.

Neither Owner nor Engineer will be responsible for full or partial sets of Bidding Documents, including Addenda if any, obtained from sources other than the Issuing Office.

Upon receipt and evaluation of bids, the owner or engineer will notify the selected vendors. Following the selection of vendors of said equipment, the owner and engineer will coordinate the incorporation of the selected products into bidding documents for the installation of said equipment. Installation of said equipment will be bid out in a separate public bid opening.

Owner will provide signed purchase order upon selection of vendor. Equipment supplier is responsible for delivery of equipment to jobsite located in the Buena Vista Township, Saginaw County, Michigan. The contractor selected for installation will be responsible for the unloading of said equipment. Delivery schedule to be determined by selected contractor and coordinated between equipment supplier and contractor. Payment for equipment will be due upon delivery of equipment.

Owner: **Saginaw County Public Works Commissioner**

By: **Brian J. Wendling**

Title: **Public Works Commissioner**

Date: **December 14, 2020**

SAGINAW COUNTY PUBLIC WORKS COMMISSIONER
SAGINAW COUNTY, MICHIGAN
GAGE DRAIN PUMP STATION EQUIPMENT PROCUREMENT

INSTRUCTIONS TO BIDDERS

Bids are being taken by the Saginaw County Public Works Commissioner (SCPWC) for the equipment to be used on the Gage Drain Pump Station. Installation will be bid out within 90 days of the SCPWC selecting equipment vendors. Bidder agrees to work cohesively with the selected contractor to verify field dimensions on the final shop drawings prior to fabrication.

Divisions A, B, and C will be awarded separately. Bidders are only required to provide prices for the division they are interested in.

The bidder shall provide complete prices on the bid form including all material, delivery and service charges related to the equipment. This shall include at a minimum the amount of service time and startup assistance noted in the specifications or otherwise deemed necessary by the supplier. The SCPWC will sign a purchase order in the amount of the bid to the selected vendor. No additional payment will be made above the bid price unless a change in specifications is agreed to by all parties following the bid.

Only bidding documents obtained from the issuing office are valid. Sealed bids shall be submitted to the office of Spicer Group, Inc. located at 230 S. Washington Avenue, Saginaw, MI 48607, to the attention of Nicholas Czerwinski, prior to the bid opening as noted in the advertisement. Bids shall be sealed and shall have the bidder's name, address, the project title, and the words "BID ENCLOSED" noted on the exterior of the envelope. Once bidding documents are obtained from the issuing office, the vendor will be placed on the bidders list. All questions shall be addressed to Nicholas Czerwinski at nickc@spicergroup.com. Bids received after the time of the bid opening will not be accepted. Questions must be received a minimum of 4 days prior to the bid opening in order to be answered in an addendum. Only questions answered in an addendum will be binding. Oral and other interpretations or clarifications will be without legal effect. All questions will be addressed via an emailed addendum that will only be sent to those vendors appearing on the bidders list.

Site visits may be made available by coordinating with the engineer prior to the bid opening.

The bid submittal shall include the following items:

- A completed bid form
- Signed addendums if any are issued
- Preliminary shop drawings and technical data on the proposed equipment including pump curves (Division A only) so the engineer can verify the proposed products included in the bid meet the project specifications
- A detailed breakdown of all items included in the bid
- Any additional performance related data that the vendor feels will assist the SCPWC in making a selection

The bidder agrees to provide any references and qualifications to the SCPWC prior to awarding the project in a timely manner. The SCPWC reserves the right to waive any informalities in the bid and make the selection based on the best interest of the project. Bids shall remain subject to acceptance for 90 days following the bid opening.

GAGE DRAIN PUMP STATION - EQUIPMENT PROCUREMENT

BID FORM

Item No.	Estimated Quantity	Unit	Description	Unit Price	Amount
----------	--------------------	------	-------------	------------	--------

DIVISION A - PUMPS AND CONTROLS

1.	3	Each	36" Axial Flow Pump w/ VFDs – Cascade Pumps (35,000 gpm @ 10.3' TDH)	\$ _____	\$ _____
2.	3	Each	Submersible Mixer – Flygt 4610.410 (1.2 HP, 3 Phase)	\$ _____	\$ _____
3.	1	Lump Sum	Pump Station Controls, SCADA, and Security (See Attached Schedule)	<u>Lump Sum</u>	\$ _____

TOTAL - DIVISION A----- \$ _____

DIVISION B - TRASH RACK

4.	1	Lump Sum	Self-Cleaning Trash Rack	<u>Lump Sum</u>	\$ _____
----	---	----------	--------------------------	-----------------	----------

TOTAL - DIVISION B----- \$ _____

DIVISION C - GENERATOR

5.	1	Lump Sum	Back Up Generator - Diesel Fueled (As Specified by Consumers Energy, acting as an agent for the Saginaw County Public Works Commissioner with respect to this equipment – See Attached Consumers Documents)	<u>Lump Sum</u>	\$ _____
----	---	----------	---	-----------------	----------

TOTAL - DIVISION C----- \$ _____

BIDDER: *[Indicate correct name of bidding entity]*

By:
[Signature] _____

[Printed name] _____

(If Bidder is a corporation, a limited liability company, a partnership, or a joint venture, attach evidence of authority to sign.)

Attest:
[Signature] _____

[Printed name] _____

Title: _____

Submittal Date: _____

Address for giving notices:

Telephone Number:

Fax Number:

Contact Name and e-mail address:

Pump Station Controls, SCADA, and Security

Schedule of Items:

CP-1: Main Control Panel

Includes all required components for pump station controls, network structure, internet access, Touchscreen Operator Interface, Data Log Records, Security System, and local Computer Operator use.

Field Instrumentation:

LE-#: Level Elements

LE-1, LE-2: Submersible Pressure Transducers, Qty 2

LE-3, LE-4, LE-5: Radar Level Transmitters, Qty 3

LIT-#: Level Indicating Transmitters, Qty 5

TIT-#: Temperature Indicating Transmitters, Qty 2

TIT-1: Indoor

TIT-2: Outdoor

Security Camera System:

DVR-1: Digital Video Recorder with 8 Camera Capacity (Minimum)

CAM-#: Security Cameras, 5MP, Outdoor, Bullet style. Qty 7.

SCADA System:

Internet "Cloud" Based SCADA System with redundant Internet service and firewall security.

CP-3: Mixer VFD Control Panel

Includes all required components for Submersible Mixer Pumps operations and ethernet communications for local Network integration. This shall include VFDs for speed control, Bypass Contactors, and all safety interlocks such as moisture sensor and thermal overloads.

SECTION 22 22 23.30
VERTICAL AXIAL FLOW PUMP

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Purchasing three (3) vertical axial flow propeller type pumps
- B. References:
 - 1. National Electrical Code
 - 2. ANSI/NFPA
 - 3. Underwriters Laboratory
- C. Regulatory Requirements:
 - 1. Conform to NEC standards.
 - 2. Conform to MIOSHA standards.
- D. Delivery:
 - 1. Coordinate with Owner to deliver purchased equipment on site to the contractor in original factory packaging.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Cascade Pump Company
 - 1. Model: AP 4214

2.2 GENERAL

- A. Each pump shall be vertical axial flow propeller type with horizontal discharge, capable of pumping screened storm water. Oil lubricated design consisting of a bowl assembly, oils reservoir with solenoid valve and fittings, and headshaft assembly for vertical hollow shaft driver.
- B. Pump Characteristics:
 - 1. Number of Pump(s): 3
 - 2. 150 Hp motor
 - 3. 1 Stage
 - 4. Rated Capacity: 35,000 gpm
 - 5. Rated Total Head*: 10.3' TDH
 - 6. Minimum Bowl Efficiency at Rated Head: 70%
 - 7. Static Head: Varies 5' to 8'
 - 8. 36" Dia. Discharge
 - 9. Base plate dimensions shall match existing floor openings – as shown on drawings.

*Pump manufacturer to confirm pump internal friction loss to develop Total Dynamic Head Bowl from design data. No field test required.

2.3 DESCRIPTION

A. General

1. The pumps shall be built to standard dimensions such that parts will be interchangeable between like units and the same manufacturer shall supply all units.
2. The pumps shall be the Cascade Pump Company model AP 4214.

B. Performance Requirements:

1. When operating at the maximum output speed of the driver, each pump shall have a characteristic performance curve which meets the duty point of 35,000 gpm at 10.3' TDH. The pumps and drivers shall be capable of operating satisfactorily under the full range of system curve conditions from 24,000 gpm at 9.0' TDH to 44,000 gpm at 11.8' TDH.
2. Maximum speeds shall not exceed that which is listed above to satisfy the specified hydraulic duty requirements.
3. With the pumping units operating at full speed, the maximum brake horsepower required by the pumps shall not exceed the maximum horsepower of 150 HP. If the pumping units require more than the maximum horsepower listed in the Pump Schedule at any specified full speed operation point, they will be rejected.

C. Pump Construction

1. For pumps up to 250 HP, a headshaft with adjusting nut shall be provided for a Vertical Hollow Shaft motor to provide a means to adjust the propeller to its proper running clearance. Headshaft shall be connected to the top lineshaft with a threaded coupling.
2. For pumps above 250 HP, a Vertical Solid Shaft motor shall be provided, with flanged pump to motor coupling. For mixed flow pumps, coupling shall have precision threaded adjusting nut to set the impeller to its proper running clearance.
3. The pump shall be furnished with a suitable, integrally fabricated steel precision machined mounting ring of adequate design with registered fit to match the mounting dimensions of the driver. The mounting ring shall be supported by a fabricated steel pedestal. The pedestal shall have an access opening of adequate size for maintenance and shall be protected by expanded metal screens. If the pump discharge is above base, the pedestal shall feature a threaded drain port.
4. The pump shall be fitted with a tension nut body suitable for tension loading of the enclosing tube. The tension nut body shall allow for the introduction of oil by a drip feed oil lubrication system consisting of a 4 Quart oil reservoir, solenoid valve and a needle valve dripper.
5. The pump column and discharge elbow shall be fabricated steel, designed for suspension from an integral baseplate, suitable to support both the pump and driver. A Sole Plate shall be provided that can be grouted into place and attached to the pump by bolting for ease of pump removal. The mating surfaces between the Sole Plate and pump base shall be machined to provide flat bearing across the mating surface.
6. The discharge elbow shall be 3-piece mitered type, constructed of fabricated steel, with a flanged discharge, and shall be oriented as shown on the plan drawings.
7. The pump column shall be constructed of fabricated steel and flanged at each end. The column shall mate with the pump bowl assembly and the discharge head with precision

machined registered fits to assure correct alignment. No column section shall be greater than 10' long.

8. Discharge elbow and columns shall have a minimum thickness and nominal outside diameter as specified in the Pump Schedule.
9. The lineshaft shall be made from pump shaft quality (PSQ) shafting and supported by bronze enclosing tube bearings.
10. The lineshaft bearings shall be threaded externally to act as a coupling for extra heavy steel enclosing tubes. The lineshaft bearings shall be of the removable type and provided with a means of passing oil lubricant from one bearing to the next.
11. The enclosing tube shall be of extra heavy steel pipe with ends precision machined to receive the bronze lineshaft bearings
12. The line shaft couplings shall be of the threaded type, constructed of steel.
13. Pump impeller shall be cast bronze and secured to the shaft by a key and thrust collars. Fabricated impellers or propellers will not be accepted. The impeller shall be dynamically balanced to ISO 1940 G6.3 such that undue vibration or other unsatisfactory characteristics will not result when the pump is in operation.
14. The pump bowls shall be cast. Fabricated bowls are not considered equal and are not allowed. The pump bowls shall be of sufficient thickness to withstand stresses and strains at full operating pressure. The bowls shall be designed and manufactured with open and smooth water passages to assure efficient, reliable operation.
15. The bowl shaft shall be made from pump shaft quality (PSQ) shafting and polished at each bearing journal.
16. The discharge bowl bushings and bearings shall be precision machined and press fit. Top bowl bearing shall be threaded for attachment of shaft enclosing tube.
17. The suction bowl bushing shall be precision machined, press fit, and grease packed. Precision machined impeller recess or sand collar shall overlap suction bearing extension OD to seal and protect suction bearing grease packing.

D. Materials of Construction

1. Pump Suction Bell and Bowl shall be cast from ASTM A48 Class 30 Cast Iron. Fabricated bowls and bells shall not be acceptable.
2. Impeller shall be cast from B584 C90300 Tin Bronze. Fabricated impellers shall not be acceptable.
3. Impeller to shaft key and thrust collar shall be ASTM A582-416 Stainless Steel. Set screw and collet designs shall not be acceptable.
4. Bowl shaft shall be ASTM A582-416 pump shaft quality (PSQ) stainless steel
5. Suction and Bowl Bearings shall be ASTM B505 C84400/C93200 or B584 C84400/C93200 Bronze.
6. Flanged Column shall be fabricated from ASTM A53 Pipe and A36 Plate.
7. Lineshaft shall be ASTM A108 Grade C-1045 pump shaft quality (PSQ) steel.
8. Lineshaft couplings shall be Grade 1045 or 1215 Steel.
9. Lineshaft Bearings shall be ASTM B505 C84400/C93200 or B584 C84400/C93200 Bronze.
10. Lineshaft Enclosing Tube shall be ASTM A-53 or A-120 Extra Heavy Sch.80
11. Tension Nut shall be cast from ASTM A48 Class 30 Cast Iron
12. Tension Nut Body shall be ASTM B505 C84400/C93200 or B584 C84400/C93200 Bronze.
13. Discharge Elbow shall be fabricated from ASTM A53 Pipe and A36 Plate
14. Sole Plate shall be fabricated from ASTM A36 Plate

15. Head Shaft (for VHS drivers) shall be ASTM A108 Grade C-1045 pump shaft quality (PSQ) steel
16. Fasteners shall be 316SS

E. Pump Coating

1. Wetted surfaces of bowl assembly ID and OD, pump column ID and OD, and discharge elbow ID shall be abrasively blasted to an SSPC SP10, with a surface profile of 2-3.5 mils.
2. Wetted surfaces of bowl assembly ID and OD, pump column ID and OD, and discharge elbow ID shall be epoxy coated with a high solids polyamine epoxy, Carboline 891, or equal. 3 coats, to a minimum dry film thickness of 12 mils, shall be applied.
3. All other non-wetted and/or above grade metal surfaces shall be solvent and wire brush cleaned, and prime coated with manufacturer's standard universal primer, or primer as required to coordinate with field applied finish coatings.

F. Certified Factory Tests:

1. Non-witness factory testing in accordance with the standards of the Hydraulic Institute shall be required for all pumps. Pumps shall be tested to H.I. acceptance grade 1U using job bowl assembly and certified test lab motor. In lieu of testing with job fabrications, bowl assembly may be tested with a laboratory column pipe and discharge head similar in size to that of the job equipment.
2. Certified pump performance curves shall be submitted, including head, capacity, brake horsepower, and bowl efficiency for each pump supplied. Certified data shall be provided to indicate the NPSH required by the pumps when operating at full speed conditions of service listed in the Pump Schedule.
3. Prior to conducting a pump test, notification of such test and a list of test equipment and test procedures shall be forwarded to the Engineer at least fifteen (15) working days before the scheduled test date.
4. All pumps shall be tested at rated speed through the specified range of flow, be run at each rated speed head condition for sufficient time to accurately determine discharge, head, power input, and bowl efficiency. Reduced speed points shall be plotted using affinity law calculations.
5. The pump must be capable of operation without instability over the entire range of heads listed in the Pump Schedule. Tolerances must be in accordance with HI requirements. Instability is defined, for this specification, as when one or more of the following conditions occur:
 - a. The pump has two or more flow rates at the same total head;
 - b. The head-capacity curve has a dip (region on curve where change in flow rate produces an abnormally low head)
 - c. When any point in the usable range of head-capacity curve cannot be repeated within 3 percent.
6. If any pump tested fails to meet any specification requirement it will be modified until it meets all specification requirements. If any pump tested fails to meet the conditions of service listed in the Pump Schedule and all reasonable attempts to correct the inefficiency and unsuccessful, the pump(s) shall be replaced with unit(s), which meet the specified requirements.

G. Motor:

1. The motor shall be Class F insulated, sealed insulation, vertical, squirrel-cage induction, WP-1 enclosure, formed coil construction, non-reverse ratchet, inverter duty, hollow shaft,

premium efficiency, with 1.15 service factor. The motor shall conform to latest NEMA Standards and shall be sized adequately to operate the pump at the specified rated condition without exceeding nameplate rating for current and power of the horsepower ratings previously specified under pump characteristics.

2. Motor for the pumps shall be 460 volts, 3 phase, 60 Hertz, and shall be suitable for reduced voltage starting.

2.4 TRAINING

- A. Manufacturer to provide up to 8 hours on site start-up assistance and training by a factory or authorized representative after installation by Contractor.

2.5 DELIVERY

- A. All pumps are to be unloaded at the project site by the prime contractor in a single load unless other arrangements are made between the manufacturer and contractor. Pump manufacturer and prime contractor shall coordinate delivery schedule.

2.6 WARRANTY

- A. All equipment supplied under this section shall be warranted for a period of 12 months after start up, but not to exceed 18 months after shipment by the pump manufacturer. The equipment shall be warranted to be free from defects in workmanship and materials.

END OF SECTION

SECTION 26 29 23
VARIABLE-FREQUENCY MOTOR CONTROLLERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes variable frequency controllers.
- B. Related Sections:
 - 1. Section 26 28 13 - Fuses.

1.2 UNIT PRICE – MEASUREMENT AND PAYMENT

- A. Variable-Frequency Drives:
 - 1. Basis of Measurement: Included in the unit bid price for axial flow pumps as stated in the proposal.
 - 2. Basis of Payment: Includes all associated labor, material, equipment coordination, transport, loading/unloading, storage, etc. required for a complete and operable system.

1.3 REFERENCES

- A. Institute of Electrical and Electronics Engineers:
 - 1. IEEE C62.41 - Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits.
- B. National Electrical Manufacturers Association:
 - 1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
 - 2. NEMA FU 1 - Low Voltage Cartridge Fuses.
 - 3. NEMA ICS 7 - Industrial Control and Systems: Adjustable Speed Drives.
 - 4. NEMA ICS 7.1 - Safety Standards for Construction and Guide for Selection, Installation, and Operation of Adjustable Speed Drive Systems.
- C. International Electrical Testing Association:
 - 1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

1.4 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Submittal procedures.
- B. Shop Drawings: Indicate front and side views of enclosures with overall dimensions and weights shown; conduit entrance locations and requirements; and nameplate legends.
- C. Product Data: Submit catalog sheets showing voltage, controller size, ratings, and size of switching and overcurrent protective devices, short circuit ratings, dimensions, and enclosure details.
- D. Test Reports: Indicate field test and inspection procedures and test results.
- E. Manufacturer's Field Reports: Indicate start-up inspection findings.

1.5 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Closeout procedures.
- B. Operation and Maintenance Data: Submit instructions complying with NEMA ICS 7.1. Include procedures for starting and operating controllers, and describe operating limits possibly resulting in hazardous or unsafe conditions. Include routine preventive maintenance schedule.

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience and with service facilities within 100 miles of project.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.
- B. Store in clean, dry space. Maintain factory wrapping or provide additional canvas or plastic cover to protect units from dirt, water, construction debris, and traffic.
- C. Handle in accordance with manufacturer's written instructions. Lift only with lugs provided. Handle carefully to avoid damage to components, enclosure, and finish.

1.8 ENVIRONMENTAL REQUIREMENTS

- A. Section 01 60 00 - Product Requirements.
- B. Conform to NEMA ICS 7 service conditions during and after installation of variable frequency controllers.

1.9 WARRANTY

- A. Section 01 70 00 - Execution and Closeout Requirements: Product warranties and product bonds.
- B. Furnish five year manufacturer warranty for variable frequency controller.

1.10 MAINTENANCE SERVICE

- A. Section 01 70 00 - Execution and Closeout Requirements: Maintenance service.
- B. Furnish service and maintenance of variable frequency controller for one year from Date of Substantial Completion.

1.11 MAINTENANCE MATERIALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Spare parts and maintenance products.
- B. Furnish two of each air filter.

- C. Furnish three of each fuse.

PART 2 - PRODUCTS

2.1 VARIABLE FREQUENCY CONTROLLER

- A. Manufacturers:
 - 1. Square D, by Schneider Electric.
 - a. Altivar, ATV630 Series
 - 2. Substitutions: Not Permitted.
- B. Product Description: NEMA ICS 7, enclosed variable frequency controller suitable for operating indicated loads. Select unspecified features and options in accordance with NEMA ICS 7.1.
- C. Ratings:
 - 1. Rated Input Voltage: 480 volts, three phase, 60 Hertz.
 - 2. Motor Nameplate Voltage: 460 volts, three phase, 60 Hertz.
 - 3. Displacement Power Factor: Between 1.0 and 0.95, lagging, over entire range of operating speed and load.
 - 4. Operating Ambient: 0 degrees C to 40 degrees C.
 - 5. Minimum Efficiency at Full Load: 95 percent.
 - 6. Time to Stop: Adjustable.
- D. Design Features:
 - 1. Employ microprocessor-based inverter logic isolated from power circuits.
 - 2. Employ pulse-width-modulated inverter system.
 - 3. Design for ability to operate controller with motor disconnected from output.
 - 4. Design to attempt five automatic restarts following fault condition before locking out and requiring manual restart.
- E. Indicators and Manual Controls:
 - 1. Input Signal: 4 - 20 mA DC.
 - 2. Display: Furnish integral digital display to indicate output voltage, output frequency, and output current.
 - 3. Status Indicators: Separate indicators for overcurrent, overvoltage, ground fault, overtemperature, and input power ON.
 - 4. Volts Per Hertz Adjustment: Plus or minus 10 percent.
 - 5. Current Limit Adjustment: 110 percent of rated.
 - 6. Acceleration Rate Adjustment: 0 to 90 seconds.
 - 7. Deceleration Rate Adjustment: 0 to 90 seconds.
 - 8. HAND-OFF-AUTOMATIC selector switch and manual speed control.
 - 9. Control Power Source: Integral control transformer.
- F. Safeties and Interlocks:
 - 1. Includes undervoltage release.
 - 2. Door Interlocks: Mechanical means to prevent opening of equipment with power connected, or to disconnect power when door is opened; include means for defeating interlock by qualified persons.

3. Safety Interlocks: Terminals for remote contact to inhibit starting under both manual and automatic mode.
4. Control Interlocks: Furnish terminals for remote contact to allow starting in automatic mode.
5. Manual Bypass: Includes contactor, motor running overload protection, and short circuit protection for full voltage, non-reversing operation of motor. Includes isolation switch to allow maintenance of inverter during bypass operation.
6. Emergency Stop: Use dynamic brakes for emergency stop function.
7. Disconnecting Means: Integral circuit breaker on line side of each controller.

G. Fabrication:

1. Wiring Terminations: Match conductor materials and sizes as indicated on Drawings.
2. Enclosure: NEMA 250, Type 1, suitable for equipment application in places restricted to persons employed on premises.
3. Finish: Manufacturer's standard enamel.

H. Communication:

1. Drive shall have an RJ45 port available for Ethernet/IP communications.
2. All Drive information shall be available for monitoring via network communication.

2.2 TRANSIENT VOLTAGE SUPPRESSION DEVICES

A. Manufacturers:

1. As supplied by Drive Manufacturer.
2. Substitutions: Not Permitted.

- B. Product Description: IEEE C62.41, factory-mounted transient voltage surge suppressor, selected to meet requirements for low exposure and to coordinate with system circuit voltage.

2.3 SOURCE QUALITY CONTROL

- A. Shop inspect and perform standard productions tests for each controller.

- B. Make completed controllers available for inspection at manufacturer's factory prior to packaging for shipment. Notify Owner and Architect/Engineer at least seven days before inspection is allowed.

- C. Allow witnessing of factory inspections and tests at manufacturer's test facility. Notify Owner and Architect/Engineer at least seven days before inspections and tests are scheduled.

PART 3 - EXECUTION (**FURNISHED BY CONTRACTOR**)

3.1 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

- B. Verify building environment is maintained within service conditions required by manufacturer.

3.2 EXISTING WORK

- A. Disconnect and remove abandoned controllers.
- B. Clean and repair existing controllers to remain or to be reinstalled.

3.3 INSTALLATION

- A. Install in accordance with NEMA ICS 7.1.
- B. Tighten accessible connections and mechanical fasteners after placing controller.
- C. Install fuses in fusible switches.
- D. Select and install overload heater elements in motor controllers to match installed motor characteristics.
- E. Install engraved plastic nameplates in accordance with Section 26 05 53.
- F. Neatly type label inside controller door identifying motor served, nameplate horsepower, full load amperes, code letter, service factor, and voltage/phase rating. Place label in clear plastic holder.
- G. Ground and bond controller in accordance with Section 26 05 26.

3.4 FIELD QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Inspect and test in accordance with NETA ATS, except Section 4.
- C. Perform inspections and tests listed in NETA ATS, Section 7.16 and NEMA ICS 7.1.

3.5 MANUFACTURER'S FIELD SERVICES

- A. Section 01 40 00 - Quality Requirements: Manufacturer's field services.
- B. Prepare and startup variable frequency controller.

3.6 DEMONSTRATION AND TRAINING

- A. Furnish 4 hours of instruction each for two persons, to be conducted at project site with manufacturer's representative.

END OF SECTION

SECTION 28 20 00
VIDEO SURVEILLANCE

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Cameras.
 - 2. Monitors.
 - 3. Digital video recorders.
- B. Related Requirements:
 - 1. Section 26 05 26 - Grounding and Bonding for Electrical Systems: Grounding and bonding of video surveillance equipment.

1.2 UNIT PRICE – MEASUREMENTS AND PAYMENTS

- A. Pump Station Controls, SCADA, and Security:
 - 1. Basis of Measurement: As part of the lump sum for Pump Station Controls, SCADA, and Security system.
 - 2. Basis of Payment: Includes all labor, materials, and equipment to provide and install the Pump Station Controls, SCADA, and Security system as shown on the contract documents and as stated in the specifications.

1.3 REFERENCE STANDARDS

- A. Society of Motion Picture and Television Engineers:
 - 1. SMPTE-170M - Composite Analog Video Signal - NTSC for Studio Applications.

1.4 COORDINATION

- A. Section 01 30 00 - Administrative Requirements: Requirements for coordination.
- B. Coordinate Work of this Section with Work of other Sections.

1.5 PREINSTALLATION MEETINGS

- A. Section 01 30 00 - Administrative Requirements: Requirements for preinstallation meeting.
- B. Convene minimum one week prior to commencing Work of this Section.

1.6 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

- B. Product Data: Submit manufacturer's catalog information showing electrical characteristics and connection requirements for each component.
- C. Shop Drawings: Indicate electrical characteristics and connection requirements, including system wiring diagram.
- D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- E. Manufacturer Instructions: Submit detailed instructions on installation requirements, including storage and handling procedures.
- F. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.
- G. Manufacturer Reports:
 - 1. Certify that equipment has been installed according to manufacturer instructions.
 - 2. Indicate activities on Site, adverse findings, and recommendations.
- H. Qualifications Statements:
 - 1. Submit qualifications for manufacturer, supplier, and installer.
 - 2. Submit manufacturer's approval of installer.

1.7 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for submittals.
- B. Project Record Documents: Record actual locations of cameras and routing of television cable.

1.8 QUALITY ASSURANCE

- A. Perform Work according to all applicable codes and standards.
- B. Maintain one copy of each standard affecting Work of this Section on Site.

1.9 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years' documented experience.
- B. Supplier: Authorized distributor of specified manufacturer with minimum three years' documented experience.
- C. Installer: Company specializing in performing Work of this Section with minimum three years' documented experience and approved by manufacturer.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

- B. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- C. Store materials according to manufacturer instructions.
- D. Protection:
 - 1. Protect materials from moisture and dust by storing in clean, dry location remote from areas involved in construction operations areas.
 - 2. Provide additional protection according to manufacturer instructions.

1.11 AMBIENT CONDITIONS

- A. Section 01 50 00 - Temporary Facilities and Controls: Requirements for ambient condition control facilities for product storage and installation.
- B. Conform to manufacturer's standard service conditions during and after installation of components.

1.12 EXISTING CONDITIONS

- A. Field Measurements:
 - 1. Verify field measurements prior to fabrication.
 - 2. Indicate field measurements on Shop Drawings.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

- A. Video surveillance and monitoring at points as indicated on Drawings.
- B. Capacity:
 - 1. Cameras: As indicated on drawings.
 - a. Include 20% Spare, Minimum of 2.
 - 2. Monitors: Two.

2.2 CAMERAS

- A. Manufacturers:
 - 1. Avigilon.
 - 2. Substitutions: Not permitted.
- B. Description: High definition security and monitoring camera, with night vision (automatic transition).
- C. Lens:
 - 1. Professional Photography lens (SLR-bayonette style).

- D. Ratings:
 - 1. Input Power: A single cable shall provide device power, control, and video/data transmission. This shall be POE (Power Over Ethernet) or other approved method.
- E. Housing: Weatherproof.

2.3 MONITORS

- A. Manufacturers:
 - 1. Panasonic Commercial
 - 2. Samsung Commercial
 - 3. NEC Commercial
 - 4. LG
 - 5. Substitutions: As specified in Section 01 60 00 - Product Requirements.
- B. Description: LED, color, flat screen, High Definition, combination Television/Computer monitor. Freestanding or wall mounted, per installation location.
- C. Screen Size: 24 inches, Minimum.
- D. Resolution: High definition, 1920 by 1080p, Minimum.
- E. Aspect Ratio: 16:9.
- F. Viewable Angle: 175 degrees
- G. Input Options: Coordinate with surveillance hardware requirements.
- H. Voltage: 120v, <70Watts operating.

2.4 DIGITAL VIDEO RECORDERS

- A. Manufacturers:
 - 1. Avigilon.
 - 2. Substitutions: Not permitted.
- B. Monitor Output: RGB (VGA), composite.
- C. Video Resolution: Match camera resolution.
- D. Image Size: 320 by 240, medium.
- E. Playback Display: Multiple simultaneous camera views.
- F. Network: LAN, Internet-based remote access.
- G. Motion Selection: Sensor integral to camera.
- H. Furnish autodetection.

- I. Data Backup: Solid-State Hard Drive.
 - 1. Solid-State Hard Drive(s) shall be removable and replaceable for future upgrades. Solid-State Hard Drive memory shall not be integral to circuit boards.
- J. Operating System: Windows 10.
- K. Mounting: Rack.

PART 3 - EXECUTION (FURNISHED BY CONTRACTOR)

3.1 PREPARATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation preparation.
- B. Install engraved plastic nameplates as specified in Section 28 05 53 - Identification for Electronic Safety and Security.
- C. Ground and bond video surveillance equipment as specified in Section 26 05 26 - Grounding and Bonding for Electrical Systems.

3.2 FIELD QUALITY CONTROL

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for testing, adjusting, and balancing.
- B. Manufacturer Services: Furnish services of manufacturer's representative experienced in installation of products furnished under this Section for not less than 8 hours on Site for installation, inspection, startup, supervision of final wiring connections and system adjustments, field testing, and instructing Owner's personnel in maintenance of equipment.
- C. Equipment Acceptance:
 - 1. Adjust, repair, modify, or replace components failing to perform as specified and rerun tests.
 - 2. Make final adjustments to equipment under direction of manufacturer's representative.
- D. Furnish Installation Certificate from equipment manufacturer's representative attesting that equipment has been properly installed and is ready for startup and testing.

3.3 ADJUSTING

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for starting and adjusting.
- B. Adjust manual lens irises to meet lighting conditions.

3.4 DEMONSTRATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for demonstration and training.
- B. Demonstrate equipment startup, shutdown, routine maintenance, and emergency repair procedures to Owner's personnel.

3.5 MAINTENANCE

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for maintenance service.
- B. Furnish service and maintenance of video surveillance system for one year from date of Substantial Completion.

END OF SECTION

SECTION 40 63 53
WEB HOSTED SCADA SERVICES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Web Hosted SCADA System.

1.2 UNIT PRICE – MEASUREMENTS AND PAYMENTS

- A. Pump Station Controls, SCADA, and Security:
 - 1. Basis of Measurement: As part of the lump sum for Pump Station Controls, SCADA, and Security system.
 - 2. Basis of Payment: Includes all labor, materials, and equipment to provide and install the Pump Station Controls, SCADA, and Security system as shown on the contract documents and as stated in the specifications.

1.3 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Submittal procedures.
- B. Shop Drawings: Indicate front and side views of enclosures with overall dimensions and weights shown; conduit entrance locations and requirements; and nameplate legends.
- C. Product Data: Submit catalog sheets showing voltage, controller size, ratings and size of switching and overcurrent protective devices, short circuit ratings, dimensions, and enclosure details.
- D. Test Reports: Indicate field test and inspection procedures and test results.
- E. Manufacturer's Field Reports: Indicate start-up inspection findings.

1.4 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Closeout procedures.
- B. Operation and Maintenance Data: Submit instructions complying with NEMA ICS 7.1. Include procedures for starting and operating controllers, and describe operating limits possibly resulting in hazardous or unsafe conditions. Include routine preventive maintenance schedule.

1.5 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience, and with service facilities within 100 miles of project.

1.6 QUALITY ASSURANCE

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with three years' experience.

1.7 EXISTING CONDITIONS

- A. Field Measurements: Verify field measurements prior to fabrication. Indicate field measurements on Shop Drawings

PART 2 - PRODUCTS

2.1 WEB HOSTED SCADA SYSTEM

- A. Manufacturers:
 - 1. KI System Master.
 - 2. Substitutions: Not Permitted.
- B. General:
 - 1. The hosted SCADA service shall be provided by a company that is regularly engaged in the work required by the County and as specified herein. The infrastructure for supporting the Hosted SCADA must have been in place for three years and be supporting a minimum of 100 customer sites at the time a proposal is submitted. A list of 10 customer references shall be submitted with the proposal.
 - 2. SCADA shall employ computerized monitoring software that facilitates communications with most standard field hardware devices using industry-standard protocols. Software shall employ a graphical user interface (GUI) as the Supervisory Control and Data Acquisition (SCADA).
 - 3. Software shall be compatible with a COTS (commercial off-the shelf) PC running Windows.
 - 4. Provide a complete and functional monitoring and control system that functions in accordance with and fulfills all the requirements set forth in this Specification, set forth in the 40 63 43 sections or indicated on the Drawings. Any omission of details from this Specification or from the Drawings shall not relieve the Contractor from furnishing a complete, operating system. In the event of a discrepancy between the Drawings and specifications, the more stringent requirements shall apply.
 - 5. Coordination: Coordinated installation, configuration and startup of the Web Hosted SCADA system with process equipment installation and facility construction provided under this contract and the other contracts comprising the overall project. Due to the nature of this project, only portions of the Web Hosted SCADA system may be delivered, installed and placed in service at any time. Coordinate system work with the various Contractors and conform to the overall project construction sequence and schedule.
- C. Hosted SCADA Service:
 - 1. The Hosted SCADA Company shall be available to the CUSTOMER 24 hours per day, 7 days per week. At minimum, the Hosted SCADA Company shall have a controls team with a least three (3) Controls Engineers, two (2) Controls Technicians, one (1) Controls Coordinator, and seven (7) field service technicians.
 - 2. The hardware and software of hosted SCADA service shall be installed into two separate facilities.

3. The Main Hosted SCADA facility shall include the following:
 - a. Facility shall be located in Michigan.
 - b. Facility shall be in a location historically free from natural disasters such as hurricanes, floods, earthquakes, and tsunamis. The Facility shall be above the 500 year flood plain.
 - c. Facility shall be monitored by Facility staff 24 hours a day, 365 days a year.
 - d. Facility shall have doorways managed by a card access system with dual authentication with biometric scanner for physical access which records all access. Security alarms to elicit an armed response.
 - e. Facility at a minimum shall be AICPA SOC2 Type II audited. SOC2 Type II is a nationally recognized standard used to assess procedures and controls. The SOC2 Type II audit evaluates the security, operational policies and systems in use. The audit appraises the physical building security, room access control, network resiliency, backup power, environmental controls such as heat rejection, and safety systems including fire suppression.
 - f. Facility at a minimum shall have nine redundant fiber paths for Internet connectivity leading to multiple upstream carriers. Including: AT&T, Comcast, Comlink, Level3, US Signal, and Waveform Tech with connectivity capabilities to CenturyLink, Orange Business, Sprint, Verizon, and XO Communications.
 - g. Facility cooling and HVAC at a minimum shall be configured to ASHRAE standards with 20 degree differential between hot and cold isles.
 - h. Facility at a minimum shall utilize an N+N UPS system with independent power delivery from transfer switch to racks. Total battery life shall be at least 20 minutes at full load. UPS system at minimum to meet or exceed concurrent maintainability tier II requirements of the Uptime Institute.
 - i. Facility at a minimum shall be FEMA rated and utilize N+N generator backup system. Including two diesel generators and two 2,000 gallon fuel tanks. System must run for at least 96 hours under full load before refueling.
 - j. Facility at a minimum shall utilize a waterless fire suppression system.
 - k. Facility at a minimum shall have an advanced security framework to safeguard both the interior and exterior of the facility. At a minimum the system shall track all environmental functions including room temperature, humidity, and equipment conditions.
4. The Backup Hosted SCADA facility shall include the following:
 - a. The Backup facility shall include identical SCADA hardware and software as the Main facility.
 - b. The Backup facility SCADA software shall be securely synced with the Main facility SCADA software at all times. This includes SCADA software programming and historical data logging.
 - c. The Backup facility shall continuously monitor the Main facility and act as a hot-backup when the Main facility is unavailable. The Backup facility shall perform all Hosted SCADA functions immediately and automatically.
 - d. The Backup facility shall be on a different power grid than the Main facility.
 - e. The Backup facility shall be owned by the Hosted SCADA provider.
5. The hosted SCADA system shall include the following hardware:
 - a. Main runtime SCADA server utilizing Server operating system and server features.
 - b. Backup runtime SCADA server utilizing Server operating system and server features.
 - c. Twelve (12) available voice modems for alarm callouts. Six (6) voice modems to be installed on main runtime server. Six (6) voice modems to be installed on backup runtime server.

- d. Four (4) different voice phone line technologies shall be used: Standard POTS lines, Cellular voice lines, Digital PBX lines, and VOIP lines.
- 6. The Main SCADA system and Backup SCADA system shall have provisions in place to monitor and ensure the uptime of the Hosted SCADA service. This shall be performed by a 3rd party:
 - a. IT Infrastructure Audit – The Hosted SCADA main and backup IT infrastructure shall be audited yearly by a 3rd party IT professional. Recommendations by the 3rd party IT professional shall be implemented within 6 months.
 - b. Disaster Recovery Testing – The Hosted SCADA main and backup IT infrastructures shall be tested against a disaster recovery plan yearly. The disaster recovery plan shall be reviewed and tested by a 3rd party IT professional.
 - c. Uptime Monitoring of Hosted SCADA Service – The Hosted SCADA main and backup IT infrastructures shall be monitored by a 3rd party company every 5 minutes. If the 3rd party company is unable to access the Main SCADA system or Backup SCADA system, the 3rd party shall notify the Hosted SCADA Company immediately.
 - d. IT Infrastructure Health Monitoring – The Hosted SCADA main and backup IT infrastructure shall be monitored by 3rd party software. If the 3rd party software identifies an issue with the IT infrastructure, another 3rd party voice callout provider shall notify the Hosted SCADA Company immediately.

D. I/O Communications:

- 1. The hosted SCADA system shall provide the ability to communicate to customer equipment using cellular communications. The cellular communication shall incorporate the following:
 - a. Contracts with multiple service providers including Verizon, AT&T and Sprint.
 - b. Cellular data to be private and secured by service provider. Hosted SCADA system shall have VPN access to each cellular service provider to securely access cellular data.
- 2. Communications diagnostics tools shall be included to aid in the visualization of proper communications. Tools shall include methods for monitoring communication statistics and reporting errors.
- 3. Software shall be capable of supporting local I/O communications (i.e. on the primary application server) or distributed I/O servers (i.e. on computers other than the primary server.) There shall be no limit to the number of allowable redundant I/O servers for any driver.
- 4. Software shall be capable of pooling modems connected to one of more servers, for use in I/O communications.
- 5. Software shall support multiple communications protocols over a single communications port. Communications drivers shall be capable of sharing communications equipment, such as a radio tower (where there is no difference in radio frequency) or a pool of shared modems.
- 6. Software shall support redundant physical links to any field device, such as primary connectivity via Ethernet and redundant connectivity via serial port. Redundant links shall support similar or different protocols.
- 7. I/O drivers shall be available at no additional cost for a variety of protocols, as follows:
 - a. Modbus (TCP, RTU, ASCII, Plus, Serial)
 - b. AB DF1
 - c. CIP
 - d. DNP3
 - e. Omron Hostlink and FINS

- f. Bristol Babcock BSAP and IBP
 - g. GE SNP and SNPX
 - h. SNMP
 - 8. OPC Client connectivity shall be available at no additional cost for drivers not included in the preceding list. This shall support OPC Servers from developers.
 - 9. DDE Client connectivity shall be available at no additional cost.
 - 10. Software shall support the development of additional I/O drivers where necessary.
 - 11. To optimize system performance, software must support multi-threaded operations for I/O drivers.
 - 12. Software shall provide tools for polling remote devices (e.g. RTUs) directly. Software shall allow real-time tuning of each device's polling frequency without interrupting the polling cycle or restarting the application.
 - 13. To optimize I/O communications for telemetry applications, the polling order shall be configurable and polling shall be asynchronous (if permitted by the remote telemetry unit), allowing the system to continue its polling sequence in the event of a communications error with the remote device.
 - 14. Software shall support radio diagnostics drivers for the following radio devices:
 - a. Dataradio/Calamp
 - b. MDS
 - 15. Software shall support writing to multiple output tags via a single write request. This shall allow writing a set of default values to a set group of field device registers.
 - 16. Software shall support rewriting the last written value to an output.
- E. System Configuration:
- 1. Configuration files and configuration history shall be encrypted.
 - 2. Change deployment shall be either automatic or manual. User's choice.
 - 3. Software shall allow configuration changes to be reviewed before they are deployed. Users shall have the option to roll back specific changes and deploy others.
 - 4. Software shall be capable of on-line configuration. That is, changes to tag configuration, server lists, user displays, security, reports development and I/O communications shall be carried out without stopping and restarting the application or the computers and without recompiling the application.
 - 5. Software shall be capable of testing on-line configuration changes to tags and screens using live data before changes are deployed.
 - 6. Software shall allow multiple users to configure an application simultaneously.
 - 7. Software shall be capable of offline changes which can be manually imported to the running application and extracted automatically.
 - 8. Software shall allow changes to the application server lists without requiring the application to be restarted.
 - 9. Any client computer not running the application while changes are being made shall automatically download newly deployed changes from the primary application server when the client is restarted.
 - 10. All application servers and clients shall automatically synchronize with the primary application server. No manual file duplication shall be required.

F. Version Control

1. Software shall offer integrated version control, such that a complete version history exists for any application. The entire version history shall reside in an encrypted repository.
2. The version history shall include the time and date when the change was applied, the user who deployed the change and any comments entered by the user when deploying this change.
3. The version history shall allow review of any incremental application changes, including displays, graphics, tags and scripts for each deployed version.
4. A tool shall be available to determine what versions of the application each (full installation) client or server computer is currently running.
5. Software shall allow rollback to a previous version of the application without stopping and restarting the application

G. Tag Database:

1. Software shall be tag-based.
2. Tag structures shall be supported, such that a custom tag structure can include a set of typical I/O tags (e.g. a lift station.) Structures shall support a base address such that its I/O may use referential addressing.
3. Tag structures shall be treated as templates in that any structure can be copied and pasted to create any number of identical structures.
4. A browser shall be provided for creation, modification and deletion of each individual tag.
5. The tag browser shall include a summary of all tags' current values.
6. Software shall provide a tool for export of all application tags to Microsoft office applications for bulk tag changes and for import of all tags from the same programs.

H. Graphics and Displays:

1. Software shall not limit the number of application displays that can be created.
2. Software shall support both animated and static graphic objects. Animated graphic objects shall provide real-time process information to the user via displays.
3. Software shall include a standard library of graphics and shall allow additional graphical elements (e.g. BMP, JPG, PNG) to be inserted into the library.
4. Software shall support the following display sizing and placement features.
 - a. Minimum and maximum display sizes for each display.
 - b. Resizing, minimizing, maximizing.
 - c. Automatic resizing displays to the workstation resolution of each user viewing the application. This shall be supported on both fully installed and browser clients.
5. Process displays shall be event-driven, in that data will be delivered to client computers by the server immediately upon receipt. Client computers will not poll the server for new data.
6. Standard tag types with graphics shall be provided for the following:
 - a. Analog/digital inputs.
 - b. Analog/digital outputs.
 - c. Retentive counters with reset. (Values should persist if power is lost and subsequently restored.)
 - d. Retentive totalizers with reset. (Values should persist if power is lost and subsequently restored.)
 - e. Multi-position switches. Position changes sent to field devices must include feedback of status received and verification of field action taken. For example, a switch intended to turn on a pump shall generate an alarm if the pump running status is not received within a predefined timeout.
 - f. Alarms.

7. Software shall include pre-built displays for standard SCADA features. The following pre-built displays shall be provided as a minimum:
 - a. Alarm display that can be filtered by name and includes current, unacknowledged, disabled and history.
 - b. Trending and tabular viewing of historical data.
 - c. Report creator.
 - d. Operator notebook.
8. Software shall include the following navigation tools:
 - a. A menu for navigating from one display to another. Menu shall be configurable to allow logical grouping of displays where necessary.
 - b. Hot box for navigating to a specific display.
 - c. Button for navigating to a specific display.
 - d. Browser-like forward and reverse buttons to view 10 (or more) previously viewed displays.
9. Software shall allow color translations, changing brightness, contrast and transparency for all graphical library objects. An easy-to-use integrated interface shall be provided to facilitate these changes.
10. Software shall allow calculations to be associated with each graphic object to facilitate movement, visibility and sizing.
11. Software shall allow multiple objects to be saved as a grouped template. The following template capabilities shall be supported:
 - a. A template may be associated with a tag structure.
 - b. Each new instance of the template will inherit the properties of the template, such that changes to the template will automatically update all instances created from it.
 - c. The template may have any number of parameters, including tags and text values, which can be used to animate objects within the template. Each new object created from the template may include different parameters.
 - d. Templates may be imported from other projects.
 - e. Copy/paste/rename/delete for any template
 - f. Ungrouping of any instance of the template.
12. Project displays shall be treated as template displays. The following capabilities shall be supported:
 - a. A template display may be associated with a tag structure.
 - b. Each new instance of the template will inherit the properties of the template, such that changes to the template will automatically update all instances created from it.
 - c. The template may have any number of parameters, including tags and text values, which can be used to animate objects within the template. Each new object created from the template may include different parameters.
 - d. Templates may be imported from other projects.
 - e. Copy/paste/rename/delete for any template.
13. Means shall be provided to allow the operator to print graphical displays.
14. Software shall support flagging tags as 'questionable data' or 'not commissioned', though they will continue to display the incoming values. These flags shall be removable by users with sufficient privileges.
15. Software shall include an object-oriented graphics and animation editor with the following capabilities:
 - a. Drawing tools with CAD-like capabilities for drawing animated and static objects and text. Developers shall have access to a user- configurable grid for use in positioning objects.
 - b. Editing tools for adding, aligning, layering, sizing, copying, cutting, pasting, and deleting objects.

- c. Creating graphics that rotate/move at a rate corresponding to the value they are displaying.
- d. Importing 3D graphic images rendered using external software tools.
- 16. There shall be no limit to the number of animation graphics that can be used to represent the same I/O tag.
- 17. Software shall support background bitmaps on graphical pages.
- 18. Software shall be capable of displaying multiple graphical windows simultaneously.

I. Historical Data Storage

- 1. Software shall include an integrated, no-cost historian and have an available MSSQL historian for backup and custom reporting.
- 2. Software shall be capable of logging up to 10,000 values per second.
- 3. A synchronization scheme shall be included such that an exact copy of all historical data resides in two computers. The scheme shall provide synchronization of data between the software's primary and backup historian. Software shall be capable of synchronizing up to 4000 values per second across each historian type.
- 4. If, at any time a historian is out of service for duration of time, this historian shall be automatically resynchronized with the historian holding the most recent logged data.

J. Historical Data Analysis

- 1. Any tag configured as an Analog Status or Digital Status tag shall be automatically available for trending on screen displays.
- 2. Software shall provide a tool for users to generate ad-hoc trends of historical data and shall allow these trends to be saved for later recall.
- 3. Software shall display historical and real-time data in both plot and tabular format. Historical and real-time plotted values shall be shown in a continuous, uninterrupted, scrolling fashion.
- 4. The plot's time frame shall be operator selectable from a minimum of one second to five years. Time intervals shall be clearly marked on the x-axis with date/time stamps and shall scroll with the data.
- 5. Scaling of each displayed tag value shall be either user-configurable or shall follow the scaling of the tag. Changing the scaling of the tag plot shall not affect the scaling of the tag.
- 6. User shall be able to see the value of plotted tags for any selected point in time.
- 7. Software shall be capable of displaying an unlimited number of analog and digital tag plots on a single display. Color shall be used to differentiate between tags. Means must be provided to quickly determine the name and description of each tag displayed.
- 8. Means must be provided for the following:
 - a. Stop/pause scrolling.
 - b. Zoom in/out on the time (x) and value (y) axis'.
 - c. Pan/Scroll along the time axis or select a particular date to display.
 - d. Move analog tag plots vertically (in the value (y) axis), either individually or as a group.
 - e. Display statistical data, including average, minimum and maximum values, for each plot.
- 9. Ability to print displayed plots shall be provided.
- 10. Ability to associate an operator note with a particular point in time shall be provided.
- 11. Trend data shall be exportable to comma separated value (.csv) file or directly to a database, for use by 3rd-party data analysis software.
- 12. Software shall include simple methods for generating historical calculations, such as average flow over last 24 hours.

K. Alarms and Events Managements

1. A synchronization scheme shall be included such that an exact copy of all alarms and events data resides in two computers.
2. If, at any time an alarms/events server is out of service for duration of time, it shall be automatically resynchronized with the more updated alarms/events server.
3. Software shall allow the application to be split into functional areas such that the alarms a user sees/acknowledges are determined by the areas to which the user has access.
4. Software shall support generation of an alarm or event for I/O driver loss of communications, tag value change or outside range, calculated value, user logon/logoff, excess rate of change, stale value and server startup.
5. Software shall provide user-configurable settings for deadband on analog alarms and delay on analog and digital alarms.
6. Each alarm and event shall be written to the application's alarms/events history.
7. Software shall support printing of alarms/events created over a range of dates/times.
8. Alarms and events records shall include:
 - a. Time/Date stamp.
 - b. The name and description of the alarm tag.
 - c. Priority.
 - d. Status of Alarm (i.e. Active, Acknowledged, Cleared). Alarm Acknowledgement records shall include the name of the user.
9. Users shall be able to filter the alarms display to show current, unacknowledged, disabled or historical alarms/event. Alarms shall be filterable by priority or by alarm areas/groups.
10. Software shall support an unlimited number of alarm priorities and shall allow unique annunciation sounds and colors for each.
11. Alarm annunciation shall be configurable to use alarm tones, text to speech descriptions, or sound files.
12. Users must be notified, both visibly and audibly, of the occurrence of an alarm, regardless which display is presently being viewed.
13. Alarm acknowledgement shall immediately be propagated to all user interfaces.

L. Alarm Dialer

1. The dialer shall perform alarm annunciation via dial-out over voice modem (using text-to-speech), text message, email and/or alphanumeric pager. It shall support alarm acknowledgement during voice modem calls and via email.
2. The dialer shall be configurable from the SCADA software configuration license and be automatically synchronized with the tag database at all times.
3. Email messages shall support outgoing mail with transport layer security (e.g. Gmail, Yahoo Mail).
4. The dialer shall share the SCADA system security, requiring users to enter a username and security code access data and to acknowledge alarms.
5. The dialer shall be capable of annunciating alarms to rosters of users with up to 30 contacts per roster. An unlimited number of rosters shall be supported.
6. The dialer shall be able to make rosters active/inactive manually or automatically. Changes to rosters and active/inactive status changes shall be made without stopping and restarting the application or computer.

M. Security

1. Software shall include a security system with privilege and role-based user accounts. Level-based access shall not be acceptable.

2. Security system shall support an unlimited number of user accounts, roles, and access privileges.
3. System shall allow creation of an unlimited number of additional security privileges where necessary.
4. User passwords shall be stored in an encrypted format.
5. User passwords must be configurable to require a minimum length, contain alphanumeric characters, and expire after a pre-set period.
6. System shall allow changes to user accounts, roles and privileges while the application is running. Changes shall become effective immediately. Networked users whose accounts have been altered shall be affected by the changes immediately without requiring application restart.
7. User login and logout activity shall be recorded in the application event log.
8. Disabling accounts after X failed attempts shall be supported.

N. Electric Operator Notebook

1. Software shall include a networked electronic operator notebook. All notes entered into the notebook shall be immediately viewable from all clients and servers.
2. Each note shall be recorded with a time/date stamp and the name of the user's account.
3. Notes shall be encrypted to minimize the risk of tampering.
4. Users shall be permitted to select any date to review notes generated on that date.
5. Software shall support printing of notes created over a range of dates/times.

O. Report Generation System

1. Software shall be capable of producing reports using historical data. Reports may be created for one-time use or saved for reuse.
2. Report generation shall be invoked either on demand, by a monitored event, or on a scheduled basis.
3. The report generation system shall be field configurable, allowing an operator to create, modify and generate reports and export data to third party software. The report generation system shall be capable of displaying reports to the user interface display or of exporting files per the following:
 - a. To a comma separated value (.csv) file.
 - b. To a text file.
 - c. To an ODBC-compliant database.
 - d. To any direct-connected or networked printer.
 - e. Directly to a new MS Excel spreadsheet.
 - f. Directly to a new MS Excel template.
 - g. To an e-mail.
4. Reports shall be able to display any analog, digital or calculated tag data from the historical database.
5. The hosted SCADA system shall perform custom reporting utilizing templates as needed by the customer. The system shall be able to report using MS Excel utilizing custom VBA coding, or by using XLReporter software.

P. Internet Connectivity

1. The hosted SCADA system shall provide a custom domain name for the customer.
2. The Internet Client shall be protected with Secure Socket Layer (SSL) security.
3. The Internet Client shall require users to enter a username and security code to run the client.

4. Internet connectivity shall not require the installation or configuration of Internet server software (e.g. Microsoft IIS, Apache).
5. On-line configuration changes shall be pushed immediately to all Internet client interfaces without requiring the browser interface to be restarted or refreshed.
6. Internet clients shall require only the latest version Microsoft Internet Explorer to communicate with the application. Internet clients shall require no software to be manually installed.
7. Internet clients shall cache displays in order to reduce display access time.
8. Internet clients shall have graphical displays identical to the standard full- installation client and shall not require separate development time or a separate development interface. The automatic display generation process shall not distort the graphical layout of any display.
9. Tools shall be provided to monitor Internet client connectivity and to disconnect users when necessary.
10. The hosted SCADA system shall provide FTP access to a secure area of the hosted servers. This functionality provides electronic storage for any document(s) selected by the customer.

Q. Handheld Device Connectivity

1. Handheld device connectivity shall share the SCADA system security, requiring users to enter a username and security code.
2. Software shall support the following functionality via hand-held devices, such as iPhone, iPad, Blackberry and Android, etc.
 - a. Alarms access and acknowledgement.
 - b. Analog and digital input monitoring.
 - c. Analog and digital output control.
 - d. Real-time and historical data trends.
3. Zoom in (pinch) and zoom out shall be supported for historical data trends.

R. Screen Display

1. The software shall include 3D models of customer pumps and other process equipment. The models shall be developed in CAD software. The pumps shall show a red impeller when not running. The pumps shall show a green impeller, with animation for rotation, when running.
2. The software shall include models of all analog inputs scaled as indicated in the written controls sequences.
3. The software shall include operator adjustable models of all alarm and control set points on the screen.

S. Server Redundancy and Load Balancing

1. A minimum of three levels of redundancy for all application services shall be supported.
2. Software shall support automatic failover from a primary server to one or more backup servers for all application services. No manual intervention shall be required.
3. Software shall support distribution of services across any number of computers to facilitate load sharing.
4. Software shall automatically redirect Internet Client connections to the Internet Server with the least active connections.
5. All servers shall be aware of which server is in control of each software process. No two servers shall perform the same function at the same time (e.g. I/O communications to a specific device, incrementing a totalizer.) This ensures efficient use of network communications and synchronization of data across the SCADA network.

6. Software must not require each redundant server to use a second network card to monitor the status of the primary server.
 7. Software shall support redundant networks and shall be able to use these for load distribution when both are available. In the event one network connection is lost, network communications shall automatically fail-over to the second connection.
- T. Application Upgrades / Support / Diagnostics / Debugging
1. Users must have the capability to upgrade the base software product as new versions become available. Such upgrades shall not require significant changes to the existing application.
 2. Support shall include phone, email, user forum and remote access methods.
 3. Training shall be available for users of all levels (i.e. Operators, Developers, Administrators)
 4. Diagnostic/debugging tools shall be provided for:
 - a. Server-to-server and server-to-client activity monitoring within the SCADA network.
 - b. Computer resource usage for all servers and full installation clients.
 - c. Communication driver activity monitoring.
 - d. Script language debugging.

END OF SECTION

SECTION 40 67 00
CONTROL SYSTEM EQUIPMENT PANELS AND RACKS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes pump control system including power disconnect, pump alternation, intrinsically safe control, lightning protection, push buttons, indicating lights, and control relays.
- B. Related Sections:
 - 1. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables.
 - 2. Section 26 05 33 - Raceway and Boxes for Electrical Systems.
 - 3. Section 26 05 83 - Wiring Connections.

1.2 REFERENCES

- A. National Electrical Manufacturers Association:
 - 1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
- B. Underwriters' Laboratories
 - 1. UL 508 - Industrial Control Equipment.

1.3 PERFORMANCE REQUIREMENTS

- A. Sequence of Operation:
 - 1. Operate three pumps in lead/lag1/lag2 mode.
 - 2. Control pumps by individual Hand-Off-Auto selector switches located on pump control panel. Provide manual start-stop control of pumps using "hand" and "off" positions of each Hand-Off-Auto switch. Automatically control pumps in "auto" position as follows:
 - a. When liquid level in wet well rises to elevation of "lead pump start" setpoint, start lead pump. When lead pump is started, run pump until liquid level in wet well is drawn down to "lead pump stop" setpoint, and then shut down lead pump.
 - b. When lead pump cannot keep up with influent flow, liquid level in wet well rises to "lag1 pump start" setpoint that starts lag1 pump. When lag1 pump is started, run pump until liquid level in wet well is pumped down to "lag1 pump stop" setpoint and shut down lag1 pump.
 - c. When lead and lag1 pumps cannot keep up with influent flow, liquid level in wet well rises to "lag2 pump start" setpoint that starts lag2 pump. When lag2 pump is started, run pump until liquid level in wet well is pumped down to "lag2 pump stop" setpoint and shut down lag2 pump.
 - d. Automatically alternate lead, lag1, and lag2 status of pumps after each pumping cycle. Provide manual selection of lead pump.
 - 3. When liquid level in wet well rises to elevation of "wet well high level" setpoint, energize "Wet Well High Level" alarm light located on pump control panel.

4. When liquid level in wet well is pumped down to elevation of "wet well low level" setpoint, energize "Wet Well Low Level" alarm light located on pump control panel and shut down pumps.
5. Thermal switches are provided in motor windings to detect high temperature in motor, wire switch to relay located in pump control panel. Provide normally open contact on relay wired in series with pump starter, and normally closed contact on relay wired to "Motor High Temperature" alarm light located on control panel. When high temperature occurs in motor windings, shut down pump and energize high temperature alarm light.
6. Pump seal leak sensor is provided and located in pump housing, wire sensor to seal failure relay located in pump control panel. Wire normally open contact on relay to "Seal Failure" alarm light located on control panel. When seal leak occurs, energize seal failure alarm light.
7. Provide dry contacts in pump control panel for each of following:
 - a. Power Failure.
 - b. Pump No. 1 Running.
 - c. Pump No. 2 Running.
 - d. Pump No. 1 Motor High Temperature/Seal Failure.
 - e. Pump No. 2 Motor High Temperature/Seal Failure.
 - f. Wet Well High Level.
 - g. Wet Well Low Level.

1.4 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Shop Drawings: Submit complete bill of materials, wiring diagrams and panel layout drawings showing dimensions to devices.
- C. Product Data: Submit catalog information and descriptive literature for components.
- D. Test Reports: Submit certified factory test report indicating control panel successfully performs functions specified.
- E. Manufacturer's Installation Instructions: Submit instructions on installation and field wiring connections.
- F. Manufacturer's Certificate: Certify Products and overall system meet or exceed specified requirements.
- G. Manufacturer's Field Reports: Submit certification after installation that control panel has been installed in accordance with manufacturer's instructions and has been successfully field tested.

1.5 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for submittals.
- B. Project Record Documents: Record actual locations of control panel and final wiring diagrams and connections.

- C. Operation and Maintenance Data: Submit operation and maintenance instructions for components and devices.

1.6 QUALITY ASSURANCE

- A. Perform Work in accordance with UL 508.
- B. Provide components compatible with functions required to form complete working system.
- C. Provide UL 508 label on complete assembly.
- D. Perform Work in accordance with all applicable codes and standards.
- E. Maintain one copy of each document on site.

1.7 QUALIFICATIONS

- A. Manufacturer and Fabricator: Company specializing in manufacturing and assembling products specified in this section with minimum three years documented experience.

1.8 PRE-INSTALLATION MEETINGS

- A. Section 01 30 00 - Administrative Requirements: Pre-installation meeting.
- B. Convene minimum one week prior to commencing work of this section.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Inspect for damage.
- C. Store in areas protected from weather, moisture, or possible damage; do not store directly on ground; handle to prevent damage to wiring and components.

1.10 COORDINATION

- A. Section 01 30 00 - Administrative Requirements: Requirements for coordination.
- B. Coordinate work and component requirements with controlled pumps.

1.11 EXTRA MATERIALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for extra materials.

- B. Furnish the following spare parts:
 - 1. 4 – pilot light bulbs.
 - 2. 1 – 24 volt DC power supply for each size utilized.
 - 3. 4 – fuses for each type and size utilized.
 - 4. 1 – general purpose relay, and mounting socket, for each type utilized.
 - 5. 1 – data cable of each type used.
 - 6. 1 – cable adapter of each type used.

PART 2 - PRODUCTS

2.1 PUMP CONTROL PANEL

- A. Manufacturers:
 - 1. Kennedy Industries.
 - 2. Primex.
 - 3. USEMCO.
 - 4. PumpCon.
 - 5. StaCon.
- B. Substitutions: Not Permitted.

2.2 COMPONENTS

- A. Control Panel Enclosure:
 - 1. Furnish NEMA 250 Type 12 enclosure fabricated of 10 gage steel with continuously welded seams.
 - a. Enclosure door gasketed with neoprene.
 - b. Heavy-duty three-point latching mechanism.
 - c. Power: 120 volt, 1 phase.
 - 2. Identify control panel components with engraved nameplate mounted on inside of panel.
 - 3. Mount components, not mounted on front of panel, on removable back panel secured to enclosure with collar studs.
 - 4. Install wiring in neat, workmanlike manner and group, bundle, support and route horizontally and vertically for neat appearance.
 - 5. Terminate wires leaving panel at terminal strips inside enclosure.
 - 6. Identify terminals and wires in accordance with panel wiring diagrams.
 - 7. Furnish copper grounding plate inside control panel for terminating ground wires.
- B. Transient Voltage Surge Suppressor: Furnish three phase transient voltage surge suppressor mounted to exterior of pump control panel to protect panel components from potential damage from transient voltages caused by lightning or surges on incoming power line. Furnish indication light to indicate unit is functioning.
- C. Power Monitor:
 - 1. Furnish power monitor in pump control panel to monitor incoming power.
 - a. Inhibit pump operation when power loss occurs.
 - b. Surface mounted.

- D. Circuit Breakers:
1. Furnish quick-make, quick-break thermal-magnetic molded case type, individually mounted and identified.
 2. Furnish individual circuit breakers for each of the following (Minimum):
 - a. Pump Control Circuit.
 - b. Duplex Receptacle (located outside of panel).
 - c. SCADA Device (Remote Monitoring and Alarming)
 - d. Programmable Logic Controller.
 - e. Human-Machine Interface.
 - f. DC Power Supplies
- E. Selector Switches:
1. NEMA Type 4X, 30.5 mm, heavy-duty, non-illuminated, maintained contact type with double-break silver contacts.
- F. Push Buttons: NEMA Type 4X, 30.5 mm, heavy-duty, non-illuminated, momentary contact type with double-break silver contacts.
- G. Pilot Lights:
1. NEMA Type 4X, 30.5 mm, heavy-duty, transformer type.
 - a. Voltage Rating: Match Control Voltage.
 - b. Color Caps: Green for "run" and red for "alarm."
 2. Furnish "run" pilot light for each pump. Energize each light through auxiliary contact on pump motor starter.
 3. Furnish "motor high temperature" and "seal failure" alarm pilot light for each pump.
 4. Furnish wet well "high level" and "low level" alarm pilot lights.
- H. Legend Plates for Pilot Devices:
1. Furnish 2-1/4 inch (60 mm) square plastic legend plate for each selector switch, push button and pilot light.
 2. Color: Gray with white lettering.
- I. Relays:
1. Heavy-duty, general purpose type, with 10 amp contacts.
 - a. Blade type terminals that plug-in to socket.
 - b. DIN rail mounted to inside of panel enclosure.
 - c. Contact Configuration: As required for proper operation of control logic.
 - d. Operating Power: Match Control Voltage.
 - e. Furnish indicator light to indicate relay coil is energized.
- J. Seal Failure Relays: Provide seal failure relay in pump control panel for each pump. Coordinate seal failure relays with controlled pump.
- K. Elapsed Time Meters:
1. Resettable, time totalizer type.
 - a. Furnish synchronous motor to drive set of digit readout wheels to indicate total time pump motor starter is energized.
 - b. Readout: Six-digit including 1/10 digit.
 - c. Range: 0 to 99999.9 hours.
 - d. Voltage Rating: Match Control Voltage.

2. Furnish elapsed time meter for each pump. Energize each elapsed time meter through auxiliary contact on pump motor starter.

L. Terminal Blocks:

1. Furnish terminal blocks in control panel for field wiring.
 - a. NEMA type, rated for 600 volts AC.
 - b. Identify with permanent machine printed marking in accordance with terminal numbers shown on panel wiring diagrams.
 - c. Furnish twenty percent spare terminal blocks, of each type utilized, in control panel.

M. Wiring:

1. Furnish pump control panel completely wired by manufacturer.
2. Furnish wiring, workmanship, and schematic wiring diagrams in compliance with UL 508. Isolate wiring and terminal blocks by voltage levels to greatest extent possible.
3. Wiring: Stranded copper, Type MTW or THW, 600 volts, color coded as follows:
 - a. Line and Load Circuits, AC Power: Black.
 - b. AC Control Circuit Less than Line Voltage: Red.
 - c. DC Control Circuit:
 - i. Positive: Blue.
 - ii. Negative: Blue with White Stripe.
 - d. Interlock Control Circuits from External Source: Yellow.
 - e. Equipment Grounding Conductor: Green.
 - f. Current Carrying Ground: White.
4. Minimum Size of Control Wiring: Number 16.
5. Tag control wiring at both ends in control panel with legible permanent coded wire marking sleeve. Mark with white PVC tubing sleeves with machine printed black marking. Mark in accordance with wire numbers shown on control wiring diagrams and terminal strip numbers.

N. Nameplates:

1. Furnish laminated phenolic nameplates on front of pump control panel.
2. Color: White with black engraved letters.
3. Minimum Size of Engraving: 1/4 inch (6 mm).

2.3 LIQUID LEVEL CONTROL SYSTEM

- A. Furnish liquid level control system to monitor wet well level and start and stop pump motors in response to changes in wet well level as set forth herein.
- B. Initiate pump controls (low water level alarm, lead pump off, lead pump start, lag1 pump off, lag1 pump start, lag2 pump off, lag2 pump start, and high water level alarm) by individual, adjustable setpoints.
- C. Level Devices:
 1. Wet Well: See Section 40 72 43 - Pressure Level Meters.
 2. Open Channel: See Section 40 72 23 - Radar Level Meters.

2.4 SOURCE QUALITY CONTROL AND TESTS

- A. Perform a factory test of completed control panel by demonstrating operation of control functions. Provide certified test results.
- B. Factory assemble and test each control and alarm function.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements: Verification of existing conditions before starting work.
- B. Verify correct power supply is available.
- C. Verify pumps are installed.

3.2 INSTALLATION

- A. Install control panel at location indicated on Drawings.
- B. Install control panel in accordance with manufacturer's instructions.

3.3 FIELD QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Section 01 70 00 - Execution and Closeout Requirements: Field inspecting, testing, adjusting, and balancing.
- C. Start-up pump control system by energizing system equipment and testing operation of hardware and process control logic under supervision of manufacturer's representative and in presence of Architect/Engineer.
- D. Equipment Acceptance:
 - 1. Adjust, repair, modify or replace system components that fail to perform as specified and rerun tests. Make final adjustments to equipment under direction of manufacturer's representative.
 - 2. Document adjustments, repairs and replacements in manufacturer's field services certification.

3.4 MANUFACTURER'S FIELD SERVICES

- A. Section 01 40 00 - Quality Requirements: Requirements for manufacturer's field services.

- B. Furnish services of manufacturer's representative experienced in installation of products furnished under this specification for not less than 5 work days on-site for installation inspection and field testing, and instructing Owner's personnel in maintenance of equipment.
- C. Certify that equipment has been properly installed and is ready for start-up and testing.

3.5 DEMONSTRATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for demonstration and training.
- B. Demonstrate equipment startup, shutdown, routine maintenance, alarm condition responses, and emergency repair procedures to Owner's personnel.

END OF SECTION

SECTION 40 72 23
RADAR LEVEL METERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Radar-level measurement devices.
2. Transmitters.

B. Related Requirements:

1. Section 26 05 83 - Wiring Connections: Control power wiring requirements.

1.2 UNIT PRICE – MEASUREMENTS AND PAYMENTS

A. Pump Station Controls, SCADA, and Security:

1. Basis of Measurement: As part of the lump sum for Pump Station Controls, SCADA, and Security.
2. Basis of Payment: Includes all labor, materials, and equipment to provide and install the Pump Station Controls, SCADA, and Security system as shown on the contract documents and as stated in the specifications.

1.3 REFERENCE STANDARDS

A. International Electrotechnical Commission:

1. IEC 61508 - Functional safety of electrical/electronic/programmable electronic safety-related systems.
2. IEC 61511 - Corrigendum 1 - Functional safety - Safety instrumented systems for the process industry sector.

B. National Electrical Manufacturers Association:

1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

C. NSF International:

1. NSF 61 - Drinking Water System Components - Health Effects.
2. NSF 372 - Drinking Water System Components - Lead Content.

1.4 COORDINATION

A. Section 01 30 00 - Administrative Requirements: Requirements for coordination.

- B. Coordinate Work of this Section with Site Work.

1.5 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit manufacturer information for system materials and component equipment, including connection requirements.
- C. Shop Drawings:
 - 1. Indicate system materials and component equipment.
 - 2. Submit installation requirements and other details.
- D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- E. Source Quality-Control Submittals: Indicate results of shop and factory tests and inspections.
- F. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.
- G. Manufacturer Reports: Certify that equipment has been installed according to manufacturer instructions.
- H. Qualifications Statement:
 - 1. Submit qualifications for manufacturer.

1.6 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for closeout procedures.
- B. Project Record Documents: Record actual locations and final orientation of equipment and accessories.

1.7 QUALITY ASSURANCE

- A. Ensure that materials of construction of wetted parts are compatible with process liquid.
- B. Materials in Contact with Potable Water: Certified to NSF 61 and NSF 372.
- C. Perform Work according to all applicable codes and standards.
- D. Maintain one copy of each standard affecting Work of this Section on Site.

1.8 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years' documented experience.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- C. Store materials according to manufacturer instructions.
- D. Protection:
 - 1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
 - 2. Provide additional protection according to manufacturer instructions.

1.10 WARRANTY

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for warranties.
- B. Furnish five-year manufacturer's warranty for radar-level measurement devices.

PART 2 - PRODUCTS

2.1 RADAR-LEVEL MEASUREMENT DEVICES

- A. Manufacturers:
 - 1. Vega.
 - 2. Substitutions: Not allowed.
- B. Description:
 - 1. Measuring Range: Minimum of 50 feet.
 - 2. Operating Temperature Range: Minus 40 to plus 150 degrees F.
 - 3. Operating Pressure: Up to 23 psig.
 - 4. Accuracy: Plus or minus 0.4 inch.
 - 5. Certified according to IEC 61508 and IEC 61511.
- C. Communications Protocol: HART.
 - 1. External communication devices will NOT be required for product setup or configuration.

- D. Operation: Menu guided.
 - 1. All device settings and functions shall be configurable via local display using pushbuttons and/or turn-dials.
- E. Transmitters:
 - 1. Selected by sensor manufacturer to match sensor.
 - 2. Visual Display: Alphanumeric.
 - a. Four digit, Minimum.
 - b. LED or Backlit LCD.
 - 3. Output Signal: 4 to 20-mA dc.
 - 4. Location: As indicated on Drawings.
 - 5. Control Power:
 - a. Wiring: As specified in Section 26 05 83 - Wiring Connections.
 - b. 24-V dc, Loop Powered.
 - 6. Enclosures: NEMA 250 Type 4, 4X, or as indicated on Drawings.
 - 7. Mounting:
 - a. Remote.
 - b. Enclosure.
 - 8. Furnish cable, field preamplifiers, and signal conditioners as required to maintain accuracy from sensor to terminal device.

2.2 SOURCE QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements: Requirements for testing, inspection, and analysis.
- B. Provide shop inspection and testing of completed assembly.

PART 3 - EXECUTION (**FURNISHED BY CONTRACTOR**)

3.1 EXAMINATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation examination.
- B. Verify that items provided by other Sections of Work are ready to receive Work of this Section.

3.2 INSTALLATION

- A. Coordinate location and orientation of level probe assemblies with final equipment installations.
- B. Ensure that instruments are located to be easily accessible for maintenance.
- C. Installation Standards: Install Work according to all applicable codes and standards.

3.3 FIELD QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements: Requirements for inspecting and testing.
- B. Section 01 70 00 - Execution and Closeout Requirements: Requirements for testing, adjusting, and balancing.
- C. Manufacturer Services: Furnish services of manufacturer's representative experienced in installation of products furnished under this Section for not less than 2 hours (per Device) on Site for installation, inspection, field testing, and instructing Owner's personnel in maintenance of equipment.
- D. Equipment Acceptance:
 - 1. Adjust, repair, modify, or replace components failing to perform as specified and rerun tests.
 - 2. Make final adjustments to equipment under direction of manufacturer's representative.
- E. Furnish installation certificate from equipment manufacturer's representative attesting that equipment has been properly installed and is ready for startup and testing.

3.4 DEMONSTRATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for demonstration and training.
- B. Demonstrate equipment startup, shutdown, routine maintenance, and emergency repair procedures to Owner's personnel.

END OF SECTION

SECTION 40 72 43
PRESSURE AND DIFFERENTIAL PRESSURE TYPE LEVEL METERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Hydrostatic-level measurement devices.
2. Transmitters.

B. Related Requirements:

1. Section 26 05 83 - Wiring Connections: Control power wiring requirements.

1.2 UNIT PRICE – MEASUREMENTS AND PAYMENTS

A. Pump Station Controls, SCADA, and Security:

1. Basis of Measurement: As part of the lump sum for Pump Station Controls, SCADA, and Security system.
2. Basis of Payment: Includes all labor, materials, and equipment to provide and install the Pump Station Controls, SCADA, and Security system as shown on the contract documents and as stated in the specifications.

1.3 REFERENCE STANDARDS

A. International Electrotechnical Commission:

1. IEC 61508 - Functional safety of electrical/electronic/programmable electronic safety-related systems.
2. IEC 61511 - Corrigendum 1 - Functional safety - Safety instrumented systems for the process industry sector.

B. NSF International:

1. NSF 61 - Drinking Water System Components - Health Effects.
2. NSF 372 - Drinking Water System Components - Lead Content.

1.4 COORDINATION

A. Section 01 30 00 - Administrative Requirements: Requirements for coordination.

B. Coordinate Work of this Section with work in Wet Well area.

1.5 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit manufacturer information for system materials and component equipment, including connection requirements.
- C. Shop Drawings:
 - 1. Indicate system materials and component equipment.
 - 2. Submit installation requirements and other details.
- D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- E. Source Quality-Control Submittals: Indicate results of shop and factory tests and inspections.
- F. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.
- G. Manufacturer Reports: Certify that equipment has been installed according to manufacturer instructions.
- H. Qualifications Statement:
 - 1. Submit qualifications for manufacturer.

1.6 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for closeout procedures.
- B. Project Record Documents: Record actual locations and final orientation of equipment and accessories.

1.7 QUALITY ASSURANCE

- A. Ensure that materials of construction of wetted parts are compatible with process liquid.
- B. Materials in Contact with Potable Water: Certified to NSF 61 and NSF 372.
- C. Perform Work according to all applicable State and Local Codes and standards.
- D. Maintain one copy of each standard affecting Work of this Section on Site.

1.8 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years' documented experience.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- C. Store materials according to manufacturer instructions.
- D. Protection:
 - 1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
 - 2. Provide additional protection according to manufacturer instructions.

1.10 WARRANTY

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for warranties.
- B. Furnish five-year manufacturer's warranty for hydrostatic level measurement devices.

PART 2 - PRODUCTS

2.1 HYDROSTATIC-LEVEL MEASUREMENT DEVICES

- A. Manufacturers:
 - 1. Endress+Hauser
 - 2. Siemens
 - 3. KPSI
 - 4. Substitutions: As specified in Section 01 60 00 - Product Requirements.
- B. Sensor:
 - 1. Description: Pressure sensor, condensate proofed and long-term stable, and incorporating continuous temperature and pressure compensation.
 - 2. Turndown: 100:1
 - 3. Certified according to IEC 61508 and IEC 61511.
 - 4. Measuring Cell:
 - a. Hermetically sealed.
 - b. Material: Ceramic.
 - c. Accuracy: Plus or minus 0.2 percent.
 - d. Furnish pressure overload resistance to 200 percent of full scale, 10-psig nominal pressure.
- C. Communications Protocol: HART.

D. Operation: Menu guided.

E. Transmitters:

1. Selected by sensor manufacturer to match sensor.
2. Visual Display: Alphanumeric.
 - a. Four digit, Minimum.
 - b. LED or Backlit LCD.
3. Output Signal: 4 to 20-mA dc.
4. Location: As indicated on Drawings.
5. Control Power:
 - a. Wiring: As specified in Section 26 05 83 - Wiring Connections.
 - b. 24-V dc, Loop Powered.
6. Enclosures: NEMA 250 Type 4, 4X, or as indicated on Drawings.
7. Mounting:
 - a. Remote.
 - b. Enclosure.
8. Furnish cable, field preamplifiers, and signal conditioners as required to maintain accuracy from sensor to terminal device.

2.2 SOURCE QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements: Requirements for testing, inspection, and analysis.
- B. Provide shop inspection and testing of completed assembly.

PART 3 - EXECUTION (**FURNISHED BY CONTRACTOR**)

3.1 EXAMINATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation examination.
- B. Verify that items provided by other Sections of Work are ready to receive Work of this Section.

3.2 INSTALLATION

- A. Coordinate location and orientation of level probe assemblies with final equipment installations.
- B. Ensure that instruments are located to be easily accessible for maintenance.

3.3 FIELD QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements: Requirements for inspecting and testing.
- B. Section 01 70 00 - Execution and Closeout Requirements: Requirements for testing, adjusting, and balancing.
- C. Manufacturer Services: Furnish services of manufacturer's representative experienced in installation of products furnished under this Section for not less than 2 hours (per device) on Site for installation, inspection, field testing, and instructing Owner's personnel in maintenance of equipment.
- D. Equipment Acceptance:
 - 1. Adjust, repair, modify, or replace components failing to perform as specified and rerun tests.
 - 2. Make final adjustments to equipment under direction of manufacturer's representative.
- E. Furnish installation certificate from equipment manufacturer's representative attesting that equipment has been properly installed and is ready for startup and testing.

3.4 DEMONSTRATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for demonstration and training.
- B. Demonstrate equipment startup, shutdown, routine maintenance, and emergency repair procedures to Owner's personnel.

END OF SECTION

SECTION 46 21 72
SELF-CLEANING TRASHRACK SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

- A. Duperon Corporation shall provide self-cleaning trashrack units, including the designing, furnishing and technical assistance during installation. The self-cleaning trashrack units shall be manufactured by Duperon Corporation, 1200 Leon Scott Court, Saginaw, Michigan, (517)-754-8800, or equal, and in accordance with this Section.
- B. Each trashrack unit shall include the following:
 - 1. Self-cleaning trashracks.
 - 2. All accessories needed for proper operation.
 - 3. Support framing.
 - 4. Safety covers.
 - 5. Controls.
 - 6. Technical assistance.
 - 7. Testing.
 - 8. Spare parts.
- C. The equipment furnished shall be fabricated, assembled and in proper operating condition in full conformity with approved drawings, specifications, engineering data, and recommendations furnished by the equipment manufacturer.
- D. Manufacturer's personnel for technical assistance during installation shall comply with the safety requirements in accordance with applicable codes/regulations.
- E. The trashrack units shall be of the front-cleaned/rear return type. It shall be designed to remove forms of matted, buoyant or semi-buoyant debris that comes into contact with the face of the trashrack and shall convey said debris over the top of the trashrack for discharge.
- F. The Plans and Specifications do not show the final design of the self-cleaning trashrack system, but show the limiting dimensions. The equipment supplier shall submit engineering drawings for approval prior to manufacturing.
- G. The lifting capacity of each trashrack shall be 3,000 pounds whether the load is on one lifting chain or across all lifting chains of a unit. The angle of the rack inclination shall be 60 degrees from the horizontal.

1.2 REFERENCES

- A. American National Standards Institute (ANSI):
 - 1. ANSI B18.6.2 - (1972) Slotted Head Cap Screws, Square Head Set Screws, and Slotted Headless Set Screws (R1983)
 - 2. ANSI B46.1 – (1985) Surface Texture (Surface Roughness, Waviness, and Lay)
- B. American Society for Testing and Materials (ASTM):
 - 1. ASTM A 36 – (1989) Structural Steel

2. ASTM A 307 – (1989) Carbon Steel Bolts and Studs, 60,000 psi Tensile
 3. ASTM A 48 – Cast Iron Castings
- C. American Welding Society (AWS):
1. AWS D1.1 – Structural Welding Code – Steel
- D. American Institute of Steel Construction (AISC):
1. Manual of Steel Construction
- E. Research Council on Structural Connections:
1. (1988) Load and Resistance Factor Design Specifications for Structural Joints Using ASTM A 325 or A 490 Bolts.

1.3 SUBMITTALS

- A. The equipment manufacturer shall submit the following items in sets of **(6)**: (Note: Shop drawings shall be understood to include, but not limited to, design calculations for the trashracks loads upon owner structure (and resistance to seismic forces, if applicable), fabrication and installation drawings, lists, graphs and operating instructions.)
1. Equipment to be furnished, assembly and subassembly drawings, specifications, engineering data, and recommendations furnished by the equipment manufacturer.
 2. Design calculations for the following:
 - a. Loading of trashrack upon site structures.
 - b. Adequate resistance to seismic forces, if applicable.
 3. As-built drawings of the trashrack structure, controls, and accessories.
 4. Provision of trashrack construction materials, start up and test procedures.
 5. List of Spare Parts and special tools (if applicable).
 6. **(6)** O & M Manuals for the self-cleaning trashrack (to be shipped separately from equipment to the Engineer prior to delivery of the equipment).

PART 2 - PRODUCTS

2.1 COMPONENTS

- A. Trashrack:
1. Trashrack bars shall be of A36 structural steel, a minimum of 3/8 inch x 4-inch flat bar and shall be spaced to maintain a 2-3 inch clear opening, and shall occupy the full width of the trashrack bay opening. The top of the trashrack shall extend above the deck to a minimum height of 10 feet. Braces and supports shall be designed in accordance with the Manual of Steel Construction (AISC), to fit the concrete outline shown on the Plans. The trashrack shall be anchored on the bay floor and deck, and shall be able to withstand a **two (2)** foot head differential.
- B. Stripper Assembly:
1. A stripper assembly shall be provided to clean the lifting fingers and force debris to discharge.
- C. Screening Rakes:

1. Rakes (or lifting fingers) shall be attached to the screen chains at maximum. 10 foot centers. Fasteners on the rake shall be galvanized A325 structural and stainless steel. Stainless steel where applicable shall be provided with positive locking devices. Lifting fingers shall be a minimum of nine (9) inches in height.

D. Screen Chains:

1. The screen chains shall be 11.1 mm x 59.18 mm x 16.66 mm, Grade 80, electrically galvanized coated and shall have a breaking force of 16,000 pounds. The chains shall be evenly spaced on 10-1/2 inch centers and shall operate at a rate of seven (7) feet per minute. No shafts, sprockets, or bearings shall be located underwater. The chains shall travel up the face of the trashrack and shall return behind the trashrack.

E. Drive Unit:

1. The electric gear motor shall be shaft mounted and weatherproof. The motor shall be 1-1/2 HP (or of sufficient size), 1750 rpm, 3 phase, 60 cycle, 230/460 volt. Final drive speed shall be approximately 2 rpm. The motor shall have a heater to eliminate condensation. The motor shall have adequate capacity. Each trashrack shall operate independently and will have its own drive unit and driven components.

F. Filler Screen:

1. Filler screens shall be provided per manufacturer recommendations to assure that there is no space wider than the opening between bars to prevent passage of larger solids than allowed through the screen.

G. Controls:

1. (1) CUSTOM Basic On/Off/Overload Pkg. - For 3PH/480V incoming power supply. Includes a common control panel for all self-cleaning trashracks (SCTs) in a single N4X SSTL enclosure with provisions for remote push button stations. SCT controls include Forward and Reversing contactors and Emotron power shaft monitors for torque overload protection (one ea. unit) and only manual operation.
2. STANDARD NEMA 4X Remote Push Button Stations per each unit- Includes operators for Forward, Jog Reverse and E-Stop. Requires field wiring to corresponding terminals in main control panel (by others).

H. Spare Parts and Special Tools:

1. There are no special tools required for installation and maintenance of the trashrack.
 - a. Spare parts shall be interchangeable with, and shall be made of the same material as the corresponding part to be replaced. Spare parts shall include:
 - 1) One (1) stripper panel
 - 2) Six (6) complete lifting car assemblies
 - 3) One (1) chain (sized for specific unit)
 - 4) One (1) spare motor

2.2 MATERIALS

A. Materials shall conform to the following:

1. Structural steel shapes, flats, plates and bars shall conform to ASTM A36.
2. Bolts and nuts shall conform to ASTM A307, or A325 as required.
3. Expansion anchors shall conform to FS FF-S-325, Interim Amendment No. 3, Group II, Type 4, Class 1. Where the expansion anchor is specified to be stainless steel, the bolt

- washer, and split ring or wedge pairs shall be stainless steel. Carbon steel components shall not be used in conjunction with stainless steel.
4. Cap screws shall conform to ANSI B18.6.2, bronze or stainless steel, at the Contractor's option.
 5. Stainless steel bolting materials shall conform to ASTM A 193.
 6. Castings for lower guides, drive castings, and lifting cars shall be constructed of close-grained cast iron (ASTM A 48 and C 130).
 7. Rails and other miscellaneous steel shall be hot rolled (ASTM A 575).
 8. Drive shaft shall be of 1144 CD and of sufficient size to transmit the power required.
 9. Drive shaft bearings shall be a four (4) bolt flange unisphre spherical roller bearing, self-aligning, with a radial load rating of 7310# at 50 rpm and 100,000 hours-life.
 10. Rake chain shall be 11.1mm chain capable of a minimum 16,000 pound test. The ultimate breaking point shall be no less than 16,000 pounds.
 11. Fasteners will be hot dipped galvanized A325 structural as required and stainless steel to withstand corrosion.
 12. The 480 volt, three-phase electrical components shall comply with the latest standard of ASA, AIEE and NEMA wherever applicable. All shall be listed as complying with the requirement of UL Inc., or other recognized testing organizations for the particular service to be encountered.

PART 3 - EXECUTION

3.1 DESIGN

- A. Design shall be in accordance with the Manual of Steel Construction (ASIC).

3.2 FABRICATION AND WORKMANSHIP

- A. Metalwork shall be free from warp, twists, dents, buckle and other defects. Installation shall be neat, plumb, square, straight and in alignment. Provisions shall be made for expansion throughout to avoid damage. Surfaces shall be cleaned and left free from stains, marks, or other defects or any other defects of any kind. Abrasive or corrosive cleaning agents and lacquer thinner shall not be used.

3.3 TESTING

- A. After the trashrack units have been installed and adjusted, each unit shall be operated for a minimum of three complete chain rotation cycles to test the unit's operation.

3.4 PAINTING

- A. The trashrack and raking components shall be painted in accordance with the manufacturer's recommendations and as approved by the Engineer. Surfaces to be coated shall be clean and dry and free of surface defects by sandblasting to near white finish. Primer and moisture-cured urethane top coat shall be applied per AWA/ANSI standards and to paint manufacturer's specifications.
 1. Finish Coat: TNEMEC SERIES 46H-413 HI-BUILD TENEME-TAR AT 16.0-20.0 MILS DFT.
 2. Touchup Paint: Self-cleaning trashrack manufacturer shall ship a sufficient amount of topcoat with the trashrack units for touch up painting (to be performed by contractor). A

minimum of one (1) gallon should be shipped with appropriate MSDS and technical data sheets.

3.5 GUARANTEE

- A. A written one-year standard warranty from the date of acceptance of the project shall be provided by the equipment supplier to guarantee that there shall be no defects in material or workmanship in any item supplied.

END OF SECTION

SECTION 46 41 23
SUBMERSIBLE MIXERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Submersible propeller mixers and accessories.
- B. Related Requirements:
 - 1. Section 05 50 00 - Metal Fabrications: Miscellaneous metalwork and fasteners as required by this Section.
 - 2. Section 26 05 83 - Wiring Connections: Wiring connections to equipment.

1.2 REFERENCE STANDARDS

- A. American Bearing Manufacturers Association:
 - 1. ABMA 9 - Load Ratings and Fatigue Life for Ball Bearings.
 - 2. ABMA 11 - Load Ratings and Fatigue Life for Roller Bearings.
- B. National Electrical Manufacturers Association:
 - 1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
- C. National Sanitation Foundation:
 - 1. NSF 61 - Drinking Water System Components - Health Effects.
 - 2. NSF 372 - Drinking Water System Components - Lead Content.

1.3 UNIT PRICE - MEASUREMENT AND PAYMENT

- A. Submersible Mixers:
 - 1. Basis of Measurement: At the unit price bid as stated in the Proposal.
 - 2. Basis of Payment: Includes all mechanical equipment, control equipment, wiring, etc. required for a full equipment package ready for purchase by the Owner.

1.4 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data:
 - 1. Submit manufacturer's Product Data for system materials and component equipment, including performance characteristics.
 - 2. Submit wiring and control diagrams, installation and anchoring requirements, fasteners, and other details.
- C. Shop Drawings:
 - 1. Indicate system materials and component equipment, including electrical characteristics.
 - 2. Submit wiring and control diagrams, installation and anchoring requirements, fasteners, and other details.

- D. Manufacturer's Certificate:
 - 1. Certify that mixers meet or exceed specified requirements.
 - 2. Certify installation is completed according to manufacturer's instructions and that mixers have been properly installed and tested and are ready for operation.
- E. Manufacturer's Instructions: Submit detailed instructions on installation requirements, including storage and handling procedures.
- F. Source Quality-Control Submittals: Indicate results of factory tests and inspections.
- G. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.
- H. Qualifications Statements:
 - 1. Submit qualifications for manufacturer and licensed professional.

1.5 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for closeout procedures.
- B. Project Record Documents: Record actual locations and final orientation of mixers.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for maintenance materials.
- B. Spare Parts:
 - 1. Furnish one set of manufacturer's recommended spare parts.

1.7 QUALITY ASSURANCE

- A. Materials in Contact with Potable Water: Comply with NSF Standard 61 and NSF Standard 372.
- B. Perform Work according to Saginaw County Drain Commission and Michigan Department of Transportation standards for construction.
- C. Maintain one copy of each standard affecting the Work of this Section On-Site.

1.8 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years' experience.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Deliver materials in manufacturer's packaging including application instructions.

- C. Inspection: Accept mixers on-Site in original packaging and inspect for damage.
- D. Store mixers according to manufacturer's instructions.
- E. Protect mixers from water and wet weather.

1.10 EXISTING CONDITIONS

- A. Field Measurements:
 - 1. Verify field measurements prior to fabrication.
 - 2. Indicate field measurements on Shop Drawings.

1.11 WARRANTY

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for warranties.
- B. Furnish five-year manufacturer's warranty for mixers.

PART 2 - PRODUCTS

2.1 SUBMERSIBLE MIXERS

- A. Manufacturers:
 - 1. Flygt
 - a. Submersible Mixer: Flygt 4610.410 Mixer, 1.2 HP, 3/460V
 - 2. Substitutions: Not permitted.
- B. Description:
 - 1. Each mixer shall be equipped with a 1.2 HP, submersible electric motor connected for operation on 460 volts, 3 phase, 60 Hertz, with 50 ft. of cable. All cables shall be oil resistant chlorinated polyethylene rubber jacketed. Each unit shall be fitted with 30 feet of lifting cable of adequate strength to permit raising and lowering the mixer. Mixers specified herein shall have propeller code 042107SJ.
- C. MANUFACTURER REQUIREMENTS
 - 1. The mixing equipment specified herein shall be the design and fabrication of a single manufacturer which shall have sole source responsibility for said equipment.
- D. MIXER DESIGN
 - 1. The mixers shall be capable of handling raw, screened sewage. The mixers shall be able to be raised and lowered and shall be easily removed for inspection or service without the need for personnel to enter the mixing vessel. A sliding guide bracket shall be an integral part of the mixer unit. The entire weight of the mixer unit shall be guided by a single bracket which must be able to handle all thrust created by the mixer. The standard mixer, with its appurtenances and cable, shall be capable of continuous submergence under water without loss of watertight integrity to a depth of 130 ft. FM approved mixers have a depth limit of 57 ft.

E. MIXER CONSTRUCTION

1. Each mixer shall be of the integral design, close coupled, submersible type. All components of the mixer, including motor shall be capable of continuous underwater operation. Major mixer components shall be of 316L Stainless Steel construction. The oil housing cover plate shall be of corrosion resistant composite (4610/20 utilize a vinyl ester composite motor cover). All exposed nuts and bolts shall be of stainless steel. In order to ensure that the low velocity area around the motor remains impervious to low PH solids and or liquid attack, the motor housing exterior shall be made of 316 Stainless Steel. All metal surfaces coming into contact with the mixed media, other than stainless steel, shall be protected by a factory applied spray coating of acrylic dispersion zinc phosphate primer with an epoxy finish coat on the exterior of the mixer.

F. MOTOR (Non-explosion proof)

1. The motor shall be directly connected to the propeller (gearbox designs are not acceptable) to produce a propeller speed of 1740 RPM. The mixer motor shall be squirrel cage, induction, shell type design, housed in an air filled, watertight chamber. The stator winding shall be insulated with moisture resistant Class F insulation which will resist a temperature of 155°C (311°F). The stator shall be dipped and baked three times in Class F varnish. The motor shall be designed for continuous duty, capable of sustaining a maximum of at least ten (10) evenly spaced starts per hour. The rotor bars and short circuit rings shall be made of aluminum. Thermal sensors shall be used to monitor stator temperatures. The stator shall be equipped with three (3) thermal switches embedded in the end coils of the stator winding and set for 260°F (125°C). These shall be used in conjunction with, and supplemental to, external motor overload protection, and wired to the control panel. In addition, a leakage detector be installed in the motor and connected through a Mini-CAS unit.

G. ELASTOMERS

1. All mating surfaces where watertight sealing is required shall be machined and fitted with a double set of Nitrile rubber or Viton O-rings. Fitting shall be such that sealing is accomplished by metal-to-metal contact between machined surfaces. This will result in controlled compression of the O-rings without requiring a specific torque limit. No secondary sealing compounds, rectangular gaskets, elliptical O-rings, grease or other devices shall be used.

H. PROPELLER

1. The propeller shall be of 316 stainless steel dynamically balanced, non-clogging backward curved design. Each blade shall be laser cut and welded to the hub to ensure that the propeller is properly balanced. The propeller shall be capable of handling solids, fibrous materials, heavy sludge and other matter found in normal sewage applications. The propeller shall have either two or three vanes 8-9/32" inches in diameter with a blade angle of 7 degrees.

I. JET RING ASSEMBLY

1. The mixer assembly shall incorporate a jet ring a full 360 degrees around the propeller. A maximum clearance of 1½ inches shall be maintained between the propeller tip and the shroud in order to maintain hydraulic efficiency and minimize power consumption.

J. CABLE ENTRY

1. The cable entry housing shall be an integral part of the back plate. The cable entry shall have a double set of elastomer grommets in order to ensure a redundant system in the event of a cable entry failure. Single sealing systems will not be deemed acceptable. The cable entry shall be comprised of two cylindrical elastomer grommets, each flanked by washers and a ferrule designed with close tolerance fit against the cable outside diameter and the entry inside diameter. This will provide a leak proof seal at the cable entrance without the need for specific torque requirements. The assembly shall bear against a shoulder in the stator casing opening and be compressed by a gland nut threaded into it. Interaction between the gland nut and the ferrule should move the grommet along the cable axially instead of with a rotary motion. The junction chamber and motor compartment shall be separated by a terminal board which shall protect the motor interior from foreign material gaining access into the mixer top. Connection shall be made between the threaded compressed type binder posts thus securely affixing the cable wires to the terminal board. The use of the terminal compressed type post and a terminal board O-ring shall render the motor compartment leak proof from any liquid which may enter the terminal compartment. Epoxies, silicones, or other secondary sealing systems shall not be considered acceptable.

K. BEARINGS

1. All bearings shall have a minimum B-10 or L-10aa rated life of 100,000 hours and shall have inner and outer races of metal construction. Bearings with races made of nonmetallic construction will not be deemed acceptable or meeting the load handling and environmental requirements of this application. The outboard propeller bearing shall be an angular contact bearing. The motor shaft end shall be supported by two bearings. A roller and an angular contact ball bearing shall take up the axial and radial loads while an angular contact ball bearing shall take up the axial loads. The bearings shall be pre-loaded by a bearing loading nut located on the motor end of the shaft in order to reduce shaft deflection and increase bearing life and seal life. Mixers without pre-loaded bearings will not be considered acceptable or equal.

L. OIL HOUSING

1. The oil housing shall contain two compartments consisting of an inner and an outer section with four ports to connect and facilitate oil flow. In the event that the mixed media bypasses the other seal, this design will allow the outer compartment to collect the heavier (denser) fluids by means of a simple gravity process.

M. MECHANICAL SEALS

1. Each mixer shall be provided with two sets of lapped end face type mechanical seals running in oil reservoirs for cooling and lubrication. The mechanical seals shall contain positively driven rotary, corrosion resistant, Tungsten Carbide/Tungsten Carbide face rings for the outer seal assembly and Tungsten Carbide/Aluminum Oxide seal faces for the inner seal assembly or optional Silicon Carbide rings (select appropriate materials). In order to avoid seal failure due to sticking, clogging, and misalignment from elements contained in the mixed media, only the seal faces of the outer seal assembly and its retaining clips shall be exposed to the mixed media. All other components shall be contained in the oil housing. The seals shall require neither maintenance nor adjustment but shall be easy to check and replace. Shaft seals without positively driven rotating members shall not be considered acceptable or equal.

N. MIXER TEST

1. The mixer manufacturer shall perform the following inspections and tests on each mixer before shipment from the factory:
 - 1) Propeller, motor rating, and electrical connections shall first be checked for compliance to the customer's purchase order.
 - 2) A dielectric test shall be carried out in accordance to IEC 60034-1 (two times rated voltage plus 1000 V). This test shall be done after assembly but before any performance tests. No records shall normally be provided.
 - 3) Prior to shipment, the mixer shall be run dry to establish correct rotation and mechanical integrity.
2. A written report stating the foregoing steps have been done may be supplied with each mixer at the time of shipment (upon request).

O. Accessories:

1. Guide Bar System:
 - a. As recommended by manufacturer for mixer assembly.
 - b. Materials: 316 stainless steel
 - c. Depth: 20-feet length.
2. Lifting Chain:
 - a. Stainless-Steel Cable: 30-feet length, 1/4-inch diameter
 - b. Capacity = 650 LBS
3. FLS:
 - a. Capable of detecting mechanical seal leaks
4. Power and sensor cable:
 - a. 50-feet length.
5. Wall mounting kit:
 - a. #14-589232, 20-feet cable and one intermediate
6. Quick Links
 - a. 1/4-inch, 304SS
 - b. Capacity = 1,700 lbs.
7. Flygt Mini-CAS W, 11 Pin socket base
 - a. Seal fail/High temp relay
8. Propeller protection:
 - a. Include vortex suppressor in bid.

2.2 SOURCE QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements: Requirements for testing, inspection, and analysis.
- B. Certificate of Compliance: When fabricator is approved by authorities having jurisdiction, submit certificate of compliance indicating Work performed at fabricator's facility conforms to Contract Documents.
 1. Specified shop tests are not required for Work performed by approved fabricator.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation examination.
- B. Verify layout, type, and orientation of piping connections.
- C. Verify that installation configuration will accommodate mixer, piping, and accessories.

3.2 FIELD QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements: Requirements for inspecting and testing.
- B. Manufacturer Services: Furnish services of manufacturer's representative experienced in installation of products furnished under this Section for not less than 1 days on-Site for installation, inspection, field testing, and instructing Owner's personnel in maintenance of equipment.
- C. Equipment Acceptance:
 - 1. Adjust, repair, modify, or replace components failing to perform as specified, and rerun tests.
 - 2. Make final adjustments to equipment under direction of manufacturer's representative.
- D. Furnish installation certificate from equipment manufacturer's representative attesting that equipment has been properly installed and is ready for startup and testing.

END OF SECTION

DIVISION C

Consumers Energy

Generator Specifications/Documents for Back-up Generator

Gage Drain Pump Station Generator/ATS Specifications

1. Qty (1) 500kW (nominal), 0.8-PF, diesel powered, 1,800-rpm engine/generator set

- 480/277-volt AC, 3-phase, 4-wire grounded wye.
- Shall include all engine safeties including loss of coolant shutdown.
- Shall include an internally mounted critical exhaust silencer.
- One (1) output breaker rated at 100% of generator output. Breaker shall have field adjustable settings for short-time, long-time, instantaneous and Ground Fault Indication per NEC Requirements.
- Provide second output breaker for Load Bank testing purposes.
- Alternator shall be rated at 105-deg C and rated for maximum kVA motor starting inrush at 30% voltage drop.
- PMG excitation is required.
- Diesel engine shall meet the latest EPA/MDNRE_emissions standards for normal standby duty.
- UL142, MDNRE-AST Division certified fuel tank rated at 1050 gallons, mounted under the generator (i.e. sub-base), is required. Fuel tank shall be painted gloss black with a rust preventative coating and shall be marked on all four (4) sides with marking that indicate the type of material to be contained in the tank, i.e. Diesel Fuel. Fuel tank shall be provided with stand-offs on the base as opposed to a flat mastic-coated bottom.
- Supply with Standard Weather Enclosure. Include rodent guards in all openings in the housing and sub-base fuel tank.
- Furnish E-Stop button.
- Furnish single phase, 120/208V load center in Generator to supply battery charger, block heater, lights, plugs, etc.
- Include batteries and a minimum 120-volt, 10-amp battery charger.
- Include pricing for a two (2) Load Bank Test upon Commissioning.
- Block heaters shall be 208V single-phase a.c.
- Furnish startup/commissioning of the unit, including one (1) hour Customer training.
- Furnish a manufacturer's standard warranty with the generator. Furnish two (2) hard copies of all maintenance and operations manuals and drawings for the generator (and ancillary equipment) and one (1) electronic copy of same.

2. Qty (1) three-pole, Non service-entrance rated, automatic transfer switch ("ATS"), rated at 1000-amps and 600-volt BIL.

- Operating voltage is 480-volt, 3-phase, 4-wire wye configuration.
- The automatic transfer switches and controls shall conform to the requirements of:
 - A. UL 1008 - Standard for Transfer Switch Equipment
 - B. IEC 60947-6-1 Low-voltage Switchgear and Controlgear; Multi-function equipment; Automatic Transfer Switching Equipment
 - C. NFPA 70 - National Electrical Code
 - D. NFPA 110 - Emergency and Standby Power Systems
 - E. IEEE Standard 446 - IEEE Recommended Practice for Emergency and Standby Power Systems for Commercial and Industrial Applications
 - F. NEMA Standard ICS10-1993 (formerly ICS2-447) - AC Automatic Transfer Switches
 - G. UL 508 Industrial Control Equipment
- The ATS should be a 3-pole unit and be UL-listed and labeled.

- The ATS shall be a delayed/programmed transition back to normal utility.
- The ATS should be in self-standing, NEMA 3R enclosure with an blank outer door and an inner door for controls, indication panel etc.
- Furnish true single phase monitoring (i.e. measurement and comparison of the phase angle of 120° between phases) on all phases of the utility supply to the switch.
- Furnish under-voltage sensing, including true phase-angle relationship sensing, on all three poles of the ATS - on utility supply source (and on generator source if normally provided – ASCO 300 Series model is acceptable). Sensing and control shall be in adjustable steps between 80-percent and 97-percent. Vendor may recommend alternate adjustable steps.
- Furnish under-frequency sensing on all three poles of the ATS on utility supply source (and on generator source if normally provided – ASCO 300 Series model is acceptable.) Sensing and control shall be in adjustable steps between 59 and 60-Hertz.
- Basic warranty on the switch shall be for a minimum of 1-year after commissioning.
- Furnish two (2) hard copies of all maintenance and operations manuals and drawings for the ATS and one (1) electronic copy of same in AdobeTM pdf format.
- Furnish factory trained technician for commissioning of the ATS and support during commissioning of new generator.

Pre-Bid Site Walk-Thru for Saginaw County Project Scope, Photos

Date: December 15, 2020 (Tuesday)

Time: 12:30PM

Place: Gage Street Pump Station, 4500 Veterans Memorial Parkway, Saginaw, MI

Bid Package: This information packet contains work-scope and photos of the Gage Street Pump Station generator installation project and is being distributed prior to the pre-bid site walk-thru to electrical contractors selected for bidding the project.

Base Scope of Service Upgrade:

- 1) Prior to the Generator pad (12.5'W x 28.5' L x 1.0' Thick – see drawing on last page) being poured, Contractor is responsible for installing conduit sweeps as per the drawing from the edge of the pad up and into the conduit sweep window. Contractor will also secure the generator to the pad, once it is set, as per the manufacturer's instructions. Other than these two (2) highlighted items, the rest of the work as defined on this drawing will be done by others.
- 2) Generator and Automatic Transfer Switch (ATS) to be delivered at the same time. Contractor will be responsible for unloading, setting and anchoring this equipment.
- 3) Refer to the attached One Line Diagram (OLD) for conduit (furnished and installed by others) and conductor schedule, including approximate circuit lengths.
- 4) Contractor will furnish/install all power and control cable as outlined in the OLD.
- 5) Contractor will be on site during start-up and commissioning of the Generator and ATS.

Objective of Pre-Bid Walk-Thru: View existing electrical equipment layout, and proposed Generator and ATS locations to provide a comprehensive bid.

Materials:

1. Consumers Energy will procure and deliver on site the Generator (including sub-base fuel tank) and ATS. All other material will be furnished and paid for by the Contractor, including any applicable Sales Tax.
2. Saginaw County will be paying the Sales Tax on the Generator and ATS. Thus, the Contractor will NOT be responsible for paying any Use Tax on this equipment.
3. Contractor will be responsible for loading and unloading all equipment (including the Generator and ATS) on site.

Labor:

1. Contractor will supply all labor and equipment (except for the Generator and ATS) for a complete installation, as described in the Base Scope and on the One Line Diagram.
2. All work (including power outage work) will be performed during normal working hours (Monday - Friday, 7:00 am – 4:00 pm). Outage work will be scheduled at the discretion of Saginaw County.

Pre-Bid Site Walk-Thru for Saginaw County Project Scope, Photos

Definitions:

Consumers Energy Company– Consumers Energy
Contractor – Electric Contractor
Customer – Saginaw County

Notes:

1. Contractor is responsible for acquiring all electrical and mechanical (if needed) permits and will perform all work to the latest edition of the National Electric Code (NEC).
2. Customer is responsible for obtaining any permission necessary from local authorities for placement and installation of the new equipment.
3. The exact locations/route of the equipment installed above will be confirmed in the field. See drawing on last page for layout details.

Drawing: Separate File Included

Pictures: Attached

Bid Due Date:

Questions of a technical nature should be addressed to Mark Shaw at (989) 280-7374
or mark.shaw@cmsenergy.com.

Please include Project No. 200617-5495, Project Spillwater in the subject line of your quote.

Please respond via email as soon as possible but NO LATER THAN December 22nd, 2020 at 4:00 PM to:

Mark Shaw, Senior Engineer II
Consumers Energy Company
mark.shaw@cmsenergy.com

THE INFORMATION PROVIDED IN THIS BID-PACKAGE CONTAINS CONFIDENTIAL AND PROPRIETARY INFORMATION AND MAY NOT BE DISCLOSED TO ANY THIRD PARTY WITHOUT THE EXPRESS WRITTEN CONSENT OF CONSUMERS ENERGY COMPANY. UNAUTHORIZED DISCLOSURE MAY RESULT IN IMMEDIATE RESTITUTION TO CONSUMERS ENERGY OF ITS COST AND EXPENSES INCURRED IN PREPARING THE SUBJECT BID-PACKAGE.

Pre-Bid Site Walk-Thru for Saginaw County Project Scope, Photos

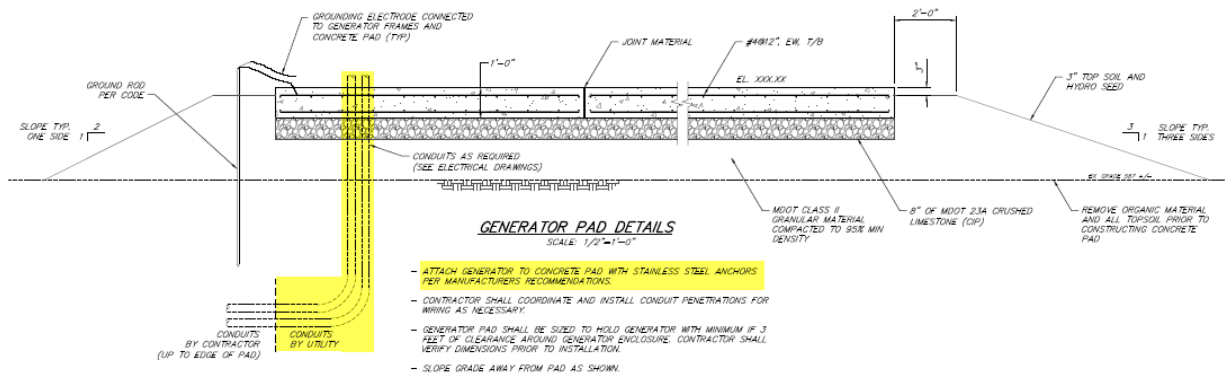


Gage Street Pump Station – View Looking East

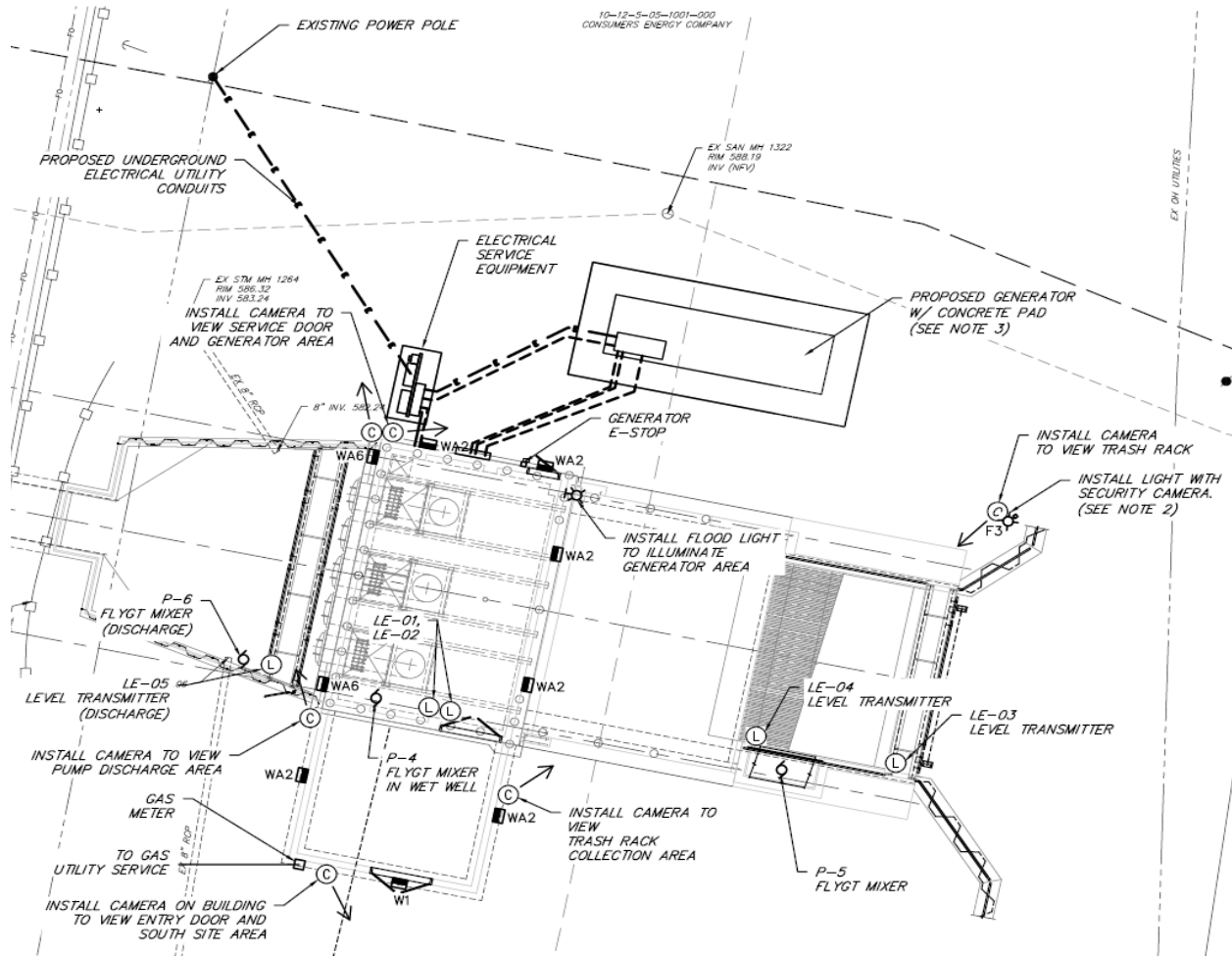


Generator and ATS Locations

Pre-Bid Site Walk-Thru for Saginaw County Project Scope, Photos



Generator Pad Drawing



Generator and ATS Location Drawing

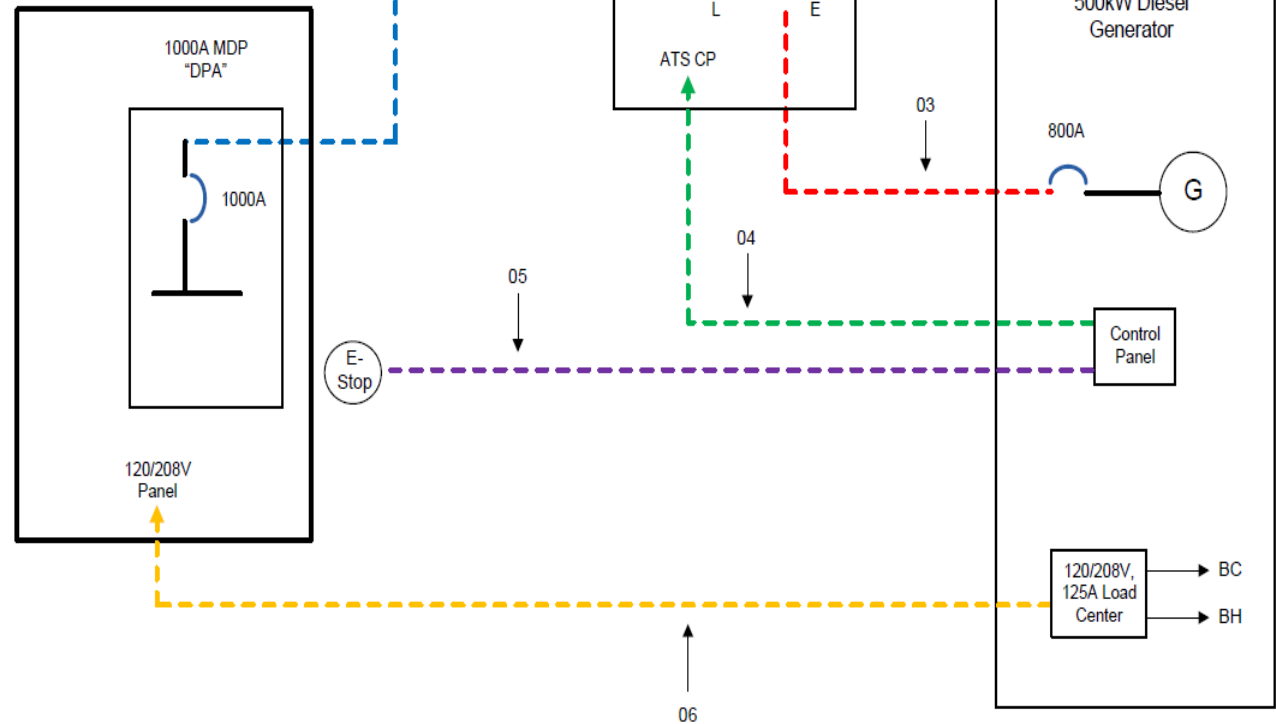
Conduit Schedule:

CKT	Route (From : To)	Qty	Size	Contents	Length	Type
00	Meter Cab : 1000A SD	3	3.50"	4 x 400MCM & 250MCM GND	15 ft	Service Feeders
01	1000A SD : 1000A ATS	3	3.50"	4 x 400MCM & 250MCM GND	15 ft	Normal Feeders
02	1000A ATS : DPA	3	3.50"	4 x 400MCM & 250MCM GND	40 ft	Load Feeders
03	1000A ATS : Gen 800A	3	3.50"	4 x 400MCM & 250MCM GND	30 ft	Emergency Feeders
04	Gen CP : ATS CP	1	0.75"	4 - #14 AWG	30 ft	DC Volt Signal & Spares
05	Gen CP : E-Stop	1	0.75"	6 x #14 AWG	40 ft	E-Stop Circuit
06	125A Panel : LV Panel	1	1.00"	3 x #6 AWG & #10AWG GND	45 ft	60A Ancillary Power Ckt

Key:

Meter Cab	Utility Meter Cabinet
1000A SD	1000A Service Disconnect
1000A ATS	1000A Transfer Switch
DPA	1000A Main Dist Panel
Gen 800A	Generator 800A Main
Gen CP	Gen Control Panel
ATS CP	ATS Control Panel
E-Stop	E-Stop Button
125A Panel	120/208V, 125A LC
LV Panel	120/208V Panel
BC	Battery Charger
BH	Block Heater

Pump Building



Notes:

- 1) All conductors shall be stranded copper with THHN insulation.
- 2) Underground conduit sweeps shall be Schedule 40.
- 3) E-Stop to be located on the outside of the Pump Building, adjacent to the access door.
- 4) Local 120/208V Panel to be determined, but will be in close proximity to DPA.
- 5) In lieu of a Remote Annunciator, generator vital signs will be accessible via wireless remote.
- 6) Concrete Pad for 500kW generator shall be 12.5' W x 28.5' L x 1.0' Thick, with mesh installed 6" from top surface.
- 7) Ground system for the generator includes 8 foot ground rods installed at each corner and bonded to the generator frame.

Saginaw County Gage Pump Station
4500 Veterans Memorial Pkwy, Saginaw MI 48601

By: Mark C. Shaw, P.E. CPQ
Date: December 9, 2020
Project No.: 20200617-5495

500kW Generator Installation
Dwg No. E-1, Rev3



BIDS FOR: GAGE DRAIN PUMP STATION - EQUIPMENT PROCUREMENT
SAGINAW COUNTY, MICHIGAN

TAKEN ON: Monday, December 28th, 2020 @ 10:00 a.m.

BIDDERS>>

Item No.	Estimated Quantity	Unit	Description	Consumers Energy Company		Duperon Corporation		Kennedy Industries	
				Unit Price	Amount	Unit Price	Amount	Unit Price	Amount
<u>DIVISION A - PUMPS AND CONTROLS</u>									
1.	3	Each	36" Axial Flow Pump w/VFDs - Cascade Pumps (35,000 gpm @ 10.3' TDH)					\$202,211.66	\$606,634.98
2.	3	Each	Submersible Mixer - Flygt 4610.410 (1.2 HP, 3 Phase)					\$15,235.00	\$45,705.00
3.	1	Lump Sum	Pump Station Controls, SCADA, and Security (See Attached Schedule)					Lump Sum	\$178,496.00
TOTAL BID AMOUNT - DIVISION A-----									\$830,835.98
<u>DIVISION B - TRASH RACK</u>									
4.	1	Lump Sum	Self-Cleaning Trash Rack			Lump Sum	\$420,000.00		
TOTAL BID AMOUNT - DIVISION B-----							\$420,000.00		
<u>DIVISION C - GENERATOR</u>									
5.	1	Lump Sum	Back Up Generator - Diesel Fueled (As Specified by Consumers Energy, acting as an agent for the Saginaw County Public Works Commissioner with respect to this equipment- See Attached Consumers Documents)	Lump Sum	\$149,500.00				
TOTAL BID AMOUNT - DIVISION C-----					\$149,500.00				