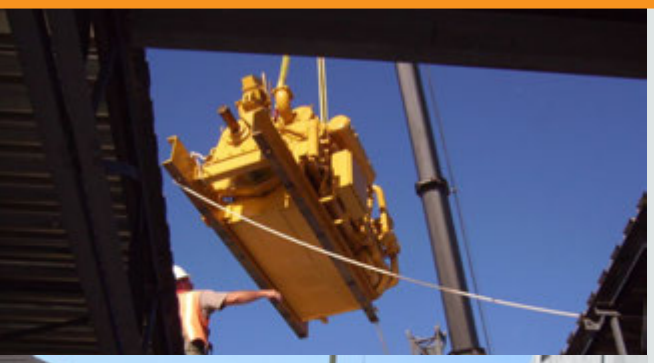
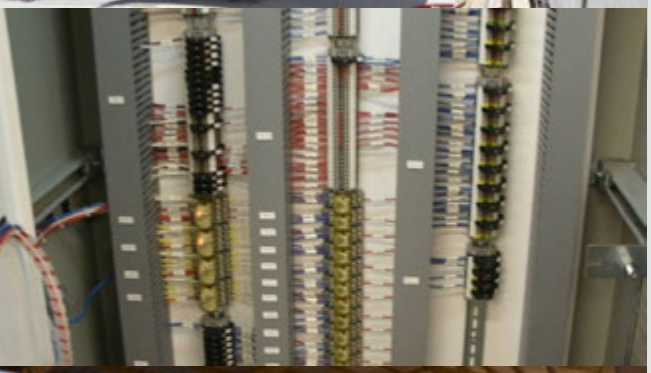
FELIX CONSTRUCTION

"EXHIBIT A"





City of Farmers Branch Office Park Lift Station Rehabilitation – Final GMP

FARMERS BRANCH

Final GMP Submittal

July 7, 2025

Felix Construction Company
403 International Pkwy, Suite 500, Richardson, TX 75081
P: (469) 458-0011
www.felixconstruction.com

TABLE OF CONTENTS

1. GMP Summary

- Summary Estimate

ESTIMATE SUMMARY BY DIVISION

Description	Quantity	Unit	Labor Total	Equipment Total	Material Total	Subcontractor Total	Other Total	Total
Division 01 - General Conditions	1.00	LS	192,236.62	57,337.58	22,748.55	50,600.00	48,182.15	371,104.90
Division 02 - Site Work	1.00	LS	0.00	0.00	0.00	2,014,881.00	0.00	2,014,881.00
Division 99 - Alternates, Contingency & Allowance	1.00	LS	1,949.50	299.98	40,320.00	123,402.00	44,800.00	210,771.48
Totals			**$194,186.12**	**$57,637.56**	**$63,068.55**	**$2,188,883.00**	**$92,982.15**	**$2,596,757.38**

Other Direct / Indirect Costs

Description	Percentage	Totals
Sub-Total (Direct Cost)		**$2,596,757.38**
Sub-Total (Other Direct / Indirect Costs) Total		**$2,596,757.38**

Construction Services Fee

Description	Percentage	Totals
Sub-Total (Other Direct / Indirect Costs)		**$2,596,757.38**
CMAR Fee	10.00%	$259,675.74
Sub-Total (Project Fee) Total		**$2,856,433.12**

Bonds and Insurance

Description	Percentage	Totals
Sub-Total (Project Fee)		**$2,856,433.12**
Insurance	1.00%	$28,564.33
Bond	1.20%	$31,161.09
Sub-Total (Bonds and Insurance) Total		**$2,916,158.54**

Arizona Gross Receipt Tax

Description	Percentage	Totals
Sub-Total (Bonds and Insurance)		**$2,916,158.54**
Sub-Total (Taxes) Total		**$2,916,158.54**

Project Contingencies

Description	Percentage	Amount	Totals
Sub-Total (Taxes)			**$2,916,158.54**
Contractor's Contingency	0.00%	0.00	$0.00
Project Contingency	0.00%	0.00	$0.00
Owner's Contingency	0.00%	0.00	$0.00
	0.00%	0.00	$0.00
Sub-Total (Project Contingencies) Total			**$2,916,158.54**

Project Allowances

Description	Amount	Amount	Totals
Sub-Total (Project Contingencies)			**$2,916,158.54**
Contractors Allowance	0.00	0.00	$0.00
Project Allowance	0.00	0.00	$0.00
Owner's Allowance	0.00	0.00	$0.00
Sub-Total (Project Allowances) Total			**$2,916,158.54**

Estimate Total

Description	Totals
Sub-Total (Project Allowances)	**$2,916,158.54**
Total Estimate Total	**$2,916,158.54**

2. GMP Detail by Division

(Each Division contains a Detailed Estimate, Scope Comparison Sheets and Quotes)

- Division 01 – General Conditions of the Work
- Division 02 – Civil / Site Work
- Division 99 - Alternates, Contingency & Allowance

DIVISION 01 – GENERAL CONDITIONS OF THE WORK

SCOPE OF WORK INCLUDED

- *CMAR Mobilization and Demobilization*
- *SWPPP*
- *Temporary Facilities*
- *Temporary Controls*
- *Survey*
- *Construction Material Testing*
- *Site Support*
- *Photography*
- *Equipment and System Start-up / Commissioning*
- *CMAR Project Supervision*

DETAILED ESTIMATE BY DIVISION

Description	Quantity	Unit	Man Hours	Labor Total	Equipment Total	Material Total	Subcontractor Total	Other Total	Total
01 Division 01 - General Conditions									
01010 Mobilization / Demobilization									
Transport - Mob / Demob Construction Equipment	6.00	EW	0.00	0.00	0.00	0.00	0.00	2,100.00	2,100.00
Mobilization Crew	3.00	DY	72.00	3,853.92	0.00	0.00	0.00	0.00	3,853.92
01010 - Mobilization / Demobilization Totals			**72.0**	**$3,853.92**	**$0.00**	**$0.00**	**$0.00**	**$2,100.00**	**$5,953.92**
01020 Permits & Environmental Controls									
Storm Water Pollution Prevention Plan Development	1.00	EA	0.00	0.00	0.00	0.00	3,500.00	0.00	3,500.00
Storm Water Pollution Prevention BMP's - Silt Fence Material	256.00	LF	0.00	0.00	0.00	844.80	0.00	0.00	844.80
SWPPP Inspections	15.00	EA	0.00	0.00	0.00	0.00	2,250.00	0.00	2,250.00
SWPPP BMP Installation & Maintenance Crew	80.00	HR	160.00	7,697.60	7,269.60	0.00	0.00	0.00	14,967.20
01020 - Permits & Environmental Controls Totals			**160.0**	**$7,697.60**	**$7,269.60**	**$844.80**	**$5,750.00**	**$0.00**	**$21,562.00**
01030 Temporary Facilities									
Storage Conex	5.00	MO	0.00	0.00	0.00	0.00	0.00	4,500.00	4,500.00
Office Conex	5.00	MO	0.00	0.00	0.00	0.00	0.00	4,500.00	4,500.00
J-John Rental / Service	5.00	MO	0.00	0.00	0.00	0.00	0.00	2,500.00	2,500.00
Handwash Station Rental / Service	5.00	MO	0.00	0.00	0.00	0.00	0.00	1,500.00	1,500.00
Water - Drinking / Ice	5.00	MO	0.00	0.00	0.00	0.00	0.00	1,250.00	1,250.00
Roll Off Dumpster & Dump Fee's	5.00	MO	0.00	0.00	0.00	0.00	0.00	4,750.00	4,750.00
01030 - Temporary Facilities Totals			**0.0**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$19,000.00**	**$19,000.00**
01040 Temporary Controls									
Periodic Clean - Up	5.00	DY	80.00	3,848.80	0.00	0.00	0.00	0.00	3,848.80
Temporary Fence Set-Up / Take-Down	1.00	EA	0.00	0.00	0.00	0.00	0.00	500.00	500.00
Temporary Fence Rental Period	5.00	MO	0.00	0.00	0.00	0.00	0.00	50.00	50.00
Temporary Fence Rental per Month	256.00	LF	0.00	0.00	0.00	0.00	0.00	768.00	768.00
Temporary Gate Rental	1.00	EA	0.00	0.00	0.00	0.00	0.00	500.00	500.00
Traffic Control Plan (TCP)	1.00	EA	0.00	0.00	0.00	0.00	0.00	350.00	350.00
Security Cameras	5.00	MO	0.00	0.00	0.00	0.00	0.00	9,000.00	9,000.00
01040 - Temporary Controls Totals			**80.0**	**$3,848.80**	**$0.00**	**$0.00**	**$0.00**	**$11,168.00**	**$15,016.80**

Description	Quantity	Unit	Man Hours	Labor Total	Equipment Total	Material Total	Subcontractor Total	Other Total	Total
01050 Engineering and Testing									
Surveying / Construction Staking (RLS)	2.50	MO	0.00	0.00	0.00	0.00	3,750.00	0.00	3,750.00
Material Testing (Concrete / Compaction)	5.00	MO	0.00	0.00	0.00	0.00	22,500.00	0.00	22,500.00
Concrete X-Ray	2.00	EA	0.00	0.00	0.00	0.00	3,600.00	0.00	3,600.00
NACE Inspections	2.00	EA	0.00	0.00	0.00	0.00	2,500.00	0.00	2,500.00
NESHAP Inspections	2.00	LS	0.00	0.00	0.00	0.00	1,500.00	0.00	1,500.00
Design / PE Stamp (Seismic Calcs, Shoring, Structural)	1.00	EA	0.00	0.00	0.00	0.00	3,500.00	3,500.00	7,000.00
Outside Drafting	24.00	HR	0.00	0.00	0.00	0.00	0.00	3,600.00	3,600.00
01050 - Engineering and Testing Totals			**0.0**	**$0.00**	**$0.00**	**$0.00**	**$37,350.00**	**$7,100.00**	**$44,450.00**
01060 Site Support									
Small Tools	3,245.00	MHR	0.00	0.00	0.00	12,980.00	0.00	0.00	12,980.00
Safety Supplies	3,245.00	MHR	0.00	0.00	0.00	8,923.75	0.00	0.00	8,923.75
Unload / Cart / Sort Materials (Shop Time)	270.42	HR	270.42	10,816.80	0.00	0.00	0.00	0.00	10,816.80
Cooling Trailer - Heat Safety	540.83	MHR	0.00	0.00	0.00	0.00	0.00	2,704.15	2,704.15
Tolls - Texas Only	5.00	MO	0.00	0.00	0.00	0.00	0.00	25.00	25.00
01060 - Site Support Totals			**270.42**	**$10,816.80**	**$0.00**	**$21,903.75**	**$0.00**	**$2,729.15**	**$35,449.70**
01085 Construction Photography / Drone / Video									
Drone Progress Photos	5.00	EA	0.00	0.00	0.00	0.00	0.00	2,000.00	2,000.00
Progress Photo's - Preconstruction	50.00	EA	0.00	0.00	0.00	0.00	0.00	250.00	250.00
Progress Photo's - Construction	542.00	EA	0.00	0.00	0.00	0.00	0.00	2,710.00	2,710.00
Progress Photo's - Close Out / Record Documents	25.00	EA	0.00	0.00	0.00	0.00	0.00	125.00	125.00
Training Videography	1.00	EA	0.00	0.00	0.00	0.00	0.00	1,000.00	1,000.00
01085 - Construction Photography / Drone / Video Totals			**0.0**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$6,085.00**	**$6,085.00**
01090 Project Close Out									
Final Clean Up - Larger Job w/Haul Off	5.00	DY	120.00	6,423.20	7,730.40	0.00	0.00	0.00	14,153.60
Professional Cleaning Services	1.00	LS	0.00	0.00	0.00	0.00	7,500.00	0.00	7,500.00
Final Clean Up - Small Job, No Haul Off	5.00	DY	80.00	3,848.80	7,152.00	0.00	0.00	0.00	11,000.80
01090 - Project Close Out Totals			**200.0**	**$10,272.00**	**$14,882.40**	**$0.00**	**$7,500.00**	**$0.00**	**$32,654.40**
01100 Equipment and System Start-Up / Commissioning									
System Start Up / Commissioning	6.00	DY	48.00	5,280.00	0.00	0.00	0.00	0.00	5,280.00

Description	Quantity	Unit	Man Hours	Labor Total	Equipment Total	Material Total	Subcontractor Total	Other Total	Total
01100 - Equipment and System Start-Up / Commissioning Totals			**48.0**	**$5,280.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$5,280.00**
01200 Project Supervision									
Construction Project Manager	3.00	MO	519.60	57,800.30	9,872.40	0.00	0.00	0.00	67,672.70
Project Area Superintendent	5.00	MO	866.00	80,789.14	22,022.38	0.00	0.00	0.00	102,811.52
Project Engineer	1.00	MO	173.20	11,878.06	3,290.80	0.00	0.00	0.00	15,168.86
01200 - Project Supervision Totals			**1558.8**	**$150,467.50**	**$35,185.58**	**$0.00**	**$0.00**	**$0.00**	**$185,653.08**
01 - Division 01 - General Conditions Totals			**2389.22**	**$192,236.62**	**$57,337.58**	**$22,748.55**	**$50,600.00**	**$48,182.15**	**$371,104.90**
Totals			**2389.22**	**$192,236.62**	**$57,337.58**	**$22,748.55**	**$50,600.00**	**$48,182.15**	**$371,104.90**

DIVISION 02 – CIVIL / SITE WORK

SCOPE OF WORK INCLUDED

- *Office Park Lift Station Rehabilitation Work Package Bid results. Selected Contractor – Felix Construction Company*

DETAILED ESTIMATE BY DIVISION

Description	Quantity	Unit	Man Hours	Labor Total	Equipment Total	Material Total	Subcontractor Total	Other Total	Total
02 Division 02 - Site Work									
01710 Lift Station Bid Package									
Lift Station Bid Package	1.00	LS	0.00	0.00	0.00	0.00	2,014,881.00	0.00	2,014,881.00
01710 - Lift Station Bid Package Totals			**0.0**	**$0.00**	**$0.00**	**$0.00**	**$2,014,881.00**	**$0.00**	**$2,014,881.00**
02 - Division 02 - Site Work Totals			**0.0**	**$0.00**	**$0.00**	**$0.00**	**$2,014,881.00**	**$0.00**	**$2,014,881.00**
Totals			**0.0**	**$0.00**	**$0.00**	**$0.00**	**$2,014,881.00**	**$0.00**	**$2,014,881.00**

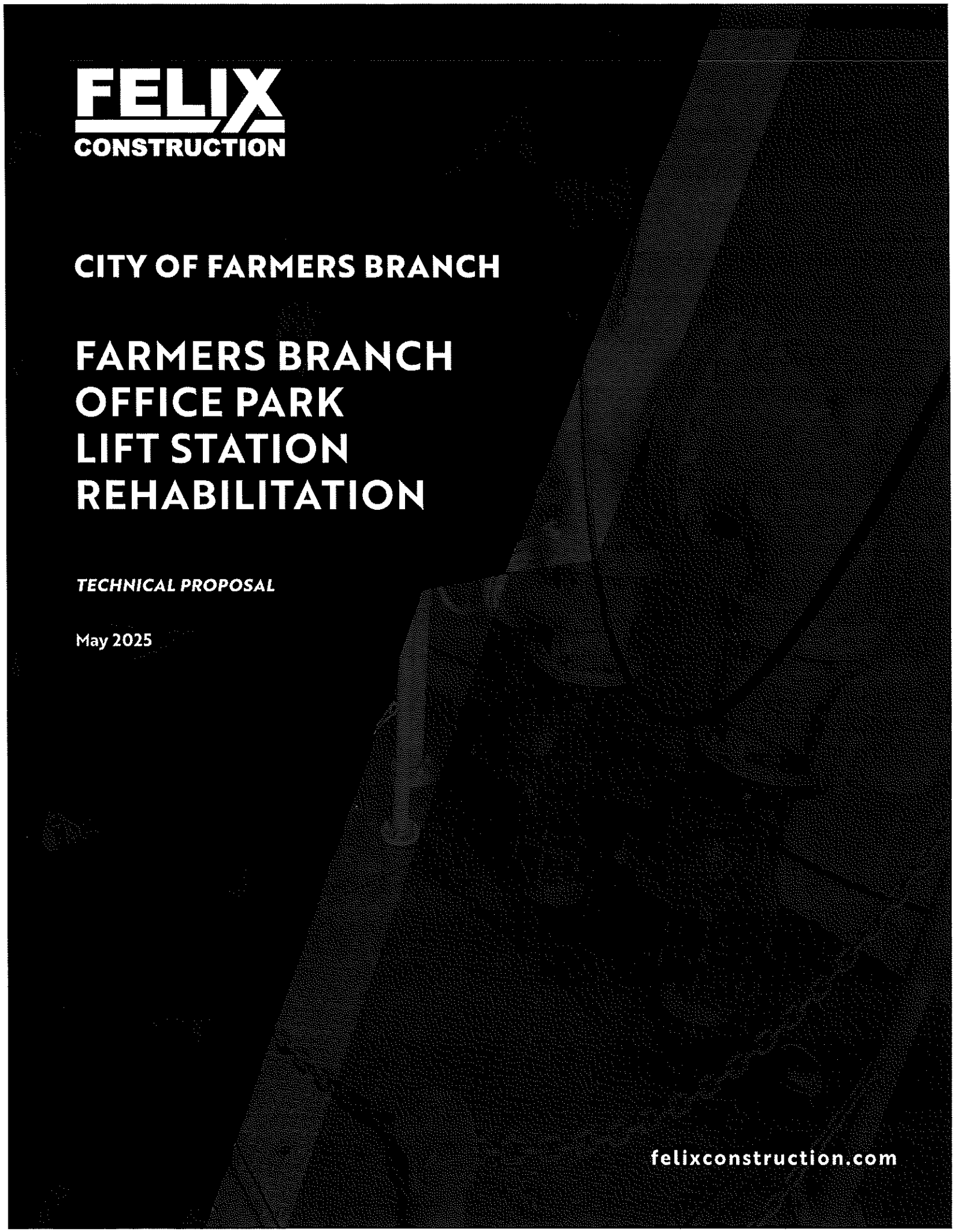
FELIX CONSTRUCTION

CITY OF FARMERS BRANCH

FARMERS BRANCH OFFICE PARK LIFT STATION REHABILITATION

TECHNICAL PROPOSAL

May 2025



felixconstruction.com

Farmers Branch Office Park Lift Station Rehabilitation

ATTACHMENT A
SAFETY RECORD QUESTIONNAIRE

The CMAR desires the safety records of potential contractors prior to awarding proposals. The CMAR has adopted the following written definition and criteria for accurately determining the safety record of a PROPOSER prior to awarding proposals.

The definition and criteria for determining the safety record of a PROPOSER for this consideration shall be:

The CMAR shall consider the safety record of the offerors in determining the responsibility thereof. The CMAR may consider any incidents involving worker safety or safety of others be it related or caused by environmental, mechanical, operational, supervision or any other cause or factor. Specifically, the CMAR may consider, among other things:

a. Complaints to, or final orders entered by, the Occupational Safety and Health Review Commission (OSHRC), against the proposer for violations of OSHA regulations within the past three (3) years.

b. Convictions of corporate officers and employees of a criminal offense within the past ten (10) years, which resulted from bodily harm or death.

c. Any other safety related matter deemed by the City Council to be material in determining the responsibility of the offeror and his or her ability to perform the services or goods required by the proposal documents in a safe environment, both for the workers and other employees of offeror and the citizens of the City of Lubbock.

To obtain proper information from PROPOSERS so that CMAR may consider the safety records of potential contractors prior to awarding proposals. The CMAR requires that PROPOSERS answer the following three (3) questions and submit them with their proposals:

QUESTION ONE

Has the offeror, or the firm, corporation, partnership, or institution represented by the offeror, or anyone acting for such firm, corporation, partnership or institution, received citations for violations of OSHA within the past three (3) years?

YES_____ NO X

If the offeror has indicated YES for question number one above, the offeror must provide to the CMAR, with its proposal submission, the following information with respect to each such citation:

Date of offense, location of establishment inspected, category of offense, final disposition of offense, if any, and penalty assessed.

_____Offeror's Initials

Farmers Branch Office Park Lift Station Rehabilitation

QUESTION TWO

Has the offeror, or the firm, corporation, partnership, or institution represented by the offeror, or anyone acting for such firm, corporation, partnership or institution, received citations for violations of environmental protection laws or regulations, of any kind or type, within the past five years? Citations include notice of violation, notice of enforcement, suspension/revocations of state or federal licenses, or registrations, fines assessed, pending criminal complaints, indictments, or convictions, administrative orders, draft orders, final orders, and judicial final judgments.

YES_____ NO_X_____

If the offeror has indicated YES for question number two above, the offeror must provide to the CMAR, with its proposal submission, the following information with respect to each such conviction:

Date of offense or occurrence, location where offense occurred, type of offense, final disposition of offense, if any, and penalty assessed.

QUESTION THREE

Has the offeror, or the firm, corporation, partnership, or institution represented by offeror, or anyone acting for such firm, corporation, partnership, or institution, ever been convicted, within the past ten (10) years, of a criminal offense which resulted from serious bodily injury or death?

YES_____ NO_X_____

If the offeror has indicated YES for question number three above, the offeror must provide to the CMAR, with its proposal submission, the following information with respect to each such conviction:

Date of offense, location where offense occurred, type of offense, final disposition of offense, in any, and penalty assessed.

Farmers Branch Office Park Lift Station Rehabilitation

QUESTION FOUR

Provide your company's Experience Modification Rate and supportinginformation: .64

ACKNOWLEDGEMENT

THE STATE OF TEXAS

COUNTY OF

I certify that I have made no willful misrepresentations in this Questionnaire nor have I withheld information in my statements and answers to questions. I am aware that the information given by me in this questionnaire will be investigated, with my full permission, and that any misrepresentations or omissions may cause my proposal to be rejected.

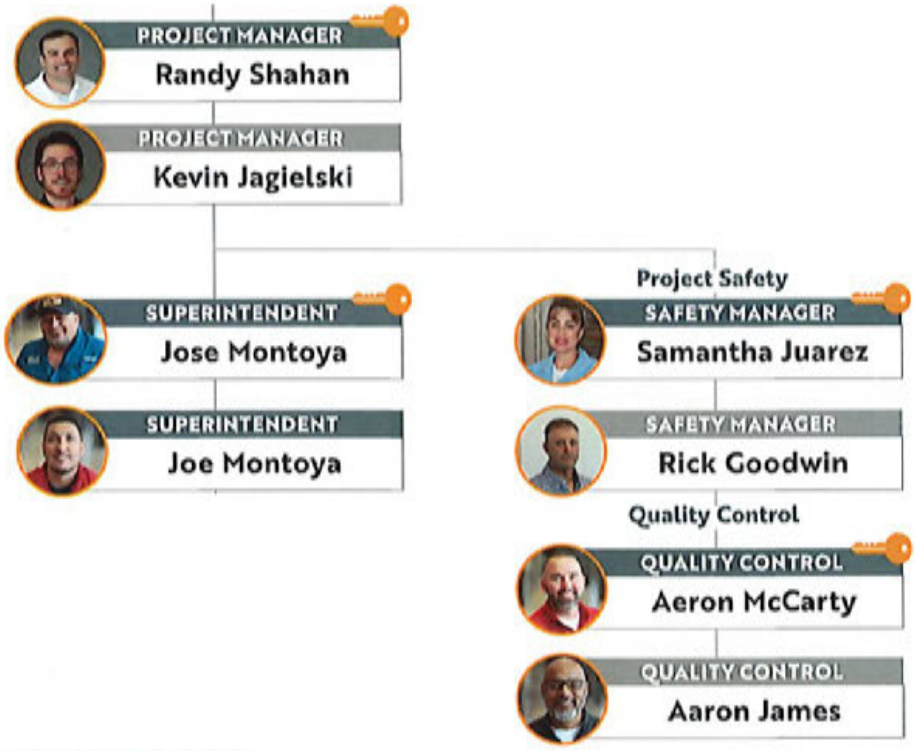
Signature

General Manager

Title

ATTACHMENT B: QUALIFICATIONS

PRIMARY
ALTERNATE



The Felix Way is our guide to conducting business. It's prioritizing doing what's right and fair for everyone involved.

Five Core Behaviors of Felix Employees

- We vs. Me: Prioritize Team's Success Over Own
- Cares: We Go Above & Beyond
- Ownership: Responsibility for fully understanding the issue and solving the right problem.
- Learner: Continuous Learning & Improvement
- Problem Solver: Take Initiative & Follow Every Problem Through to the End

Team Organization

The team organization will be structured around clear roles and responsibilities with a focus on effective project management.

At Felix, our project management approach is centered on proactive problem-solving, attention to detail, and FELIXibility. Our experienced project management team understands that avoiding project pitfalls is crucial to the success of any project. As such, we prioritize early identification and correction of potential issues before they escalate. This begins in preconstruction with a detailed project plan outlining of the scope, objectives, and alignment with the clients needs and expectations. Having a clear understanding of the project before it starts is key to ensuring that the project is completed on time and within budget.

We understand that construction projects can become unpredictable, and flexibility is necessary to ensure that the needs of the City of Farmers Branch and the entire project team are met. As such, we remain open and flexible in our approach to project management, ensuring that we can adapt to any changes that may arise during the construction process.

Emphasizing a partnership-oriented communication style, decisions are collectively made within the project team and promptly communicated. Each project manager is equipped with training in the "Felix Way" and is empowered to make executive decisions on behalf of the organization for their respective projects. Members of the leadership team and company owners actively participate in every project team to ensure prompt decision making when escalated.

ATTACHMENT B: QUALIFICATIONS

Farmers Branch Office Park Lift Station Rehabilitation

Contractor's General Information

Organization Doing Business As	Felix Construction Company					
Business Address of Principle Office	2530 S 52nd Ave. Phoenix, AZ 85043					
Telephone Numbers						
Main Number	480.464.0078					
Fax Number	N/A					
Web Site Address	felixconstruction.com					
Form of Business (Check One)	X	A Corporation		A Partnership		An Individual
If a Corporation						
Date of Incorporation	1987					
State of Incorporation	Arizona					
Chief Executive Officer's Name	David Giannetto					
President's Name	Archie Lopez					
Vice President's Name(s)	Matt Phillips					
Secretary's Name	Kevin Felix					
Treasurer's Name	Joel Felix					
If a Partnership						
Date of Organization						
State whether partnership is general or limited						
If an Individual						
Name						
Business Address						
Identify all individuals not previously named which exert a significant amount of business control over the organization						
Ryan Koontz						
Zack Foster						
Indicators of Organization Size						
Average Number of Current Full Time Employees	355		Average Estimate of Revenue for the Current Year	$200M		

ATTACHMENT B: QUALIFICATIONS

Farmers Branch Office Park Lift Station Rehabilitation

Contractor's Organizational Experience

Organization Doing Business As	Felix Construction Company
Business Address of Regional Office	403 International Pkwy, Suite 500, Richardson, TX 75081
Name of Regional Office Manager	Ryan Koontz
Telephone Numbers	
Main Number	469.458.0011
Fax Number	N/A
Web Site Address	felixconstruction.com

Organization History

List of names that this organization currently, has or anticipates operating under over the history of the organization, including the names of related companies presently doing business:

Names of Organization	From Date	To Date
Felix Construction Company	1987	Current

List of companies, firms or organizations that own any part of the organization.

Name of companies, firms or organization	Percent Ownership

Construction Experience

Years experience in projects similar to the proposed project:

As a General Contractor	38	As a Joint Venture Partner	

Current Contractor Experience Modification Ratio	
Has this or a predecessor organization ever defaulted on a project or failed to complete any work awarded to it?	No
If yes provide full details in a separate attachment. See attachment No.	
Has this or a predecessor organization been released from a bid or proposal in the past ten years?	No
If yes provide full details in a separate attachment. See attachment No.	
Has this or a predecessor organization ever been disqualification as a bidder or proposer by any local, state, or federal agency within the last five years?	No
If yes provide full details in a separate attachment. See attachment No.	
Is this organization or your proposed surety currently in any litigation or contemplating litigation?	No
If yes provide full details in a separate attachment. See attachment No.	
Has this or a predecessor organization ever refused to construct or refused to provide materials defined in the contract documents?	No
If yes provide full details in a separate attachment. See attachment No.	

ATTACHMENT B: QUALIFICATIONS

Farmers Branch Office Park Lift Station Rehabilitation

Contractor's Proposed Key Personnel

Organization Doing Business As	Felix Construction Company

Proposed Project Organization

Provide a brief description of the managerial structure of the organization and illustrate with an organizational chart. Include the title and names of key personnel. Include this chart as an attachment to this description. See attachment No.

Felix is 100% employee owned, and operated by David Giannetto, Matt Phillips, Joel Felix and Kevin Felix. The company has delivered the highest quality water/wastewater projects for the past 37 years and in the DFW Metroplex for the past 10 years. The Texas office is managed by Ryan Koontz. Felix is a general engineering contractor (GC) and construction manager (CM). Our GC work focuses on water and wastewater projects. Our CM work includes cost modeling/estimating, project planning/scheduling, alternate systems evaluation, constructibility review, long-lead studies and procurement, efficiency analysis, permitting assistance, safety/hazard analysis, quality analysis/control, and value comparison/engineering. Our approach is to anticipate a project's problems, and to offer cost-effective and timely solutions. We are a for-profit corporation, incorporated in Mesa, Arizona in 1987.

Provide a brief description of the managerial structure proposed for this project and illustrate with an organizational chart. Include the title and names of proposed key personnel and alternates. Include this chart as an attachment to this description. See attachment No.

The team organization will be structured around clear roles and responsibilities with a focus on effective project management. As the Project Manager, Randy Shahan will be the main point of contact. Jose Montoya will collaborate with Randy, Aeron, and Samantha to develop project schedules, ensure quality, and manage safety. To provide management continuity throughout the entire project, the same team members will be assigned to the project from the construction phase and project closeout. This approach ensures that each team member understands the project's requirements, complexities, and nuances and can provide continuity of knowledge and support to ensure successful project delivery.

Experience of Key Personnel

Provide information on the key personnel proposed for this project that will provide the following key functions. Provide information for candidates for each of these positions on the pages for each of these key personnel. Also provide biographical information for each primary and alternate candidate as an attachment. The biographical information must include the following as a minimum: technical experience, managerial experience, education and formal training, work history which describes project experience, including the roles and responsibilities for each assignment, and primary language. Additional information highlighting experience which makes them the best candidate for the assignment should also be included.

Role	Primary Candidate	Alternate Candidate
Project Manager	Randy Shahan	Kevin Jagielski
Project Superintendent	Jose Montoya	Joe Montoya
Project Safety Officer	Samantha Juarez	Rick Goodwin
Quality Control Manager	Aeron McCarty	Aaron James

If key personnel are to fulfill more than one of the roles listed above, provide a written narrative describing how much time will be devoted to each function, their qualifications to fulfill each role and the percentage of their time that will be devoted to each role. If the individual is not to be devoted solely to this project, indicate how time it to be divided between this project and their other assignments.

ATTACHMENT B: QUALIFICATIONS

Farmers Branch Office Park Lift Station Rehabilitation

Proposed Project Manager

Organization Doing Business As	Felix Construction Company		
Primary Candidate			
Name of Individual	Randy Shahan		
Years of Experience as Project Manager	3		
Years of Experience with this Organization	6		
Number of similar projects as Project Manager	10		
Number of similar projects in other positions	10		
Current Project Assignments			
Name of Assignment	Percent of Time Used for this Project	Estimated Project Completion Date	
Seis Lagos WWTP	10%	June 2025	
Sandy Lake Lift Station	40%	December 2025	
Robson Ranch Improvements	15%	July 2025	
Reference Contact Information (listing names indicates approval to contacting the names individuals as a reference)			
Name	Ashley Broughton	Name	Daniel Huffines
Title/ Position	Engineer	Title/ Position	Engineer
Organization	LJA Engineering	Organization	Freese and Nichols
Telephone	469.621.0710	Telephone	214.217.2218
E-mail	abroughton@lja.com	E-mail	dwh@freese.com
Project	Ventana Lift Station	Project	Stacy Road Pump Station
Candidates role on Project	Project Manager	Candidates role on Project	Project Manager
Alternate Candidate			
Name of Individual	Kevin Jagielski		
Years of Experience as Project Manager	1		
Years of Experience with this Organization	2		
Number of similar projects as Project Manager	1		
Number of similar projects in other positions	3		
Current Project Assignments			
Name of Assignment	Percent of Time Used for this Project	Estimated Project Completion Date	
Talty Pump Station	30%	6/10/2025	
Crandall Meter Vault	20%	6/1/2025	
RCH Take Point Pump Station	20%	4/21/2026	
Reference Contact Information (listing names indicates approval to contacting the names individuals as a reference)			
Name	Tyler Hendrickson	Name	Ashley Burt
Title/ Position	Project Engineer	Title/ Position	Wastewater Projects Coordinator
Organization	Velvin & Weeks	Organization	North Texas Municipal Water District
Telephone	903.675.3903	Telephone	469.626.4929
E-mail	then@velvin-weeks.com	E-mail	aburt@ntmwd.com
Project	NTMWD Crandall Meter Vault	Project	Stewart Creek West WWTP
Candidates role on Project	Project Manager	Candidates role on Project	Project Engineer

ATTACHMENT B: QUALIFICATIONS

Farmers Branch Office Park Lift Station Rehabilitation

Proposed Project Superintendent

Organization Doing Business As		Felix Construction Company	
Primary Candidate			
Name of Individual		Jose Montoya	
Years of Experience as Project Superintendent		34	
Years of Experience with this Organization		8	
Number of similar projects as Superintendent		5	
Number of similar projects in other positions			
Current Project Assignments			
Name of Assignment		Percent of Time Used for this Project	Estimated Project Completion Date
Doe Branch Discharge Improvements		20%	June 2025
Sandy Lake Lift Station and System Improvements		20%	August 2025
Reference Contact Information (listing names indicates approval to contacting the names individuals as a reference)			
Name	Matt Kuykendall	Name	Eric Johnson
Title/ Position	Project Engineer	Title/ Position	Project Engineer
Organization	Plummer Associates	Organization	City of Irving
Telephone	817.806.1719	Telephone	214.790.9314
E-mail	mkukendall@plummer.comBud	E-mail	ejohnson@cityofirving.com
Project	Bud Ervvin TWTP	Project	Doe Branch Discharge Improvements
Candidates role on Project	Superintendent	Candidates role on Project	Superintendent
Alternate Candidate			
Name of Individual		Joe Montoya	
Years of Experience as Project Superintendent		18	
Years of Experience with this Organization		8	
Number of similar projects as Superintendent		20+	
Number of similar projects in other positions		20+	
Current Project Assignments			
Name of Assignment		Percent of Time Used for this Project	Estimated Project Completion Date
FM 741 Pump Station		50%	July 2025
Reference Contact Information (listing names indicates approval to contacting the names individuals as a reference)			
Name	Matt Kuykendall	Name	Michael McBee
Title/ Position	PE	Title/ Position	Project Engineer
Organization	Plummer Associates	Organization	Freese and Nichols
Telephone	469.595.1947	Telephone	817.735.7361
E-mail	mkukendall@plummer.com	E-mail	michael.mcbee@freese.com
Project	Sanger WTP	Project	Robinson Road
Candidates role on Project	Superintendent	Candidates role on Project	Superintendent

ATTACHMENT B: QUALIFICATIONS

Farmers Branch Office Park Lift Station Rehabilitation

Proposed Project Safety Officer

Organization Doing Business As		Felix Construction Company	
Primary Candidate			
Name of Individual		Samantha Juarez	
Years of Experience as Project Safety Officer		8	
Years of Experience with this Organization		1	
Number of similar projects as Safety Officer		8	
Number of similar projects in other positions		8	
Current Project Assignments			
Name of Assignment		Percent of Time Used for this Project	Estimated Project Completion Date
Safety Manager of All TX Projects		100%	
Reference Contact Information (listing names indicates approval to contacting the names individuals as a reference)			
Name	Michael Boule	Name	Brad Richards
Title/ Position	Director of Water Resources	Title/ Position	Senior Project Manager
Organization	City of Surprise	Organization	Town of Gilbert
Telephone	623.670.7040	Telephone	480.695.3963
E-mail	michael.boule@surpriseaz.gov	E-mail	bradley.richards@gilbertaz.gov
Project	multiple projects	Project	multiple projects
Candidates role on Project	Safety Director	Candidates role on Project	Safety Director
Alternate Candidate			
Name of Individual		Rick Goodwin	
Years of Experience as Project Safety Officer		7	
Years of Experience with this Organization		1	
Number of similar projects as Safety Officer		15	
Number of similar projects in other positions		1	
Current Project Assignments			
Name of Assignment		Percent of Time Used for this Project	Estimated Project Completion Date
Safety Director of All AZ & TX Projects		100%	
Reference Contact Information (listing names indicates approval to contacting the names individuals as a reference)			
Name	Robert Garcia	Name	Andy Giza
Title/ Position	Environmental Health & Safety Manager	Title/ Position	Assistant Vice President
Organization	City of Phoenix	Organization	Lockton
Telephone	602.534.6574	Telephone	602.735.8963
E-mail		E-mail	andy.giza@lockton.com
Project	multiple projects	Project	multiple projects
Candidates role on Project	Safety Director	Candidates role on Project	Safety Director

ATTACHMENT B: QUALIFICATIONS

Farmers Branch Office Park Lift Station Rehabilitation

Proposed Project Quality Control Manager

Organization Doing Business As		Felix Construction Company	
Primary Candidate			
Name of Individual		Aeron McCarty	
Years of Experience as Quality Control Manager		11	
Years of Experience with this Organization		2	
Number of similar projects as Quality Manager		10+	
Number of similar projects in other positions		10+	
Current Project Assignments			
Name of Assignment		Percent of Time Used for this Project	Estimated Project Completion Date
Josephine 1.0 MGD SBR WWTP Expansion		30%	July 2026
Midlothian Auger WTP & Joe Pool		20%	December 2028
RWPS Electrical			
Reference Contact Information (listing names indicates approval to contacting the names individuals as a reference)			
Name	Gennady Broksiner	Name	Justin Hutto
Title/ Position	Project ManagerFreed	Title/ Position	Plant Operations Manager
Organization	Freese and Nichols	Organization	City of Midlothian
Telephone	817.721.3527	Telephone	972.935.2224
E-mail	gb@freese.com	E-mail	justin.hutto@midlothian.tx.us
Project	Red Oak WTP	Project	Midlothian Auger WTP
Candidates role on Project	Quality Manager	Candidates role on Project	Operations/Quality Control
Alternate Candidate			
Name of Individual		Aaron James	
Years of Experience as Quality Control Manager		10	
Years of Experience with this Organization		2	
Number of similar projects as Quality Manager		2	
Number of similar projects in other positions		5	
Current Project Assignments			
Name of Assignment		Percent of Time Used for this Project	Estimated Project Completion Date
NTMWD N. Garland System GST		20%	December 2026
Midlothian Auger WTP & Joe Pool		10%	December 2028
RWPS Electrical			
Reference Contact Information (listing names indicates approval to contacting the names individuals as a reference)			
Name	Kirk Iverson	Name	Chitra Foster
Title/ Position	Project Manager	Title/ Position	Water Practice Regional Manager
Organization	City of Carrollton	Organization	Barns & McDonnell
Telephone	972.466.3482	Telephone	940.232.7256
E-mail	kirk.iverson@cityofcarrollton.com	E-mail	cfoster@burnsmcd.com
Project	2022-2023 Street Repair	Project	Doe Branch WWTP Phase I
Candidates role on Project	Project Manager/QC Manager	Candidates role on Project	Senior PM/QA/QC

ATTACHMENT B: QUALIFICATIONS

RANDY SHAHAN | PROJECT MANAGER

As Project Manager in the industrial, water, and wastewater industries, Randy will be an invaluable asset to the City. He can provide a comprehensive and unique perspective that adds value to construction. Randy's ability to implement project plans and maintain clear communication throughout the project ensures that there are no surprises, and he is committed to finishing projects on time, within budget, and with the highest quality standards. He understands the unique challenges and requirements that come with working at an existing facility.

Home Office: Richardson

6 Years with Felix

7 Years Total Experience

EDUCATION:

- B.A. General Studies
  Louisiana State University

TRAINING/ CERTIFICATIONS:

- OSHA 10 Hour
- CPR/First Aid

EXPERIENCE:

- Stacy Road Pump Station No. 1 Rehabilitation, Allen, TX
  Role: Project Manager
- Sandy Lake Lift Station and System Improvements, Coppell, TX
  Role: Project Manager
- Southwest Sector Pump Station, City of Grand Prairie
  Role: Project Manager
- NTMWD Richardson Meter Vaults, Richardson, TX
  Role: Project Managerr
- White Settlement Well Site 10, White Settlement, TX
  Role: Project Manager
- Ventana Lift Station, Fort Worth, TX
  Role: Project Manager

ATTACHMENT B: QUALIFICATIONS

KEVIN JAGIELSKI | PROJECT MANAGER - ALTERNATE

Kevin has 4 years of experience in the water and wastewater project industry. As the Project Manager he oversees projects from design to construction. He has experience in project scheduling, budgets, progress reports, and ensuring compliance with regulatory requirements. Kevin posses analytical and problem solving skills that will help identify potential issues and develop effective solutions and will ensure that the project is completed on time, within budget and to the highest quality standards

Home Office: Richardson

2 Years with Felix

4 Years Total Experience

EDUCATION:

- B.S. Marketing & Management University of Arkansas

TRAINING/ CERTIFICATIONS:

- OSHA 10 Hour
- CPR/First Aid

EXPERIENCE:

- ARD Road Pump Station, Seagoville, TX
  Role: Project Manager
- Crandall Meter Vaults, Forney, TX
  Role: Project Manager
- Union Valley Pump Station, Royse City, TX
  Role: Project Manager
- NTMWD Richardson Meter Vaults, Richardson, TX
  Role: Project Engineer
- White Settlement Well Site 10, White Settlement, TX
  Role: Project Engineer
- Stewart Creek West WWTP Primary Clarifier and Blower Improvements, Frisco, TX
  Role: Project Manager

ATTACHMENT B: QUALIFICATIONS

JOSE MONTOYA | SUPERINTENDENT

With 34 years of water/wastewater experience, Jose has an unwavering commitment to safety and quality control on every project, instilling confidence in stakeholders and guaranteeing the highest standards throughout the build. His expertise in overseeing project field staff and implementing project protocols further solidifies his suitability for this role.

Home Office: Richardson

8 Years with Felix

34 Years Total Experience

TRAINING/CERTIFICATIONS:

- OSHA 10 Hour
- CPR/First Aid

EXPERIENCE:

- Sandy Lake Lift Station and System Improvements, Coppell, TX
  Role: Superintendent
- Denison - Iron Ore Lift Station, Denison, TX
  Role: Superintendent
- Doe Branch Discharge Improvements, Irving, TX
  Role: Superintendent
- Bud Ervin WWTP Clearwell No. 4 and HSPS Improvements, Mansfield, TX
  Role: Superintendent
- Stewart Creek West WWTP Aeration Piping Replacement, Frisco, TX
  Role: Superintendent
- Little Elm WWTP Expansion, Town of Little Elm, TX
  Role: Superintendent

ATTACHMENT B: QUALIFICATIONS

Home Office: Richardson

8 Years with Felix

17 Years Total Experience

JOSE MONTOYA | SUPERINTENDENT - ALTERNATE

Joe's career spans over 18 years of effectively building a diverse array of water and wastewater projects, encompassing everything from treatment plants to lift stations and distribution systems. He has been instrumental in guiding teams towards strict adherence to project schedules and budgets, resulting in projects being completed within established parameters. Joe has an unwavering commitment to safety. His collaboration with engineers and project stakeholders has ensured seamless alignment between construction activities and project specifications.

TRAINING/CERTIFICATIONS:

- OSHA 10 Hour
- CPR/First Aid

EXPERIENCE:

- Denton Lake Ray Roberts Water Treatment Plant, Denton, TX
  Role: Superintendint
- Doe Branch Discharge Improvements, Irving, TX
  Role: Superintendent
- FM 741 Pump Station, Crandall, TX
  Role: Superintendent
- NTMWD Meter Vaults, Multiple Locations, TX
  Role: Superintendent
- Little Elm Bar Screen Install, Little Elm, TX
  Role: Superintendent
- Northlake Heritage PS Upgrade, Nortlake, TX
  Role: Superintendent
- Saginaw NW Booster Pump Station, Saginaw, TX
  Role: Superintendent
- Southwest Sector Pump Station, Saginaw, TX
  Role: Superintendent

ATTACHMENT B: QUALIFICATIONS

AERON MCCARTY | QUALITY CONTROL

Aeron brings over 17 years of experience in the construction industry and is responsible for managing and overseeing all on-site activities, including quality control. He ensures that the project consistently meets established standards of quality, reliability, and performance. Aeron implements and maintains quality processes throughout the construction project to guarantee compliance with project specifications. He collaborates closely with the project manager and superintendent to ensure that all quality expectations are met.

Home Office: Richardson

2 Years with Felix

17 Years Total Experience

- Felix Extended Leadership Team

EDUCATION:

- BS, Business Management
  ITT Technical Institute

TRAINING/ CERTIFICATIONS:

- OSHA 10 Hour
- CPR/First Aid

PRIMARY LANGUAGE :

- English

EXPERIENCE:

- Union Valley Pump Station, Royse City, TX
  Role: Field Operations Manager / Quality Control
- FM 741 Pump Station, Crandall, TX
  Role: Field Operations Manager / Quality Control
- Talty Pump Station, Crandall, TX
  Role: Field Operations Manager / Quality Control
- Hutton Lift Station, Farmers Branch, TX
  Role: Field Operations Manager / Quality Control
- Josephine 1.0 MGD WWTP Expansion, Royse City, TX
  Role: Field Operations Manager / Quality Control
- Robson Ranch Improvements, Denton, TX
  Role: Field Operations Manager / Quality Control
- Farmers Branch Marsh Lane Pump Station, Farmers Branch, TX
  Role: Field Operations Manager / Quality Control
- Farmers Branch Lift Station Rehab, Farmers Branch, TX
  Role: Field Operations Manager / Quality Control
- Little Elm TOLE WWTP UV Upgrade, Frisco, TX
  Role: Field Operations Manager / Quality Control
- Sandy Lift Station and System Improvements, Coppell, TX
  Role: Field Operations Manager / Quality Control

ATTACHMENT B: QUALIFICATIONS

AARON JAMES | QUALITY CONTROL - ALTERNATE

Aaron is a highly experienced project executive with a remarkable track record spanning over 20 years in the water and wastewater industry. His extensive knowledge and expertise in this field make him a valuable asset to any project. Aaron's primary role is to provide efficient management and oversight across multiple projects, ensuring strict adherence to company standards and best management practices. With a keen eye for detail, he ensures that projects are executed smoothly and within the defined parameters, meeting both client expectations and regulatory requirements.

Home Office: Richardson

2 Years with Felix

22 Years Total Experience

- Felix Extended Leadership Team

EDUCATION:

- BS, Construction Engineering Technology, Louisiana Tech University

TRAINING/ CERTIFICATIONS:

- OSHA 10 Hour
- CPR/First Aid

ORGANIZATIONAL INVOLVEMENT:

- NACME - National Action Council for Minorities in Engineering
- NSBE - National Society for Black Engineers

EXPERIENCE:

- Talty Pump Station, Forney, TX
  Role: Project Manager
- FM 741 Pump Station, Crandall, TX
  Role: Project Manager
- ARD Road Pump Station, Seagoville, TX
  Role: Project Manager
- NTMWD Richardson Meter Vault, Richardson, TX
  Role: Project Manager
- Conn Pump Station, North Richland Hills, TX
  Role: Project Manager
- Robinson Road Pump Station, Grand Prairie, TX
  Role: Project Manager
- Stewart Creek West WWTP, Frisco, TX
  Role: Project Manager
- NTMWD Richardson Meter Vaults, Richardson, TX
  Role: Project Manager
- Village Creek Deep Filters, Fort Worth, TX
  Role: Project Manager
- Rowlett Creek WWTP Peak Flow Management, Plano, TX
  Role: Project Manager
- City of Kemp Water Treatment Plant Improvements, Kemp, TX
  Role: Project Manager

ATTACHMENT B: QUALIFICATIONS

SAMANTHA JUAREZ | SAFETY MANAGER

Samantha is dedicated to implementing comprehensive safety programs, conducting thorough risk assessments, and providing regular safety training to the Felix team. She prioritizes safety at every stage of the project, creating a safe and secure working environment for all involved, by conducting regular safety audits, toolbox talks, and job hazard analyses, collaborating closely with field crews and subcontractors to ensure safety is integrated into every task.

Home Office: Richardson

1 Years with Felix

8 Years Total Experience

TRAINING/ CERTIFICATIONS:

- CHST - Construction Health and Safety Technician
- STSC - Safety Trained Supervisor Construction
- OSHA 30 Hour
- OSHA 10 Hour
- CPR/First Aid Instructor

PRIMARY LANGUAGE :

- Bilingual - English & Spanish

EXPERIENCE:

- Robinson Road Pump Station, Grand Prairie, TX
  Role: Safety Manager
- Union Valley Pump Station, Royse City, TX
  Role: Safety Manager
- FM 741 Pump Station, Crandall, TX
  Role: Safety Manager
- Talty Pump Station, Crandall, TX
  Role: Safety Manager
- Farmers Branch Lift Station Rehab, Farmers Branch, TX
  Role: Safety Manager
- Josephine 1.0 MGD WWTP Expansion, Royse City, TX
  Role: Safety Manager
- Sandy Lift Station and System Improvements, Coppell, TX
  Role: Safety Manager

ATTACHMENT B: QUALIFICATIONS

RICK GOODWIN | SAFETY MANAGER - ALTERNATE

As Safety Director, Rick is responsible for leading all safety efforts across the company and every water and wastewater project. He develops and enforces the project-specific Health and Safety Plan, ensuring full compliance with OSHA regulations, local environmental standards, and client safety requirements. With a deep understanding of safety requirements related to water and wastewater construction - confined space entry, trenching and excavation, and electrical safety common to treatment plants and pump stations, Rick proactively identifies risks and implements preventative measures. personnel, equipment, and the community.

Home Office: Phoenix

1 Years with Felix

15 Years Total Experience

TRAINING/ CERTIFICATIONS:

- OSHA 500
- OSHA 30 Hour Trainer
- OSHA 10 Hour Trainer
- CPR/First Aid Instructor

EXPERIENCE:

- Robinson Road Pump Station, Grand Prairie, TX
  Role: Safety Director
- Union Valley Pump Station, Royse City, TX
  Role: Safety Director
- FM 741 Pump Station, Crandall, TX
  Role: Safety Director
- Talty Pump Station, Crandall, TX
  Role: Safety Director
- Farmers Branch Lift Station Rehab, Farmers Branch, TX
  Role: Safety Director
- Josephine 1.0 MGD WWTP Expansion, Royse City, TX
  Role: Safety Director
- Sandy Lift Station and System Improvements, Coppell, TX
  Role: Safety Director

Attachment C- Relevant Project Experience (Complete a new form for each reference project)

Project owner	City of Farmers Branch	Project name	Mercer Crossing Lift Station

General description of project

Construction of a new 40' Deep Wet Well and Valve Vault. Install ~800' of Force Main with two jack and bore pits. New Electrical Building and controls.

Project Budget and Schedule Performance

Budget history

	Amount	% of Bid Amount
Bid	$1,024,217	100
Change orders		
Owner enhancements	$24,371	2.38
Unforeseen conditions		
Design issues		
Total	$24,371	2.38
Final cost	$1,048,588	102.38

Schedule performance

	Date	Days
Notice to Proceed	10/16/2014	0
Contract Substantial Completion date at Notice to Proceed	01/31/2015	90
Contract final completion date at Notice to Proceed	1/31/2015	90
Change Order authorized Substantial Completion date	2/17/2015	133
Change Order authorized final completion date	2/17/2015	133
Actual / estimated Substantial Completion date	2/17/2015	133
Actual / estimated final completion date	2/17/2015	133

Key Project Personnel

	Project Manager	Project Superintendent	Safety Manager	Quality Control Manager
Name	Ryan Koontz	Brandon Martindale	BJ Felix	Matt Phillips
Percentage of time devoted to the project.	50%	100%	10%	10%
Proposed for this project.	Yes	Yes	Yes	Yes
Did Individual start and complete the project?	Yes	Yes	Yes	Yes
If not, who started or completed the project in their place.				
Reason for change.				

Reference contact information (listing names indicates approval to contacting the names individuals as a reference)

	Name	Title/ position	Organization	Telephone	E-mail
Owner	Craig Hahn	Utilities Superintendent	City of Farmers Branch	972.919.2612	craig.hahn@farmerbranchtx.gov
Designer					
Construction Manager					
Surety	Stephanie Bucholz	Account Manager	CBI Bonding, Inc	480.968.0100	stephanie@cbibonding.com

Issues / disputes resolved or pending resolution by arbitration, litigation or dispute review boards

Number of issues resolved:	0	Total amount involved in resolved issues:	0	Number of issues pending:	0	Total amount involved in resolved Issues:	0

Farmers Branch Office Park Lift Station Rehabilitation

Attachment C- Relevant Project Experience (Complete a new form for each reference project)

Project owner	City of Farmers Branch	Project name	Hutton Lift Station

General description of project

Sewer Lift Station rehab work consisting of replacing pumps, guiderails, & chains. Adding an additional 8x19 addition onto the electrical room along with new gear, concrete deck, and metal roof.

Project Budget and Schedule Performance

Budget history

	Amount	% of Bid Amount
Bid	$662,412	100
Change orders		
Owner enhancements	$155,828	23.52
Unforeseen conditions		
Design issues		
Total	$155,828	23.52
Final cost	$818,240	123.52

Schedule performance

	Date	Days
Notice to Proceed	06/17/2014	0
Contract Substantial Completion date at Notice to Proceed	01/14/2015	211
Contract final completion date at Notice to Proceed	01/14/2015	211
Change Order authorized Substantial Completion date		
Change Order authorized final completion date		
Actual / estimated Substantial Completion date	01/14/2015	211
Actual / estimated final completion date	01/14/2015	211

Key Project Personnel

	Project Manager	Project Superintendent	Safety Manager	Quality Control Manager
Name	Ryan Koontz	Matt Phillips	BJ Felix	Ryan Koontz
Percentage of time devoted to the project.	50%	100%	10%	10%
Proposed for this project.	Yes	Yes	Yes	Yes
Did Individual start and complete the project?	Yes	Yes	Yes	Yes
If not, who started or completed the project in their place.				
Reason for change.				

Reference contact information (listing names indicates approval to contacting the names individuals as a reference)

	Name	Title/ position	Organization	Telephone	E-mail
Owner	Craig Hahn	Utilities Superintendent	City of Farmers Branch	972.919.2612	craig.hahn@farmerbranchtx.gov
Designer	Bryan Caswell	Project Manager	BGE, Inc.		bcaswell@browngay.com
Construction Manager					
Surety	Stephanie Bucholz	Account Manager	CBI Bonding, Inc	480.968.0100	stephanie@cbibonding.com

Issues / disputes resolved or pending resolution by arbitration, litigation or dispute review boards

Number of issues resolved:	0	Total amount involved in resolved issues:	0	Number of issues pending:	0	Total amount involved in resolved Issues:	0

Farmers Branch Office Park Lift Station Rehabilitation

Attachment C- Relevant Project Experience (Complete a new form for each reference project)

Project owner	City of Rowlett	Project name	Rowlett Road Lift Station Upgrades

General description of project

Upgrades included the installation of one new pump to match the two existing pumps as well as associated lift station piping and valve replacement and electrical upgrades.

Project Budget and Schedule Performance

Budget history

	Amount	% of Bid Amount
Bid	$388,500	100
Change orders		
Owner enhancements	$13,409	3.45
Unforeseen conditions		
Design issues		
Total	$13,409	3.45
Final cost	$401,909	103.45

Schedule performance

	Date	Days
Notice to Proceed	2/24/2020	0
Contract Substantial Completion date at Notice to Proceed	7/23/2020	150
Contract final completion date at Notice to Proceed		
Change Order authorized Substantial Completion date		
Change Order authorized final completion date		
Actual / estimated Substantial Completion date	7/23/2020	150
Actual / estimated final completion date	7/23/2020	150

Key Project Personnel

	Project Manager	Project Superintendent	Safety Manager	Quality Control Manager
Name	Ryan Koontz	Jose Montoya	BJ Felix	Randy Shahan
Percentage of time devoted to the project.	50%	100%	10%	10%
Proposed for this project.	Yes	Yes	Yes	Yes
Did Individual start and complete the project?	Yes	Yes	Yes	Yes
If not, who started or completed the project in their place.				
Reason for change.				

Reference contact information (listing names indicates approval to contacting the names individuals as a reference)

	Name	Title/ position	Organization	Telephone	E-mail
Owner	Tom Harris	City Engineer	City of Rowlett	972.463.3934	tharris@rowletttx.gov
Designer	Bruce Grantham	Project Engineer	Grantham & Associates, Inc		bgrantham@gra-ce.net
Construction Manager	Molly Pierson	Project Engineer	Grantham & Associates, Inc		mpierson@gra-ce.net
Surety	Stephanie Bucholz	Account Manager	CBI Bonding, Inc	480.968.0100	stephanie@cbibonding.com

Issues / disputes resolved or pending resolution by arbitration, litigation or dispute review boards

Number of issues resolved:	0	Total amount involved in resolved issues:	0	Number of issues pending:	0	Total amount involved in resolved Issues:	0

Farmers Branch Office Park Lift Station Rehabilitation

Attachment C- Relevant Project Experience (Complete a new form for each reference project)

Project owner	PMB, inc. for City of Fort Worth	Project name	Ventana Lift Station

General description of project

The major work consisted of the following: 167 LF of Gravity Sewer; 69 LF of Force Main, concrete paving, site improvements, and 2-pump lift station with concrete wet well, valve vault, and mechanical and electrical appurtenances.

Project Budget and Schedule Performance

Budget history			Schedule performance		
	Amount	% of Bid Amount		Date	Days
Bid	$2,296,535		Notice to Proceed	10/31/2019	
Change orders			Contract Substantial Completion date at Notice to Proceed		
Owner enhancements			Contract final completion date at Notice to Proceed		
Unforeseen conditions	-$97,491		Change Order authorized Substantial Completion date	07/27/2020	
Design issues			Change Order authorized final completion date		
Total	-$97,491		Actual / estimated Substantial Completion date	08/25/2020	
Final cost	$2,199,044		Actual / estimated final completion date	08/25/2020	

Key Project Personnel

	Project Manager	Project Superintendent	Safety Manager	Quality Control Manager
Name	Randy Shahan	Robert Skinner	BJ Felix	Ryan Koontz
Percentage of time devoted to the project.	50%	100%	10%	10%
Proposed for this project.	Yes	Yes	Yes	Yes
Did Individual start and complete the project?	Yes	Yes	Yes	Yes
If not, who started or completed the project in their place.				
Reason for change.				

Reference contact information (listing names indicates approval to contacting the names individuals as a reference)

	Name	Title/ position	Organization	Telephone	E-mail
Owner	Sonny Davis	Project Manager	PMB Ventana	713.962.0525	sonny@pmbinc.com
Designer	Laura Preston	Engineer	LJA Engineering	214.442.6579	lpreston@LJA.com
Construction Manager					
Surety	Stephanie Bucholz		CBI Bonding, Inc	480.968.0100	stephanie@cbibonding.com

Issues / disputes resolved or pending resolution by arbitration, litigation or dispute review boards

Number of issues resolved:	0	Total amount involved in resolved issues:	0	Number of issues pending:	0	Total amount involved in resolved Issues:	0

Farmers Branch Office Park Lift Station Rehabilitation

Attachment C- Relevant Project Experience (Complete a new form for each reference project)

Project owner	City of Coppell	Project name	Sandy Lake Lift Station and System Improvements

General description of project

Work consists of the construction of a new 6.15 MGD Sandy Lake Lift Station inclusive of yard piping, electrical improvements, site improvements, decommissioning of the existing lift station, permanent flow meter installation at six sites in the City of Coppell including the SLLS, SCADA improvements at facilities through City of Coppell, and all appurtenant work as laid out and described in the construction plans.

Project Budget and Schedule Performance

Budget history			Schedule performance		
	Amount	% of Bid Amount		Date	Days
Bid	$6,466,574	100	Notice to Proceed	3/1/2022	0
Change orders			Contract Substantial Completion date at Notice to Proceed		
Owner enhancements			Contract final completion date at Notice to Proceed	10/05/2023	583
Unforeseen conditions			Change Order authorized Substantial Completion date	8/27/2024	910
Design issues			Change Order authorized final completion date		
Total			Actual / estimated Substantial Completion date	8/27/2024	910
Final cost	$6,466,574	100	Actual / estimated final completion date	8/27/2024	910

Key Project Personnel

	Project Manager	Project Superintendent	Safety Manager	Quality Control Manager
Name	Randy Shahan	Jose Montoya	BJ Felix	Ryan Koontz
Percentage of time devoted to the project.	50%	100%	10%	10%
Proposed for this project.	Yes	Yes	Yes	Yes
Did Individual start and complete the project?	Yes	Yes	Yes	Yes
If not, who started or completed the project in their place.				
Reason for change.				

Reference contact information (listing names indicates approval to contacting the names individuals as a reference)

	Name	Title/ position	Organization	Telephone	E-mail
Owner	Kumar Gali	Project Engineer	City of Coppell	972.304.3680	khali@coppelltx.gov
Designer	Adrian Dongell	Engineer/Project Manager	Plummer Associates	214.631.6100	adongell@plummer.com
Construction Manager	Adrian Dongell	Engineer/Project Manager	Plummer Associates	214.631.6100	adongell@plummer.com
Surety	Stephanie Bucholz	Account Manager	CBI Bonding, Inc	480.968.0100	stephanie@cbibonding.com

Issues / disputes resolved or pending resolution by arbitration, litigation or dispute review boards

Number of issues resolved:	0	Total amount involved in resolved issues:	0	Number of issues pending:	0	Total amount involved in resolved Issues:	0

Attachment D: Exceptions to Subcontract Agreement

Farmers Branch Office Park Lift Station Rehabilitation

Provide name and contact information for person authorized to negotiate these listed exceptions:

Name: Felix Construction Company

Phone Number: 469.531.7911 Email: ryank@felixconstruction.com

Instructions: *Proposer shall list any and all requested exceptions or revisions to the sample Subcontract Agreement included in Appendix A. The Construction Manager will take these items into consideration but is not obligated to accept any of the requested revisions or modifications.*

1. No exceptions
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____

ATTACHMENT E: CONFLICT OF INTEREST QUESTIONNAIRE AND CERTIFICATION

CERTIFICATIONS AND REPRESENTATIONS

CERTIFICATION OF INDEPENDENT PRICE DETERMINATION

By submission of this proposal, the proposer certifies, and in the case of a joint offer, each party thereto certifies as to its own organization, that in connection with this procurement:

1. The prices in this proposal have been arrived at independently, without consultation, communication, or agreement, for the purpose of restricting competition, as to any matter relating to such prices with any other proposer or with any competitor;

2. Unless otherwise required by law, the prices which have been proposed herein have not knowingly been disclosed by the proposer and will not knowingly be disclosed by the proposer prior to opening of bids, directly or indirectly to any other proposer or competitor; and

3. No attempt has been made by the proposer to induce any other person or firm to submit or not to submit a proposal for the purpose of restricting competition.

CERTIFICATION OF FEDERAL LAW COMPLIANCE

1. The contractor (successful proposer) and/or any subcontractor(s), if permitted, certifies complete compliance with the Federal Civil Rights Law and the Americans with Disabilities Act, agreeing to non-discrimination based on race, age, color, religion, disability, gender, ancestry, national origin, or place of birth in employment practices, programs and services. These practices, programs, and services shall include, but not be limited to, the following: employment, upgrading, demotion or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other compensation; and selection for training, including apprenticeship.

2. The contractor shall in all solicitations or advertisements for employees placed by or on behalf of the contractor, state that all qualified applicants will receive consideration for employment without regard to race, age, color, religion, disability, gender, ancestry, national origin, or place of birth.

3. Upon request by the City of Farmers Branch, the contractor shall furnish all information or reports required to investigate his/her payrolls and personnel records which pertain to current contract(s) with the City for purposes of ascertaining compliance with this non-discrimination certification.

4. Contractor shall at all times observe and comply with all applicable Federal labor and immigration laws with respect to performance of work relative to this contract.

M/W/DBE OR HUB STATUS

Felix Construction Company IS CERTIFIED AS A:

(CHECK ONE, IF APPLICABLE) TX

DISADVANTAGED BUSINESS ENTERPRISE	N/A
MINORITY-OWNED BUSINESS ENTERPRISE	N/A
WOMEN-OWNED BUSINESS ENTERPRISE	N/A
HISTORICALLY UNDERUTILIZED BUSINESS	N/A

A COPY OF THE CERTIFICATION FROM _____ IS ATTACHED.

***** NOTE *****

THIS DATA IS REQUESTED FOR INFORMATIONAL PURPOSES ONLY AND WILL NOT AFFECT THE PROPOSAL AWARD.

(SUBMISSION OF THIS INFORMATION IS NOT A REQUIREMENT.)

0700 (RFP) Certifications and Representations Revised 0515/02

ATTACHMENT E: CONFLICT QUESTIONNAIRE AND INTEREST

CERTIFICATION OF NON-COLLUSION, NON-CONFLICT OF INTEREST AND ANTI-LOBBYING

1. Neither I nor any of my officers, partners, owners, agents, representatives, employees, or parties in interest, have in any way colluded, conspired, or agreed, directly or indirectly, with any person, firm, corporation or other proposer or potential proposer in regard to the amount of this proposal or the terms or conditions of this proposal. I have not paid or agreed to pay, directly or indirectly any person, firm, corporation or other proposer or potential proposer, any money or anything of value in return for assistance in procuring or attempting to procure a contract or in return for fixing the prices in the attached proposal or the proposal of any other proposer. I will not pay any money or anything of value in the future for those purposes.

2. None of the deciding factors set forth in the proposal or in the subsequent agreement were my idea or the idea of anyone representing my company, unless the suggestion was made at a meeting open to all bidders, which all bidders had notice of.

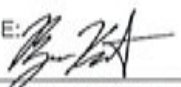
3. No officer or stockholder of my company is an employee of the City of Farmers Branch, or an employee of any elected official of the City, or is related to any employee or elected official of the City of Farmers Branch.

4. My agents, representatives, sub-consultants or I will not undertake any activities or actions to promote or advertise my proposal to any member of any City Commission or Board reviewing the proposals, member of the Farmers Branch City Council or City staff except in the course of City-sponsored inquiries, briefings, interviews or presentations between the proposal submission date and award by City Council.

PROPOSAL CERTIFICATION

The undersigned hereby certifies that he has read, understands and agrees that acceptance by the City of Farmers Branch of the proposer's offer by issuance of a purchase order will create a binding contract. Further, he agrees to fully comply with documentary forms herewith made a part of this specific procurement.

NAME OF COMPANY:
Felix Construction Company

AUTHORIZED SIGNATURE: 

ADDRESS: 403 International Pkwy, Suite 500

CITY AND STATE: Richardson, TX ZIP: 75081

PHONE NUMBER: 469.458.0011

DATE: 05/27/2025

ATTACHMENT E: CONFLICT QUESTIONNAIRE AND INTEREST

State of Texas Conflict of Interest Questionnaire

Pursuant to the requirements of Section 176.002(a) of the Texas Local Government Code, vendors or respondents who meet the following criteria must fill out a State of Texas Conflict of Interest Questionnaire (CIQ) form no later than the 7th day after the person begins contract discussions or negotiations with the City or submits to the City a bidders list application, response to a request for proposals or invitation for bids, correspondence or another writing relating to a potential agreement with the City:

A vendor or respondent that -

(1) contracts or seeks to contract for sale or purchase of property, goods or services with a local government entity; or

(2) is an agent of a person described in Subdivision (1) in the person's business with the local government entity. Any person who meets the criteria. As for enforcement to ensure the veracity of the vendors, the statute makes it a Class C Misdemeanor to violate the vendor disclosure provisions.

ATTACHMENT E: CONFLICT QUESTIONNAIRE AND INTEREST

This questionnaire is being filed in accordance with chapter 176 of the Local

OFFICE USE ONLY

Date Received

CONFLICT OF INTEREST QUESTIONNAIRE

For vendor or other person doing business with local governmental entit

Government Code by a person doing business with the governmental entity.

By law this questionnaire must be filed with the records administrator of the local government not later than the 7th business day after the date the person becomes aware of facts that require the statement to be filed. See

1	**Name of person doing business with local governmental entity.** Felix Construction Company
2	☐ **Check this box if you are filing an update to a previously filed questionnaire.** (The law requires that you file an updated completed questionnaire with the appropriate filing authority not later than September 1 of the year for which an activity described in Section 176.006(a), Local Government Code, is pending and not later than the 7th business day after the date the originally filed questionnaire becomes incomplete or inaccurate.)
3	**Name each employee or contractor of the local governmental entity who makes recommendations to a local government officer of the governmental entity with respect to expenditures of money AND describe the affiliation or business relationship.** N/A
4	**Name each local government officer who appoints or employs local government officers of the governmental entity for which this questionnaire is filed AND describe the affiliation or business relationship.** N/A

Adopted 11/02/2005

FORM CIQ
Page 2

CONFLICT OF INTEREST QUESTIONNAIRE

For vendor or other person doing business with local governmental entity

5 **Name of local government officer with whom filer has affiliation or business relationship. (Complete this section only if the answer to A, B, or C is YES.**

This section, item 5 including subparts A, B, C & D, must be completed for each officer with whom the filer has affiliation or other relationship. Attach additional pages to this Form CIQ as necessary.

A. Is the local government officer named in this section receiving or likely to receive taxable income from the filer of the questionnaire? ☐ Yes ☐ No

N/A

B. Is the filer of the questionnaire receiving or likely to receive taxable income from or at the direction of the local government officer named in this section AND the taxable income is not from the local governmental entity? ☐ Yes ☐ No

N/A

C. Is the filer of this questionnaire affiliated with a corporation or other business entity that the local government officer serves as an officer or director, or holds an ownership of 10 percent or more? ☐ Yes ☐ No

N/A

D. Describe each affiliation or business relationship.

N/A

6

Signature of person doing business with the governmental entity

5/27/2025
Date

Adopted 11/02/2005

0700 (RFP) Certifications and Representations

Revised 0515/02

cbi bonding, inc.
EXPERIENCED · TRUSTWORTHY · RELIABLE

535 E. McKellips Rd
Suite 129
Mesa, AZ 85203-2566

Phone: 480-968-0100
Fax: 480-968-4043

www.cbibonding.com

May 23, 2025

City of Farmers Branch , TX
13000 William Dodson Parkway
Farmers Branch, TX 75234

Re: Felix Construction Company
Construction Manager at Risk (CMAR) - Farmers Branch Office Park Lift Station Rehabilitation

To Whom It May Concern:

It is my understanding that our client, **Felix Construction Company,** will be submitting a proposal to you on the captioned project. Please be advised that we have done business with this construction firm for many years and during that time have found them to exhibit a high degree of integrity in all of their dealings, thereby attributing to their success as an excellent contractor.

The line of credit available to **Felix Construction Company** stands in excess of $75,000,000 per job with an aggregate limit of $300,000,000, which has been set to meet their day-to-day needs. Should you require performance and payment bonds be provided to you, please be advised that we know of no reason we would not be in a position to issue such bonds. Of course, this is conditioned upon normal underwriting, i.e., review of contract documents, bond forms and project financing. We assume no liability to third parties or to you if for any reason we do not execute said bonds.

Felix Construction Company is a highly valued client of CBI Bonding, Inc. and Travelers Casualty and Surety Company of America, an *A++* Rated company with a Treasury Listing of $ $231,823,000. **Felix Construction Company** has an excellent relationship with their surety company. We highly recommend them to you.

Should you have any questions or require further information on this client, please do not hesitate to contact me.

Regards,

Gregory P. Griffith, Attorney-in-Fact
TRAVELERS CASUALTY AND SURETY COMPANY OF AMERICA

GPG:slb

TRAVELERS

SURETY BOND ELECTRONIC SIGNATURE & SEAL ADDENDUM
TRAVELERS CASUALTY AND SURETY COMPANY OF AMERICA

Travelers Casualty and Surety Company of America ("Travelers") has authorized its Attorneys-In-Fact to utilize an electronic, facsimile, or digital signature (each an "Electronic Signature") to execute bonds on behalf of Travelers and has further authorized its Attorneys-In-Fact to attach this Addendum to any such bonds.

Travelers hereby acknowledges and agrees that the attached bond executed by the Attorney-In-Fact on behalf of Travelers with an Electronic Signature shall have the same force and effect as if executed by the Attorney-In-Fact with a wet ink signature.

Travelers also hereby agrees that the seal below shall be deemed affixed to the attached bond to the same extent as if Travelers' raised corporate seal was physically affixed to the face of the bond.

Dated this 1st day of April, 2023.

Travelers Casualty and Surety Company of America

By: _____
Robert L. Raney, Senior Vice President

TRAVELERS

Travelers Casualty and Surety Company of America
Travelers Casualty and Surety Company
St. Paul Fire and Marine Insurance Company

POWER OF ATTORNEY

KNOW ALL MEN BY THESE PRESENTS: That Travelers Casualty and Surety Company of America, Travelers Casualty and Surety Company, and St. Paul Fire and Marine Insurance Company are corporations duly organized under the laws of the State of Connecticut (herein collectively called the "Companies"), and that the Companies do hereby make, constitute and appoint **Gregory P. Griffith** of **Mesa** **Arizona** , their true and lawful Attorney-in-Fact to sign, execute, seal and acknowledge any and all bonds, recognizances, conditional undertakings and other writings obligatory in the nature thereof on behalf of the Companies in their business of guaranteeing the fidelity of persons, guaranteeing the performance of contracts and executing or guaranteeing bonds and undertakings required or permitted in any actions or proceedings allowed by law.

IN WITNESS WHEREOF, the Companies have caused this instrument to be signed, and their corporate seals to be hereto affixed, this **3rd** day of **February, 2017.**

State of Connecticut

City of Hartford ss.

By: _____
Robert L. Raney, Senior Vice President

On this the **3rd** day of **February, 2017,** before me personally appeared **Robert L. Raney,** who acknowledged himself to be the Senior Vice President of Travelers Casualty and Surety Company of America, Travelers Casualty and Surety Company, and St. Paul Fire and Marine Insurance Company, and that he, as such, being authorized so to do, executed the foregoing instrument for the purposes therein contained by signing on behalf of the corporations by himself as a duly authorized officer.

In Witness Whereof, I hereunto set my hand and official seal.

My Commission expires the **30th** day of **June, 2021**

Marie C. Tetreault
Marie C. Tetreault, Notary Public

This Power of Attorney is granted under and by the authority of the following resolutions adopted by the Boards of Directors of Travelers Casualty and Surety Company of America, Travelers Casualty and Surety Company, and St. Paul Fire and Marine Insurance Company, which resolutions are now in full force and effect, reading as follows:

RESOLVED, that the Chairman, the President, any Vice Chairman, any Executive Vice President, any Senior Vice President, any Vice President, any Second Vice President, the Treasurer, any Assistant Treasurer, the Corporate Secretary or any Assistant Secretary may appoint Attorneys-in-Fact and Agents to act for and on behalf of the Company and may give such appointee such authority as his or her certificate of authority may prescribe to sign with the Company's name and seal with the Company's seal bonds, recognizances, contracts of indemnity, and other writings obligatory in the nature of a bond, recognizance, or conditional undertaking, and any of said officers or the Board of Directors at any time may remove any such appointee and revoke the power given him or her; and it is

FURTHER RESOLVED, that the Chairman, the President, any Vice Chairman, any Executive Vice President, any Senior Vice President or any Vice President may delegate all or any part of the foregoing authority to one or more officers or employees of this Company, provided that each such delegation is in writing and a copy thereof is filed in the office of the Secretary; and it is

FURTHER RESOLVED, that any bond, recognizance, contract of indemnity, or writing obligatory in the nature of a bond, recognizance, or conditional undertaking shall be valid and binding upon the Company when (a) signed by the President, any Vice Chairman, any Executive Vice President, any Senior Vice President or any Vice President, any Second Vice President, the Treasurer, any Assistant Treasurer, the Corporate Secretary or any Assistant Secretary and duly attested and sealed with the Company's seal by a Secretary or Assistant Secretary; or (b) duly executed (under seal, if required) by one or more Attorneys-in-Fact and Agents pursuant to the power prescribed in his or her certificate or their certificates of authority or by one or more Company officers pursuant to a written delegation of authority; and it is

FURTHER RESOLVED, that the signature of each of the following officers: President, any Executive Vice President, any Senior Vice President, any Vice President, any Assistant Vice President, any Secretary, any Assistant Secretary, and the seal of the Company may be affixed by facsimile to any Power of Attorney or to any certificate relating thereto appointing Resident Vice Presidents, Resident Assistant Secretaries or Attorneys-in-Fact for purposes only of executing and attesting bonds and undertakings and other writings obligatory in the nature thereof, and any such Power of Attorney or certificate bearing such facsimile signature or facsimile seal shall be valid and binding upon the Company and any such power so executed and certified by such facsimile signature and facsimile seal shall be valid and binding on the Company in the future with respect to any bond or understanding to which it is attached.

I, **Kevin E. Hughes,** the undersigned, Assistant Secretary of Travelers Casualty and Surety Company of America, Travelers Casualty and Surety Company, and St. Paul Fire and Marine Insurance Company, do hereby certify that the above and foregoing is a true and correct copy of the Power of Attorney executed by said Companies, which remains in full force and effect.

Dated this **23rd** day of **May** , **2025** .

Kevin E. Hughes, Assistant Secretary

To verify the authenticity of this Power of Attorney, please call us at 1-800-421-3880.
Please refer to the above-named Attorney-in-Fact and the details of the bond to which the power is attached.

Farmers Branch Office Park Lift Station Rehabilitation

PROPOSAL FORM (TO BE SUBMITTED IN A SEALED ENVELOPE) City of Farmer Branch Lift Station Rehabilitation

Proposal of: Felix Construction Company

Address: 403 International Pkwy, Suite 500

City & State and Zip: Richardson, TX 75081

To: City of Farmers Branch

ATTN: Danielle Rix

Address: 13000 William Dodson Parkway, Farmers Branch, TX 75234

ARTICLE 1: PROPOSER'S DECLARATION AND UNDERSTANDING

1.1 This Proposal I genuine and not made in the interest of or on behalf of any undisclosed person, firm, or corporation and is not submitted in conformity with any agreement or rules of any group, association organization or corporation; Proposer has not directly or indirectly induced or solicited any other Proposer to submit a false or sham Proposal; Proposer has not solicited or induced any person, firm, or corporation to refrain from proposing; an Proposer has not sought by collusion to obtain for itself any advantage over any other Proposer or over Owner.

1.2 The Submission of the Proposal has been duly authorized by, and in all respects of, the Proposer. The undersigned declared that it is the Proposer or by holding the position below indicated is authorized to execute this proposal from on behalf of the Proposer and that all representations made on this form are true and accurate.

1.3 In submitting this Proposal, the Proposer certifies it is qualified to do business in the State of Texas as required by laws, regulations, and rules or, if allowed by stature, covenants to obtain such qualifications prior to contract award.

1.4 In submitting this proposal, the Proposer makes all representations required by the Notice to Proposers and further warrants and represents that:

- Proposer has examined copies of all Contract Documents, the Notice to Proposers, the Instructions to Proposers, and all the Addenda (receipt of which is hereby acknowledged):

Addendum No.	Addendum Date	Signature Acknowledging Receipt
1	4/30/2025	
2	5/13/2025	
3	5/14/2025	
4	5/20/2025	
5	5/28/2025	

- Proposer has familiarized itself with the nature and extent of the Contract Documents, Work, Site, and local conditions and Laws and Regulations that in any

manner may affect cost, progress, performance or furnishing the Goods and Special Services.

1.5 The undersigned agrees to enter into a Subcontract Agreement with the CMAR (Felix Construction) for the proposed FBOP Lift Station Rehabilitation for the amount indicated in this Proposal Form and in accordance with the other terms and conditions of these Contract Documents.

1.6 This proposal shall remain subject to acceptance for a period of 90calendar days after the day of Proposal opening. If the CMAR has not executed the Subcontract Agreement with the 90calendar day period, the Proposer will have the right to negotiate ay price increases with the
CMAR.

1.7 The CMAR's decision on the Package selection will be final. By submitting a Proposal, Proposer waives any right to protest.

ARTICLE 2: STATE AND LOCAL SALES AND USE TAXES

2.1 Except as may be specifically provided to the contrary in any of the Contract Documents, the Proposal Price shall include all applicable international, federal, state and local transportation, privilege, occupation, and other applicable taxes to the work and all international, federal, state, and local taxes, contributions, and premiums imposed upon or measured, by Proposer's payroll. The CONSTRUCTION MANAGER shall not be responsible for any state or local sales, use or excise taxes. The OWNER is a governmental body whose purchase or purchases on behalf of the OWNER are exempt from state and local sales, use and excise taxes.

ARTICLE 3: LICENSES, PERMITS, AND INSPECTIONS

3.1 The CMAR will be responsible for adhering to SWPPP. The CMAR will be responsible to design, furnish, install, and protect and maintain the BMPs within the work areas. The PROPOSER will have to follow and comply with the CMARs plan.

ARTICLE 4: SUMMARY OF WORK

4.1 You agree to furnish all equipment, material, labor, supervision, and insurances for the FBOP lift Station Rehabilitation per specifications below for the City of Farmers Branch Office Park Lift Station Rehabilitation Project including Addenda noted in Article 1.4 above consists of the following:

- Sewer Lift Station Rehabilitation
- Underground Pipe Vaults
- Flat Work Concrete
- Electrical, Instrumentation and Controls

Farmers Branch Office Park Lift Station Rehabilitation

Contract Drawings

- Construction Drawings

Contract Specifications

• Division 02501	Ductile Iron Pipe Fittings
• Division 02515	Hydrostatic Testing or Pipelines
• Division 02532	Sanitary Sewer Force Mains
• Division 03210	Reinforcing Steel
• Division 03300	CAST-IN-PLACE CONCRETE
• Division 03575	FLOWABLE FILL
• Division 05120	Structural Steel
• Division 06610	FRP Ladders & Ladder Cages
• Division 11311	Submersible Pumps
• Division 15050	Basic Mechanical Materials and Methods
• Division 15140	Pipe Hangers, Supports, and Restraints
• Division 16	Electrical

Scope of Work Includes, but not limited to:

- Sewer Lift Station Rehabilitation
- Underground Pipe Vaults
- Flat Work Concrete
- Electrical, Instrumentation and Controls

Specific exclusions to the scope of work:

1. Sales Tax for permanent material incorporated into the project.

ARTICLE 5: CONTRACT PAYMENT STRUCTURE

5.1 This contract will be paid out as a Lump Sum Contract based on totals from Article 6: Proposal Bid Form below. Payments will be made on a monthly basis. Monthly payment applications are to be submitted by the 20th of each month for work completed to that date with updated progress schedule and approved schedule of values.

Farmers Branch Office Park Lift Station Rehabilitation

ARTICLE 6: PROPOSAL BID FORM

#	Description	QTY	Unit	Unit Price	Total Price
1	Lift Station Rehab and Valve Vault	1	LS	$1,967,090	$1,967,090.00
2	Instrumentation and Controls- Provided by Super Tech- Automation, See Appendix D	1	LS	$47,791.00	$47,791.00
	TOTAL BID				$2,014,881.00

ARTICLE 7: PROPOSERS

Respectfully submitted,

By: Ryan Koontz Title: General Manager

Address: 403 International Pkwy, Suite 500, Richardson, TX 75081

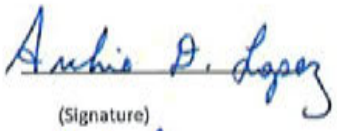
(SEAL)

If Proposer is Corporation

Date: 6/11/2025

CORPORATION EVIDENCE OF AUTHORITY

The following individuals are authorized to execute, sign, and submit proposals, pay applications, contracts, contract amendments, change orders, subcontracts, and contract bonds on behalf of the corporation, Felix Construction Company per Corporate Resolution via Board Meeting in October 2021 until revoked.

	(Print Name)	(Signature)	(Title)
1.	Archie Lopez		President
2.	David Giannetto		CEO
3.	Matt Phillips		Vice President
4.	Kevin Felix		Corp Secretary
5.	Joel Felix		Treasurer
6.	Zach Foster		General Manager
7.	Ryan Koontz		General Manager

DIVISION 99 – Alternates, Contingency & Allowance

SCOPE OF WORK INCLUDED

- *Additional Bypass Pumping – 2 Months*
- *Crack Injection - $/LF*

DETAILED ESTIMATE BY DIVISION

Description	Quantity	Unit	Man Hours	Labor Total	Equipment Total	Material Total	Subcontractor Total	Other Total	Total
99 Division 99 - Alternates, Contingency & Allowance									
11212 Additional Bypass Pumping	2.00	MO	40.00	1,949.50	299.98	40,320.00	94,652.00	44,800.00	182,021.48
11340 Crack Injection									
Crack Injection	250.00	LF	0.00	0.00	0.00	0.00	28,750.00	0.00	28,750.00
11340 - Crack Injection Totals			**0.0**	**$0.00**	**$0.00**	**$0.00**	**$28,750.00**	**$0.00**	**$28,750.00**
99 - Division 99 - Alternates, Contingency & Allowance Totals			**40.0**	**$1,949.50**	**$299.98**	**$40,320.00**	**$123,402.00**	**$44,800.00**	**$210,771.48**
Totals			**40.0**	**$1,949.50**	**$299.98**	**$40,320.00**	**$123,402.00**	**$44,800.00**	**$210,771.48**

3. REFERENCE DOCUMENTS

Drawings

CONSTRUCTION PLANS
FOR
Farmers Branch Office Park Lift Station Rehabilitation
CITY OF FARMERS BRANCH, TEXAS

MARCH 2025

100% FOR BID

INDEX OF SHEETS	
SHEET NO.	DESCRIPTION
G-01	COVER
G-02	GENERAL NOTES SHEET 1 OF 2
G-03	GENERAL NOTES SHEET 2 OF 2
C-01	EXISTING SITE PLAN
C-02	DEMOLITION PLAN
C-03	PROPOSED SITE PLAN
C-04	DIMENSION PLAN
C-05	MECHANICAL PLAN AND SECTION
C-06	STANDARD DETAILS
L-01	LANDSCAPE PLAN
L-02	ARCHITECTURAL RENDERING
L-02B	SITE ELEVATION
E-01	ELECTRICAL SITE-PLAN
E-02	ELECTRICAL ONE-LINE DIAGRAM
E-03	ELECTRICAL CONTROL DIAGRAM (SHEET 1 OF 2)
E-04	ELECTRICAL CONTROL DIAGRAM (SHEET 2 OF 2)
E-05	ELECTRICAL DETAILS (SHEET 1 OF 2)
E-06	ELECTRICAL DETAILS (SHEET 2 OF 2)
S-01	STRUCTURAL DETAILS (SHEET 1 OF 4)
S-02	STRUCTURAL DETAILS (SHEET 2 OF 4)
S-03	STRUCTURAL DETAILS (SHEET 3 OF 4)
S-04	STRUCTURAL DETAILS (SHEET 4 OF 4)

MAYOR
TERRY LYNNE

MAYOR PRO-TEM
OMAR ROMAN

DEPUTY MAYOR PRO-TEM
RICHARD JACKSON

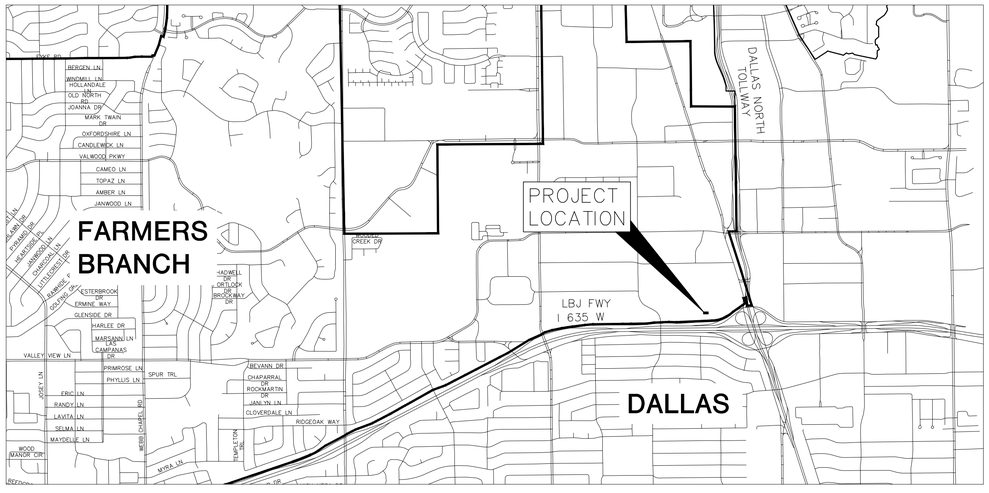
CITY MANAGER
BEN WILLIAMSON

CITY COUNCIL
DISTRICT 1 COUNCIL MEMBER OMAR ROMAN
DISTRICT 2 COUNCIL MEMBER TINA BENNETT-BURTON
DISTRICT 3 COUNCIL MEMBER DAVID REID
DISTRICT 4 COUNCIL MEMBER RICHARD JACKSON
DISTRICT 5 COUNCIL MEMBER ROGER NEAL

DIRECTOR OF PUBLIC WORKS
RAY SILVA-REYES

APPROVED BY:

CITY OF FARMERS BRANCH DATE



LOCATION MAP
SCALE: 1"=2,000'

FARMERS BRANCH

OWNER:
CITY OF FARMERS BRANCH
13000 WM DODSON PARKWAY
P.O. BOX 81900
FARMERS BRANCH, TEXAS 75234
PHONE: (972) 919-2588
FAX: (972) 919-2585

STATE OF TEXAS
D. BRYANT CASWELL
91721
LICENSED
PROFESSIONAL ENGINEER
4/4/2025

ENGINEER:
BGE, Inc.
2595 Dallas Pkwy, Suite 101, Frisco, TX 75034
Tel: 972-464-4800 ● www.bgeinc.com
TBPE Registration No. F-1046

1 GENERAL NOTES

1. ALL CONSTRUCTION SHALL CONFORM TO THE REQUIREMENTS OF THE "STANDARD SPECIFICATIONS FOR PUBLIC WORKS CONSTRUCTION" BY NORTH CENTRAL TEXAS COUNCIL OF GOVERNMENTS (NCTCOG) 2017 (FIFTH EDITION), AND AMENDMENTS THERETO AND IN ACCORDANCE WITH THE CITY OF FARMERS BRANCH CONSTRUCTION SPECIFICATIONS AND STANDARD DETAILS. CONTRACTOR IS RESPONSIBLE FOR OBTAINING A COPY OF THE ABOVE-MENTIONED SPECIFICATIONS AND DETAILS AND HAVING ON THE JOB SITE.
2. THE CONTRACTOR SHALL PROVIDE "AS BUILT" PLANS TO THE ENGINEER SO THAT THE REPRODUCIBLE SHEETS OF THE ENGINEERING PLANS MAY BE CORRECTED TO REFLECT "AS BUILT" CONDITIONS. THE ENGINEER SHALL FURNISH ONE SET OF MYLAR REPRODUCIBLE PLANS, A PDF SET AND AUTOCAD DRAWING FILE REFLECTING THE "AS BUILT" CONDITIONS, TO THE CITY PRIOR TO FINAL ACCEPTANCE OF THE WORK.
3. THE CONTRACTOR SHALL NOT STOCKPILE MATERIAL CONTIGUOUS TO ANY CREEK WITHOUT THE WRITTEN PERMISSION OF THE ENGINEER.
4. THE CONTRACTOR SHALL NOT ALLOW SOILS AND DEBRIS TO ENTER EXISTING INLETS. ALL INLETS SHALL BE PROTECTED DURING CONSTRUCTION.
5. THE CONTRACTOR SHALL LIMIT HIS WORK TO THE R.O.W. OR EASEMENTS SHOWN ON THE DRAWINGS. ALL DISTURBED/DAMAGED AREAS OUTSIDE THE CONSTRUCTION LIMITS SHALL BE REPAIRED AND OR REPLACED AT CONTRACTOR'S EXPENSE.
6. THE CONTRACTOR SHALL MAINTAIN ADEQUATE DRAINAGE AT ALL TIMES AND PROVIDE AND MAINTAIN EROSION PROTECTION IN AND ADJACENT TO CONSTRUCTION SITE.
7. ALL GROUNDWATER, SEEPAGE, STORM WATER, OR WATER FROM ANY SOURCE THAT MAY OCCUR OR ACCUMULATE IN EXCAVATIONS DURING THE PROGRESS OF THE WORK SHALL BE REMOVED. ALL EXCAVATIONS SHALL BE KEPT ENTIRELY FREE OF STANDING WATER AT ALL TIMES DURING THE CONSTRUCTION WORK OR UNTIL OTHERWISE DIRECTED BY THE CITY. ALL EXPENSE NECESSARY TO COMPLY WITH THIS REQUIREMENT SHALL BE BORNE BY THE CONTRACTOR.
8. AREAS WHICH HAVE BEEN BACKFILLED TO COMPLY WITH THE REQUIREMENTS OF PARAGRAPH #7, ABOVE, BUT HAVE NOT BEEN PROPERLY COMPACTED, SHALL BE PROMPTLY REMOVED AT THE START OF THE NEXT WORKING DAY AND COMPACTED IN ACCORDANCE WITH SECTIONS OF THE SPECIFICATIONS.
9. THE CONTRACTOR SHALL NOT DISPOSE WASTES OR ANY OTHER MATERIALS INTO STREAMS OR WATERWAYS. EXCESS MATERIAL SHALL BE HAULED AWAY EACH DAY AND NOT BE ALLOWED TO ACCUMULATE.
10. THE CONTRACTOR SHALL NOT BURN OR BURY RUBBISH AND WASTE MATERIALS ON PROJECT SITE.
11. THE CONTRACTOR SHALL WET DOWN DRY MATERIALS TO ALLAY DUST AND PREVENT BLOWING DUST.
12. ALL DIMENSIONS SHOWN ON THE PLANS ARE TO BACK OF CURB AND/OR TO THE CENTERLINE OF PIPE, UNLESS NOTED OTHERWISE.
13. THE CONTRACTOR WILL BE RESPONSIBLE FOR NOTIFYING THE ENGINEER, THE TRAFFIC ENGINEER, THE POLICE AND FIRE DEPARTMENTS AT LEAST 24 HOURS IN ADVANCE WHEN ANY ROADWAY WILL BE CLOSED OR REOPENED.
14. THE CONTRACTOR SHALL BE REQUIRED TO PROVIDE AND MAINTAIN ALL NECESSARY WARNING AND SAFETY DEVICES (FLASHING LIGHTS, BARRICADES, SIGNS, ETC. IN CONFORMANCE WITH THE TEXAS MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES) TO PROTECT PUBLIC SAFETY AND HEALTH UNTIL THE WORK HAS BEEN COMPLETED AND ACCEPTED BY THE CITY.
15. THE LOCATIONS OF EXISTING UTILITIES AND STRUCTURES SHOWN ON THESE PLANS ARE APPROXIMATE AND THE COMPLETENESS AND THE ACCURACY OF THIS DATA IS NOT GUARANTEED. IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO LOCATE AND VERIFY IN THE FIELD ANY UTILITIES AND STRUCTURES THAT MAY CONFLICT WITH THE CONSTRUCTION OF THE PROJECT. ANY UTILITIES AND/OR STRUCTURES DAMAGED DURING THE CONSTRUCTION OF THE PROJECT SHALL BE REPAIRED AT THE CONTRACTOR'S EXPENSE. AT LEAST 24 HOURS PRIOR TO BEGINNING CONSTRUCTION IN THE VICINITY OF EXISTING UNDERGROUND UTILITIES, THE CONTRACTOR SHALL NOTIFY THE FOLLOWING, AS APPLICABLE:

CITY OF FARMERS BRANCH	972-247-3131
PUBLIC WORKS DEPARTMENT	972-919-2597
UTILITIES DEPARTMENT	972-919-2597
TRA	817-493-5100
ONCOR ELECTRIC DELIVERY	
LINE LOCATION SERVICE (DIGTESS)	1-800-344-8377
EMERGENCIES	1-888-313-4747
ATMOS ENERGY	
LINE LOCATION SERVICE (DIGTESS)	1-800-344-8377
EMERGENCIES	1-800-817-8090
SPECTRUM/TIME WARNER CABLE	
LINE LOCATION SERVICE (DIGTESS)	1-800-344-8377
EMERGENCIES	1-877-833-6350 (OPTION2)
A.T. & T.	1-800-245-4545
LINE LOCATION SERVICE (DIGTESS)	1-800-344-8377
EMERGENCIES	214-458-8879

THE PUBLIC WORKS DEPARTMENT, UTILITY DIVISION (972.919-2597), SHALL TO BE CONTACTED TO LOCATE CITY-OWNED WATER LINES AND SANITARY SEWER LINES. THE PARKS AND RECREATION DEPARTMENT (972.919-2620) SHALL BE CONTACTED TO LOCATE CITY-OWNED IRRIGATION LINES AND ELECTRIC (LIGHTING) LINES. THE PUBLIC WORKS DEPARTMENT, STREETS DIVISION (972.919-2597) SHALL TO BE CONTACTED TO LOCATE CITY-OWNED FIBER OPTIC LINES AND TRAFFIC SIGNAL LINES.

WHEN THE CITY-OWNED LINES ARE LOCATED BY ANY CITY DEPARTMENT, THE LOCATES SHALL BE CONSIDERED VALID UP TO TWO WEEKS, AFTER WHICH NEW LOCATES SHALL BE REQUIRED. UNLESS THE LINES ARE PHYSICALLY UNCOVERED, SURFACE LOCATES OF CITY-OWNED LINES SHALL BE CONSIDERED TO BE APPROXIMATE. FOR ANY FACILITIES THAT ARE TO BE CONSTRUCTED WITHIN 3 FEET OF THE SURFACE LOCATES, ADDITIONAL SUBSURFACE INVESTIGATION SHOULD BE CONSIDERED TO ENSURE THAT THE CITY-OWNED LINES ARE APPROPRIATELY LOCATED.

16. CONTRACTOR MUST HAVE A SET OF PLANS WITH RED STAMP STATING "RELEASED FOR CONSTRUCTION" ON THE PROJECT AT ALL TIMES.
17. PRODUCT MANUFACTURER'S NAME(S) AND/OR MODEL NUMBERS ARE USED HEREIN TO SET A STANDARD OF QUALITY AND ARE NOT INTENDED TO BE A RESTRAINT OF TRADE OR PREVENT SUBMITTALS OF OTHER MANUFACTURER'S PRODUCTS OF EQUAL QUALITY AND EQUAL COLORS, FOR PRODUCTS SO MENTIONED.
18. SHOULD ANY PART OF A CONCRETE PAVEMENT PANEL BE REMOVED FOR UTILITY LINE INSTALLATION, THE ENTIRE PANEL SHALL BE REPLACED EXCEPT OTHERWISE DIRECTED BY THE ENGINEER.
19. EXISTING REGULATORY SIGNS AND STREET DESIGNATION SIGNS IN CONFLICT WITHIN THE CONSTRUCTION LIMITS SHALL BE REMOVED AND RELOCATED OR REMOVED, SALVAGED, AND REPLACED BY THE CONTRACTOR AS DIRECTED BY THE ENGINEER. COST OF REMOVAL AND RELOCATION OF PERMANENT AND TEMPORARY SIGNS SHALL BE SUBSIDIARY TO OTHER ITEMS OF THE PROJECT. SIGN REMOVAL, REPLACEMENT AND RELOCATION SHALL INCLUDE FOUNDATION, POST, SIGN PANEL AND ASSOCIATED LABOR COST.
20. CONTRACTOR SHALL MAINTAIN CONTINUOUS ALL WEATHER ACCESS INTO AND OUT OF THE SUBDIVISION, TO LOCAL STREETS, AND TO AND FROM EACH RESIDENCE DURING THE CONSTRUCTION.
21. WORK MAY NOT BE BACKFILLED OR COVERED UNTIL IT HAS BEEN INSPECTED BY THE CITY INSPECTOR.
22. ANY WORK INDICATED ON THE PLANS THAT DOES NOT HAVE A SPECIFIC PAY ITEM SHALL BE CONSIDERED SUBSIDIARY TO RELATED PAY ITEMS
23. THE CONTRACTOR SHALL PROVIDE THE CITY A MAINTENANCE BOND THAT COVERS ALL CONSTRUCTED PUBLIC WORKS INFRASTRUCTURE AS SHOWN ON THESE PLANS. MAINTENANCE BOND SHALL BE FOR A PERIOD OF ONE YEAR FROM ACCEPTANCE OF PROJECT BY THE CITY AND SHALL BE IN AN AMOUNT OF 100% OF THE COST OF SAID INFRASTRUCTURE. BOND SHALL BE PREPARED BY A SURETY AUTHORIZED TO DO BUSINESS IN THE STATE OF TEXAS.
24. ALL BORING IN CITY OF FARMERS BRANCH RIGHTS-OF-WAY AND EASEMENTS MUST BE PERFORMED WITH A STEERABLE, TRACEABLE BORING MACHINE AND ALL PIPES 6" AND ABOVE SHALL BE ENCASED.

2 PAVEMENT

1. ALL CONCRETE SHALL BE CLASS 'C' 3600 PSI (SIX SACK MIX) COMPRESSIVE STRENGTH AT 28 DAYS, UNLESS NOTED OTHERWISE. FLY ASH WILL NOT BE ALLOWED. REINFORCEMENT SHALL BE SPACED ON 18" CENTERS IN BOTH DIRECTIONS. PAVEMENT THICKNESS 8" & ABOVE SHALL HAVE #4 REBAR AND 7" & BELOW SHALL USE #3 REBAR.
2. ALL JOINTS SHALL BE SAWED INTO THE COMPLETED CONCRETE PAVEMENT SURFACE WITHIN 12 HOURS OF PLACEMENT.
3. CONTRACTOR SHALL BAKER BROOM FINISH ALL PLACED CONCRETE AS APPROVED BY THE ENGINEER UNLESS NOTED OTHERWISE.
4. CONTRACTOR SHALL MATCH ALL PROPOSED PAVEMENT, CURB, SIDEWALK AND DRIVEWAYS WITH EXISTING UNLESS NOTED OTHERWISE.
5. THE COST OF ELEVATION ADJUSTMENT OF MANHOLES, VALVES, CLEANOUTS, IRRIGATION HEADS, PULLBOXES AND WATER METERS SHALL BE SUBSIDIARY TO THE OTHER ITEMS OF THE PROJECT. ALL METERS, VALVES AND MANHOLES REQUIRING ADJUSTMENT SHALL BE CROSS-REFERENCED BY THE CONTRACTOR SO THAT THEY MAY BE EASILY RELOCATED AFTER PAVING. ALL ELEVATION ADJUSTMENTS SHALL BE COMPLETED PRIOR TO PLACING THE PAVEMENT.
6. ALL DIMENSIONS AND STATION LOCATIONS SHOWN ON THE PLANS ARE TO BACK OF CURB UNLESS NOTED OTHERWISE.
7. REMOVAL OF EXISTING CURB SHALL BE SUBSIDIARY TO PAVEMENT REMOVAL PAY ITEM.
8. CONSTRUCTION OF 6" INTEGRAL CURB ON STREETS SHALL BE SUBSIDIARY TO STREET PAVEMENT PAY ITEM.
9. ALL SAWCUTS INCLUDING LONGITUDINAL BUTT JOINTS & REINFORCING STEEL SHALL BE SUBSIDIARY TO REMOVAL OR REPLACEMENT OF PAVEMENT PAY ITEM.
10. AT ALL STREETS, ALLEYS, AND DRIVEWAYS THE CONTRACTOR SHALL CONSTRUCT CITY OF FARMERS BRANCH STANDARD DRIVEWAY APPROACH WITH TAS COMPLIANT PATH.
11. PREPARATION OF R.O.W. (NCTCOG ITEM 203.3.) INCLUDES BUT IS NOT LIMITED TO REMOVAL OF EXISTING CURB AND GUTTER, DRIVEWAYS, PAVEMENTS, TREES, INLETS, MANHOLES, PIPES AND NECESSARY EXCAVATION TO PROPOSED GRADE SHOWN ON THE PLANS UNLESS OTHERWISE PROVIDED FOR IN A SEPARATE BID ITEM.
12. UNCLASSIFIED EXCAVATION (REFERENCE: NCTCOG ITEM 203.4, 203.5) INCLUDES ALL EXCAVATION, REMOVAL AND DISPOSAL WITHIN THE LIMITS OF R.O.W. AND AREAS ADJACENT THERETO AS SHOWN ON THE PLANS.
13. ALL BARRIER FREE RAMP TRUNCATED DOMES SHALL BE ACCESS TILE REPLACEABLE CAST IN PLACE PLATES IN COLOR BRICK RED (22144), OR APPROVED EQUAL. ALLTRUNCATED DOME PRODUCTS SHALL BE DOMESTICALLY PRODUCED.

3 BACKFILL

1. BACKFILL (NCTCOG SECTION 1, DIV. 301) UNDER PAVEMENT SHALL HAVE A UNIFORM DENSITY OF NOT LESS THAN 95% OF THE MAXIMUM DENSITY AS DETERMINED BY ASTM D698. BACKFILL NOT UNDER PAVEMENT SHALL HAVE A UNIFORM DENSITY OF NOT LESS THAN 90% OF THE MAXIMUM DENSITY AS DETERMINED BY ASTM D698.

4 STORM SEWER

1. ALL STORM SEWER PIPE SHALL BE REINFORCED CONCRETE PIPE, CLASS III, WITH C+ EMBEDMENT, UNLESS NOTED OTHERWISE. EMBEDMENT, BACKFILL AND COMPACTION IS SUBSIDIARY TO PIPE INSTALLATION.
2. FROM THE TIME A STATION FOR MANHOLE IS REACHED, THE CONTRACTOR SHALL CASE AND CURE THE MANHOLE AND BACKFILL TO A DRIVABLE SURFACE WITHIN FOURTEEN (14) CALENDAR DAYS UNLESS OTHERWISE SPECIFIED BY THE ENGINEER.
3. CONCRETE COLLAR SHALL BE PLACED AT ALL PIPE SIZE CHANGES AS PER DETAIL AND COST IS SUBSIDIARY TO PIPE INSTALLATION.

5 CURB PAINTING

1. THE ADDRESS NUMBERS MUST BE 3 INCHES, WHITE IN COLOR CENTERED WITHIN A 5-INCH HIGH RED COLOR BACKGROUND.
2. WHEN PAINTING AN ADDRESS AT ONE LOCATION, IT MUST BE PLACED AT THE CENTER OF THE PROPERTY. WHEN PAINTING AN ADDRESS AT TWO LOCATIONS, IT MUST BE PAINTED ON EACH SIDE OF THE DRIVEWAY.

6 TRENCH

1. ALL TRENCHING AND EXCAVATION SHALL BE PERFORMED IN ACCORDANCE WITH OSHA STANDARDS. THE MAXIMUM LENGTH OF OPEN EXCAVATION FOR TRENCHES SHALL BE LIMITED TO 100 LINEAR FEET REGARDLESS OFDEPTH. ALL TRENCHES THAT OPEN TO TRAFFIC SHALL BE PLATED OR BACKFILLED WITH FLEXBASE OR CRUSHED CONCRETE AND SHALL BE A DRIVABLE SURFACE. A DRIVABLE SURFACE SHALL NOT BE LOWER THAN THE ADJOINING/EXISTING DRIVABLE SURFACE AND NOT GIVE WAY WHEN DRIVEN ON OR SHALL BE AS DETERMINED BY THE ENGINEER. ALL THE TRENCHES THAT REMAIN BEHIND BARRICADES DO NOT NEED TO BE BACKFILLED. THE COST OF THIS BACKFILL IS NOT A SEPARATE PAY ITEM.

7 SANITARY SEWER

1. ALL SANITARY SEWER MAINS 6" TO 15" SHALL BE ASTM D3034 SDR-26 P.V.C. GRAVITY SEWER PIPE. PIPE COLOR SHALL BE GREEN.
2. ALL SANITARY SEWER MAINS 18" TO 27" SHALL BE ASTM F679 (TYPE 1) PS115 P.V.C. GRAVITY SEWER PIPE COLOR SHALL BE GREEN.
3. ALL SANITARY SEWER MAINS LARGER THAN 27" SHALL BE RCP ASTM C76 OF MINIMUM STRENGTH CLASS III. ALL JOINTS TO BE RUBBER O-RING GASKET TYPE CONFORMING TO ASTM C443.
4. ALL SANITARY SEWERS SHALL BE AIR TESTED IN ACCORDANCE WITH THE NCTCOG SPECIFICATIONS AND MANDREL.
5. ALL SANITARY SEWERS SHALL BE TELEVISED IN THE PRESENCE OF THE CITY INSPECTOR AND A VIDEO TAPE SHALL BE MADE AND FURNISHED TO THE CITY.
6. ALL SANITARY SEWER SERVICE LATERALS (4") SHALL BE PREFERABLY SDR-26 P.V.C GRAVITY PIPE OR SCHEDULE 40 POLY VINYL CHLORIDE (PVC) PIPE.
7. EMBEDMENT SHALL BE EMBEDMENT B-2 PER NCTCOG EMBEDMENT DETAIL 3030 UNLESS NOTED OTHERWISE ON PLANS AND IS NOT A SEPARATE PAY ITEM.
8. FOR PAVEMENT CUTS USE NCTCOG 3070 DETAIL WITH FULL DEPTH SAW CUT.
9. MANHOLE RING AND COVER SHALL BE BASS & HAYS HM ERGO 30XL W/FARMERS BRANCH LOGO OR APPROVED EQUAL.
10. ALL SANITARY SEWER MANHOLES SHALL BE VACUUM TESTED IN THE PRESENCE OF THE CITY INSPECTOR.
11. CUTTING & PLUGGING OF EXISTING SEWER MAINS ARE SUBSIDIARY TO SEWER MAIN INSTALLATION ITEM UNLESS SPECIFIED OTHERWISE.
12. ALL FITTINGS INCLUDING BUT NOT LIMITED TO PLUGS, TEES, CROSSES, BENDS, REDUCERS, CAPS ETC ARE SUBSIDIARY TO THE SEWER MAIN INSTALLATION ITEM UNLESS SPECIFIED OTHERWISE.

REV	DESCRIPTION	DATE	APR
◁			
◁			
◁			
◁			
◁			

DESIGNED BY: CC
REVIEWED BY: BC
DRAWN BY: MC

BGE, Inc.
2595 DALLAS PARKWAY, SUITE 101
FRISCO, TX 75034
TEL: 972-464-4080 • www.bgeinc.com
TBPE Registration No. F-1046

FBOP LIFT STATION REHABILITATION
CITY OF FARMERS BRANCH, TEXAS

GENERAL NOTES SHEET 1 OF 2

STATE OF TEXAS
BRYANT CASWELL
91721
LICENSED
PROFESSIONAL ENGINEER

4/4/2025

SHEET
G-02 OF 22

8 WATER

1. ALL WATER MAIN CONSTRUCTION SHALL CONFORM TO THE MINIMUM REQUIREMENTS OF THE TEXAS COMMISSION ON ENVIRONMENTAL QUALITY (TCEQ) RULES AND REGULATIONS FOR PUBLIC WATER AND SEWER SYSTEMS.
2. ACCEPTABLE WATER MAIN SIZES SHALL BE 6" AND LARGER. WATER MAINS LESS THAN 6" DIAMETER WILL NOT BE PERMITTED.
3. ALL WATER MAINS 8" OR LESS SHALL BE DR18, AWWA C900 P.V.C. WATER PIPE. PIPE COLOR SHALL BE BLUE UNLESS SPECIFIED OTHERWISE.
4. ALL 12" WATER MAINS SHALL BE DR14 (UNLESS SPECIFIED OTHERWISE), AWWA C900 P.V.C. WATER PIPE OR AWWA C303 RCCP. P.V.C. PIPE COLOR SHALL BE BLUE.
5. ALL 16" WATER MAINS SHALL BE DR14 (UNLESS SPECIFIED OTHERWISE), AWWA C900 P.V.C. WATER PIPE OR AWWA C303 RCCP. P.V.C. PIPE COLOR SHALL BE BLUE.
6. ALL WATER MAINS LARGER THAN 18" SHALL BE AWWA C303 BAR-WRAPPED CONCRETE CYLINDER PIPE.
7. ALL 4" THROUGH 12" RESILIENT SEAT GATE VALVES SHALL BE MUELLER (A-2370-SERIES), EJ FLOWMASTER OR APPROVED EQUAL.
8. ALL 16" AND LARGER VALVES SHALL BE MUELLER LINESEAL III BUTTERFLY VALVES (B-3211-SERIES-0024) OR APPROVED EQUAL.
9. ALL TAPPING SLEEVES SHALL BE MUELLER FULL CIRCLE STAINLESS STEEL OR APPROVED EQUAL.
10. ALL JOINTS SHALL BE MECHANICAL JOINTS WITH NON-CORROSIVE BOLTS AND BE EQUIPPED W/ MEGA LUG STYLE RINGS.
11. ALL WATER MAINS SHALL HAVE A MINIMUM COVER OF 48" BELOW FINISHED GRADES.
12. ALL WATER MAINS SHALL BE PRESSURE TESTED IN ACCORDANCE WITH THE NCTCOG SPECIFICATIONS. THE CONTRACTOR SHALL FLUSH AND STERILIZE ALL WATER MAINS. THE CITY WILL TAKE WATER SAMPLES AND HAVE LABORATORY TESTS PERFORMED TO PROVE THE WATER MAINS TO BE FREE OF BACTERIA/MICRO-ORGANISMS.
13. THE WATER SERVICES THAT ARE INSTALLED BEFORE THE COMPLETION OF STREET CONSTRUCTION SHALL BE LAID IN THE SERVICE DITCH AT THE SAME ELEVATION AS THE WATER MAIN OR A MINIMUM COVER OF 30" BELOW TOP OF CURB GRADE. AT THE PROPER LOCATION FOR THE METER BOX, THE METER (CURB) STOP SHALL BE RAISED TO 18" BELOW TOP OF CURB GRADE WITH EXCESS COPPER TUBING TO RAISE THE STOP AT A FUTURE DATE TO 8" BELOW TOP OF CURB GRADE.
14. FOR SERVICE CONNECTIONS, USE DOUBLE BRASS STRAP SERVICE CLAMP WHEN TAPPING ALL PIPE.
15. ALL FIRE HYDRANTS SHALL CONFORM TO AWWA STANDARD SPECIFICATIONS FOR FIRE HYDRANTS FOR ORDINARY WATER WORKS SERVICE, C-502. FIRE HYDRANTS SHALL BE THREE-WAY AND HAVE A 5 1/4" BARREL, 4 1/2" STEAMER NOZZLE AND 2 1/2" HOSE NOZZLES. ALL HYDRANTS SHALL BE EQUIPPED WITH A BREAKAWAY FLANGE. FIRE HYDRANT SHALL HAVE NON-RISING STEM "O" RING SEALS AND MECHANICAL JOINT INLET ENDS.
16. ALL NEW FIRE HYDRANTS SHALL BE AVK 2780, MUELLER SUPER CENTURION 250, M&H MODEL 129, OR APPROVED EQUAL. ALL FIRE HYDRANTS SHALL BE POWDER COATED RAL 3020 TRAFFIC RED IN COLOR.
17. HOSE/PUMPER NOZZLES ON FIRE HYDRANTS SHALL BE 18" TO 24" ABOVE THE TOP OF CURB, OR FINISHED GRADE, AND SHALL FACE THE STREETS OR FIRELANE. FIRE HYDRANT SHALL BE PLACED NOT LESS THAN 3' NOR MORE THAN 6' BEHIND THE CURB. SET FIRE HYDRANT ON THE LOT LINE EXTENDED AND/OR AT CURB RETURN OF STREET INTERSECTION. FIRE HYDRANT SHALL BE NO CLOSER THAN 18" TO EXISTING OR PROPOSED SIDEWALKS. STANDARD BURY DEPTH OF FIRE HYDRANT IS 4'. ACTUAL VALVE LOCATION WILL DEPEND ON LOCATION OF WATER MAIN.
18. EMBEDMENT SHALL BE EMBEDMENT B+ PER NCTCOG EMBEDMENT DETAIL 3020 UNLESS NOTED OTHERWISE ON PLANS AND IS NOT A SEPARATE PAY ITEM.
19. FOR THRUST BLOCK USE NCTCOG 4010A-4040 DETAILS AND IS NOT A SEPARATE PAY ITEM.
20. FOR PAVEMENT CUTS USE NCTCOG 3070 DETAIL WITH FULL DEPTH SAW CUT.
21. ALL SERVICE FITTINGS SHALL BE BRASS W/ COMPRESSION STYLE FITTINGS.
22. ALL VALVE STACKS LOCATED IN UNIMPROVED AREAS SHALL HAVE 24"X24"X6" CONCRETE PAD.
23. ALL TEES SHALL BE M.J. X FLANGE AND EQUIPPED WITH APPROPRIATE FLANGED VALVE (UNLESS SPECIFIED OTHERWISE).
24. ALL 1" AND 2" TAPS SHALL BE MADE ON 45 DEGREE ANGLES.
25. WATER METER BOXES FOR SIZE 1" OR SMALLER SHALL BE "DFW" (DFW37C-12-1BA) WITH BRASS KEY LOCK OR APPROVED EQUAL.
26. WATER METER BOXES FOR SIZE 1 1/2" TO 2" SHALL BE "DFW" (DFW65C-14-1BA) WITH BRASS KEY LOCK OR APPROVED EQUAL.
27. CUTTING & PLUGGING OF EXISTING WATER MAINS ARE SUBSIDIARY TO WATER MAIN INSTALLATION UNLESS SPECIFIED OTHERWISE.
28. ALL FITTINGS INCLUDING BUT NOT LIMITED TO PLUGS, TEES, BENDS, REDUCERS, CAPS ETC ARE SUBSIDIARY TO THE WATER MAIN INSTALLATION ITEM UNLESS SPECIFIED OTHERWISE.
29. ALL FITTINGS SHALL BE COMPACT DUCTILE IRON MEETING AWWA C153. FITTINGS SHALL BE DOMESTICALLY MANUFACTURED.
30. WATER METERS SHALL BE BADGER, NEPTUNE, OR A BRAND APPROVED BY THE CITY AND MUST BE POTTED FOR ITRON 100W+END POINTS. SPLICING IS NOT ACCEPTABLE. THE COST OF ALL NEW WATER METERS AND THE INSTALLATION SHALL BE BORNE BY THE WATER SERVICE APPLICANT/DEVELOPER/OWNER OF THE PROPERTY AND SHALL INCLUDE THE REQUIRED ITRON 100W+END POINTS. THE APPLICANT/DEVELOPER/OWNER SHALL INSTALL OR CAUSE TO BE INSTALLED THE WATER METER AND SHALL ALSO PROVIDE THE CITY OF FARMERS BRANCH PUBLIC WORKS DEPARTMENT, UTILITY DIVISION WITH THE ABOVE APPROVED ITRON END POINT TO BE INSTALLED BY THE CITY. UPON COMPLETE INSTALLATION OF WATER METER BY THE APPLICANT/DEVELOPER/OWNER, AND INSTALLATION OF THE END POINT BY THE CITY OF FARMERS BRANCH, THE CITY SHALL OWN SAID EQUIPMENT.
31. WATER VALVE ABANDONMENT: REMOVE EXISTING VALVE COVER LID, VALVE COVER, VALVE STACK AS NEEDED FOR 12" MIN. CLEARANCE FROM EXISTING PAVEMENT, SOIL, OR PROPOSED PAVEMENT (WHICHEVER IS GREATER), REMOVE VALVE STEM EXTENSION IF EQUIPPED, AND BACKFILL VALVE STACK WITH MIN. 2 SACK CONC. MIX.

9 IRRIGATION & LANDSCAPE

1. ALL EXISTING IRRIGATION SHALL BE CONSIDERED TO REMAIN UNLESS NOTED OTHERWISE. DAMAGE TO EXISTING IRRIGATION SHALL BE REPAIRED/REPLACED AT THE CONTRACTOR'S EXPENSE. DAMAGE TO EXISTING IRRIGATION SYSTEMS SHALL BE REPAIRED WITHIN 24 HOURS.
2. EXISTING IRRIGATION HEADS TO BE RELOCATED ARE TO BE SET 4" FROM EDGE OF PAVEMENT OR BACK OF CURB. SET HEADS FLUSH WITH FINISHED GRADE.
3. ALL LANDSCAPING IN RIGHTS-OF-WAY OR EASEMENTS SHALL BE APPROVED BY THE ENGINEER PRIOR TO CONSTRUCTION.
4. DAMAGE TO EXISTING LANDSCAPE TO REMAIN SHALL BE REPLACED WITH LIKE KIND AND SIZE AT THE CONTRACTOR'S EXPENSE.

10 SOD

1. ALL SODDING SHALL BE ACCOMPLISHED WITH THE TYPE OF TURF WHICH MATCHES THE EXISTING SOD, OR AS SPECIFIED IN THE PLANS OR SPECIFICATIONS.
2. ALL TURF AREAS DISTURBED BY WORK SHALL BE SODDED UNLESS OTHERWISE NOTED ON THE PLANS. PAYMENT SHALL BE MADE FOR WORK REQUIRED INSIDE GRADING LIMITS AND CONSTRUCTION LIMITS AS SHOWN ON PLANS. ALL TURF AREAS DISTURBED OUTSIDE THESE LIMITS SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR AND SHALL BE SODDED AT THE CONTRACTOR'S EXPENSE. ALL SODDING SHALL ADHERE TO REQUIREMENTS OF CITY OF FARMERS BRANCH STANDARD SPECIFICATIONS FOR TURF ESTABLISHMENT / SOLID SOD.

11 TREES

1. THE CONTRACTOR IS TO EXERCISE EXTREME CAUTION DURING ALL PHASES OF THE PROJECT TO PROTECT EXISTING TREES AND SHRUBS. CONTRACTOR SHALL BE RESPONSIBLE FOR REPLACEMENT OF ANY TREES AND SHRUBS DAMAGED THAT WAS NOT INDICATED TO BE REMOVED DURING THE CONSTRUCTION. CONTRACTOR SHALL FULLY REMOVE THE TREES INDICATED ON THE PLANS TO BE REMOVED. DAMAGED TREE ROOTS SHALL BE SAW CUT.

12 ABBREVIATIONS

APPROX	APPROXIMATE
ATS	AUTOMATIC TRANSFER SWITCH
CIRF	CAPPED IRON PIN FOUND (SURVEY)
CI	CAST IRON
CL	CENTERLINE
CONC	CONCRETE
DIA	DIAMETER
DIP	DUCTILE IRON PIPE
EL	ELEVATION
EX	EXISTING
FFEL	FINISHED FLOOR ELEVATION
FL	FLOW LINE
IRF	IRON PIN FOUND (SURVEY)
INV	INVERT
LF	LINEAR FEET
LS	LUMP SUM
MCC	MOTOR CONTROL CENTER
MH	MANHOLE
MIN	MINIMUM
NG	NATURAL GRADE
PROP	PROPOSED
PVC	POLYVINYL CHLORIDE
SF	SQUARE FEET
SS	SANITARY SEWER
SSMH	SANITARY SEWER MANHOLE
STD	STANDARD
SY	SQUARE YARDS
TC	TOP OF CURB
TRA	TRINITY RIVER AUTHORITY
TYP	TYPICAL
VCT	VITRIFIED CLAY TILE (PIPE)
W/	WITH
WL	WATER LINE

REV	DESCRIPTION	DATE	APR

DESIGNED BY: CC
REVIEWED BY: CC
DRAWN BY: BGE

BGE, Inc.
2595 DALLAS PARKWAY, SUITE 101
FRISCO, TX 75034
TEL: 972-464-4080 • www.bgeinc.com
TBPE Registration No. F-1046

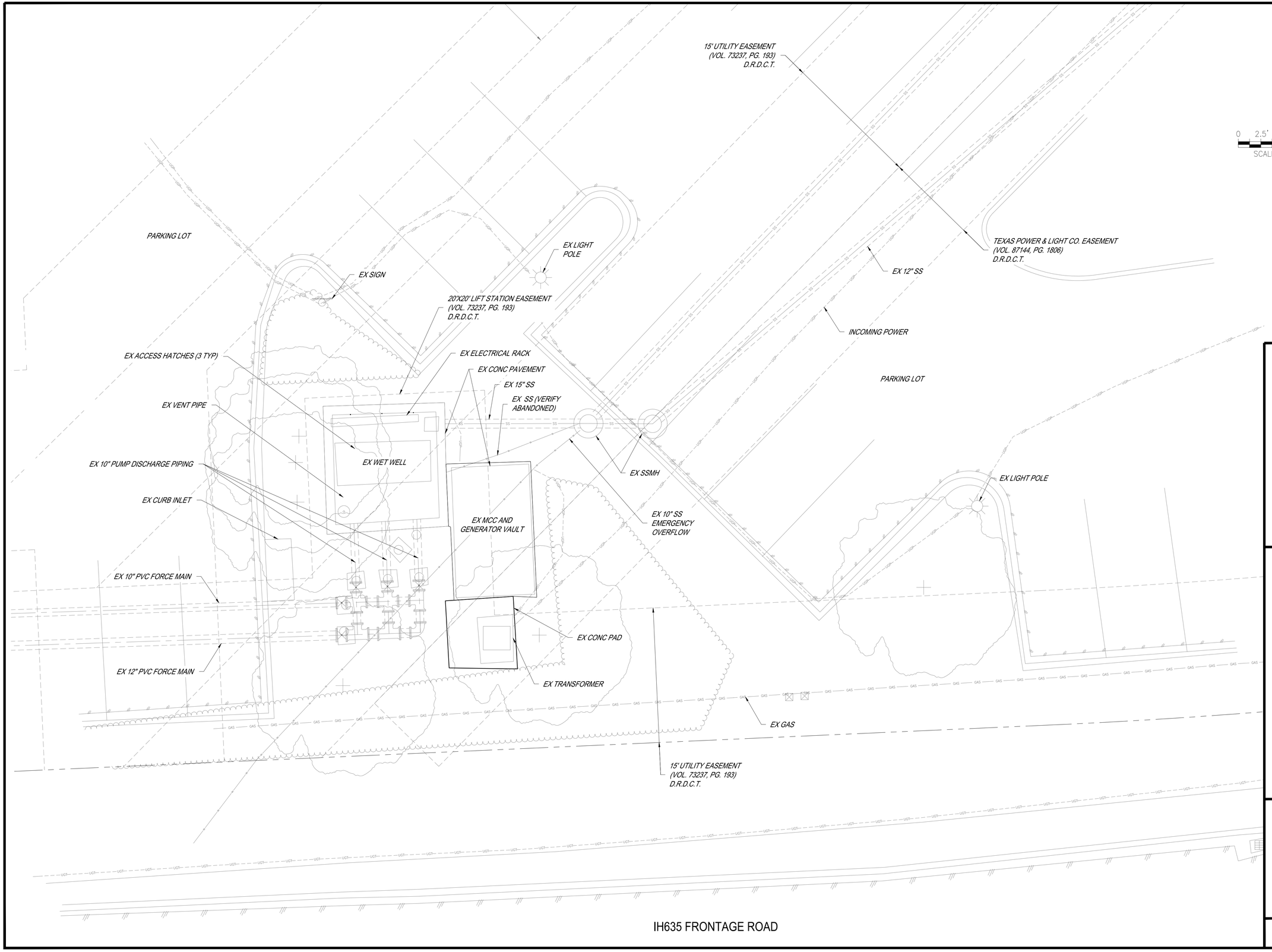
FBOP LIFT STATION REHABILITATION
CITY OF FARMERS BRANCH, TEXAS

GENERAL NOTES SHEET 2 OF 2

STATE OF TEXAS
D. BRYANT CASWELL
91721
LICENSED
PROFESSIONAL ENGINEER

4/4/2025

SHEET
G-03 OF 22



REV	DESCRIPTION	DATE	APR

DESIGNED BY: CC
REVIEWED BY: BC
DRAWN BY: MC

BGE, Inc.
2595 DALLAS PARKWAY, SUITE 101
FRISCO, TX 75034
TEL: 972-464-4080 • www.bgeinc.com
TBPE Registration No. F-1046

FBOP LIFT STATION REHABILITATION
CITY OF FARMERS BRANCH, TEXAS

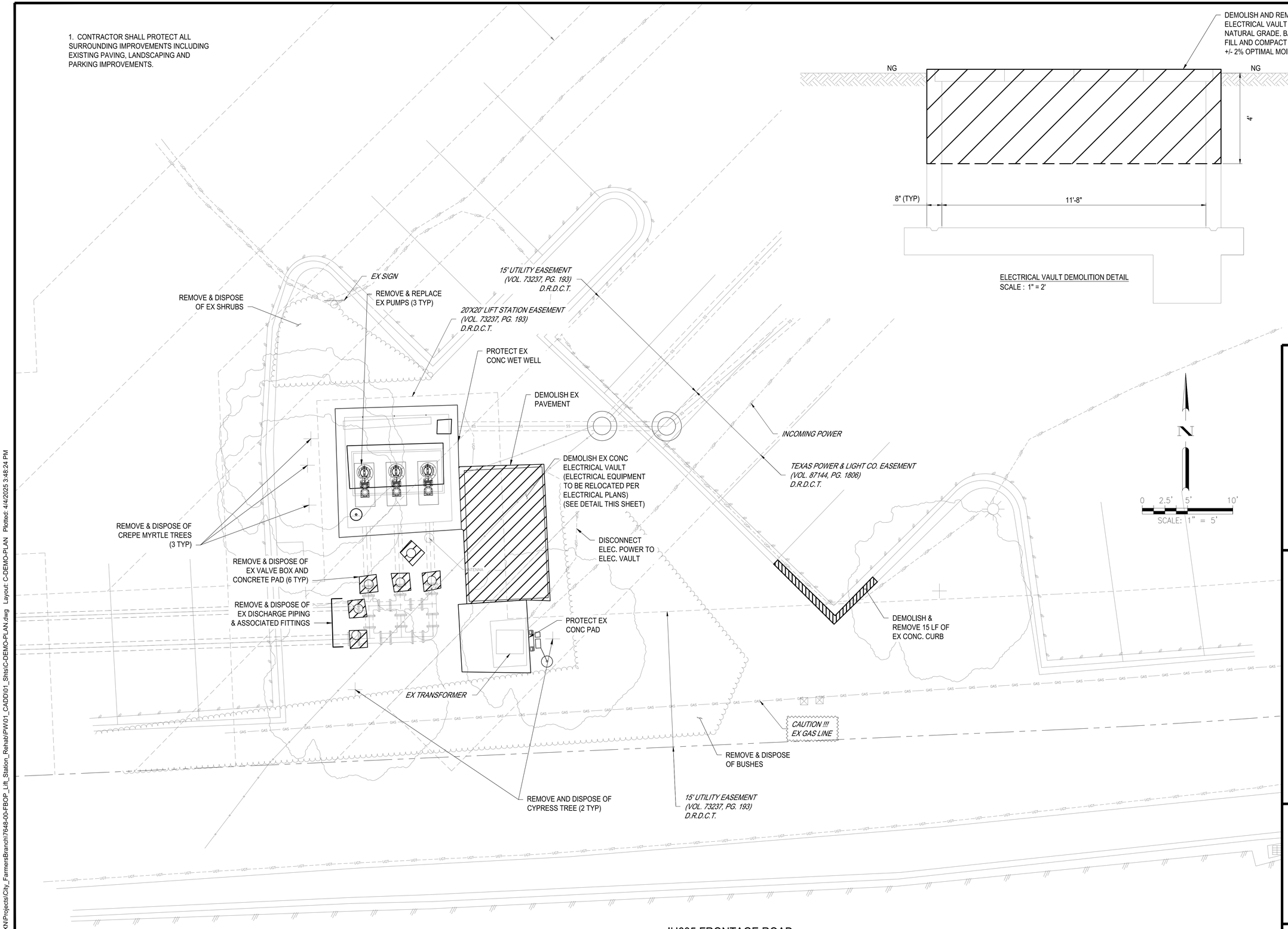
EXISTING SITE PLAN

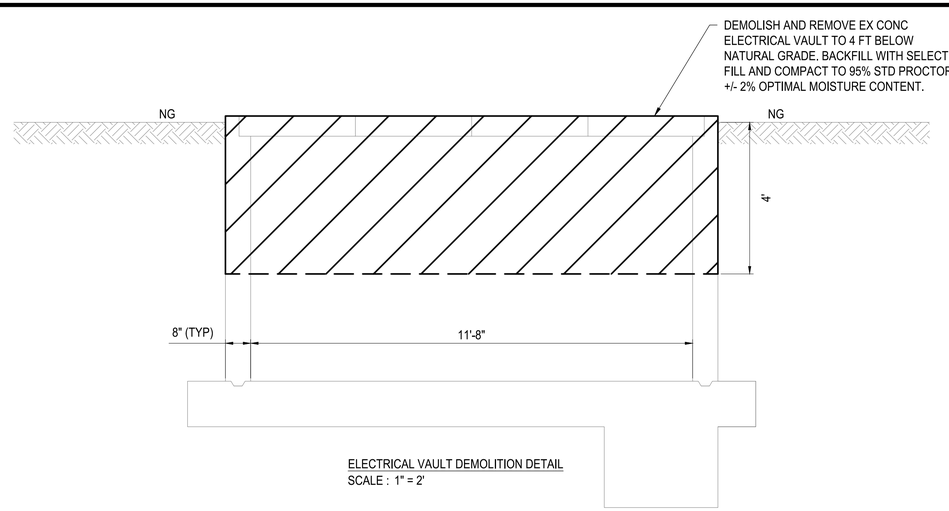
STATE OF TEXAS
D. BRYANT CASWELL
91721
LICENSED
PROFESSIONAL ENGINEER

4/4/2025

SHEET
C-01 OF 22

1. CONTRACTOR SHALL PROTECT ALL SURROUNDING IMPROVEMENTS INCLUDING EXISTING PAVING, LANDSCAPING AND PARKING IMPROVEMENTS.





ELECTRICAL VAULT DEMOLITION DETAIL
SCALE : 1" = 2'

REV	DESCRIPTION	DATE	APR

DESIGNED BY: CC
REVIEWED BY: BC
DRAWN BY: MC

BGE, Inc.
2595 DALLAS PARKWAY, SUITE 101
FRISCO, TX 75034
TEL: 972-464-4080 • www.bgeinc.com
TBPE Registration No. F-1046

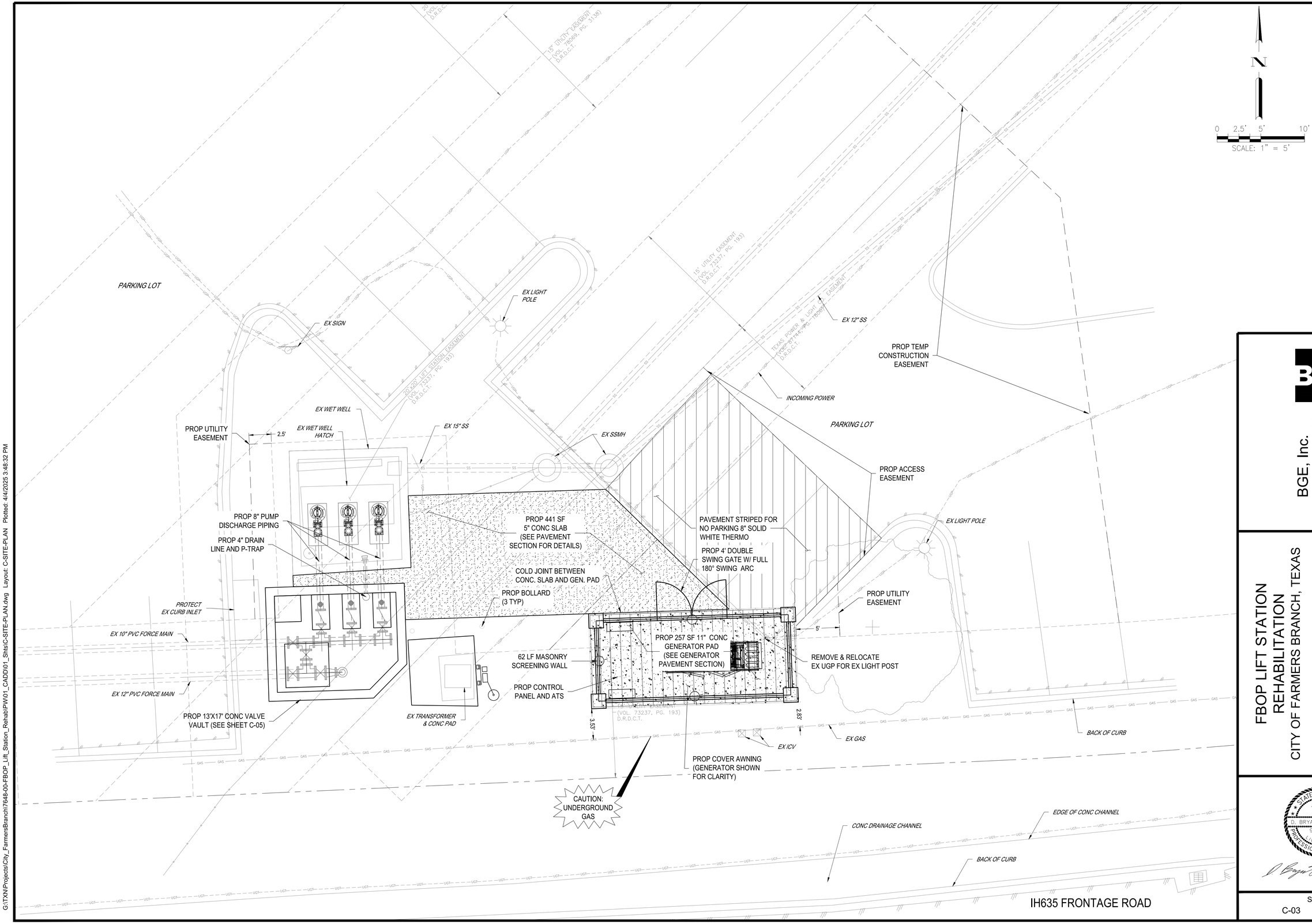
FBOP LIFT STATION REHABILITATION
CITY OF FARMERS BRANCH, TEXAS

DEMOLITION PLAN

STATE OF TEXAS
D. BRYANT CASWELL
91721
LICENSED
PROFESSIONAL ENGINEER

4/4/2025

SHEET
C-02 OF 22



REV	DESCRIPTION	DATE
△		APR
△		
△		
△		
△		

DESIGNED BY: CC
REVIEWED BY: BC
DRAWN BY: MC

BGE, Inc.
2595 DALLAS PARKWAY, SUITE 101
FRISCO, TX 75034
TEL: 972-464-4080 • www.bgeinc.com
TBPE Registration No. F-1046

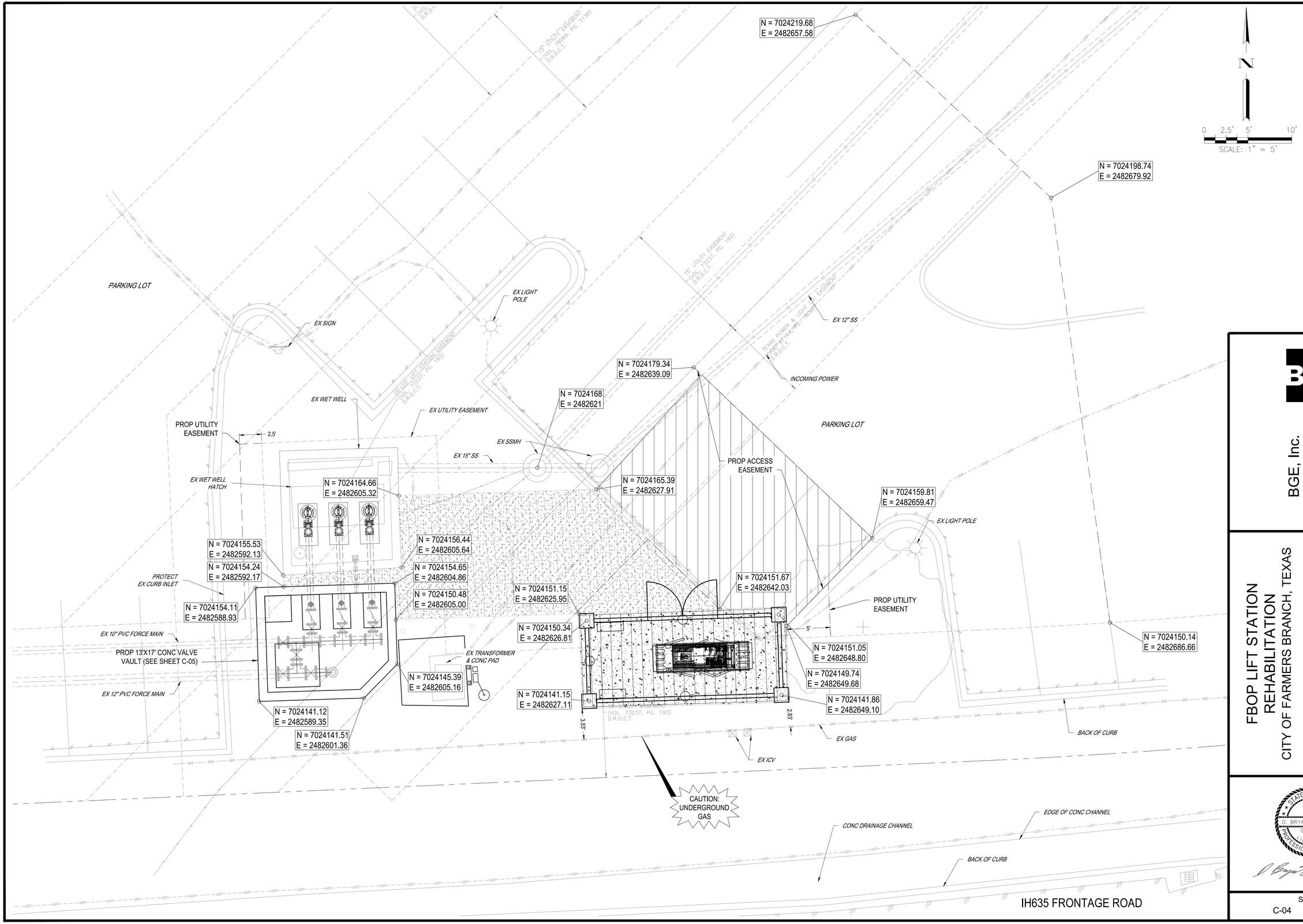
FBOP LIFT STATION REHABILITATION
CITY OF FARMERS BRANCH, TEXAS

PROPOSED SITE PLAN

STATE OF TEXAS
BRYANT CASWELL
91721
LICENSED
PROFESSIONAL ENGINEER

4/4/2025

SHEET
C-03 OF 22



REV	DESCRIPTION	DATE
◁		APR
◁		
◁		
◁		
◁		

DESIGNED BY: CC

REVIEWED BY: CC

DRAWN BY: BGE

BGE, Inc.
2595 DALLAS PARKWAY, SUITE 101
FRISCO, TX 75034
TEL: 972-464-4080 • www.bgeinc.com
TBPE Registration No. F-1046

FBOP LIFT STATION REHABILITATION
CITY OF FARMERS BRANCH, TEXAS

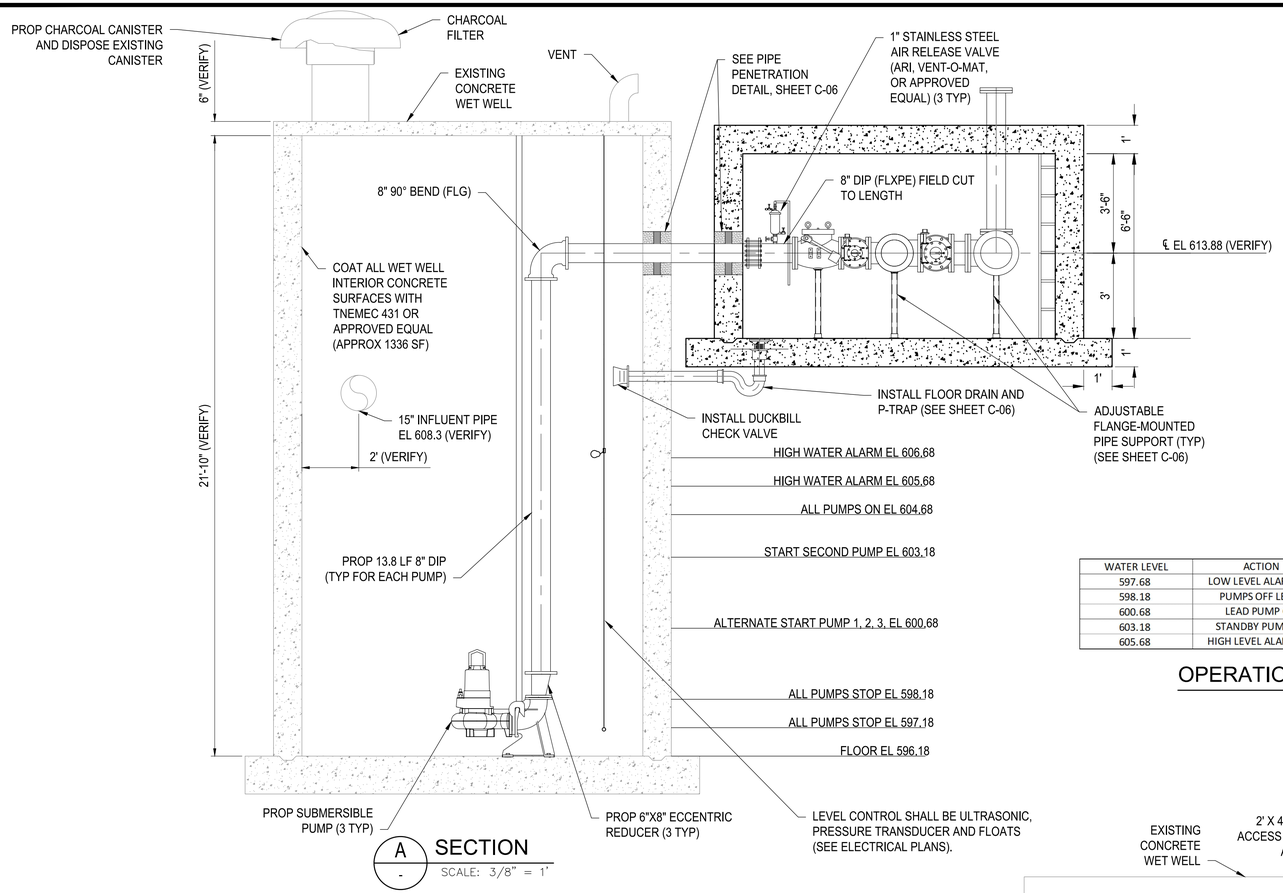
DIMENSION PLAN

STATE OF TEXAS
BRYANT CASWELL
91721
LICENSED
PROFESSIONAL ENGINEER

4/4/2025

SHEET
C-04 OF 22

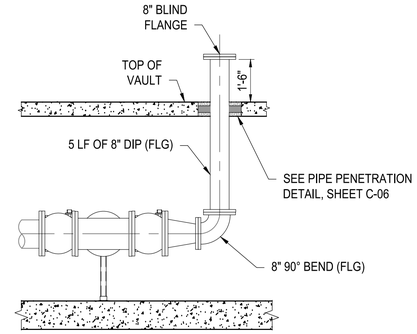
G:\TXN\Projects\City_FarmersBranch\7648-00-FBOP_Lift_Station_Rehab\PW\01_CADD\01_Shts\C-SITE-DIMPLAN.dwg Layout: C-SITE-DIMPLAN Plotted: 4/4/2025 3:48:39 PM



A
-
SECTION
SCALE: 3/8" = 1'

NOTES:

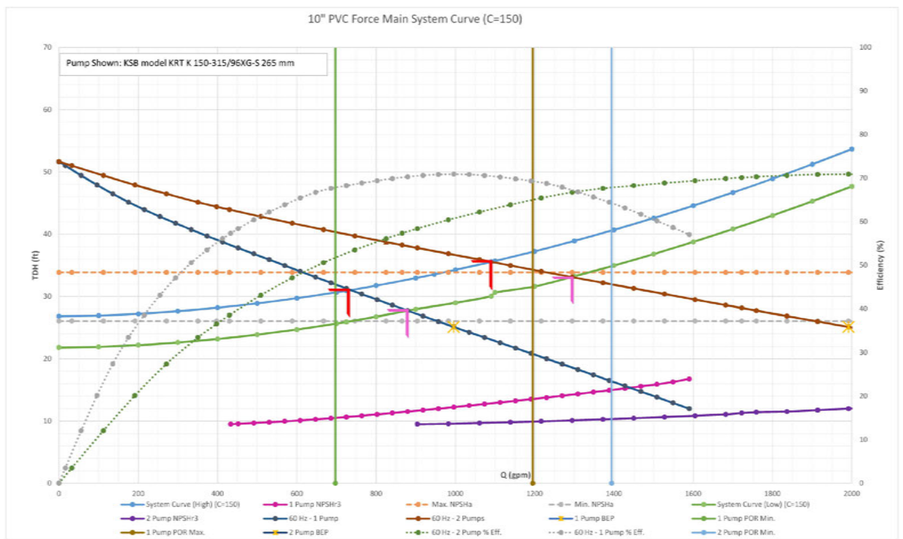
1. ACCESS HATCH DIMENSIONS SHOWN ARE CLEAR OPENING DIMENSIONS.
2. EXISTING CONDITION OF WET WELL TO BE ASSESSED PRIOR TO COATING INTERIOR CONCRETE SURFACE
3. WATERSTOPS AT WALL PENETRATIONS TO BE LINK-SEAL



B
-
BYPASS DETAIL
SCALE: 3/8" = 1'

WATER LEVEL	ACTION	PUMP(S) IN OPERATION
597.68	LOW LEVEL ALARM ON	N/A
598.18	PUMPS OFF LEVEL	NONE
600.68	LEAD PUMP ON	LEAD PUMP
603.18	STANDBY PUMP ON	STANDBY PUMP
605.68	HIGH LEVEL ALARM ON	LEAD & STANDBY PUMP

OPERATION TABLE

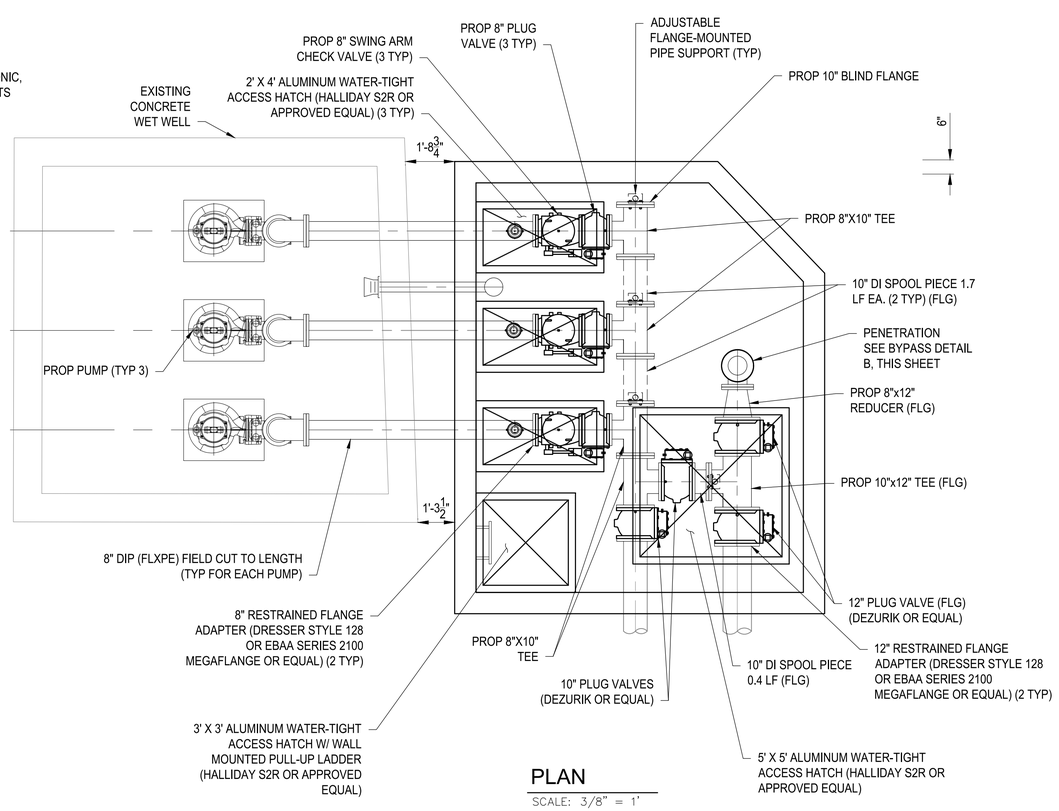


Denotes the primary duty point at pump-on elevation; used to select pumps.

Denotes duty point at pump shut-off elevation.

	1 PUMP	2 PUMPS
Flow (gpm)	725	1,090
TDH (ft)	31.4	35.5
Efficiency (%)	68.4	62.2

PERFORMANCE CURVES



PLAN
SCALE: 3/8" = 1'

REV	DESCRIPTION	DATE	APR

DESIGNED BY: CC
REVIEWED BY: BC
DRAWN BY: MC

BGE, Inc.
2595 DALLAS PARKWAY, SUITE 101
FRISCO, TX 75034
TEL: 972-464-4080 • www.bgeinc.com
TBPE Registration No. F-1046

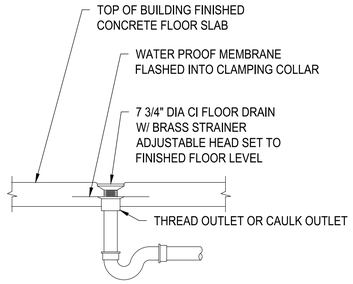
FBOP LIFT STATION REHABILITATION
CITY OF FARMERS BRANCH, TEXAS

MECHANICAL PLAN AND SECTION

STATE OF TEXAS
D. BRYANT CASWELL
91721
LICENSED
PROFESSIONAL ENGINEER

4/4/2025

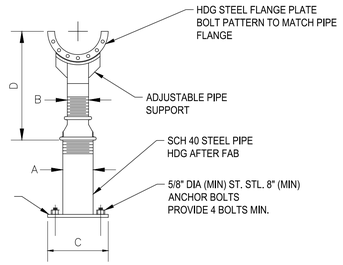
SHEET
C-05 OF 22



A - FLOOR DRAIN & P-TRAP DETAIL

N.T.S.

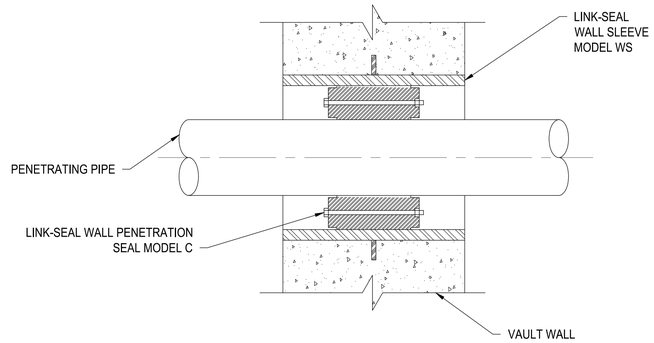
PIPE SIZE	"A"	"B"	"C"	"D"
4"	3"	2 1/2"	7 1/2"	14"
6"	3"	2 1/2"	7 1/2"	15"
8"	3"	2 1/2"	7 1/2"	16"
10"	3"	2 1/2"	7 1/2"	17"
12"	6"	4"	11"	18"
14"	6"	4"	11"	19"
16"	6"	4"	11"	20"
18"	6"	4"	11"	24 1/2"
20"	6"	4"	11"	25 1/2"
24"	6"	4"	11"	27 1/2"
30"	6"	4"	11"	31"
36"	6"	4"	11"	33"



150# THREADED FLANGE

B - FLANGED PIPE SUPPORT DETAIL

N.T.S.

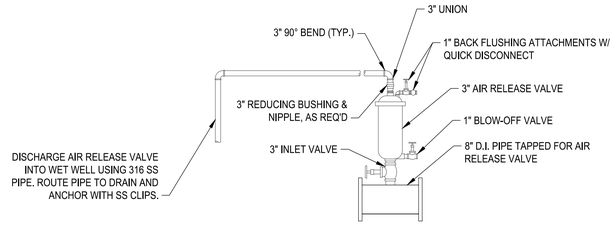


NOTE:
SLEEVED WET WELL PENETRATION IS NOT TO BE USED FOR CONDUIT INSTALLATION

IN VERTICAL INSTALLATIONS GROUT EXTERIOR TOP SIDE.

C - LINK SEAL WALL PENETRATION

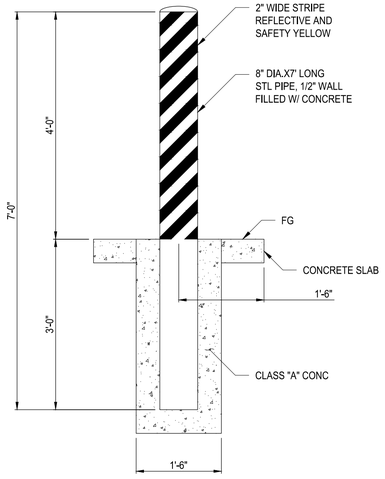
N.T.S.



MODEL PER SPECIFICATIONS

D - SEWAGE AIR & VACUUM VALVE

N.T.S.



E - BOLLARD DETAIL

SCALE: 3/4"=1'-0"

						APR
						DATE
						DESCRIPTION
△	△	△	△	△	△	REV

DESIGNED BY: CC

REVIEWED BY: BC

DRAWN BY: MC

BGE, Inc.
2595 DALLAS PARKWAY, SUITE 101
FRISCO, TX 75034
TEL: 972-464-4080 • www.bgeinc.com
TBPE Registration No. F-1046

FBOP LIFT STATION
REHABILITATION
CITY OF FARMERS BRANCH, TEXAS

STANDARD DETAILS

STATE OF TEXAS
D. BRYANT CASWELL
91721
LICENSED
PROFESSIONAL ENGINEER

4/4/2025

SHEET
C-06 OF 22

G:\TXN\Projects\City_FarmersBranch\7648-00-FBOP_Lift_Station_Rehab\PW\01_CADD\01_Shts\C_DETL_SHT1.dwg Layout: STANDARD DETAILS Plotted: 4/4/2025 3:48:49 PM

SCREEN SHRUBS

Glossy Abelia

Scientific Name:
Abelia x grandiflora

Size:
full size: 5'h x 4'w,
planted 1'h x 1'w

Description:
This low maintenance, hearty shrub flowers throughout spring to fall. Not a fast grower, it is consistent in size and form.

Dwarf Burford Holly

Scientific Name:
Ilex cornuta 'Dwarf Burford'

Size:
full size: 3'h x 3'w, planted 1.5'h x 1'w

Description:
A heat tolerant, drought tolerant, hearty grass native to the U.S. prairie. Its prolific pink flowers are seen in late summer to fall.

GROUNDCOVER

Giant Liriope

Scientific Name:
Liriope gigantea

Size:
full size: 3'h x 3'w,
planted 1'h x 1'w

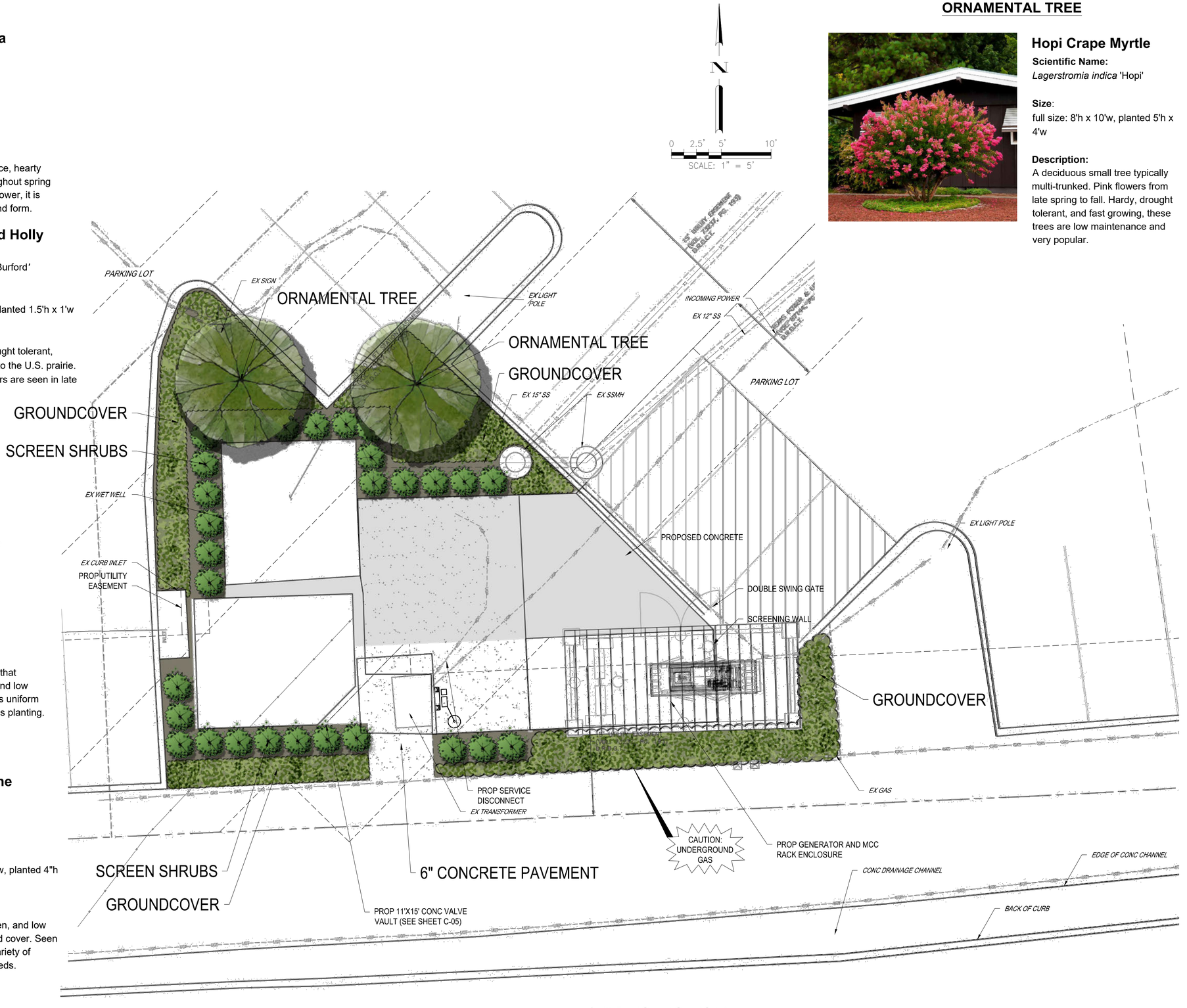
Description:
A dark green grass that thrives in part sun and low water conditions. Its uniform size is ideal for mass planting.

Asian Jasmine

Scientific Name:
Trachelospermum asiaticum

Size:
full size:12"h x 24" w, planted 4"h x 6"w

Description:
Voracious, evergreen, and low maintenance ground cover. Seen in medians and a variety of bordered planting beds.



ORNAMENTAL TREE

Hopi Crape Myrtle

Scientific Name:
Lagerstromia indica 'Hopi'

Size:
full size: 8'h x 10'w, planted 5'h x 4'w

Description:
A deciduous small tree typically multi-trunked. Pink flowers from late spring to fall. Hardy, drought tolerant, and fast growing, these trees are low maintenance and very popular.

REV	DESCRIPTION	DATE	APR

DESIGNED BY: MH
REVIEWED BY: BM
DRAWN BY: MH

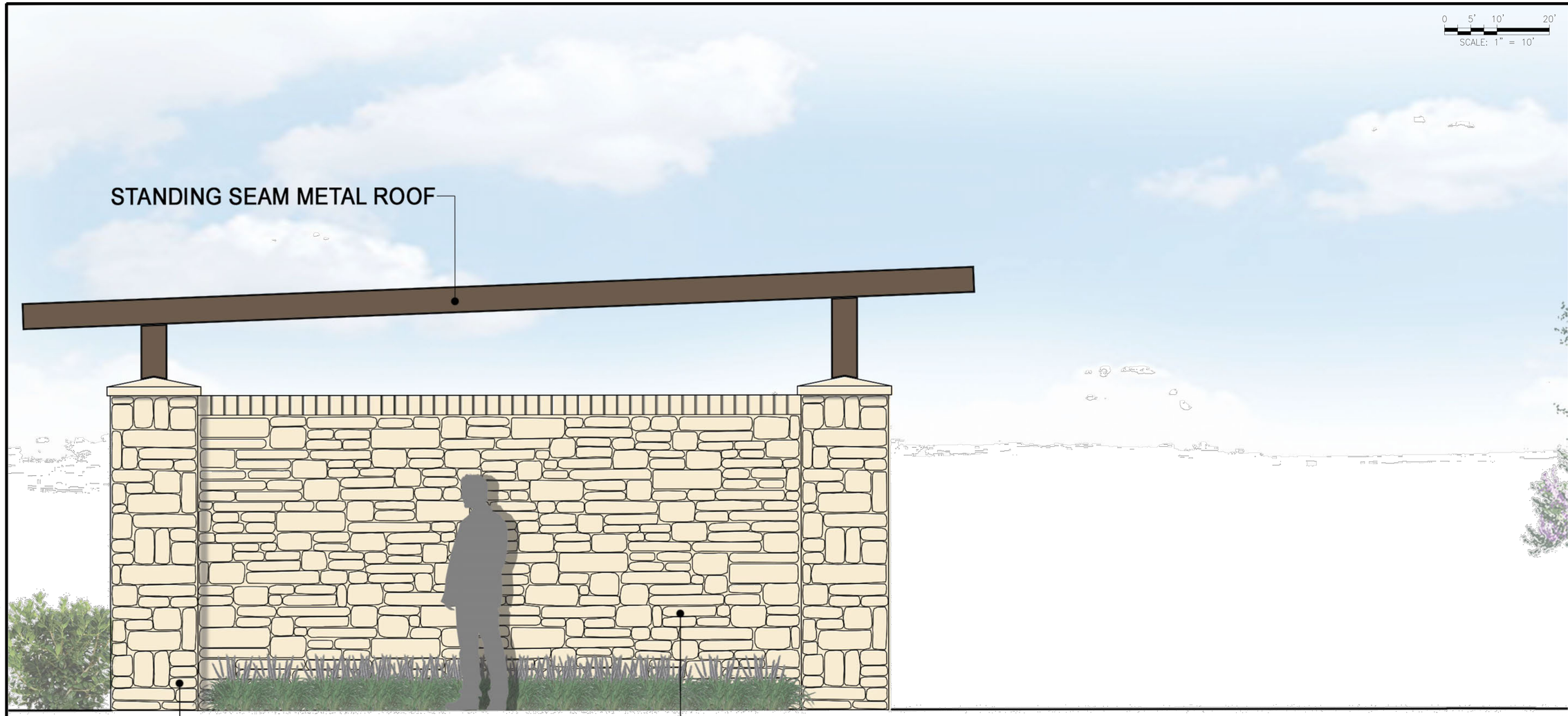
BGE, Inc.
2595 DALLAS PARKWAY, SUITE 101
FRISCO, TX 75034
TEL: 972-464-4080 • www.bgeinc.com
TBPE Registration No. F-1046

FBOP LIFT STATION REHABILITATION
CITY OF FARMERS BRANCH, TEXAS

LANDSCAPE PLAN

STATE OF TEXAS
DALE SON
139932
LICENSED PROFESSIONAL ENGINEER
03-06-2025

SHEET
L-01 OF 22



0 5' 10' 20'
SCALE: 1" = 10'

REV	DESCRIPTION	DATE	APR

DESIGNED BY: SF
REVIEWED BY: BM
DRAWN BY: SF

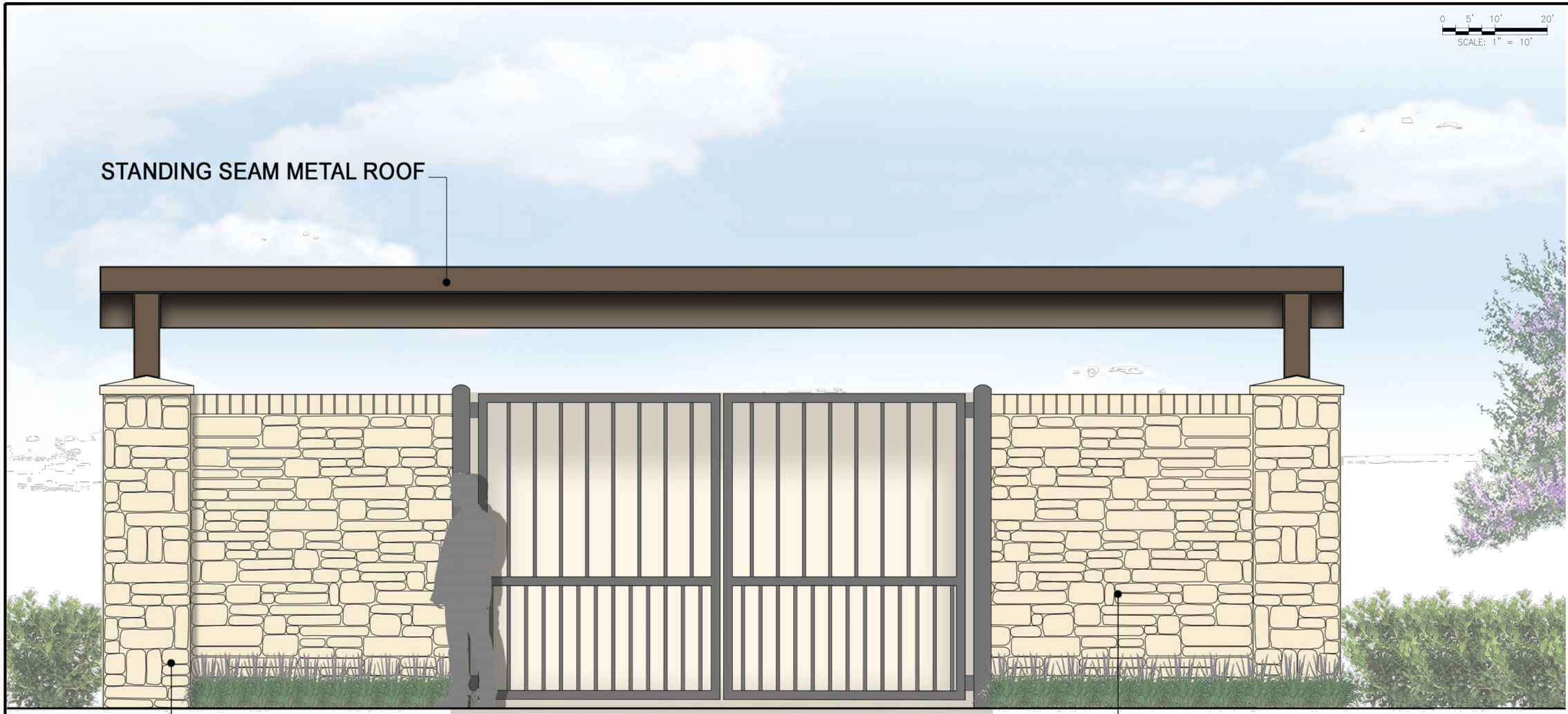
BGE, Inc.
2595 DALLAS PARKWAY, SUITE 101
FRISCO, TX 75034
TEL: 972-464-4080 • www.bgeinc.com
TBPE Registration No. F-1046

FBOP LIFT STATION REHABILITATION
CITY OF FARMERS BRANCH, TEXAS

WALL AND GATE RENDERING

STATE OF TEXAS
DALE SON
139932
LICENSED
PROFESSIONAL ENGINEER
03-06-2025

SHEET
L-02 OF 22



0 5’ 10’ 20’
SCALE: 1” = 10’

REV	DESCRIPTION	DATE	APR
△			
△			
△			
△			
△			

DESIGNED BY: SF
REVIEWED BY: BM
DRAWN BY: SF

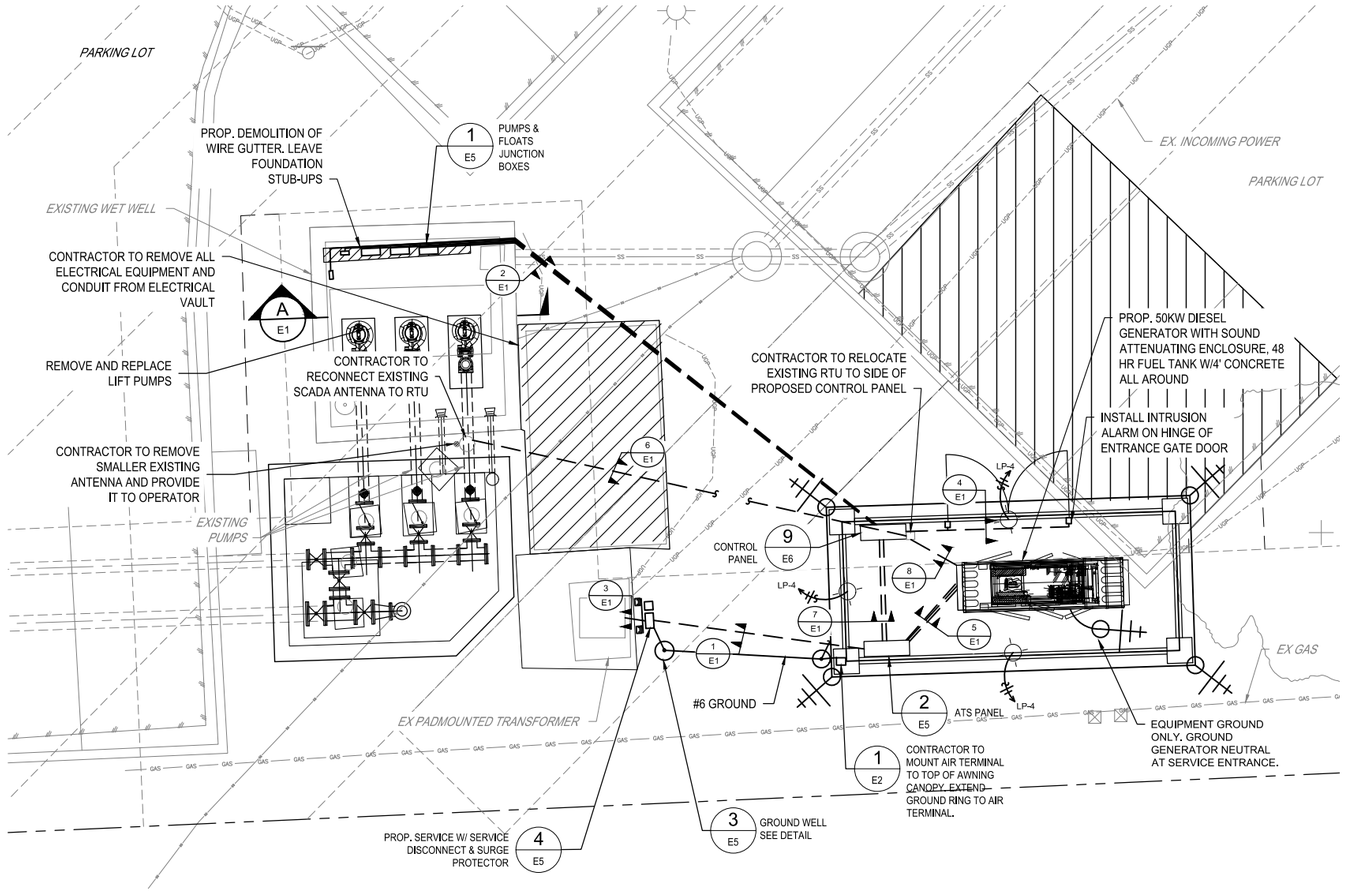
BGE, Inc.
2595 DALLAS PARKWAY, SUITE 101
FRISCO, TX 75034
TEL: 972-464-4080 • www.bgeinc.com
TBPE Registration No. F-1046

FBOP LIFT STATION REHABILITATION
CITY OF FARMERS BRANCH, TEXAS

WALL AND GATE RENDERING

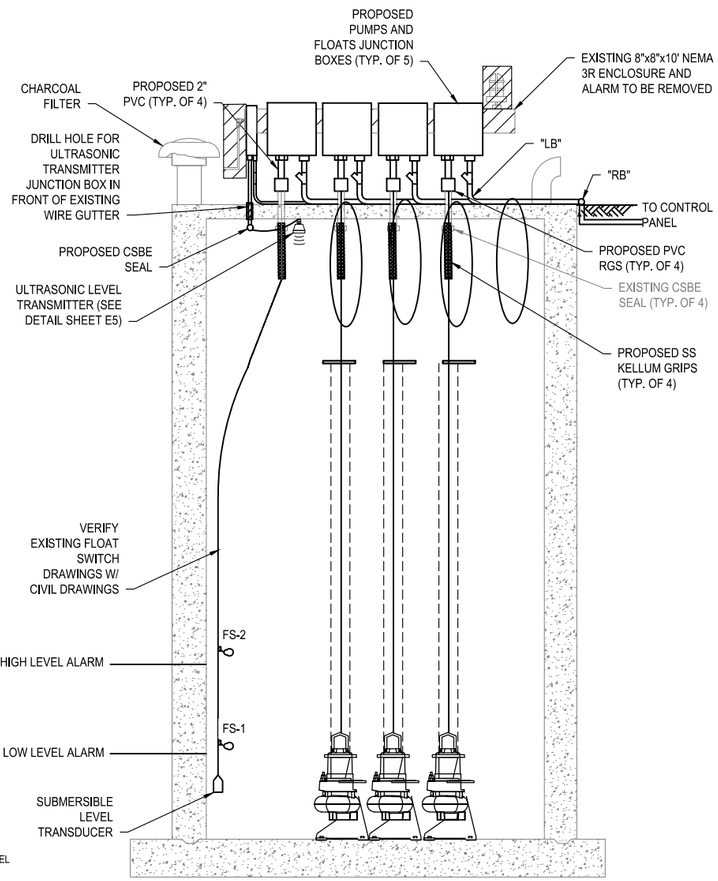
STATE OF TEXAS
DALE SON
139932
LICENSED
PROFESSIONAL ENGINEER
03/06/2025

SHEET
L-02BOF 22

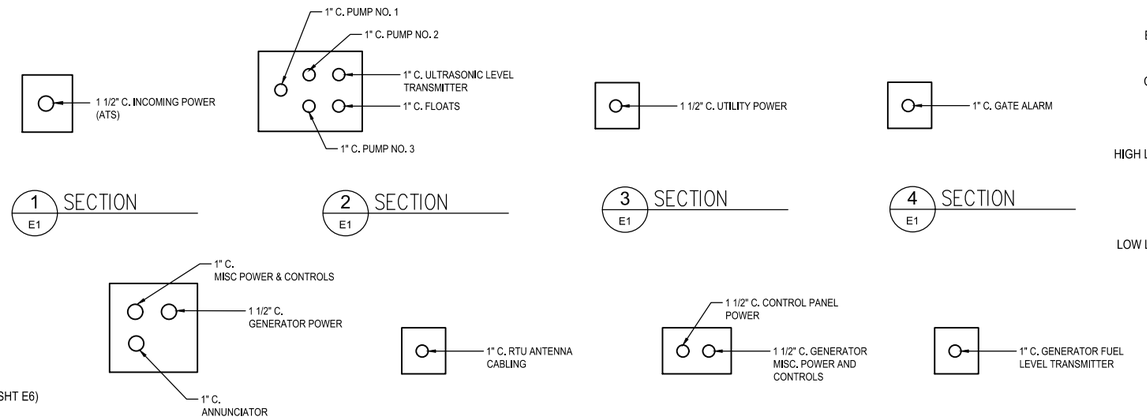


NOTES:

1. ALL WORK SHALL BE IN COMPLIANCE WITH THE LATEST EDITION OF THE NATIONAL ELECTRICAL CODE AND ALL APPLICABLE LOCAL CODES.
2. SERVICE EQUIPMENT DETAILS ARE SHOWN DIAGRAMMATICALLY ON PLANS. INSTALLATION SHALL STRICTLY COMPLY WITH LOCAL POWER COMPANY STANDARDS IN EVERY RESPECT. CONSULT LOCAL POWER COMPANY FOR SPECIFIC REQUIREMENTS BEFORE STARTING CONSTRUCTION.
3. PLAN VIEW CONDUIT ROUTING IS DIAGRAMMATIC ONLY. ROUTE BEST WAY MINIMIZING BENDS.
4. CONTRACTOR SHALL BE RESPONSIBLE FOR OBTAINING ANY AND ALL PERMITS ASSOCIATED WITH THE WORK. THE COSTS OF THE PERMITS, IF ANY, SHALL BE BORNE BY THE CONTRACTOR.
5. LIFT STATION PLAN AND PROFILE VIEWS SHOWN ON THESE ELECTRICAL DRAWINGS ARE INTENDED FOR FUNCTIONAL CLARIFICATION OF INSTALLED ELECTRICAL COMPONENTS. FOR ANY REQUIRED DETAILS OF ELEVATION, DIMENSION, MOUNTING, OR ORIENTATION, REFER TO CIVIL DRAWINGS.
6. ALL ABOVE GRADE CONDUIT TO BE PVC COATED RGS, UNLESS NOTED OTHERWISE. ALL PROPOSED ENCLOSURES TO BE NEMA 4X.
7. CONTRACTOR/MCC SUPPLIER ARE TO PROVIDE A SHORT CIRCUIT ANALYSIS AND POWER COORDINATION STUDY AND ARC FLASH HAZARD ANALYSIS THAT WILL BECOME PART OF THE OEM MANUALS. SEE SPECIFICATION NO. 16015. CONTACT JOHN GILROY, JGILROY@BGDENG.COM, 281-529-5005 EXT. 102.
8. CONTRACTOR TO WORK WITH LOCAL UTILITY COMPANY FOR DISCONNECTING AND RECONNECTING OF UTILITY SERVICES.



A E1 ELECTRICAL WET WELL ELEVATION
N.T.S.



DUCTBANK SECTIONS
N.T.S

LEGEND

- ELECTRICAL PULL BOX
- ELECTRICAL DUCT BANK MARKER
- GROUND CONDUCTOR
- ELECTRICAL DUCT BANK (SEE DTL SHT E6)
- CAPPED ELECTRICAL CONDUIT
- GROUND ROD (SEE DTL SHT E5)
- WEATHERHEAD
- FLOODLIGHT (SEE DTL SHT E5)
- SP EXISTING SERVICE POLE
- UGP EXISTING UNDERGROUND POWER

REV	DESCRIPTION	DATE	APR

DESIGNED BY: TA
REVIEWED BY: CLR
DRAWN BY: EO

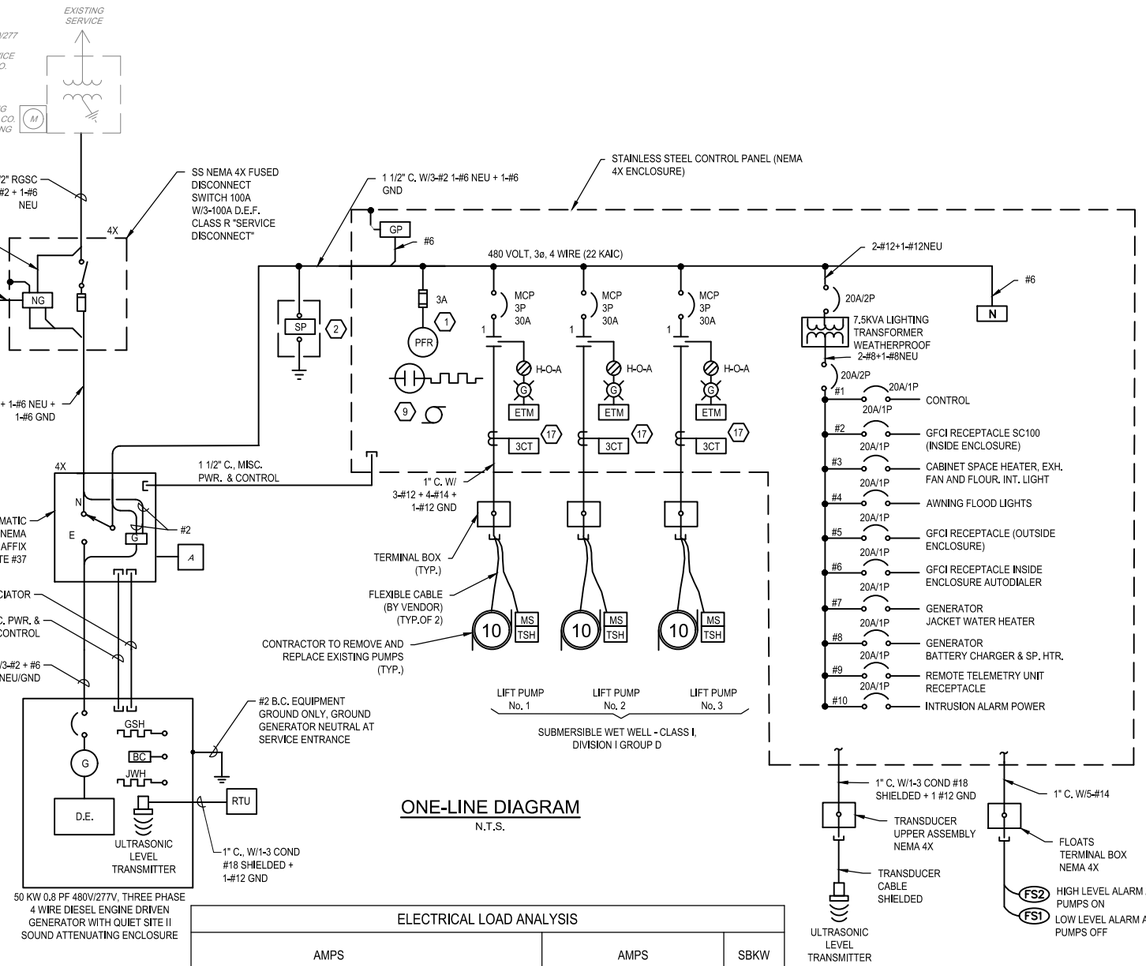
BGE, Inc.
2595 DALLAS PARKWAY, SUITE 101
FRISCO, TX 75034
TEL. 972-464-4080 • www.bgeinc.com
TBPE Registration No. F-1046

FBOP LIFT STATION REHABILITATION
CITY OF FARMERS BRANCH, TEXAS

ELECTRICAL SITE-PLAN

5/12/2025

SHEET
E-01 OF 22



ONE-LINE DIAGRAM
N.T.S.

ELECTRICAL LOAD ANALYSIS

AMPS		AMPS ØA	AMPS ØB	AMPS ØC	SBKW
LIFT STATION PUMP No. 1	10 HP	14	14	14	9
LIFT STATION PUMP No. 2	10 HP	14	14	14	9
LIFT STATION PUMP No. 3	10 HP	14	14	14	-
+ 25% LARGEST MOTOR		4	4	4	
CONTROL & LIGHTING 7.5KVA		16	16	0	7.50
TOTAL LOAD		62	62	46	25.50
SERVICE AMPACITY @ 480 VOLT, 3Ø 4 WIRE		100	100	100	
SPARE AMPACITY		38	38	54	
FAULT CURRENT				< 22 KAIC	

CONDUIT SCHEDULE

No.	SIZE & CONDUCTORS	DESCRIPTION
1	1 1/2" C. W/3-#2 + #6 NEU + #6 GND	UTILITY POWER
2	1" C. W/3-#12 + 4-#14 + #12 GND	LIFT PUMP No. 1 POWER & CONTROL
3	1" C. W/3-#12 + 4-#14 + #12 GND	LIFT PUMP No. 2 POWER & CONTROL
4	1" C. W/3-#12 + 4-#14 +#12 GND	LIFT PUMP No. 3 POWER & CONTROL
5	1" C. W/3-COND. #18 SHIELDED + #12 GND	LEVEL TRANSMITTER
6	1" C. W/4-#14 + #14 GND	FLOATS
7	1" C. W/2-#12 + 1-#12 GND	AWNING FLOOD LIGHTS
8	1 1/2" C. W/3-#2 + #6 NEU + #6 GND	GENERATOR POWER
9	1 1/2" C. W/20-#12 + #12 GND	GENERATOR MISC. PWR. & CONTROLS
10	1" C. W/VENDORS CABLE	GENERATOR ANNUNCIATOR
11	1 1/2" C. W/3-#2 + #6 NEU + #6 GND	INCOMING POWER TO ATS
12	1" C. W/3-COND. #18 SHIELDED + #12 GND	GENERATOR FUEL LEVEL TRANSMITTER
13	1" C. W/RTU CABLE	RTU ANTENNA CABLE
14	1" C. W/ALARM CABLE	INTRUSION ALARM POWER & CONTROL
15	1 1/2" C. W/3-#2 + #6 NEU + #6 GND	CONTROL PANEL POWER

CONTROL DIAGRAM SYMBOL LEGEND

SYMBOL	DESCRIPTION
3 OL'S	NEMA STANDARD MAGNETIC MOTOR STARTER (SEE SPECIFICATIONS)
CR	CONTROL RELAY - 4 POLE UNIVERSAL - PLUG IN
TD	TIME DELAY RELAY
B	LED TYPE PILOT LIGHT PUSH-TO-TEST W-WHITE; R-RED; G-GREEN
	THERMOSTAT
B	BELL
ETM	ELAPSED TIME METER
TD1	SPACE HEATER
NO-TC	CONTRACT ON TIME DELAY RELAY TIME DELAY CLOSED AFTER ENERGIZATION
OFF-ON	ON-OFF SWITCH, 2 POSITION TOGGLE
	PUSH BOTTOM
M M	HOLDING COIL CONTACT (NORMALLY OPEN-NORMALLY CLOSED)
CR CR	CONTROL RELAY CONTACT (NORMALLY OPEN-NORMALLY CLOSED)
▲	ITEM LOCATED FACE OF LIFT STATION CONTROL PANEL
12	ITEM ON SPECIAL DEVICE SCHEDULE (SEE SHEET E3)
H-O-A	HAND-OFF-AUTO SWITCH
F	FLOAT SWITCH

NAMEPLATE SCHEDULE

No.	TITLE	NO.	TITLE
1	DISCONNECT LIFT PUMP No. 1	20	LIFT PUMP No. 3 H-O-A
2	DISCONNECT LIFT PUMP No. 2	21	BELL OFF-ON
3	DISCONNECT LIFT PUMP No. 3	22	HIGH LEVEL WET WELL
4	DISCONNECT LIGHTING PANEL	23	BEACON OFF-ON
5	LIGHTING BREAKER (8)	24	No. 1 PUMP PROTECTION MODULE RESET
6	PHASE FAILURE BYPASS	25	No. 2 PUMP PROTECTION MODULE RESET
7	SERVICE POWER ON	26	No. 3 PUMP PROTECTION MODULE RESET
8	AWNING FLOOD LIGHTS ON/OFF	27	ALARM RESET
9	LIFT PUMP No. 1 OVERTEMP	28	ALARM SILENCE
10	LIFT PUMP No. 2 OVERTEMP	29	ALARM TEST
11	LIFT PUMP No. 3 OVERTEMP	30	TEST FLOATS
12	LIFT PUMP No. 1 SEAL FAILURE	31	RESET FLOATS
13	LIFT PUMP No. 2 SEAL FAILURE	32	PUMPS ON FLOATS
14	LIFT PUMP No. 3 SEAL FAILURE	33	TWO PUMP RUN TIME
15	LIFT PUMP No. 1 OVERLOAD	34	PUMP No. 1 RUN
16	LIFT PUMP No. 2 OVERLOAD	35	PUMP No. 2 RUN
17	LIFT PUMP No. 3 OVERLOAD	36	PUMP No. 3 RUN
18	LIFT PUMP No. 1 H-O-A	37	DO NOT OPERATE UNDER LOAD
19	LIFT PUMP No. 2 H-O-A	38	ENCLOSURE LIGHT

NAMEPLATES SHALL BE CONSTRUCTED FROM LAMINATED PLASTIC MATERIAL A MINIMUM OF 1/16" THICK. LETTERS SHALL BE GOTHIC 3/16" HIGH MINIMUM, USE TWO LINES IF DESCRIPTION WILL CAUSE LENGTH TO EXCEED 2 1/2". ALARM NAMEPLATES SHALL BE RED ON WHITE, OTHERS SHALL BE BLACK ON WHITE. AFFIX NAMEPLATES TO PANEL USING SELF-TAPPING STAINLESS STEEL SCREWS. SUBMIT DETAILS WITH SHOP DRAWINGS.

NOTES:

1. FLOATS AND INTRINSICALLY SAFE RELAYS ARE PART OF AN INTRINSICALLY SAFE CIRCUIT THAT REQUIRES 3" SPACING FROM NON-INTRINSICALLY SAFE CIRCUITS IN BOTH THE FIELD JUNCTION BOX AND CONTROL CABINET. LABEL CIRCUITS AS INTRINSICALLY SAFE.
2. ENCLOSURE SHOWN IS APPROXIMATE SIZE. VERIFY DIMENSIONAL REQUIREMENTS OF COMPONENTS AND SIZE ACCORDINGLY. MATCH EQUIPMENT SCHEDULE HEATER AND COOLING FAN OPTIONS TO SELECTED MANUFACTURER.
3. PROVIDE TRADITIONAL "NEMA" DEVICES AS DEFINED IN NEMA STANDARDS PUBLICATION NO. ICS 2.4-1989. IES COMPONENTS ARE NOT ALLOWED.

FIXTURE SCHEDULE

TYPE	DESCRIPTION	LAMPS	MANUFACTURER	VOLTS	REMARKS
B	TWO LAMP VAPORTIGHT ENCLOSED & GASKETED	61W LED	LITHONIA #FAM4LAD & PLCL	120	
C	OLB LED BULLET FLOODLIGHT	56W LED	LITHONIA #OLBF 8 30K DDB M6	120	GENSET ENCLOSURE (IF EQUIPPED)

CANOPY ELECTRICAL EQUIPMENT ELEVATION — LOOKING EAST (1/E2)
N.T.S.

						APR
						DATE
						DESCRIPTION
◁	◁	◁	◁	◁		REV

DESIGNED BY: TA
REVIEWED BY: CLR
DRAWN BY: EO

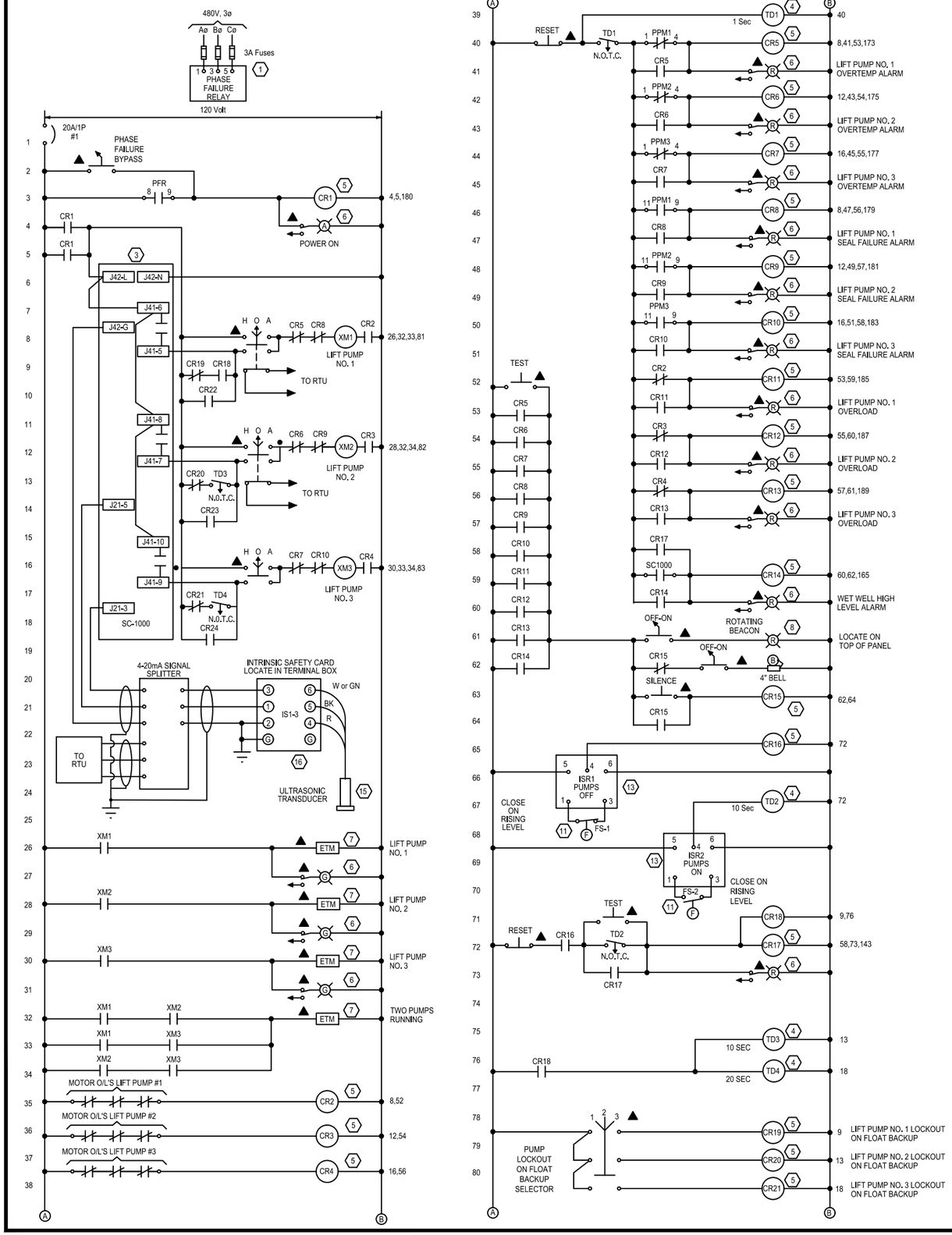
BGE, Inc.
2595 DALLAS PARKWAY, SUITE 101
FRISCO, TX 75034
TEL: 972-464-4080 • www.bgeinc.com
TBPE Registration No. F-1046

FBOP LIFT STATION REHABILITATION
CITY OF FARMERS BRANCH, TEXAS

ELECTRICAL ONE-LINE DIAGRAM

CHAD T. RANEY 131611 LICENSED PROFESSIONAL ENGINEER
5/12/2025

SHEET E-02 OF 22



NOTES:

1. FLOATS AND INTRINSICALLY SAFE RELAYS ARE PART OF AN INTRINSICALLY SAFE CIRCUIT THAT REQUIRES 3" SPACING FROM NON-INTRINSICALLY SAFE CIRCUITS IN BOTH THE FIELD JUNCTION BOX AND CONTROL CABINET. LABEL CIRCUITS AS INTRINSICALLY SAFE.
2. ADD M COIL AUXILLARY RELAY IF REQUIRED.
3. TCEQ REQUIRED FORCE MAIN FLUSH CIRCUIT FOR THREE PUMP LIFT STATIONS. IF ANY TWO PUMPS HAVE NOT SIMULTANEOUSLY RUN FOR 12 HOURS, THEN RUN TWO PUMPS FOR A MINIMUM OF 20 SECONDS. PROVIDE A TEN SECOND SEPARATION IN PUMP STARTS.

	DATE	DESCRIPTION
◁	APR	

DESIGNED BY: TA

REVIEWED BY: CLR

DRAWN BY: EO

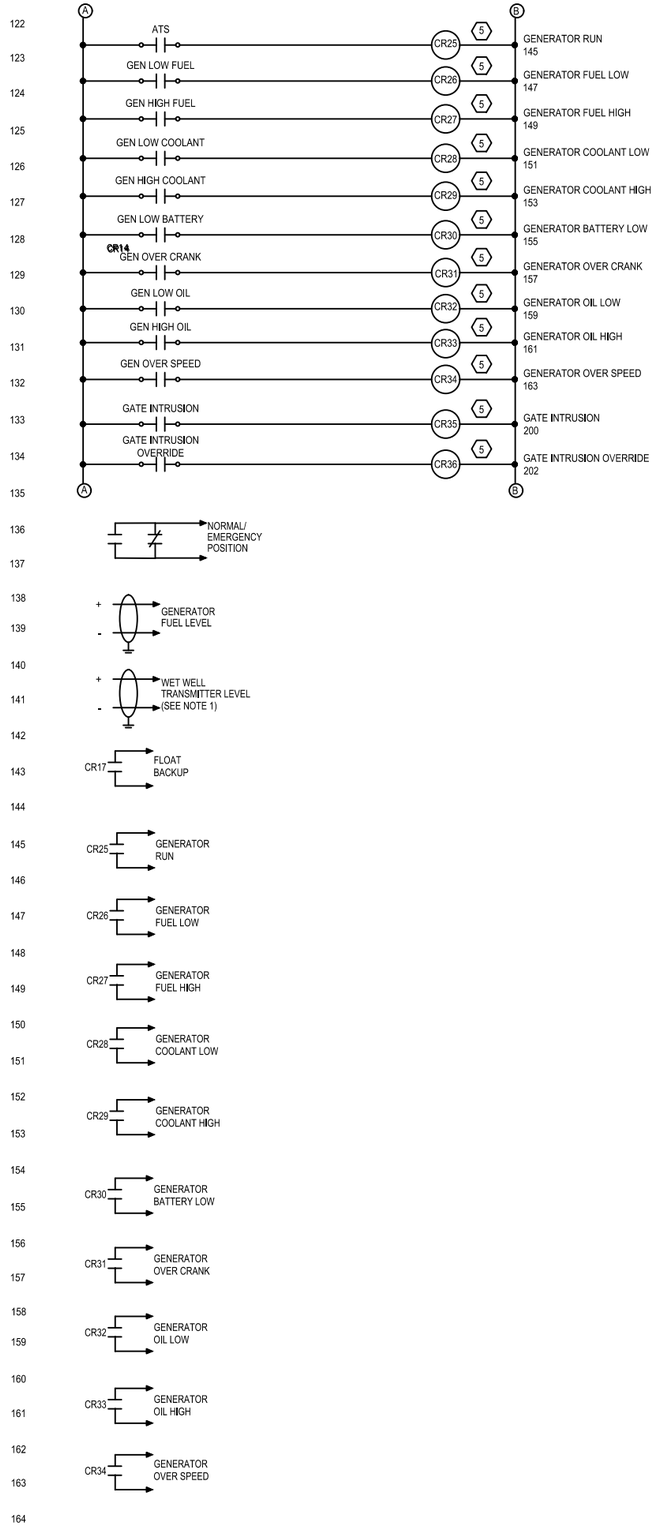
BGE, Inc.
2595 DALLAS PARKWAY, SUITE 101
FRISCO, TX 75034
TEL: 972-464-4080 • www.bgeinc.com
TBPE Registration No. F-1046

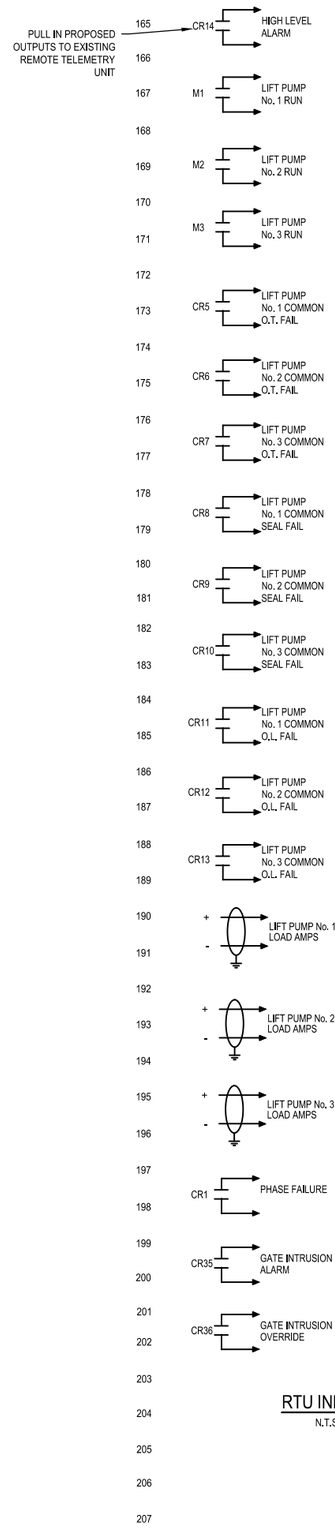
FBOP LIFT STATION REHABILITATION
CITY OF FARMERS BRANCH, TEXAS

ELECTRICAL CONTROL DIAGRAM (SHEET 1 OF 2)

5/12/2025

SHEET E-03 OF 22





RTU INPUTS
N.T.S.

SCADA DATA				
PUMPS	WET WELL LEVEL	SITE ALARMS	GENERATOR	GENERATOR ALARMS
HOA STATUS	LEVEL TRANSMITTER	COMMUNICATION FAIL	GENERATOR STATUS	GENERATOR ALARM
PUMP STATUS		INTRUDER ALARM	ATS STATUS	LOW FUEL
LOAD AMPS		COMMUNICATION OVERRIDE	FUEL LEVEL	HIGH FUEL
TODAY RUNTIME		INTRUDER OVERRIDE	RUNTIME TODAY	HIGH COOLANT
TODAY STARTS			STARTS TODAY	LOW COOLANT
				LOW BATTERY
				OVER CRANK
				HIGH OIL
				LOW OIL
				OVER SPEED

NOTES:

1. CONTRACTOR TO PROVIDE 4-20mA SPLITTER FOR TRANSDUCER OUTPUT.

REV	DATE	DESCRIPTION	APR

DESIGNED BY: T.A.

REVIEWED BY:C.L.R.

DRAWN BY: E.O.

BGE, Inc.
2595 DALLAS PARKWAY, SUITE 101
FRISCO, TX 75034
TEL: 972-464-4080 • www.bgeinc.com
TBPE Registration No. F-1046

FBOP LIFT STATION REHABILITATION
CITY OF FARMERS BRANCH, TEXAS

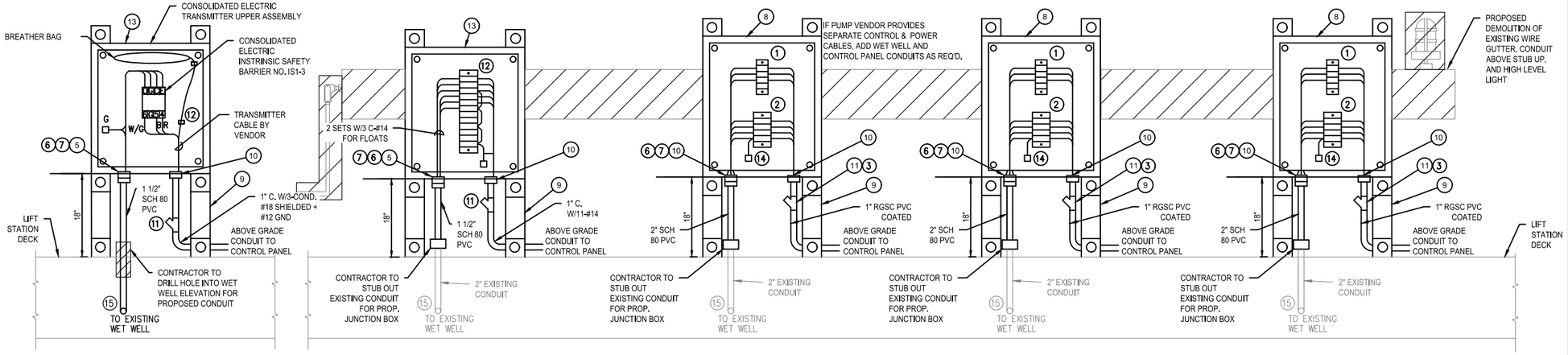
ELECTRICAL CONTROL DIAGRAM (SHEET 2 OF 2)

CHAD C. NAMES
131411
LICENSED PROFESSIONAL ENGINEER
STATE OF TEXAS

5/12/2025

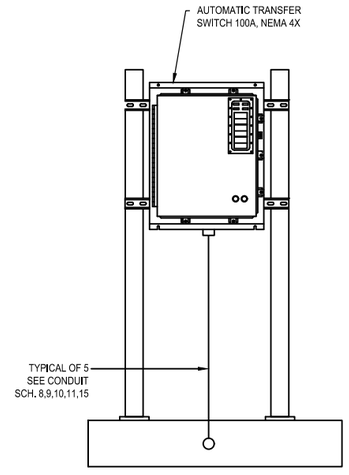
SHEET
E-04 OF 22

1. 4 POINT, 30A, 300 VOLT TERMINAL BLOCK
2. 4 POINT, 100A, 600 VOLT TERMINAL BLOCK
3. C.H. EYD - 1 1/2" SEAL
4. 1" MYERS HUB
5. OZ GEDNEY TYPE CSB1 CONDUIT SEALING BUSHING
6. C.H. ES SEALING FITTING
7. RIGID TO PVC ADAPTER
8. HOFFMAN #A-1412NFSS6 W/#A-14P12 PANEL (14"x12"x6")
9. STAINLESS STEEL P1000 UNISTRUT SUPPORT W/P2072 SS POST BASE ANCHOR W/4-1/2"o S.S. ANCHOR SETS.
10. 1" MYERS HUB
11. C.H. EYD - 1" SEAL
12. BREATHER TUBE SUPPORT
13. HOFFMAN #A-1212NFSS6 W/#A-12P12 PANEL (12"x12"x6")
14. GROUND LUG
15. CSBE CONDUIT SEAL
16. 1 1/2" MYERS HUB



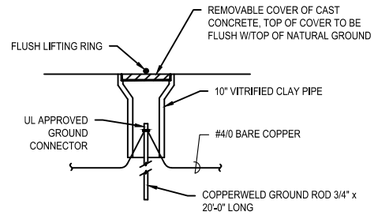
1 TERMINAL BOX DETAIL

SCALE: N.T.S.



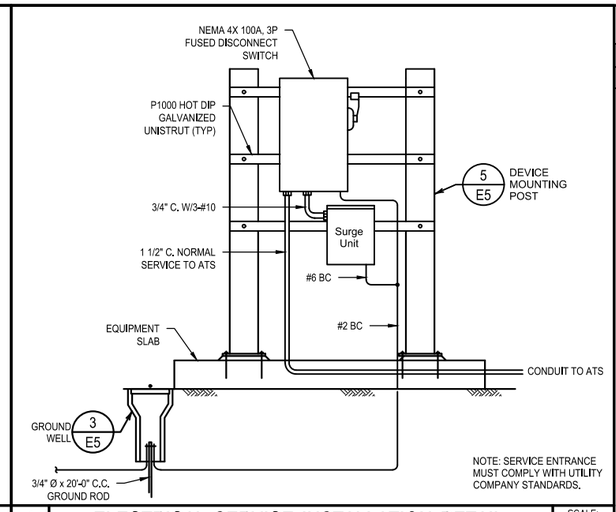
2 AUTOMATIC TRANSFER SWITCH DETAIL

SCALE: N.T.S.



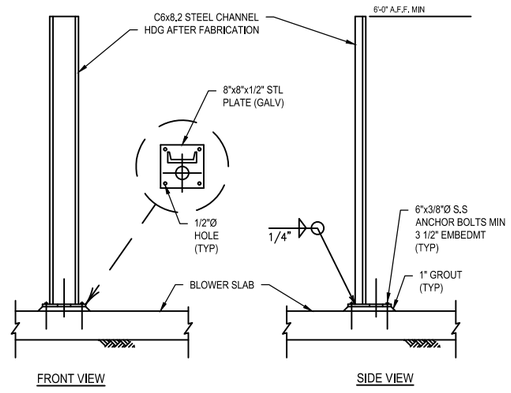
3 GROUND WELL DETAIL

SCALE: N.T.S.



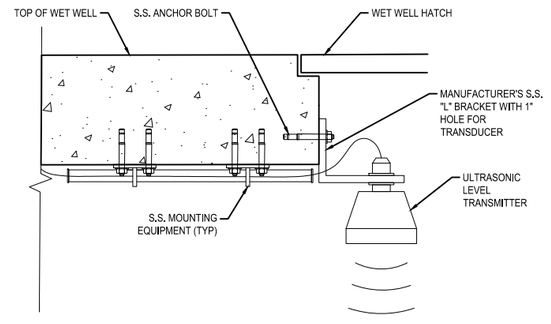
4 ELECTRICAL SERVICE INSTALLATION DETAIL

SCALE: N.T.S.



5 DEVICE MOUNTING DETAIL

SCALE: N.T.S.



6 LEVEL TRANSMITTER MOUNTING DETAIL

SCALE: N.T.S.

SPECIAL DEVICE SCHEDULE

ITEM	DESCRIPTION
1	PHASE FAILURE RELAY - DIVERSIFIED ELECTRONICS #SLA-460-ALE, 480 VOLT, 3 PHASE
2	SURGE SUPPRESSOR - SEE SPECIFICATIONS
3	MOTOR PROTECTION ELECTRIC STATION CONTROLLER, SC100 W/ALARM RELAY, 120 VOLTS, 60HZ, OR APPROVED EQUAL SET FOR TWO PUMP OPERATION
4	TIME DELAY RELAY - WITH 2 S.P.D.T. SWITCHES RATED 5 AMPS AT 120 VOLT, CONTACTS AND COIL, PLUG IN BASE AND SOCKET, 3 RANGES, 0.1 TO 100 SEC. ATC MODEL #319D-134
5	CONTROL RELAY - WITH 4 S.P.D.T. SWITCHES RATED 10 AMPS AT 120 VOLT, 120 VOLT COIL, PLUG IN BASE AND SOCKET
6	INDICATING LIGHT - PUSH TO TEST - LED TYPE, ALLEN BRADLEY BULLETIN 800 TYPE, 120 VOLT, 60HZ - COLOR AS INDICATED
7	ELAPSED TIME METER - CRAMER #635G/HRS, 120 VOLT
8	ROTATING BEACON - 35 WATTS, 90FPM, 120 VOLT, 3578DC LAMP, RED ACRYLIC DOME LEN, PARABOLIC TYPE, EDWARDS #52R
9	VENT FAN - HOFFMAN CAT. #A-PA4AXFN, 21 WATT, 120 VOLT (WITH RAIN SHIELD GRILL)
10	AUTODIALER - 8 CH., RACO VERBATIM, SEE SPECIFICATIONS
11	CONSOLIDATED ELECTRIC MODEL 9G DIRECT ACTING FLOAT SWITCH WITH 40 FOOT OF CABLE
12	EXHAUST GRILLE - HOFFMANCAT. #A-VK66 LOUVER WITH #A-FLT66 FILTER K.T. (WITH RAIN SHIELD GRILL)
13	DIVERSIFIED ELECTRONICS CAT. #150-120-AFN LOW CURRENT ISOLATION SWITCH, 5 AMPS, 120 VOLT CONTACTS, (INTRINSICALLY SAFE CIRCUIT TO FLOAT SWITCH)
14	FLYGT MINICAS II/FUS PUMP PROTECTION MODULE OR EQUAL UNIT MUST PROVIDE SEAL LEAK AND WINDING OVERTEMP ALARM, INDICATION, AND PROTECTION AS SHOWN
15	ROSEMONT 310S LEVEL TRANSMITTER WITH S.S. CABLE AND ALL ACCESSORIES
16	CONSOLIDATED ELECTRIC MODEL IS1-3 INTRINSIC SAFETY BARRIER.
17	3ACT SERIES AC CURRENT TRANSDUCER

	DATE	APR
	DESCRIPTION	
REV		

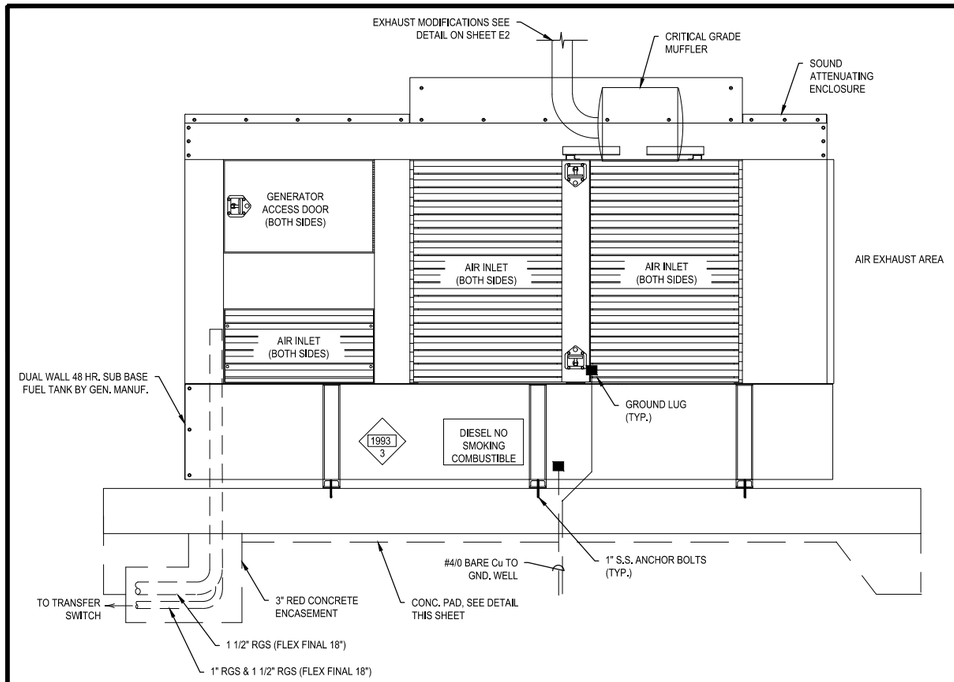
DESIGNED BY: TA
REVIEWED BY: CLR
DRAWN BY: EO

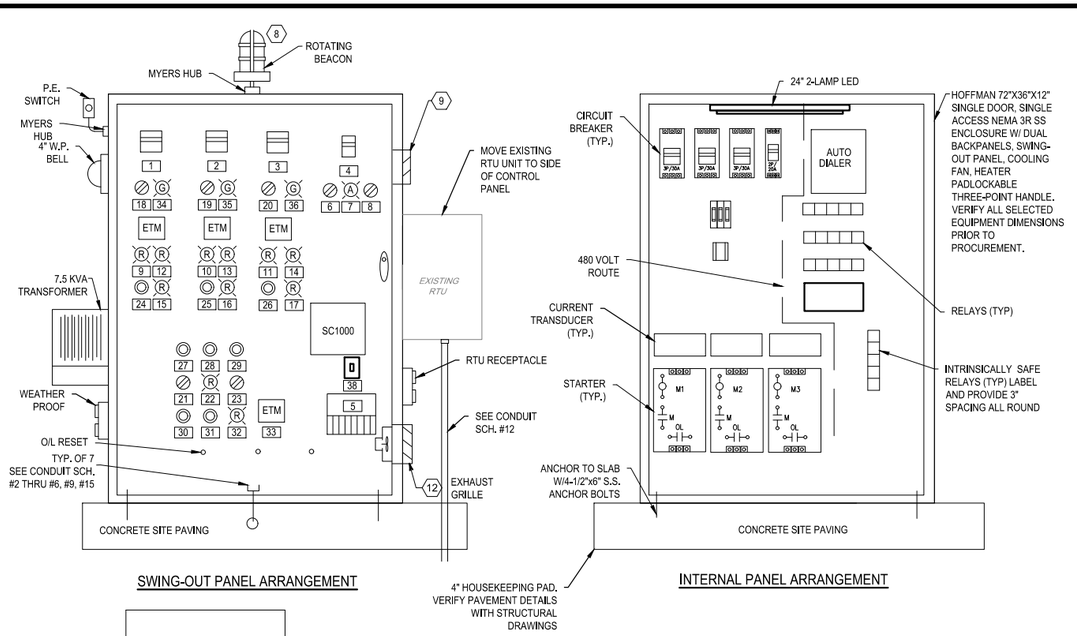
BGE, Inc.
2595 DALLAS PARKWAY, SUITE 101
FRISCO, TX 75034
TEL: 972-464-4080 • www.bgeinc.com
TBPE Registration No. F-1046

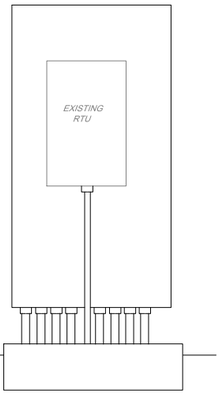
FBOP LIFT STATION REHABILITATION
CITY OF FARMERS BRANCH, TEXAS

ELECTRICAL DETAILS (SHEET 1 OF 2)

SHEET
E-05 OF 22



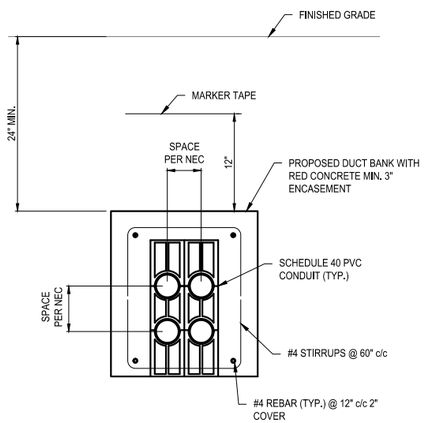




9 CONTROL PANEL ELEVATION DETAIL — SCALE: N.T.S.

STRIP MIN 12" SOIL AND REPLACE WITH SELECT FILL COMPACTED TO 95% STANDARD PROCTOR MAXIMUM DRY DENSITY PER ASTM D698.

7 GENERATOR & WEATHERPROOF ENCLOSURE DETAIL — SCALE: N.T.S.



8 TYPICAL DUCT BANK CONSTRUCTION — SCALE: N.T.S.

REV	DESCRIPTION	DATE	APR

DESIGNED BY: TA
REVIEWED BY: CLR
DRAWN BY: EO

BGE, Inc.
2595 DALLAS PARKWAY, SUITE 101
FRISCO, TX 75034
TEL: 972-464-4080 • www.bgeinc.com
TBPE Registration No. F-1046

FBOP LIFT STATION REHABILITATION
CITY OF FARMERS BRANCH, TEXAS

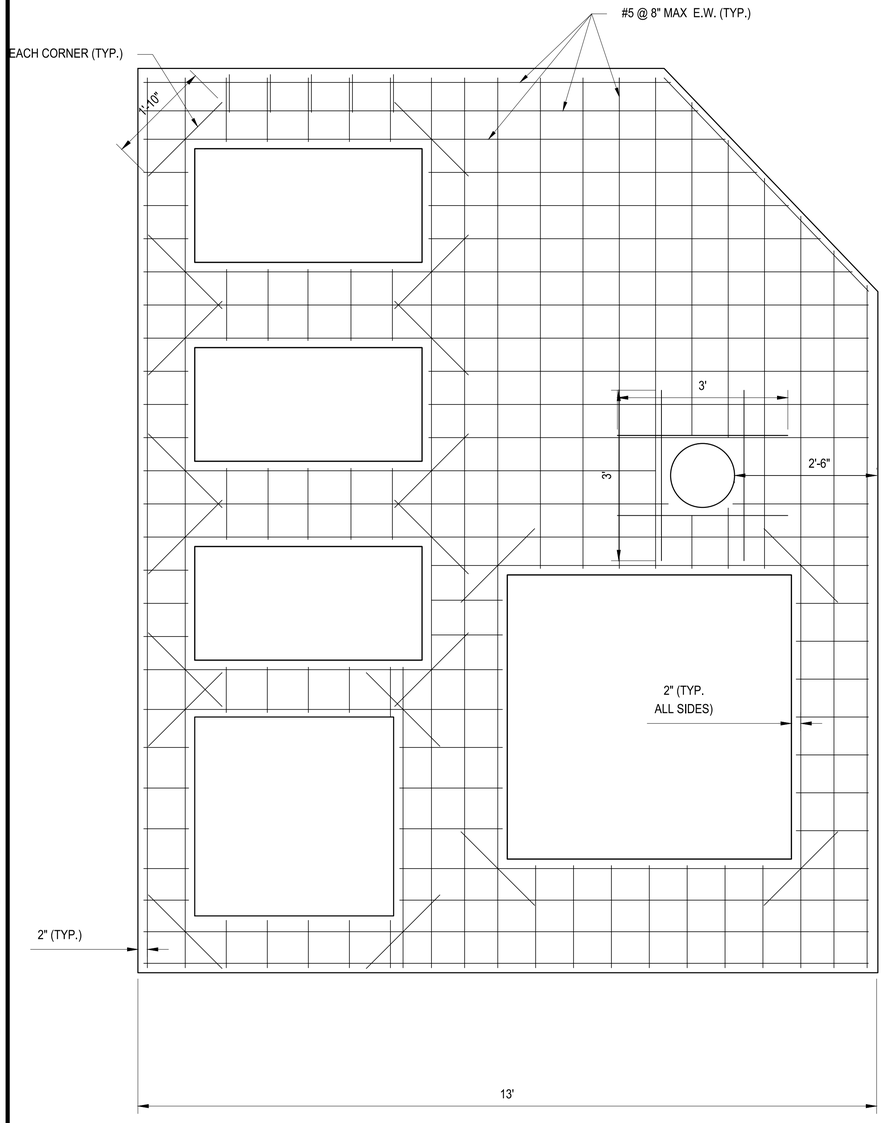
ELECTRICAL DETAILS (SHEET 2 OF 2)

5/12/2025

SHEET
E-06 OF 22

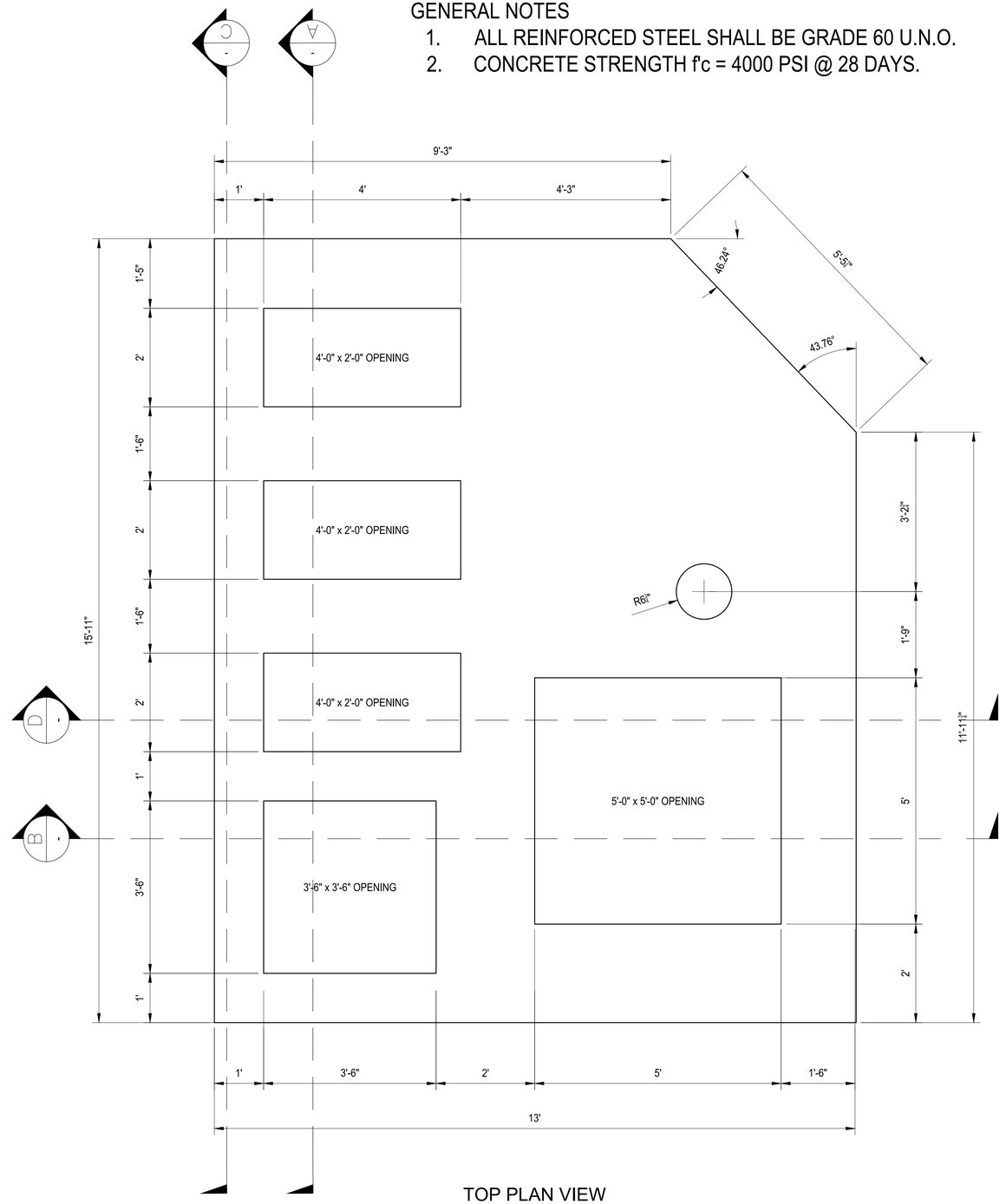
GENERAL NOTES

1. ALL REINFORCED STEEL SHALL BE GRADE 60 U.N.O.
2. CONCRETE STRENGTH f'c = 4000 PSI @ 28 DAYS.



TOP PLAN VIEW - REBAR SPACING

SCALE: 1/16" = 1'



TOP PLAN VIEW

SCALE: 1/16" = 1'

REV						DESCRIPTION	DATE
							APR

DESIGNED BY: CC

REVIEWED BY: CC

DRAWN BY: BGE

BGE, Inc.
2595 DALLAS PARKWAY, SUITE 101
FRISCO, TX 75034
TEL: 972-464-4080 • www.bgeinc.com
TBPE Registration No. F-1046

FBOP LIFT STATION
REHABILITATION
CITY OF FARMERS BRANCH, TEXAS

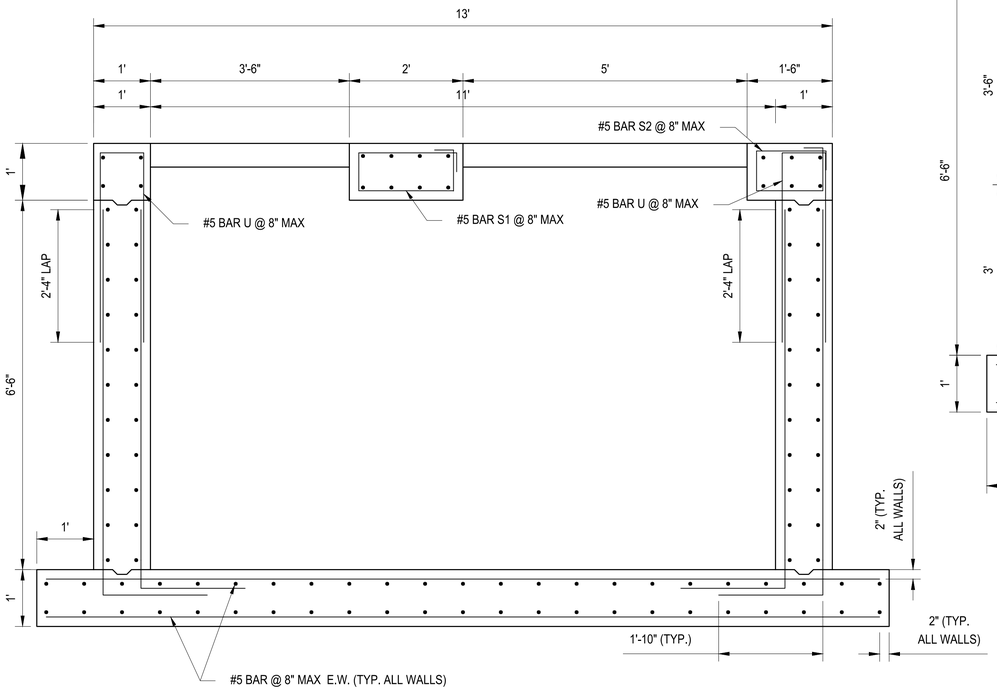
STRUCTURAL DETAILS (SHEET 1 OF 4)

STATE OF TEXAS
GREGG T. DURHAM
95652
LICENSED
PROFESSIONAL ENGINEER
04/04/2025

Brown & Gay Engineers, Inc.
F-1046

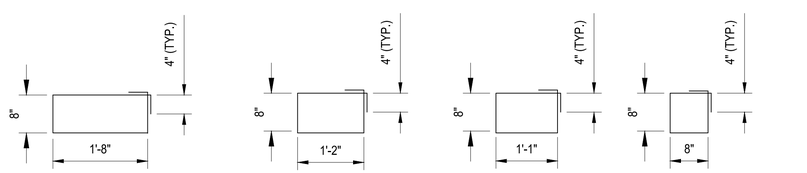
4/4/2025

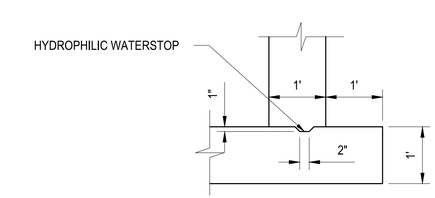
SHEET
S-01 OF 22



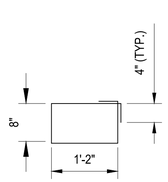
B VAULT SECTION
SCALE: 1/16" = 1'

NOTE: BARS S1 BECOME BARS S5 AT SECTION D. SECTION D NOT SHOWN, REFER TO SECTION B FOR REINFORCEMENT DETAILS. THE ONLY CHANGE IN THE SECTION B REINFORCEMENT FOR SECTION D IS THE S BAR. ALL OTHER REINFORCEMENT REMAINS THE SAME.

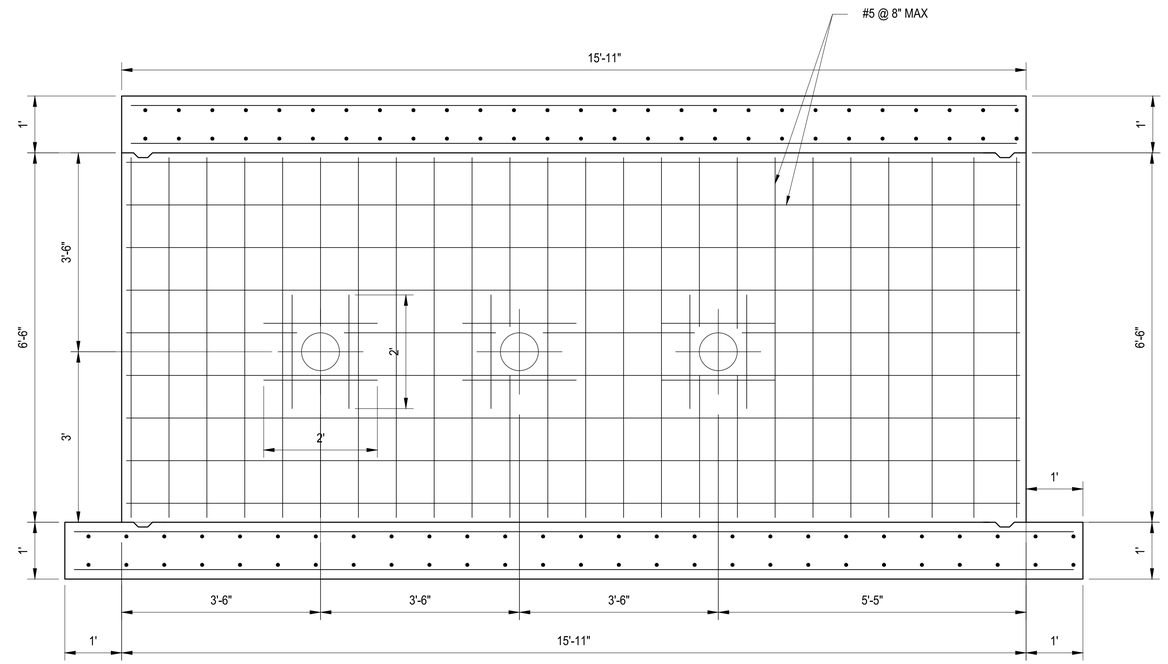




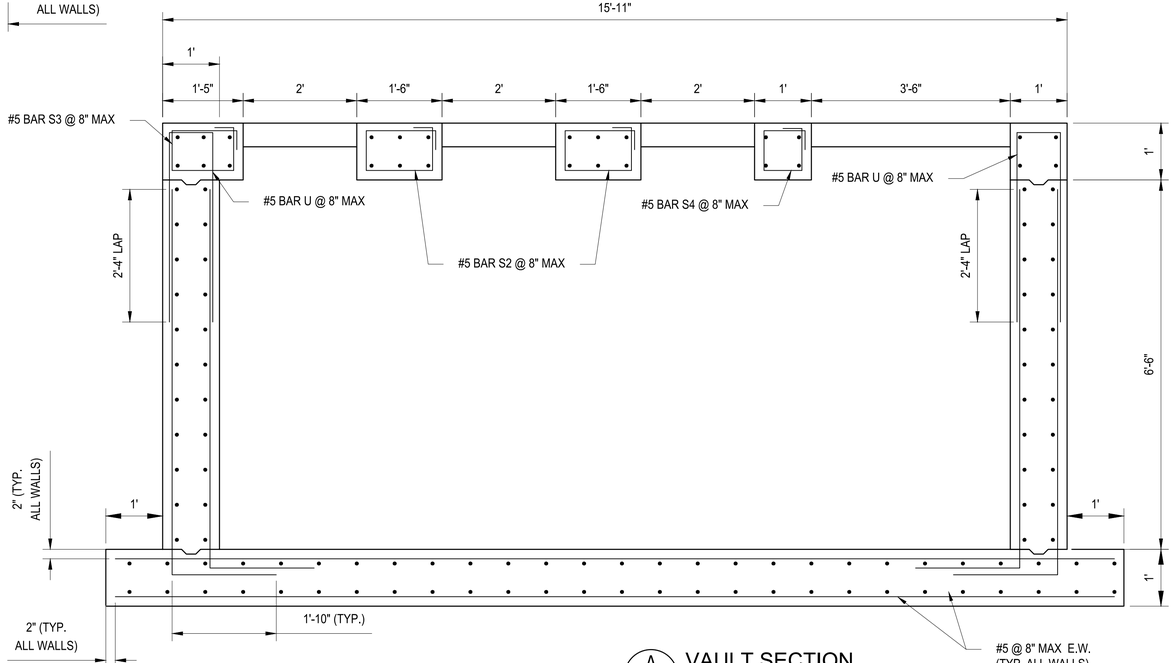
KEYWAY DETAIL



BAR S5



C VAULT SECTION
SCALE: 1/16" = 1'



A VAULT SECTION
SCALE: 1/16" = 1'

REV	DESCRIPTION	DATE
△		APR
△		
△		
△		
△		

DESIGNED BY: CC
REVIEWED BY: CC
DRAWN BY: BGE

BGE, Inc.
2595 DALLAS PARKWAY, SUITE 101
FRISCO, TX 75034
TEL: 972-464-4080 • www.bgeinc.com
TBPE Registration No. F-1046

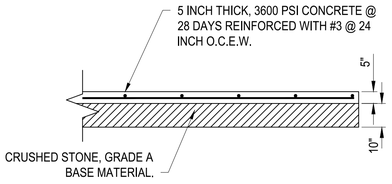
FBOP LIFT STATION REHABILITATION
CITY OF FARMERS BRANCH, TEXAS

STRUCTURAL DETAILS (SHEET 2 OF 4)

STATE OF TEXAS
GREGG T. DURHAM
95652
LICENSED PROFESSIONAL ENGINEER
04/04/2025

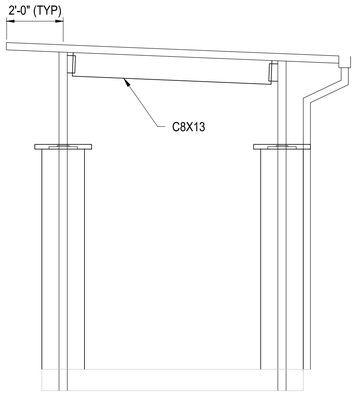
Brown & Gay Engineers, Inc.
F-1046
4/4/2025

SHEET
S-02 OF 22



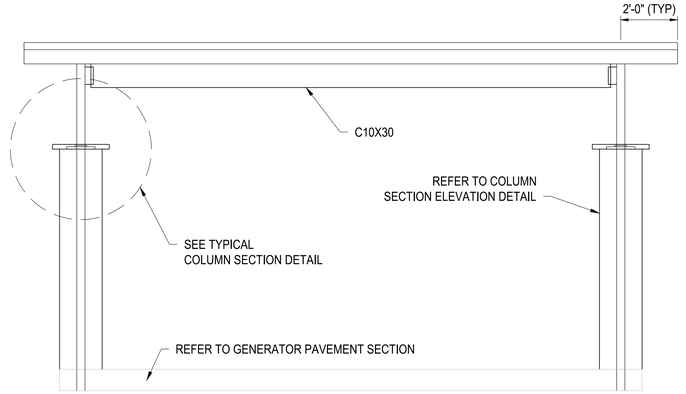
PAVEMENT SECTION

NTS



ELEVATION (LOOKING EAST)

NTS

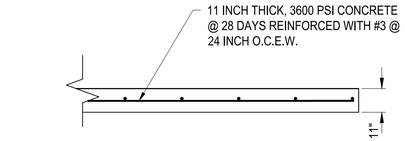


ELEVATION (LOOKING NORTH)

NTS

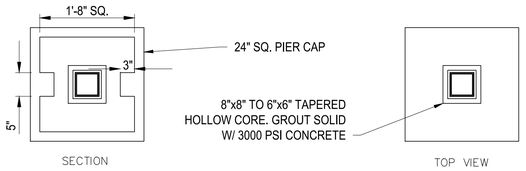
GENERAL NOTES

1. CONTRACTOR TO COORDINATE AWNING HEIGHTS WITH ELECTRICAL EQUIPMENT AND GENERATOR MANUFACTURER MINIMUM RECOMMENDED CLEARANCES.
2. ALL WELDS SHALL BE PERFORMED BY A CERTIFIED WELDER.
3. STEEL SHALL MEET AISC CURRENT STANDARDS.
4. ALL REINFORCED STEEL SHALL BE GRADE 60 U.N.O.
5. PROVIDE 1.5" REINFORCING CLEAR COVER U.N.O.
6. CONCRETE STRENGTH, f'c = 3600 PSI @ 28 DAYS.
7. PROPOSED PAVEMENT TO MATCH EXISTING GRADES UNLESS OTHERWISE NOTED.
8. CONCRETE COLUMN SECTION DIMENSIONS BASED ON PRODUCT SUPPLIED BY VERTI-CRETE. THE CONCRETE COLUMN FOR THE SCREEN WALL IS TO BE HOLLOW AND SLIDE OVER HSS COLUMN FOR EQUIPMENT AWNING. DESIGN OF COLUMN TO BE THE RESPONSIBILITY OF THE MANUFACTURER.
9. PROVIDE BLOCK OUT IN PIER CAP TO ALLOW FOR HSS COLUMN AT EQUIPMENT AWNING ONLY.



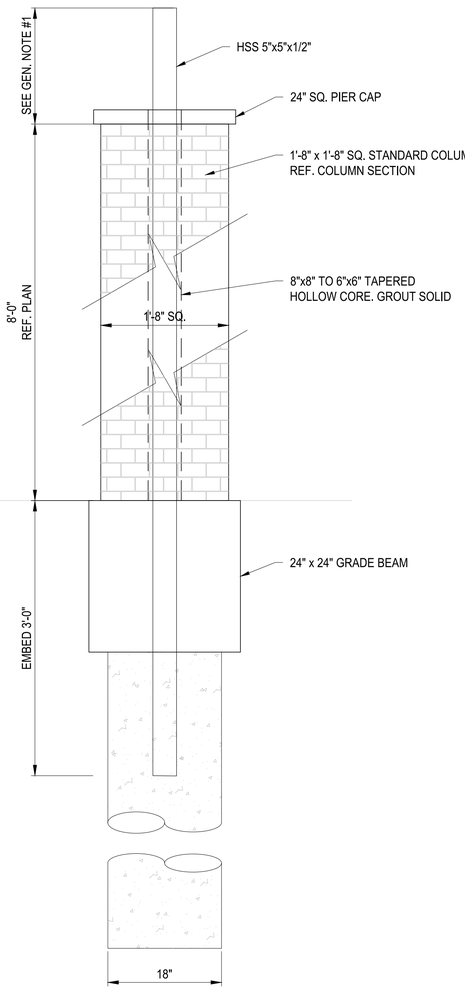
GENERATOR PAVEMENT SECTION

NTS



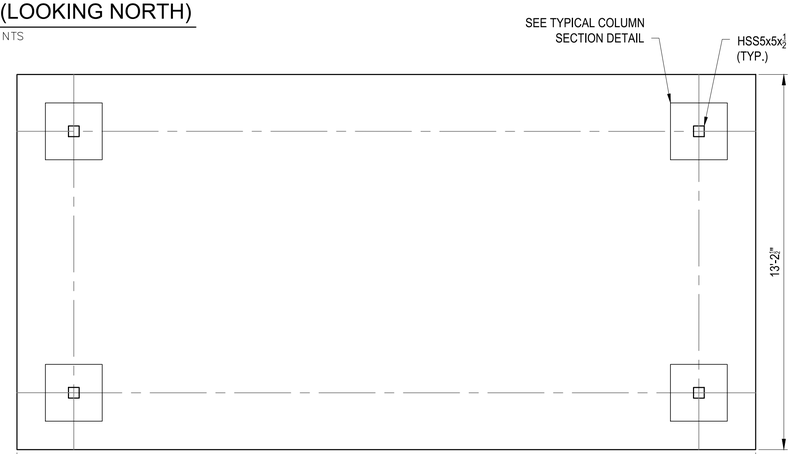
TYPICAL COLUMN SECTION / TOP COIL LOOP INSERT

NTS



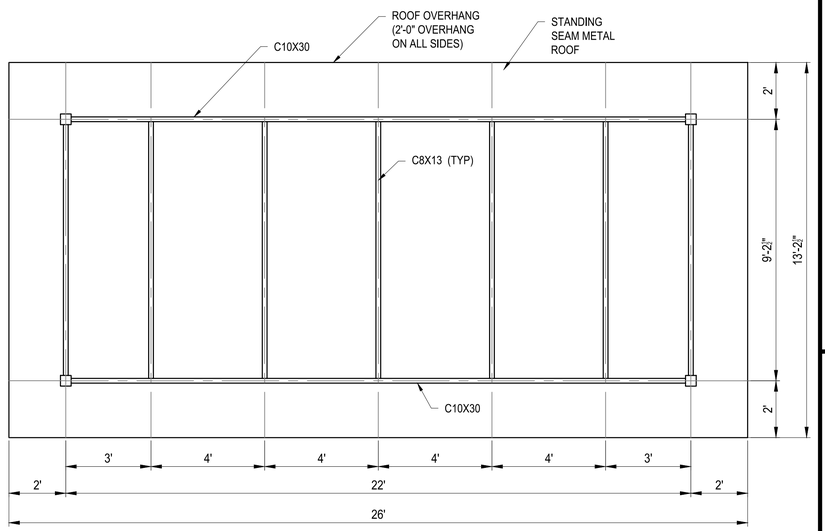
COLUMN SECTION / ELEVATION

NTS



PLAN

NTS



FRAMING PLAN

NTS

							APR
							DATE
							DESCRIPTION
△	△	△	△	△			REV

DESIGNED BY: GD

REVIEWED BY: GD

DRAWN BY: AW

BGE, Inc.
2595 DALLAS PARKWAY, SUITE 101
FRISCO, TX 75034
TEL.: 972-464-4080 • www.bgeinc.com
TBPE Registration No. F-1046

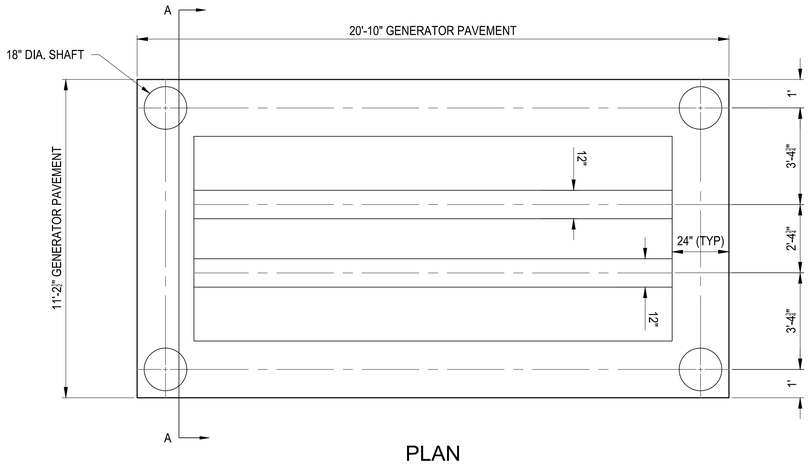
FBOP LIFT STATION REHABILITATION
CITY OF FARMERS BRANCH, TEXAS

STRUCTURAL DETAILS (SHEET 3 OF 4)

STATE OF TEXAS
GREGG T. DURHAM
95652
LICENSED PROFESSIONAL ENGINEER
04/04/2025

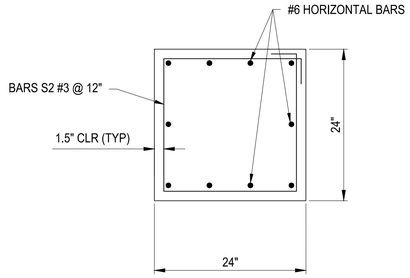
Brown & Gay Engineers, Inc.
F-1046
4/4/2025

SHEET
S-03 OF 22



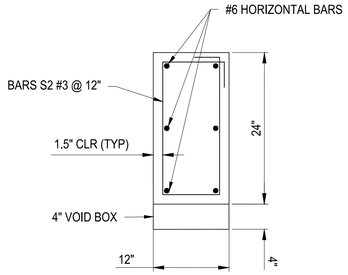
PLAN

NTS



24"x24" GRADE BEAM

NTS

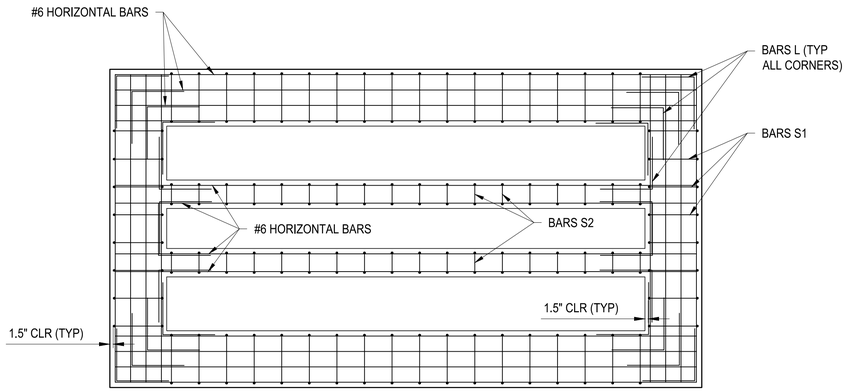


12"x12" GRADE BEAM

NTS

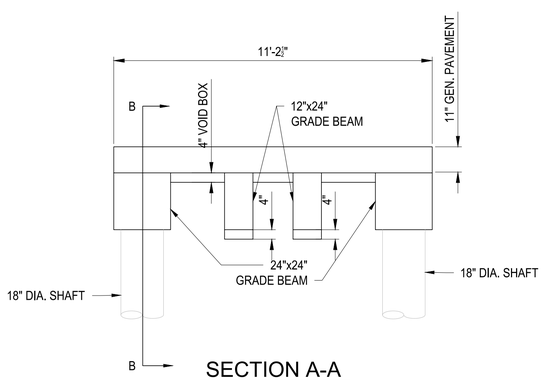
GENERAL NOTES

1. ALL REINFORCED STEEL SHALL BE GRADE 60 U.N.O.
2. PROVIDE 1.5" REINFORCING CLEAR COVER U.N.O.
3. CONCRETE STRENGTH, f'c = 3600 PSI @ 28 DAYS.
4. NO MECHANICAL CONNECTION BETWEEN GRADE BEAM AND GENERATOR PAVEMENT.
5. PER GEOTECHNICAL REPORT PROVIDED BY REED ENGINEERING, DATED OCT. 2022, GREY LIMESTONE IS ESTIMATED TO BE BETWEEN 6' TO 11.5' BELOW GRADE. FIELD ADJUST LENGTH OF DRILLED SHAFT, AS NEEDED, TO PROVIDE 1' MINIMUM PENETRATION INTO GREY UNWEATHERED LIMESTONE.



REINFORCEMENT PLAN

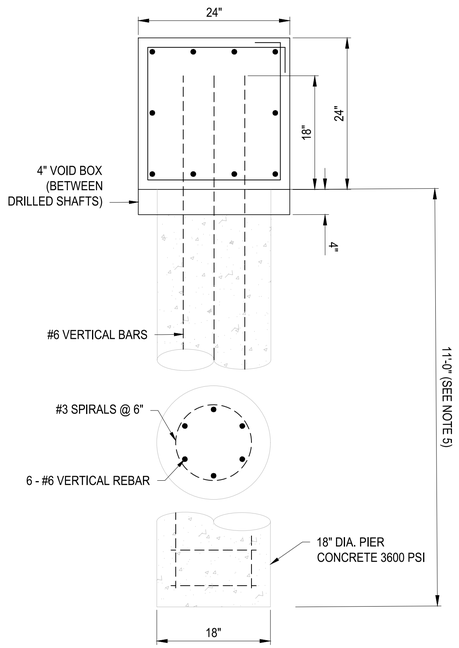
NTS



SECTION A-A

NTS

SEE REINFORCEMENT PLAN, GENERATOR PAVEMENT PLAN, SECTION B-B, 24"x24" GRADE BEAM, AND 12"x24" GRADE BEAM FOR DETAILS NOT SHOWN.



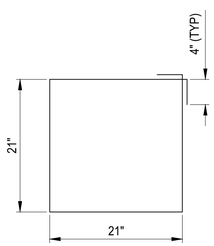
SECTION B-B

NTS

PIER SPECIFICATIONS:

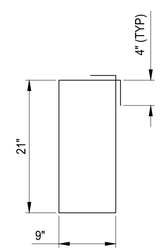
18" DIAMETER PIER 3' INTO UNWEATHERED LIMESTONE.
CONCRETE 3600 PSI @ 28 DAYS, STEEL 60 KSI

A. (6) # 6 VERTICAL REBAR
3 SPIRALS @ 6"



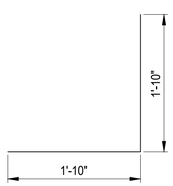
BARS S1

NTS



BARS S2

NTS



BARS L

NTS

REV	DESCRIPTION	DATE	APR

DESIGNED BY: CC

REVIEWED BY: CC

DRAWN BY: BGE

BGE, Inc.
2595 DALLAS PARKWAY, SUITE 101
FRISCO, TX 75034
TEL: 972-464-4080 • www.bgeinc.com
TBPE Registration No. F-1046

FBOP LIFT STATION REHABILITATION
CITY OF FARMERS BRANCH, TEXAS

STRUCTURAL DETAILS (SHEET 4 OF 4)

STATE OF TEXAS
GREGG T. DURHAM
95652
LICENSED PROFESSIONAL ENGINEER
04/04/2025

Brown & Gay Engineers, Inc.
F-1046

4/4/2025

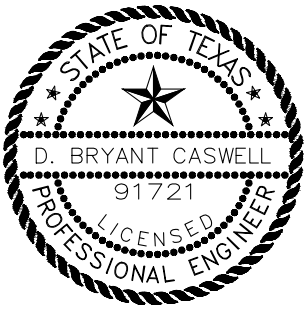
SHEET
S-04 OF 22

G:\TXN\Projects\City_FarmersBranch\7648-00-FBOP_Lift_Station_Rehab\PW\01_CADD\01_Shts\S-STR-DETAILS.dwg Layout: S-STR-PLAN (3) Plotted: 4/4/2025 3:48:58 PM

Specifications

Farmers Branch Office Park Lift Station

Technical Specifications for the Construction of
Farmers Branch Office Park Lift Station



4/8/2025

Divisions 1 - 15

TBPE Registration No. F-1046
2595 Dallas Pkwy, Suite 101
Frisco, TX 75034
972-464-4800

4/8/2025

Division 16

TBPE Registration No. F-1046
2595 Dallas Pkwy, Suite 101
Frisco, TX 75034
972-464-4800

April 2025

SPECIFICATIONS

TABLE OF CONTENTS

SECTION 02501
DUCTILE IRON PIPE AND FITTINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Ductile iron pipe and fittings for water lines, wastewater force mains, gravity sanitary sewers, and storm sewers.

1.02 MEASUREMENT AND PAYMENT

A. No separate payment will be made for work required under this section. Contractor will include all costs of the requirements of this section in appropriate bid item(s) on Bid Form.

1.03 REFERENCES

A. ANSI A 21.4 (AWWA C 104) - Standard for Cement-Mortar Lining for Ductile-Iron Pipe and Fittings, for Water.

B. ANSI A 21.10 (AWWA C 110) - Standard for Ductile-Iron and Gray-Iron Fittings, 3-in. through 48-in.

C. ANSI A 21.11 (AWWA C 111) - Standard for Rubber Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.

D. ANSI A 21.15 (AWWA C 115) - Standard for Flanged Ductile-Iron Pipe With Ductile-Iron or Gray-Iron Threaded Flanges.

E. ANSI A21.16 (AWWA C 116) - Protective Fusion Bonded Epoxy Coating for the Interior and Exterior Surfaces of Ductile Iron and Grey iron Fittings for Water Supply Service.

F. ANSI A 21.50 (AWWA C 150) - Standard for Thickness Design of Ductile-Iron Pipe.

G. ANSI A 21.51 (AWWA C 151) - Standard for Ductile-Iron Pipe, Centrifugally Cast, for Water and Other Liquids.

H. ANSI A 21.53 (AWWA C 153) - Standard for Ductile Iron Compact Fittings, 3 inches through 24 inches and 54 inches through 64 inches for Water Service.

I. ASME B 16.1 - Cast Iron Pipe Flanges and Flanged Fittings.

J. ASTM D 1248 - Standard Specification Polyethylene Plastics Molding and Extrusion Materials for Wire and Cable.

K. ASTM F 477 - Elastomeric Seals (gaskets) for Joining Plastic Pipe.

L. ASTM G 62 - Standard Test Methods for Holiday Detection in Pipeline Coatings.

M. AWWA C 105 - Polyethylene Encasement for Ductile-Iron Pipe Systems.

N. AWWA C 300 - Standard for Prestressed Concrete Pressure Pipe, Steel-Cylinder Type, for Water and other Liquids.

O. AWWA C 600 - Standard for Installation of Ductile-Iron Water Mains and Their Appurtenances.

P. SSPC-SP 6 - Steel Structures Painting Council, Commercial Blast Cleaning.

Q. American Railway Engineering and Maintenance-of-Way Association (AREMA) Manual for Railway Engineering.

R. American Association of State Highway Transportation Officials (AASHTO).

1.04 SUBMITTALS

A. Conform to requirements of Section 01330 - Submittal Procedures.

B. For pipes 24 inches and greater submit shop drawings signed and sealed by Professional Engineer registered in State of Texas showing the following:

1. Manufacturer’s pipe design calculations.

2. Provide lay schedule of pictorial nature indicating alignment and grade, laying dimensions, fitting, flange, and special details, with plan and profile view of each pipe segment sketched, detailing pipe invert elevations, horizontal bends, restrained joints, and other critical features. Indicate station numbers for pipe and fittings corresponding to Drawings. Do not start production of pipe and fittings prior to review and approval by Engineer.

3. Calculations and limits of thrust restraint.

4. Class and length of joint.

C. Submit manufacturer's certifications that ductile iron pipe and fittings meet provisions of this Section and have been hydrostatically tested at factory and meet requirements of ANSI A 21.51.

D. Submit certifications that pipe joints have been tested and meet requirements of ANSI A 21.11.

E. Submit affidavit of compliance in accordance with ANSI A21.16 for fittings with fusion bonded epoxy coatings or linings.

PART 2 PRODUCTS

2.01 DUCTILE IRON PIPE

A. Ductile Iron Pipe Barrels: ANSI A 21.15, ANSI A 21.50 or ANSI A 21.51; bear mark of Underwriters' Laboratories approval; minimum thickness Class 51 for water lines and thickness Class 52 for sanitary sewers, or as shown on Drawings. Provide minimum thickness Class 53 for flanged pipe, and minimum thickness Class 52 for areas with pipe offset sections. Maximum allowable lead content of 0.25 percent per section 1417 of the Safe Drinking Water Act.

B. Provide pipe sections in standard lengths, not less than 18 feet long, except for special fittings and closure sections as indicated on shop drawings.

C. Modify pipe for cathodic protection in accordance with Section 13111 - Cathodic Protection for Pipelines (NOT USED). In lieu of furnishing ductile iron pipe for water lines with cathodic protection system, furnish ductile iron pipe with polyethylene encasement, provided the following criteria are met:

1. Provide minimum thickness class of 51.

2. Provide polyethylene encasement material and installation in accordance with AWWA C105, and backfill as specified. Minimum of two complete wraps of 8-mil-thick polyethylene.

3. Use polyethylene encasement for open cut installations only. For augered sections or sections installed inside a casing, provide coating in accordance with paragraph 2.05 D.1.

4. Adhere to other requirements specified herein (e.g., insulation kits, etc.).

D. For use of pressure class pipe for water lines, design pipe and fittings to withstand most critical simultaneous application of external loads and internal pressures. Base design on minimum of AASHTO HS-20 loading, AREMA E-80 loads and depths of bury as indicated on Drawings. Design pipes with Marston's earth loads for a transition width trench for zero to 16 feet of cover. Use Marston's earth loads for a trench width of O.D. (of pipe) + 4 feet for pipe greater than 16 feet of cover. Use Marston's equations for a trench condition in both open-cut and tunnel applications. Design for most critical groundwater level condition. Pipe design conditions:

1. Working pressure = 100 psi.

2. Hydrostatic field test pressure = 150 psi.

3. Maximum pressure due to surge = 150 psi.

4. Minimum Pressure due to surge = -5 psi.

5. Design tensile stress due to surge or hydrostatic test pressure: No greater than 50% minimum yield.

6. Design bending stress due to combined earth loads and surge or hydrostatic test pressure: No greater than 48,000 psi.

7. Unit weight of fill = 120 pcf.

8. Deflection lag factor (Dl) = 1.2.

9. Bedding constant (K) = 0.1.

10. Moment coefficient = 0.16.

11. Fully saturated soil conditions hw=h=depth of cover above top of pipe.

E. Hydrostatic Test of Pipe: AWWA C 151, Section 5.2.1, at point of manufacture. Hold test for a minimum 2 minutes for thorough inspection of pipe. Repair or reject pipe revealing leaks or cracks.

F. Pipe Manufacturer for large diameter water lines: Minimum of 5 years of successful pipe installations in continuous service. Manufacturer must maintain on site or in plant enough fittings to satisfy the following requirements:

Line Diameter	Required Bends*
20 and 24 inches	Four 45° bends per 5,000 LF of water line
> 24 inches	Four 22.5° bends per 10,000 LF of water line
*Based on total length of contract (minimum of four). Any combination of bends may be substituted at manufacturer's option (i.e. two 22.5° bends are equivalent to one 45° bend) and will be counted as one fitting.	

Manufacturer or supplier must be capable of delivering bends to job site within 12 hours of notification. Use fittings at direction of Engineer where unforeseen obstacles are encountered during construction. These fittings are in addition to any fittings called out in construction documents and must be available at all times.

G. Provide flange adapter with insulating kit as required when connecting new piping to existing piping and piping of different materials, unless otherwise approved by Engineer.

H. Clearly mark pipe section to show location and thickness/pressure class color coded.

2.02 JOINTS

A. Joint Types: ANSI A 21.11 push-on; ANSI A 21.11 mechanical joint; or ANSI A 21.16 flanged end. Provide push-on joints unless otherwise indicated on the Drawings or required by these specifications. For bolted joints, conform to requirements of AWWA C111; provide minimum 304 stainless steel for restraint joints.

B. Where restrained joints for buried service are required by Drawings, provide one of the following, or equal:

1. Super-Lock by Clow Corporation.

2. Flex-Ring or Lok-Ring by American Cast Iron Pipe Company.

3. TR-Flex or Field Lok by U.S. Pipe and Foundry Company.

4. One Bolt by One Bolt, Inc. (4 to 12 inches)

5. Sur-Grip by JCM Industries. (4 to 12 inches)

C. Threaded or grooved-type joints that reduce pipe wall thickness below minimum required are not acceptable.

D. Provide for restrained joints designed to meet test pressures required under Section 02515 - Hydrostatic Testing of Pipelines or Section 02532 - Sanitary Sewer Force Mains, as applicable. Provide restrained joints for test pressure or maximum surge pressure as specified, whichever is greater for water lines. Do not use passive resistance of soil in determining minimum restraint lengths.

E. Bond rubber gasketed joints to provide electrical continuity along entire pipeline, except where insulating flanges are required by Drawings.

F. Make curves and bends by deflecting joints. Do not exceed maximum deflection recommended by pipe manufacturer for pipe joints or restraint joints. Submit details of other methods of providing curves and bends for consideration by Engineer. When other methods are deemed satisfactory, install at no additional cost to Owner.

2.03 GASKETS:

A. Furnish, when no contaminant is identified, plain rubber (SBR) gasket material in accordance with ANSI A21.11 or ASTM F 477 (One Bolt only); for flanged joints 1/8-inch-thick gasket in accordance with ANSI A 21.15.

B. For pipes to be installed in potentially contaminated areas, see Specification Section 02105 - Sampling and Analysis in PPCA (NOT USED).

2.04 FITTINGS

A. Use fittings of same size as pipe. Reducers are not permitted to facilitate an off-size fitting. Reducing bushings are also prohibited. Make reductions in piping size by reducing fittings. Line and coat fittings as specified for pipe they connect to.

B. Push-on Fittings: ANSI A 21.10; ductile iron ANSI A 21.11 joints, gaskets, and lubricants, pressure rated at 250 psig.

C. Flanged Fittings: ANSI 21.10; ductile iron ANSI A 21.11 joints, gaskets, and lubricants, pressure rated at 250 psig.

D. Mechanical Joint Fittings: ANSI A 21.11; pressure rated at 250 psi.

E. Ductile Iron Compact Fittings for Water lines: ANSI A 21.53; 4-inch through 12-inch diameter fusion bonded epoxy-lined or cement mortar lining.

2.05 COATINGS AND LININGS

A. Water line Interiors: ANSI A21.4, cement lined with seal coat; ANSI A 21.16 fusion bonded epoxy coating for interior.

B. Sanitary Sewer and Force Main Interiors:

1. Preparation: Commercial blast cleaning conforming to SSPC-SP6.

2. Liner thickness: Nominal 40 mils, minimum 35 mils, for pipe barrel interior; minimum 6 to 10 mils at gasket groove and outside spigot end to 6-inches back from end.

3. Testing: ASTM G 62, Method B for voids and holidays; provide written certification.

4. Acceptable Lining Materials:

a. Ceramic Epoxy: Tnemec 431 or equal – Reference Specification Section 02505, High – Performance Ceramic Epoxy Linings for Ductile Iron Pipe and Fitting.

C. Sanitary Sewer Point Repair Pipe: For pipes which will be lined with high density polyethylene liner pipe or cured-in-place liner, provide cement-lined with seal coat in accordance with ANSI A 21.4. For pipes which will not be provided with named liner, provide pipe as specified in Paragraph 2.05B, Sanitary Sewer and Force Main Interiors.

D. Exterior:

1. Water Lines

a. Tunnel, Casing or Auger Holes: Conform to requirements of Section 02527 - Polyurethane Coatings on Steel or Ductile Iron Pipe (NOT USED)

b. Above Ground (or Exposed): Conform to requirements of Section 02502 - Steel Pipe and Fittings (NOT USED), Paragraph 2.03.

c. Direct Bury: Conform to requirements of Paragraph 2.05E or Section 02527 - Polyurethane Coatings on Steel or Ductile Iron Pipe as required herein (NOT USED).

2. Sanitary Sewers: Prime coat and outside asphaltic coating conforming to ANSI A21.10, ANSI A21.15, or ANSI A21.51 for pipe and fittings in open cut excavation and in casings.

E. Polyethylene Wrap: For buried water lines not cathodically protected and sanitary sewers, including point repairs, provide polyethylene wrap unless otherwise specified or shown. Conform to requirements of Section 02528 - Polyethylene Wrap.

F. For flanged joints in buried service, provide petrolatum wrapping system, Denso, or equal, for the complete joint and alloy steel fasteners. Alternatively, provide bolts made of Type 304 stainless steel.

G. Pipe to be installed in potentially contaminated areas shall have coatings and linings recommended by the manufacturer for maximum resistance to the contaminants identified in the Phase II Environmental Site Assessment Report.

H. For water lines cathodically protected, supply ductile iron pipe with either tape coatings or some other bonded dielectric coating as specified in Section 02518 - Steel Pipe and Fittings for Large Diameter Water Lines (NOT USED).

PART 3 EXECUTION

3.01 INSTALLATION

A. Conform to installation requirements of Sections 02511 - Water Mains (NOT USED), 02531 - Gravity Sanitary Sewers, 02532 - Sanitary Sewer Force Mains, 02631 - Storm Sewers (NOT USED), and 02553 - Point Repairs and Obstruction Removal (NOT USED), except as modified in this Section.

B. Install in accordance with AWWA C 600 and manufacturer's recommendations.

C. Install all ductile iron pipe in polyethylene wrap, unless cathodic protection is provided. Do not use polyethylene wrap with a cathodic protection system.

D. Holiday Testing.

1. Polyurethane: Conform to requirements of Section 02527 - Polyurethane Coatings for Steel or Ductile Iron Pipe (NOT USED).

2. Fusion Bonded Epoxy: Conform to requirements for new fittings in ANSI A 21.16.

3.02 FIELD REPAIR OF COATINGS

A. Polyurethane: Conform to requirements of Section 02527 - Polyurethane Coatings for Steel or Ductile Iron Pipe (NOT USED).

B. Fusion Bonded Epoxy: Conform to requirements for new fittings in ANSI A 21.16.

END OF SECTION

SECTION 02515
HYDROSTATIC TESTING OF PIPELINES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Field hydrostatic testing of newly installed water piping and pipelines.

B. Specifications identify requirements for both small-diameter (less than or equal to 20 inches) and large-diameter (greater than 20 inches) water lines. When specifications for large-diameter water lines differ from those for small- diameter water lines, paragraphs for large-diameter lines will govern for large-diameter pipe. Water piping includes plant piping.

1.02 MEASUREMENT AND PAYMENT

A. No separate payment will be made for work required under this section. Contractor will include all costs of the requirements of this section in the appropriate bid item(s) on the bid form.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION

3.01 PREPARATION

A. Disinfect water system piping and pipelines prior to hydrostatic testing.

B. Hydrostatically test newly installed water piping and pipelines after disinfection, if required, and before connecting to the Owner’s water distribution system.

C. Water for testing will be provided to Contractor at no charge by the Owner for the initial test and one (1) retest, if required.

D. For large-diameter water lines, test pipelines in lengths between valves, or plugs, of not more than 4400 feet.

E. Small-diameter pipe shall be tested in lengths between valves, or plugs, of not more than 1500 feet.

F. Conduct hydrostatic tests in presence of the Engineer.

3.02 TEST PROCEDURES

A. Furnish, install, and operate connections, pump, meter and gages necessary for hydrostatic testing.

B. Allow piping and pipeline to sit a minimum of 24 hours from time it is initially disinfected until testing begins, to allow pipe wall or lining material to absorb water. Periods of up to 7 days may be required for mortar lining to become saturated.

C. Test pipe at 150 psig or 1.5 times design pressure of the pipe, whichever is greater. Design pressure of the force main shall be the rated total dynamic head of the lift station pump.

D. Test pipe at the required pressure for a minimum of 4 hours according to requirements of Uni-B-3. If a large quantity of water is required to maintain pressure during test, testing shall be discontinued until cause of water loss is identified and corrected.

E. Keep valves inside pressure reducing stations closed during hydrostatic pressure test.

3.03 ALLOWABLE LEAKAGE FOR WATER LINES

A. During hydrostatic tests, no leakage will be allowed for sections of water lines and piping consisting of welded joints.

B. Maximum allowable leakage shall be as calculated by the following formula:

$$L = (S)\,(D)\,(P0.5) / 133{,}200$$

Where:	L	=	Leakage in gallons per hour.
	S	=	Length of pipe in feet.
	D	=	Inside diameter of pipe in inches.
	P	=	Pressure in pounds per square inch.

3.04 CORRECTION FOR FAILED TESTS

A. Repair joints showing visible leaks on surface regardless of total leakage shown on test. Check valves and fittings to ensure that no leakage occurs that could affect or invalidate test. Remove any cracked or defective pipes, fittings, and valves discovered during pressure test and replace with new items.

B. The Engineer may require failed pipe to be disinfected after repair and prior to retesting. Conduct and pay for subsequent disinfection operations in accordance with requirements of Section 02514 - Disinfection of Water Lines (NOT USED). Contractor shall pay for water required for additional disinfection and retesting.

C. Repeat test until satisfactory results are obtained.

3.05 COMPLETION

A. Upon satisfactory completion of testing, remove risers remaining from disinfection and hydrostatic testing, and backfill excavation promptly.

END OF SECTION

SECTION 02532
SANITARY SEWER FORCE MAINS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Sanitary sewer force mains.

1.02 MEASUREMENT AND PAYMENT

A. No separate payment will be made for work required under this Section. Contractor will include all costs of the requirements of this Section in the appropriate bid item(s) on the Bid Form.

1.03 REFERENCE STANDARDS

A. ACI 318 - Building Code Requirements for Reinforced Concrete.

B. ASTM D 696 - Standard Test Method for Coefficient of Linear Expansion of Plastics Between -30 degrees C and 30 degrees C.

C. ASTM D 1248 - Polyethylene Plastics Molding and Extrusion Materials.

D. ASTM D 2122 - Standard Test Method for Determining Dimensions of Thermoplastic Pipe and Fittings.

E. ASTM D 2310 - Standard Specification for Machine-Made Reinforced Thermosetting - Resin Pipe.

F. ASTM D 2837 - Standard Test Methods for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials.

G. ASTM D 2992 - Standard Practice for Obtaining Hydrostatic or Pressure Design Basis for "Fiberglass" (Glass-Fiber Reinforced Thermosetting-Resin) Pipe and Fittings.

H. ASTM D 2996 - Standard Specification for Filament-Wound "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe.

I. ASTM D 3350 - Standard Specification for Polyethylene Plastic Pipe and Fittings Materials.

J. ASTM F 714 - Standard Specification for Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter.

K. Uni-Bell UNI-B-3 Polyvinyl Chloride (PVC) Pressure Pipe (complying with AWWA C 900).

1.04 SUBMITTALS

A. Conform to requirements of Section 01330 - Submittal Procedures.

B. Submit proposed methods, equipment, materials, and sequence of operations for force main construction. Plan operations to minimize disruption of utilities to occupied facilities or adjacent property.

C. Submit shop drawings and design calculations for joint restraint systems using reinforced concrete encasement of pressure pipe and fittings.

D. Submit qualifications, proposed methods, equipment, materials, and sequence for acceptance testing of the pipeline. Submit evidence of experience with pipeline proving by pigging for at least three projects of equal or greater scope; project list shall include dates, size and length of pipe, location, owner name, contact person, and telephone number. Provide certificate of training by the manufacturer of the pigging equipment being used.

E. Submit test reports as specified in Part 3 of this Section.

PART 2 PRODUCTS

2.01 DUCTILE-IRON PIPE AND FITTINGS

A. Conform to requirements of Section 02501 – Ductile Iron Pipe & Fittings.

2.02 HDPE PIPE

A. Conform to requirements of Section 02507 - High Density Polyethylene (HDPE) Pipe For Sanitary Sewer.

B. Provide lined ductile iron fittings conforming to Section 02501 – Ductile Iron Pipe & Fittings Piping.

2.03 THRUST RESTRAINT

A. Unless otherwise shown on the Drawings, provide concrete thrust blocking for force mains up to 12-inches in diameter, to prevent movement of buried lines under pressure at bends, tees, caps, valves and hydrants. Blocking shall be Portland cement concrete, as specified in Section 03300 – Cast In Place Concrete. Place concrete in accordance with details on the Drawings. Place thrust blocks between undisturbed ground and the fittings. Anchor fittings to thrust blocks so that pipe and fitting joints are accessible for repairs. Concrete shall extend from 6 inches below the pipe or fitting to 12 inches above.

B. For force mains larger than 12 inches in diameter, and where indicated on the Drawings, provide restrained joints conforming to the requirements of the force main pipe material specifications. Restrained joints shall be installed for the length of pipe on both sides of each bend or fitting for the full length shown on the Drawings.

C. Horizontal and vertical bends between zero and 10 degrees deflection angle will not require thrust blocks or harnessed or restrained joints.

D. Horizontal and vertical bends between 10 degrees and 90 degrees deflection angle shall have thrust restraint as shown on the Drawings.

E. Provide thrust restraint at tees, plugs, blowoff drains, valves, and caps, as indicated.

F. Reinforced concrete encasement of force main pipe and fittings may be used in lieu of manufactured joint restraint systems. Alternate joint restraint systems using reinforced concrete encasement shall conform to the following design requirements.

1. Design calculations shall be performed and sealed by a Professional Engineer licensed in the State of Texas.

2. Design calculations shall be based upon soil parameters quantified in the geotechnical report for the site where the alternative thrust restraint system is to be installed. If data is not available for the site, use parameters recommended by the geotechnical engineer.

3. The design system pressure shall be the specified test pressure.

4. The following safety factors shall be used in sizing the restraint system:

a. Apply a factor of safety equal to 1.5 for passive soil resistance.

b. Apply a factor of safety equal to 2.0 for soil friction.

5. The encasement shall be contained entirely within the standard trench width and terminate on both ends at a pipe bell or coupling.

6. Concrete encasement reinforcement steel shall be designed for all loads, including internal pressure and longitudinal forces. Concrete design shall be in accordance with ACI 318.

PART 3 EXECUTION

3.01 PIPE INSTALLATION BY OPEN-CUT

A. Perform excavation, bedding, and backfill in accordance with Section 02317 – Excavation, Trenching, and Backfill for Utilities.

B. Wrap ductile-iron pipe and fittings with polyethylene. Polyethylene wrap shall not be installed on ductile iron pipe protected by a cathodic protection system.

C. Install pipe in accordance with the pipe manufacturer's recommendations and as specified in the following paragraphs.

D. Install pipe only after excavation is completed, the bottom of the trench is fine graded, bedding material is installed, and the trench has been approved by the Engineer.

E. Install pipe to the line and grade indicated. Place pipe so that it has continuous bearing of barrel on bedding material and is laid in the trench so the interior surfaces of the pipe follow the grades and alignment indicated. Provide bell holes where necessary.

F. Install pipe with the spigot ends toward the direction of flow. Form a concentric joint with each section of adjoining pipe so as to prevent offsets.

G. Keep the interior of pipe clean as the installation progresses. Where cleaning after laying the pipe is difficult because of small pipe size, use a suitable swab or drag in the pipe and pull it forward past each joint immediately after the joint has been completed. Remove foreign material and debris from the pipe.

H. Provide lubricant, place and drive home newly laid sections with come-a-long winches so as to eliminate damage to sections. Install pipe to "home" mark where provided. Use of backhoes or similar powered equipment will not be allowed unless protective measures are provided and approved in advance by the Engineer.

I. Keep excavations free of water during construction and until final inspection.

J. When work is not in progress, cover the exposed ends of pipes with an approved plug to prevent foreign material from entering the pipe.

K. Where sanitary sewer force main is to be installed under an existing water line with a separation distance of less than 2 feet, install one full joint length of pipe centered on the water line and maintain a minimum 6-inch separation distance.

3.02 PIPE INSTALLATION OTHER THAN OPEN-CUT

A. For installation of pipe by auguring, jacking, or tunneling, conform to requirements of specification section of auguring or tunneling work.

3.03 HYDROSTATIC TESTING

A. After the pipe and appurtenance have been installed, test line and drain. Prevent damage to the Work or adjacent areas. Use clean water to perform tests.

B. The Engineer may direct tests of relatively short sections of completed lines to minimize traffic problems or potential public hazards.

C. Test pipe in the presence of the Engineer.

D. Test pipe at 150 psig or 1.5 times design pressure of the pipe, whichever is greater. Design pressure of the force main shall be the rated total dynamic head of the lift station pump.

E. Test pipe at the required pressure for a minimum of 4 hours according to requirements of Uni-B-3.

F. Maximum allowable leakage shall be as calculated by the following formula:

$$L = (S)\ (D)\ (P0.5) / 133{,}200$$

Where:	L	=	Leakage in gallons per hour.
	S	=	Length of pipe in feet.
	D	=	Inside diameter of pipe in inches.
	P	=	Pressure in pounds per square inch.

G. Correct defects, cracks, or leakage by replacement of defective items or by repairs as approved by the Engineer.

H. Plug openings in the force main after testing and flushing. Use cast iron plugs or blind flanges to prevent debris from entering the tested pipeline.

3.04 PIGGING TEST

A. After completion of hydrostatic testing and prior to final acceptance, test force mains longer than 200 feet by pigging to ensure piping is free of obstructions.

B. Pigs: Provide proving pigs manufactured of an open-cell polyurethane foam body, without any coating or abrasives which would scratch or otherwise damage interior pipe wall surface or lining. Pigs shall be able to pass through reductions of up to 65 percent of the nominal cross-sectional area of the pipe. Pigs shall be able to pass through standard fittings such as 45-degree and 90-degree elbows, crosses, tees, wyes, gate valves, or plug valves, as applicable to the force main being tested.

C. Test Execution: Pigging test shall be conducted in the presence of the Engineer. Provide at least 48-hours notice of scheduled pigging of the force main prior to commencing the test.

END OF SECTION

SECTION 03210
REINFORCING STEEL

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Minimum requirements for reinforcing steel as specified in American Concrete Institute 301, "Specifications for Structural Concrete in Buildings" and these specifications.

1.02 MEASUREMENT AND PAYMENT

A. No separate payment will be made for work required under this section. Contractor will include all costs of the requirements of this section in the appropriate bid item(s) on the Bid Form.

PART 2 PRODUCTS

2.01 MATERIALS

A. Billet Steel: ASTM A615 Grade 60 or as specified on the drawings, open hearth, basic oxygen or electric furnace.

B. Bar Size Numbers, Deformation and Unit Weights: ASTM A305.

C. Cold-drawn Wire and Welded Wire Fabric: ASTM A82 and ASTM A185.

D. Spiral Reinforcement: Use smooth bars or wire.

2.02 BENDING

A. Bend reinforcing steel to required shapes while steel is cold. Excessive irregularities in bending will be cause for rejection. Detail bars in accordance with ACI 315 latest addition.

2.03 STORING

A. Store reinforcement above ground on platforms, skids or other supports and protects from mechanical injury and surface deterioration caused by exposure to weather. Use reinforcing steel that is free from dirt, scale, rust, paint, oil or other foreign material.

2.04 PLACING

A. Place reinforcement in exact positions indicated and hold securely in place during placing of concrete. Do not use "Pig Tails", looped wire bar ties. Provide minimum of 1-1/2 bar diameter clear distance between bars.

B. Space steel in walls required distance from face of forms by use of galvanized metal spacers. Use galvanized metal chairs to support reinforcing steel. Use heavy bolsters

to support bottom layer of reinforcing in abutment and bent caps. In bridge deck slab use two rows of supports for bottom layer of reinforcing parallel to beams for each bay between beams. Use high chairs to support top layer as directed. Clean mortar from reinforcing steel. Obtain Engineer's approval before placing concrete. If reinforcing steel is left exposed for future construction, protect against corrosion as directed.

END OF SECTION

SECTION 03300
CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section includes cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes, for the following:

1. Footings.
2. Foundation walls.
3. Slabs-on-grade.
4. Suspended slabs.
5. Concrete toppings.
6. Building frame members.
7. Building walls.

B. Related Sections:

1. Section 03210 Reinforcing Steel.

1.03 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume; subject to compliance with requirements.

1.04 ACTION SUBMITTALS

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

B. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

1. Indicate amounts of mixing water to be withheld for later addition at Project site.

C. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup

spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.

D. Formwork Shop Drawings: Prepared by or under the supervision of a qualified professional engineer detailing fabrication, assembly, and support of formwork.

1. Shoring and Reshoring: Indicate proposed schedule and sequence of stripping formwork, shoring removal, and reshoring installation and removal.

E. Construction Joint Layout: Indicate proposed construction joints required to construct the structure.

1. Location of construction joints is subject to approval of the Architect.

F. Samples: For waterstops and vapor retarder.

1.05 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer, manufacturer and testing agency.

B. Welding certificates.

C. Material Certificates: For each of the following, signed by manufacturers:

1. Cementitious materials.
2. Admixtures.
3. Form materials and form-release agents.
4. Steel reinforcement and accessories.
5. Fiber reinforcement.
6. Waterstops.
7. Curing compounds.
8. Floor and slab treatments.
9. Bonding agents.
10. Adhesives.
11. Vapor retarders.
12. Semirigid joint filler.
13. Joint-filler strips.
14. Repair materials.

D. Material Test Reports: For the following, from a qualified testing agency, indicating compliance with requirements:

1. Aggregates. Include service record data indicating absence of deleterious expansion of concrete due to alkali aggregate reactivity.

E. Floor surface flatness and levelness measurements indicating compliance with specified tolerances.

F. Field quality-control reports.

G. Minutes of preinstallation conference.

1.06 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs on Project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician.

B. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.

1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."

C. Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.

1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.
2. Personnel performing laboratory tests shall be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician - Grade I. Testing Agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician - Grade II.

D. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.

E. Welding Qualifications: Qualify procedures and personnel according to AWS D1.4/D 1.4M, "Structural Welding Code - Reinforcing Steel."

F. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:

1. ACI 301, "Specifications for Structural Concrete," Sections 1 through 5.
2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."

G. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.

H. Mockups: Cast concrete slab-on-grade and formed-surface panels to demonstrate typical joints, surface finish, texture, tolerances, floor treatments, and standard of workmanship.

1. Build panel approximately 200 sq. ft. for slab-on-grade and 100 sq. ft. for formed surface in the location indicated or, if not indicated, as directed by Architect.

2. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

I. Preinstallation Conference: Conduct conference at Project site.

1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:

a. Contractor's superintendent.
b. Independent testing agency responsible for concrete design mixtures.
c. Ready-mix concrete manufacturer.
d. Concrete subcontractor.
e. Special concrete finish subcontractor.

2. Review special inspection and testing and inspecting agency procedures for field quality control, concrete finishes and finishing, cold- and hot-weather concreting procedures, curing procedures, construction contraction and isolation joints, and joint-filler strips, semirigid joint fillers, forms and form removal limitations, shoring and reshoring procedures, vapor-retarder installation, anchor rod and anchorage device installation tolerances, steel reinforcement installation, floor and slab flatness and levelness measurement, concrete repair procedures, and concrete protection.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage. Avoid damaging coatings on steel reinforcement.

B. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

PART 2 - PRODUCTS

2.01 FORM-FACING MATERIALS

A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.

1. Plywood, metal, or other approved panel materials.
2. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:

a. High-density overlay, Class 1 or better.
b. Medium-density overlay, Class 1 or better; mill-release agent treated and edge sealed.
c. Structural 1, B-B or better; mill oiled and edge sealed.
d. B-B (Concrete Form), Class 1 or better; mill oiled and edge sealed.

B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.

C. Forms for Cylindrical Columns, Pedestals, and Supports: Metal, glass-fiber-reinforced plastic, paper, or fiber tubes that will produce surfaces with gradual or abrupt irregularities not exceeding specified formwork surface class. Provide units with sufficient wall thickness to resist plastic concrete loads without detrimental deformation.

D. Pan-Type Forms: Glass-fiber-reinforced plastic or formed steel, stiffened to resist plastic concrete loads without detrimental deformation.

E. Void Forms: Biodegradable paper surface, treated for moisture resistance, structurally sufficient to support weight of plastic concrete and other superimposed loads.

F. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum.

G. Rustication Strips: Wood, metal, PVC, or rubber strips, kerfed for ease of form removal.

H. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

1. Formulate form-release agent with rust inhibitor for steel form-facing materials.

I. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.

1. Furnish units that will leave no corrodible metal closer than 1 inch to the plane of exposed concrete surface.
2. Furnish ties that, when removed, will leave holes no larger than 1 inch in diameter in concrete surface.
3. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.

2.02 STEEL REINFORCEMENT

A. Reinforcing Bars: ASTM A 615, Grade 60, deformed.

B. Low-Alloy-Steel Reinforcing Bars: ASTM A 706, deformed.

C. Steel Bar Mats: ASTM A 184, fabricated from ASTM A 615, Grade 60, deformed bars, assembled with clips.

D. Plain-Steel Wire: ASTM A 82, as drawn.

E. Deformed-Steel Wire: ASTM A 496.

F. Plain-Steel Welded Wire Reinforcement: ASTM A 185, plain, fabricated from as-drawn steel wire into flat sheets.

2.03 REINFORCEMENT ACCESSORIES

A. Joint Dowel Bars: ASTM A 615, Grade 60, plain-steel bars, cut true to length with ends square and free of burrs.

B. Epoxy-Coated Joint Dowel Bars: ASTM A 615, Grade 60, plain-steel bars, ASTM A 775 epoxy coated.

C. Epoxy Repair Coating: Liquid, two-part, epoxy repair coating; compatible with epoxy coating on reinforcement and complying with ASTM A 775.

D. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:

1. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.
2. For epoxy-coated reinforcement, use epoxy-coated or other dielectric-polymer-coated wire bar supports.
3. For zinc-coated reinforcement, use galvanized wire or dielectric-polymer-coated wire bar supports.

2.04 CONCRETE MATERIALS

A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:

1. Portland Cement: ASTM C 150, Type I or Type I/II gray or white. Supplement with the following:

   a. Fly Ash: ASTM C 618, Class F.
   b. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.

2. Blended Hydraulic Cement: ASTM C 595, Type IP, portland-pozzolan cement.

B. Silica Fume: ASTM C 1240, amorphous silica.

1. Maximum Coarse-Aggregate Size: 1-1/2 inches nominal.
2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

C. Lightweight Aggregate: ASTM C 330, 1-inch nominal maximum aggregate size.

D. Water: ASTM C 94 and potable.

2.05 ADMIXTURES

A. Air-Entraining Admixture: ASTM C 260.

B. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.

1. Water-Reducing Admixture: ASTM C 494, Type A.
2. Retarding Admixture: ASTM C 494, Type B.
3. Water-Reducing and Retarding Admixture: ASTM C 494, Type D.
4. High-Range, Water-Reducing Admixture: ASTM C 494, Type F.
5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494, Type G.
6. Plasticizing and Retarding Admixture: ASTM C 1017, Type II.

C. Set-Accelerating Corrosion-Inhibiting Admixture: Commercially formulated, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete and complying with ASTM C 494, Type C.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. BASF Construction Chemicals - Building Systems; Rheocrete CNI.
   b. Grace Construction Products, W. R. Grace & Co.; DCI.
   c. Sika Corporation; Sika CNI.

D. Non-Set-Accelerating Corrosion-Inhibiting Admixture: Commercially formulated, non-set-accelerating, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete.

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

   a. BASF Construction Chemicals - Building Systems; Rheocrete 222+.
   b. Grace Construction Products, W. R. Grace & Co.; DCI-S.
   c. Sika Corporation; FerroGard 901.

E. Color Pigment: ASTM C 979, synthetic mineral-oxide pigments or colored water-reducing admixtures; color stable, free of carbon black, nonfading, and resistant to lime and other alkalis.

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

   a. ChemMasters.
   b. Davis Colors.
   c. Scofield, L. M. Company.

2. Color: As selected by Architect from manufacturer's full range.

2.06 WATERSTOPS

A. Flexible Rubber Waterstops: CE CRD-C 513, with factory-installed metal eyelets, for embedding in concrete to prevent passage of fluids through joints. Factory fabricate corners, intersections, and directional changes.

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

a. Greenstreak.
b. Williams Products, Inc.

2. Profile: Ribbed with center bulb.
3. Dimensions: 6 inches by 3/8 inch thick for construction joints and 9 inches by 3/8 inch thick for expansion joints; nontapered.

B. Flexible PVC Waterstops: CE CRD-C 572, with factory-installed metal eyelets, for embedding in concrete to prevent passage of fluids through joints. Factory fabricate corners, intersections, and directional changes.

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

a. BoMetals, Inc.
b. Greenstreak.
c. Paul Murphy Plastics Company.
d. Vinylex Corp.

2. Profile: Ribbed with center bulb or as indicated.
3. Dimensions: 6 inches by 3/8 inch thick for control joints and 9 inches by 3/8 inch thick for expansion joints; nontapered.

C. Self-Expanding Rubber Strip Waterstops: Manufactured rectangular or trapezoidal strip, bentonite-free hydrophilic polymer modified chloroprene rubber, for adhesive bonding to concrete, 3/8 by 3/4 inch.

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

a. Adeka Ultra Seal/OCM, Inc.; Adeka Ultra Seal.
b. Greenstreak; Hydrotite.
c. Vinylex Corp.; Swellseal.

2.07 VAPOR RETARDERS

A. Sheet Vapor Retarder: ASTM E 1745, Class A, except with maximum perm rating of 0.1. Include manufacturer's recommended adhesive or pressure-sensitive tape.

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

a. Carlisle Coatings & Waterproofing, Inc.; Blackline 400.

b. Grace Construction Products, W. R. Grace & Co.; Florprufe 120.
c. Meadows, W. R., Inc.; Perminator 10 mil.

B. Granular Fill: Clean mixture of crushed stone or crushed or uncrushed gravel; ASTM D 448, Size 57, with 100 percent passing a 1-1/2-inch sieve and 0 to 5 percent passing a No. 8 sieve.

C. Fine-Graded Granular Material: Clean mixture of crushed stone, crushed gravel, and manufactured or natural sand; ASTM D 448, Size 10, with 100 percent passing a 3/8-inch sieve, 10 to 30 percent passing a No. 100 sieve, and at least 5 percent passing No. 200 sieve; complying with deleterious substance limits of ASTM C 33 for fine aggregates.

2.08 FLOOR AND SLAB TREATMENTS

A. Slip-Resistive Emery Aggregate Finish: Factory-graded, packaged, rustproof, nonglazing, abrasive, crushed emery aggregate containing not less than 50 percent aluminum oxide and not less than 20 percent ferric oxide; unaffected by freezing, moisture, and cleaning materials with 100 percent passing 3/8-inch sieve.

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

a. Anti-Hydro International, Inc.; Emery.
b. Dayton Superior Corporation; Emery Tuff Non-Slip.
c. Lambert Corporation; EMAG-20.
d. L&M Construction Chemicals, Inc.; Grip It.
e. Metalcrete Industries; Metco Anti-Skid Aggregate.

B. Slip-Resistive Aluminum Granule Finish: Factory-graded, packaged, rustproof, nonglazing, abrasive aggregate of not less than 95 percent fused aluminum-oxide granules.

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

a. Anti-Hydro International, Inc.; A-H Alox.
b. BASF Construction Chemicals - Building Systems; Frictex NS.
c. L&M Construction Chemicals, Inc.; Grip It AO.

C. Unpigmented Mineral Dry-Shake Floor Hardener: Factory-packaged dry combination of portland cement, graded quartz aggregate, and plasticizing admixture.

1. Products: Subject to compliance with requirements, provide one of the following:
a. ChemMasters; ConColor.
b. Kaufman Products, Inc.; Tycron.
c. L&M Construction Chemicals, Inc.; Quartzplate FF.

D. Pigmented Mineral Dry-Shake Floor Hardener: Factory-packaged, dry combination of portland cement, graded quartz aggregate, color pigments, and plasticizing admixture. Use color pigments that are finely ground, nonfading mineral oxides interground with cement.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. ChemMasters; ConColor.
   b. Kaufman Products, Inc.; Tycron.
   c. L&M Construction Chemicals, Inc.; Quartz Plate FF.

2. Color: As selected by Architect from manufacturer's full range.

2.09 LIQUID FLOOR TREATMENTS

A. VOC Content: Liquid floor treatments shall have a VOC content of 200 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Penetrating Liquid Floor Treatment: Clear, chemically reactive, waterborne solution of inorganic silicate or siliconate materials and proprietary components; odorless; that penetrates, hardens, and densifies concrete surfaces.

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

   a. ChemMasters; Chemisil Plus.
   b. Kaufman Products, Inc.; SureHard.
   c. L&M Construction Chemicals, Inc.; Seal Hard.
   d. Meadows, W. R., Inc.; LIQUI-HARD.

2.10 CURING MATERIALS

A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. BASF Construction Chemicals - Building Systems; Confilm.
   b. ChemMasters; SprayFilm.
   c. Kaufman Products, Inc.; Vapor-Aid.
   d. Lambert Corporation; LAMBCO Skin.
   e. L&M Construction Chemicals, Inc.; E-CON.
   f. Meadows, W. R., Inc.; EVAPRE.

B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.

C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

D. Water: Potable.

E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, 18 to 25 percent solids, nondissipating, certified by curing compound manufacturer to not interfere with bonding of floor covering.

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

a. BASF Construction Chemicals - Building Systems; Kure-N-Seal W.
b. ChemMasters; Safe-Cure Clear.
c. Kaufman Products, Inc.; SureCure Emulsion.
d. L&M Construction Chemicals, Inc.; Dress & Seal WB.
e. Meadows, W. R., Inc.; Vocomp-20.

2. VOC Content: Curing and sealing compounds shall have a VOC content of 200 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

3. VOC Content: Curing and sealing compounds shall have a VOC content of 200 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.11 RELATED MATERIALS

A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber or ASTM D 1752, cork or self-expanding cork.

B. Bonding Agent: ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.

C. Epoxy Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to suit requirements, and as follows:

1. Types I and II, non-load bearing and Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

D. Reglets: Fabricate reglets of not less than 0.022-inch- thick, galvanized-steel sheet. Temporarily fill or cover face opening of reglet to prevent intrusion of concrete or debris.

E. Dovetail Anchor Slots: Hot-dip galvanized-steel sheet, not less than 0.034 inch thick, with bent tab anchors. Temporarily fill or cover face opening of slots to prevent intrusion of concrete or debris.

2.12 REPAIR MATERIALS

A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.

1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by underlayment manufacturer.

4. Compressive Strength: Not less than 4100 psi at 28 days when tested according to ASTM C 109.

B. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 inch and that can be filled in over a scarified surface to match adjacent floor elevations.

1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by topping manufacturer.
4. Compressive Strength: Not less than 5000 psi at 28 days when tested according to ASTM C 109.

2.13 CONCRETE MIXTURES, GENERAL

A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.

1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.

B. Cementitious Materials: Use fly ash, pozzolan, ground granulated blast-furnace slag, and silica fume as needed to reduce the total amount of portland cement, which would otherwise be used, by not less than 40 percent. Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:

1. Fly Ash: 25 percent.
2. Combined Fly Ash and Pozzolan: 25 percent.
3. Ground Granulated Blast-Furnace Slag: 50 percent.
4. Combined Fly Ash or Pozzolan and Ground Granulated Blast-Furnace Slag: 50 percent portland cement minimum, with fly ash or pozzolan not exceeding 25 percent.
5. Silica Fume: 10 percent.
6. Combined Fly Ash, Pozzolans, and Silica Fume: 35 percent with fly ash or pozzolans not exceeding 25 percent and silica fume not exceeding 10 percent.
7. Combined Fly Ash or Pozzolans, Ground Granulated Blast-Furnace Slag, and Silica Fume: 50 percent with fly ash or pozzolans not exceeding 25 percent and silica fume not exceeding 10 percent.

C. Limit water-soluble, chloride-ion content in hardened concrete to 0.06 percent by weight of cement.

D. Admixtures: Use admixtures according to manufacturer's written instructions.

1. Use water-reducing, high-range water-reducing or plasticizing admixture in concrete, as required, for placement and workability.

2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
3. 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.
4. Use corrosion-inhibiting admixture in concrete mixtures where indicated.

E. Color Pigment: Add color pigment to concrete mixture according to manufacturer's written instructions and to result in hardened concrete color consistent with approved mockup.

2.14 CONCRETE MIXTURES FOR BUILDING ELEMENTS

A. Footings: Proportion normal-weight concrete mixture as follows:

1. Minimum Compressive Strength: 5000 psi at 28 days.
2. Maximum Water-Cementitious Materials Ratio: 0.45.
3. Slump Limit: 4.5 inches, plus or minus 1 inch.
4. Air Content: 5.0 percent, plus or minus 1.5 percent at point of delivery for 1-1/2-inch (38-mm) nominal maximum aggregate size.

B. Foundation Walls: Proportion normal-weight concrete mixture as follows:

1. Minimum Compressive Strength: 5000 psi at 28 days.
2. Maximum Water-Cementitious Materials Ratio: 0.45.
3. Slump Limit: 4.5 inches, plus or minus 1 inch.
4. Air Content: 5.0 percent, plus or minus 1.5 percent at point of delivery for 1-1/2-inch nominal maximum aggregate size.

C. Slabs-on-Grade: Proportion normal-weight concrete mixture as follows:

1. Minimum Compressive Strength: 4000 psi at 28 days.
2. Minimum Cementitious Materials Content: 520 lb/cu. yd.
3. Air Content: 5.5 percent, plus or minus 1.5 percent at point of delivery for 1-1/2-inch nominal maximum aggregate size.
4. Air Content: Do not allow air content of trowel-finished floors to exceed 3 percent.

D. Suspended Slabs: Proportion normal-weight concrete mixture as follows:

1. Minimum Compressive Strength: 5000 psi at 28 days.
2. Minimum Cementitious Materials Content: 520 lb/cu. yd.
3. Slump Limit: 4.5 inches, plus or minus 1 inch.
4. Air Content: 5.0 percent, plus or minus 1.5 percent at point of delivery for 1-1/2-inch nominal maximum aggregate size.
5. Air Content: Do not allow air content of trowel-finished floors to exceed 3 percent.

E. Suspended Slabs: Proportion structural lightweight concrete mixture as follows:

1. Minimum Compressive Strength: 4500 psi at 28 days.
2. Calculated Equilibrium Unit Weight: 110 lb/cu. ft., plus or minus 3 lb/cu. ft. as determined by ASTM C 567.
3. Slump Limit: 4 inches, plus or minus 1 inch.
4. Air Content: 6 percent, plus or minus 2 percent at point of delivery for nominal maximum aggregate size greater than 3/8 inch.
5. Air Content: Do not allow air content of trowel-finished floors to exceed 3 percent.

F. Concrete Toppings: Proportion normal-weight concrete mixture as follows:

1. Minimum Compressive Strength: 5000 psi at 28 days.
2. Minimum Cementitious Materials Content: 540 lb/cu. yd.
3. Slump Limit: 4 inches, plus or minus 1 inch (25 mm).
4. Air Content: 5.5 percent, plus or minus 1.5 percent at point of delivery for 1-1/2-inch nominal maximum aggregate size.
5. Air Content: Do not allow air content of trowel-finished toppings to exceed 3 percent.

G. Building Frame Members: Proportion normal-weight concrete mixture as follows:

1. Minimum Compressive Strength: 4000 psi at 28 days.
2. Maximum Water-Cementitious Materials Ratio: 0.45.
3. Slump Limit: 5 inches, plus or minus 1 inch.
4. Air Content: 5.5 percent, plus or minus 1.5 percent at point of delivery for 1-1/2-inch nominal maximum aggregate size.

H. Building Walls: Proportion normal-weight concrete mixture as follows:

1. Minimum Compressive Strength: 4000 psi at 28 days.
2. Maximum Water-Cementitious Materials Ratio: 0.45.
3. Slump Limit: 5 inches, plus or minus 1 inch.
4. Air Content: 5.5 percent, plus or minus 1.5 percent at point of delivery for 1-1/2-inch nominal maximum aggregate size.

2.15 FABRICATING REINFORCEMENT

A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.16 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94 and ASTM C 1116, and furnish batch ticket information.

1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M. Mix concrete materials in appropriate drum-type batch machine mixer.

1. For mixer capacity of 1 cu. yd. or smaller, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released.
2. For mixer capacity larger than 1 cu. yd., increase mixing time by 15 seconds for each additional 1 cu. yd.
3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixture time, quantity, and amount of water added. Record approximate location of final deposit in structure.

PART 3 - EXECUTION

3.01 FORMWORK

A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.

B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.

C. Limit concrete surface irregularities, designated by ACI 347 as abrupt or gradual, as follows:

1. Class A, 1/8 inch for smooth-formed finished surfaces.
2. Class B, 1/4 inch for rough-formed finished surfaces.

D. Construct forms tight enough to prevent loss of concrete mortar.

E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.

1. Install keyways, reglets, recesses, and the like, for easy removal.
2. Do not use rust-stained steel form-facing material.

F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.

G. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.

H. Chamfer exterior corners and edges of permanently exposed concrete.

I. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.

J. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.

K. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

L. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.02 EMBEDDED ITEMS

A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC's "Code of Standard Practice for Steel Buildings and Bridges."
2. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.
3. Install dovetail anchor slots in concrete structures as indicated.

3.03 REMOVING AND REUSING FORMS

A. General: Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F for 24 hours after placing concrete. Concrete has to be hard enough to not be damaged by form-removal operations and curing and protection operations need to be maintained.

1. Leave formwork for beam soffits, joists, slabs, and other structural elements that supports weight of concrete in place until concrete has achieved at least 70 percent of its 28-day design compressive strength.
2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.

B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.

C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

3.04 SHORES AND RESHORES

A. Comply with ACI 318 and ACI 301 for design, installation, and removal of shoring and reshoring.

1. Do not remove shoring or reshoring until measurement of slab tolerances is complete.

B. In multistory construction, extend shoring or reshoring over a sufficient number of stories to distribute loads in such a manner that no floor or member will be excessively loaded or will induce tensile stress in concrete members without sufficient steel reinforcement.

C. Plan sequence of removal of shores and reshore to avoid damage to concrete. Locate and provide adequate reshoring to support construction without excessive stress or deflection.

3.05 VAPOR RETARDERS

A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder according to ASTM E 1643 and manufacturer's written instructions.

1. Lap joints 6 inches and seal with manufacturer's recommended tape.

B. Bituminous Vapor Retarders: Place, protect, and repair bituminous vapor retarder according to manufacturer's written instructions.

C. Granular Course: Cover vapor retarder with granular fill or fine-graded granular material], moisten, and compact with mechanical equipment to elevation tolerances of plus 0 inch or minus 3/4 inch.

1. Place and compact a 1/2-inch- thick layer of fine-graded granular material over granular fill.

3.06 STEEL REINFORCEMENT

A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.

1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.

B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that would reduce bond to concrete.

C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.

1. Weld reinforcing bars according to AWS D1.4/D 1.4M, where indicated.

D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

E. Install welded wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.

F. Epoxy-Coated Reinforcement: Repair cut and damaged epoxy coatings with epoxy repair coating according to ASTM D 3963/D 3963M. Use epoxy-coated steel wire ties to fasten epoxy-coated steel reinforcement.

G. Zinc-Coated Reinforcement: Repair cut and damaged zinc coatings with zinc repair material according to ASTM A 780. Use galvanized steel wire ties to fasten zinc-coated steel reinforcement.

3.07 JOINTS

A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.

B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.

1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
2. Form keyed joints as indicated. Embed keys at least 1-1/2 inches into concrete.
3. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
4. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
5. Space vertical joints in walls as indicated. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
6. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
7. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:

1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch. Repeat grooving of contraction joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- wide joints into

concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.

D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.

1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated.
2. Terminate full-width joint-filler strips not less than 1/2 inch or more than 1 inch below finished concrete surface where joint sealants are indicated.
3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

E. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length to prevent concrete bonding to one side of joint.

3.08 WATERSTOPS

A. Flexible Waterstops: Install in construction joints and at other joints indicated to form a continuous diaphragm. Install in longest lengths practicable. Support and protect exposed waterstops during progress of the Work. Field fabricate joints in waterstops according to manufacturer's written instructions.

B. Self-Expanding Strip Waterstops: Install in construction joints and at other locations indicated, according to manufacturer's written instructions, adhesive bonding, mechanically fastening, and firmly pressing into place. Install in longest lengths practicable.

3.09 CONCRETE PLACEMENT

A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.

B. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Architect.

C. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301.

1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.

D. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.

1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.
2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.

E. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.

1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
2. Maintain reinforcement in position on chairs during concrete placement.
3. Screed slab surfaces with a straightedge and strike off to correct elevations.
4. Slope surfaces uniformly to drains where required.
5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.

F. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

1. When average high and low temperature is expected to fall below 40 deg F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.

G. Hot-Weather Placement: Comply with ACI 301 and as follows:

1. Maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

3.10 FINISHING FORMED SURFACES

A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

1. Apply to concrete surfaces not exposed to public view.

B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

1. Apply to concrete surfaces exposed to public view.

C. Rubbed Finish: Apply the following to smooth-formed finished as-cast concrete where indicated:

1. Smooth-Rubbed Finish: Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture. Do not apply cement grout other than that created by the rubbing process.
2. Grout-Cleaned Finish: Wet concrete surfaces and apply grout of a consistency of thick paint to coat surfaces and fill small holes. Mix one part portland cement to one and one-half parts fine sand with a 1:1 mixture of bonding admixture and water. Add white portland cement in amounts determined by trial patches so color of dry grout will match adjacent surfaces. Scrub grout into voids and remove excess grout. When grout whitens, rub surface with clean burlap and keep surface damp by fog spray for at least 36 hours.
3. Cork-Floated Finish: Wet concrete surfaces and apply a stiff grout. Mix one part portland cement and one part fine sand with a 1:1 mixture of bonding agent and water. Add white portland cement in amounts determined by trial patches so color of dry grout will match adjacent surfaces. Compress grout into voids by grinding surface. In a swirling motion, finish surface with a cork float.

D. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

3.11 FINISHING FLOORS AND SLABS

A. General: Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

B. Scratch Finish: While still plastic, texture concrete surface that has been screeded and bull-floated or darbied. Use stiff brushes, brooms, or rakes to produce a profile amplitude of 1/4 inch in one direction.

1. Apply scratch finish to surfaces indicated and to receive concrete floor toppings.

C. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraightening until surface is left with a uniform, smooth, granular texture.

1. Apply float finish to surfaces to receive trowel finish and to be covered with fluid-applied or sheet waterproofing, built-up or membrane roofing, or sand-bed terrazzo.

D. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.

1. Apply a trowel finish to surfaces exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.
2. Finish surfaces to the following tolerances, according to ASTM E 1155, for a randomly trafficked floor surface:

    a. Specified overall values of flatness, F(F) 25; and of levelness, F(L) 20; with minimum local values of flatness, F(F) 17; and of levelness, F(L) 15.
    b. Specified overall values of flatness, F(F) 35; and of levelness, F(L) 25; with minimum local values of flatness, F(F) 24; and of levelness, F(L) 17; for slabs-on-grade.
    c. Specified overall values of flatness, F(F) 30; and of levelness, F(L) 20; with minimum local values of flatness, F(F) 24; and of levelness, F(L) 15; for suspended slabs.
    d. Specified overall values of flatness, F(F) 45; and of levelness, F(L) 35; with minimum local values of flatness, F(F) 30; and of levelness, F(L) 24.

3. Finish and measure surface so gap at any point between concrete surface and an unleveled, freestanding, 10-ft.- long straightedge resting on two high spots and placed anywhere on the surface does not exceed 1/8 inch.

E. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces indicated or where ceramic or quarry tile is to be installed by either thickset or thin-set method. While concrete is still plastic, slightly scarify surface with a fine broom.

1. Comply with flatness and levelness tolerances for trowel-finished floor surfaces.

F. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, ramps, and elsewhere as indicated.

1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.

G. Slip-Resistive Finish: Before final floating, apply slip-resistive aggregate or aluminum granule finish where indicated and to concrete stair treads, platforms, and ramps. Apply according to manufacturer's written instructions and as follows:

1. Uniformly spread 25 lb/100 sq. ft. of dampened slip-resistive aggregate or[aluminum granules over surface in one or two applications. Tamp aggregate flush with surface, but do not force below surface.
2. After broadcasting and tamping, apply float finish.
3. After curing, lightly work surface with a steel wire brush or an abrasive stone and water to expose slip-resistive aggregate aluminum granules.

H. Dry-Shake Floor Hardener Finish: After initial floating, apply dry-shake floor hardener to surfaces according to manufacturer's written instructions and as follows:

1. Uniformly apply dry-shake floor hardener at a rate of 100 lb/100 sq. ft. unless greater amount is recommended by manufacturer.
2. Uniformly distribute approximately two-thirds of dry-shake floor hardener over surface by hand or with mechanical spreader, and embed by power floating. Follow power floating with a second dry-shake floor hardener application, uniformly distributing remainder of material, and embed by power floating.
3. After final floating, apply a trowel finish. Cure concrete with curing compound recommended by dry-shake floor hardener manufacturer and apply immediately after final finishing.

3.12 MISCELLANEOUS CONCRETE ITEMS

A. Filling In: Fill in holes and openings left in concrete structures after work of other trades is in place unless otherwise indicated. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.

B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.

C. Equipment Bases and Foundations: Provide machine and equipment bases and foundations as shown on Drawings. Set anchor bolts for machines and equipment at correct elevations, complying with diagrams or templates from manufacturer furnishing machines and equipment.

D. Steel Pan Stairs: Provide concrete fill for steel pan stair treads, landings, and associated items. Cast-in inserts and accessories as shown on Drawings. Screed, tamp, and trowel finish concrete surfaces.

3.13 CONCRETE PROTECTING AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.

B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for the remainder of the curing period.

D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.

E. Cure concrete according to ACI 308.1, by one or a combination of the following methods:

1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:

    a. Water.
    b. Continuous water-fog spray.
    c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.

2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.

    a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
    b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
    c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies will not interfere with bonding of floor covering used on Project.

3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

    a. Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound will not interfere with bonding of floor covering used on Project.

4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

3.14 LIQUID FLOOR TREATMENTS

A. Penetrating Liquid Floor Treatment: Prepare, apply, and finish penetrating liquid floor treatment according to manufacturer's written instructions.

1. Remove curing compounds, sealers, oil, dirt, laitance, and other contaminants and complete surface repairs.
2. Do not apply to concrete that is less than 28 days' old.
3. Apply liquid until surface is saturated, scrubbing into surface until a gel forms; rewet; and repeat brooming or scrubbing. Rinse with water; remove excess material until surface is dry. Apply a second coat in a similar manner if surface is rough or porous.

B. Polished Concrete Floor Treatment: Apply polished concrete finish system to cured and prepared slabs to match accepted mockup.

1. Machine grind floor surfaces to receive polished finishes level and smooth and to depth required to reveal aggregate to match approved mockup.
2. Apply penetrating liquid floor treatment for polished concrete in polishing sequence and according to manufacturer's written instructions, allowing recommended drying time between successive coats.
3. Continue polishing with progressively finer grit diamond polishing pads to gloss level to match approved mockup.
4. Control and dispose of waste products produced by grinding and polishing operations.
5. Neutralize and clean polished floor surfaces.

C. Sealing Coat: Uniformly apply a continuous sealing coat of curing and sealing compound to hardened concrete by power spray or roller according to manufacturer's written instructions.

3.15 JOINT FILLING

A. Prepare, clean, and install joint filler according to manufacturer's written instructions.

1. Defer joint filling until concrete has aged at least one month(s). Do not fill joints until construction traffic has permanently ceased.

B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joint clean and dry.

C. Install semirigid joint filler full depth in saw-cut joints and at least 2 inches deep in formed joints. Overfill joint and trim joint filler flush with top of joint after hardening.

3.16 CONCRETE SURFACE REPAIRS

A. Defective Concrete: Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval.

B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part portland cement to two and one-half parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.

C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.

1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch (13 mm) in any dimension to solid concrete. Limit cut depth to 3/4 inch. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Architect.

D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.

1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
2. After concrete has cured at least 14 days, correct high areas by grinding.
3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.
5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer

according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.

6. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4-inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
7. Repair random cracks and single holes 1 inch or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.

E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.

F. Repair materials and installation not specified above may be used, subject to Architect's approval.

3.17 FIELD QUALITY CONTROL

A. Testing and Inspecting: Engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.

B. Inspections:

1. Steel reinforcement placement.
2. Steel reinforcement welding.
3. Headed bolts and studs.
4. Verification of use of required design mixture.
5. Concrete placement, including conveying and depositing.
6. Curing procedures and maintenance of curing temperature.
7. Verification of concrete strength before removal of shores and forms from beams and slabs.

C. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:

1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd., but less than 25 cu. yd., plus one set for each additional 50 cu. yd. or fraction thereof.
2. Testing Frequency: Obtain at least one composite sample for each 100 cu. yd. or fraction thereof of each concrete mixture placed each day.

a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.

3. Slump: ASTM C 143; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
4. Air Content: ASTM C 231, pressure method, for normal-weight concrete; ASTM C 173, volumetric method, for structural lightweight concrete;]one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
5. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F and below and when 80 deg F and above, and one test for each composite sample.
6. Unit Weight: ASTM C 567, fresh unit weight of structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
7. Compression Test Specimens: ASTM C 31/C 31M.

    a. Cast and laboratory cure two sets of two standard cylinder specimens for each composite sample.
    b. Cast and field cure two sets of two standard cylinder specimens for each composite sample.

8. Compressive-Strength Tests: ASTM C 39/C 39M; test one set of two laboratory-cured specimens at 7 days and one set of two specimens at 28 days.

    a. Test one set of two field-cured specimens at 7 days and one set of two specimens at 28 days.
    b. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.

9. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
10. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.
11. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.

12. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
13. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42 or by other methods as directed by Architect.
14. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
15. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

D. Measure floor and slab flatness and levelness according to ASTM E 1155 within 24 hours of finishing.

3.18 PROTECTION OF LIQUID FLOOR TREATMENTS

A. Protect liquid floor treatment from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by liquid floor treatments installer.

END OF SECTION

SECTION 03575
FLOWABLE FILL

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Furnish labor, materials, equipment, and incidentals necessary to mix and place a flowable mortar fill, consisting of Portland Cement, fine aggregate, fly ash, and water in the proper proportions as specified herein. Flowable fill shall be used to bed and backfill around piping and utilities where indicated.

1.02 QUALITY ASSURANCE

A. Design Criteria; Concrete Proportions and Consistency: Concrete shall be proportioned to give the necessary workability and strength and shall conform to the following governing requirements.

28 Day Compressive Strength-psi	Min. Cement Lbs. Per Cu. Yd.	Fine Aggregate Lbs. Per Cu. Yd.	Max. Water Lbs. Per Cu. Yd.	Max. Fly Ash Lbs. Per Cu. Yd.
70 - 150	50	2720	290	150

Fluidity of the flowable mortar shall be measured by the Corps of Engineers flow cone method, according to their specification CRD-C611-80. Prior to filling the flow cone with flowable mortar, the mixture shall be passed through a 3” screen. Time of efflux shall be approximately 12 seconds.

B. Factory Testing: The Contractor shall be responsible for the design of the material. A trial mix shall be designed by an independent testing laboratory, retained by the Contractor. The testing laboratory shall submit verification that the materials and proportions of the trial mix design meets the requirement of the specifications. Concrete mix additive such as "Darafill" manufactured by Grace Construction Products or equal products may be required to achieve the low strength and the flowability requirements. In lieu of trial mix design, Contractor may submit a mix design used successfully in previous similar work, for similar materials for approval by Engineer. The Contractor shall not make changes in materials (gradation, source, brand, or proportions) of the mixture after having been approved, except by specific approval of the Engineer.

C. Pre-job Testing: Pre-job testing with actual equipment and intended configuration of concrete sample may be required by the OWNER to determine whether the material can be excavated. The testing equipment and configuration of concrete sample shall be determined by the Owner's representative.

D. Owner Testing: It is the responsibility of the Contractor to achieve and maintain the quality of material required by this specification. However, the Owner may secure the services of an independent testing laboratory to verify the quality of the material. The Owner shall have the right to require additional testing, strengthening, or replacement of concrete that has failed to meet the minimum requirements of this section.

1.03 SUBMITTALS

A. Submittals shall be in accordance with Section 01330 SUBMITTAL PROCEDURES and shall include a trial mix design as record data and certified test reports for compressive strength tests.

1.04 STANDARDS

A. Materials shall meet recommendation for mix design and placement, as published by National Ready Mixed Concrete Association.

B. The applicable provisions of the following references and standards shall apply to this section as if written herein in their entirety.

1. American Society for Testing and Materials (ASTM) Publications:

ASTM C 33	Specifications for Concrete Aggregates
ASTM C 40	Test Method for Organic Impurities In Fine Aggregates For Concrete
ASTM C 150	Specification for Portland Cement
ASTM C 618	Specification for Fly Ash and Raw or Calcined Natural Pozzolan for Use as Mineral Admixture in Portland Cement Concrete

2. Federal Specifications:

COE	CRD-C611-80

PART 2 - PRODUCTS

2.01 MATERIALS

A. Cement: Portland Cement conforming to the specifications and test for Type I Portland Cement per ASTM C 150.

B. Fine Aggregate: Fine aggregate consisting of natural, washed and screened sand having clean, hard, strong, durable, uncoated grains complying with the requirements for ASTM C 33. The sand shall generally be of such size that all will pass a 3/8@ sieve, at least 95% pass at 1/4" screen and at least 80% pass a No. 8 sieve. Aggregate shall not contain strong alkali, or organic material that gives a color darker than the standard color when tested in accordance with ASTM C 40.

C. Fly Ash/pozzolans: Fly ash shall be an ASTM C 618, Class "C" fly ash.

D. Water: Water for concrete shall be clean and free from oil, acid, alkali, organic matter or other harmful impurities. Water that is suitable for drinking or for ordinary household use will be acceptable for concrete. Where available, water shall be obtained from mains of a waterworks system.

E. Additive: "Darafill" may be required to meet the strength and flowability requirements of these specifications.

2.02 MIXES

A. In the determination of the amount of water required for mix, consideration shall be given to the moisture content of the aggregate. The net amount of water in the mix will be the amount added at the mixer; plus the free water in the aggregate; and minus the absorption of the aggregate, based on a 30 minute absorption period. No water allowance shall be made for evaporation after batching.

B. The methods of measurement of materials shall be such that the proportions of water to cement can be closely controlled during the progress of the work and easily checked at any time by the Owner's Representative. To avoid unnecessary or haphazard changes in consistency, the aggregate shall be obtained from sources which will insure a uniform quality and grading during any single day's operation and they shall be delivered to the work and handled in such a manner that the variation in moisture content will not interfere with the steady production of concrete of reasonable degree of uniformity. Sources of supply shall be approved by the Owner's Representative.

C. All material shall be separately and accurately measured. Measurement may be made by weight or by volume, as determined by the Contractor; however; all equipment for measurement of materials shall be subject to approval by the Owner's Representative.

D. The proportions of the mix shall be such as to produce material that can be placed readily into the void area without spading or vibrating, and without segregation or undue accumulation of water or laitance of the surface.

E. When additive is contained in the concrete mix, the additive ingredients, proportions and placement of the additive shall be per manufacturer's recommendations.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Contractor shall give the Owner's Representative sufficient advance notice before starting to place material in any area to permit inspection of the area and to prepare for pouring.

B. Conduct the operation of depositing and compacting the material so as to form a compact, dense, impervious mass.

C. Flowable fill shall be placed the full depth into the trenches. The fill shall be brought up uniformly to the elevation shown in the Plans. Flowable fill shall be protected from traffic for a period of 72 hours.

D. The material shall be placed against undisturbed trench walls and shall not be placed on or against frozen ground.

E. Material shall be placed in lifts or other measures shall be taken to prevent pipe flotation. Material shall be allowed to harden before placing next lift.

END OF SECTION

SECTION 05120

STRUCTURAL STEEL

1.00 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Structural steel shapes and plate.
   2. Fasteners and structural hardware:
      a. All thread rods.
      b. All thread rods, high-strength.
      c. Forged steel structural hardware.
      d. High-strength bolts.
   3. Welding.
   4. Bolting.

B. Related sections:
   1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
   2. It is the Contractor's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of Contractor's Work.

1.02 REFERENCES

A. American Institute of Steel Construction (AISC):
   1. 303 – Code of Standard Practice for Steel Buildings and Bridges.
   2. 360 – Specification for Structural Steel Buildings.

B. American Iron and Steel Institute (AISI):
   1. Steel and stainless steel alloys ("types") as indicated.

C. American Welding Society (AWS):
   1. A5.1 – Specification for Carbon Steel Electrodes for Shielded Metal Arc Welding.
   2. A5.17 – Specification for Carbon Steel Electrodes and Fluxes for Submerged Arc Welding.
   3. A5.20 – Specification for Carbon Steel Electrodes for Flux Cored Arc Welding.
   4. D1.1 – Structural Welding Code – Steel.
   5. D1.6 – Structural Welding Code – Stainless Steel.

D. ASTM International (ASTM):
   1. A 6 – Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling.
   2. A 36 – Standard Specification for Carbon Structural Steel.
   3. A 53 – Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded, and Seamless.
   4. A 123 – Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

5. A 153 – Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
6. A 193 – Standard Specification for Alloy Steel and Stainless Steel Bolting Materials for High-Temperature or High Pressure Service and Other Special Purpose Applications.
7. A 194 – Standard Specification for Steel Bars Subject to Restricted End-Quench Hardenability Requirements.
8. A 240 – Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
9. A 276 – Standard Specification for Stainless Steel Bars and Shapes.
10. A 325 – Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
11. A 380 – Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems.
12. A 489 – Standard Specification for Carbon Steel Lifting Eyes.
13. A 490 – Standard Specification for Structural Bolts, Alloy Steel, Heat Treated, 150 ksi Minimum Tensile Strength.
14. A 500 – Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
15. A 501 – Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.
16. A 563 – Standard Specification for Carbon and Alloy Steel Nuts.
17. A 992 – Standard Specification for Structural Steel Shapes.
18. F 436 – Standard Specification for Hardened Steel Washers.
19. F 959 – Standard Specification for Compressible-Washer-Type Direct Tension Indicators for Use with Structural Fasteners.
20. F 2329 – Standard Specification for Zinc Coating, Hot-Dip, Requirements for Application to Carbon and Alloy Steel Bolts, Screws, Washers, Nuts, and Special Threaded Fasteners.

E. Research Council on Structural Connections (RCSC):
1. Specification for Structural Joints Using High-Strength Bolts (RCSC Specification).

1.03 DEFINITIONS

A. Snug-tight: At bolted joints, the tightness attained with a few impacts of an impact wrench, or by the full effort of an ironworker using a spud wrench to bring the connected plies into firm contact.

B. Stainless steel related terms:
1. Descaling: Removal of heavy, tightly adherent oxide films resulting from hot-forming, heat-treatment, welding, and other high-temperature operations.
2. Pickling: Chemical descaling of stainless steel using aqueous solutions of nitric and hydrofluoric acid, or various proprietary formulations as specified.
3. Passivation: Chemical treatment of stainless steel with a mild oxidant for the purpose of enhancing the spontaneous formation of the steel's protective passive film.

1.04 SUBMITTALS

A. Product data:
   1. Compressible-washer-type direct tension indicators: Manufacturer's detailed installation instructions including:
      a. Requirements for type and frequency of pre-installation verification.
      b. Requirements for coordination with regular washers.
      c. Instructions for assembling and tightening the joint so that work progresses from the most rigid part until the connected plies are in firm contact.
   2. Stainless steel: Fabricator name and qualifications, and specifications and procedures used for pickling and passivating members.

B. Quality control submittals:
   1. Submit shop drawings of members to be fabricated before starting fabrication.
   2. Welder's certificates.
   3. Submit steel fabricator's AISC certification.

C. Test reports:
   1. Certified copies of mill tests and analyses made in accordance with applicable ASTM standards, or reports from a recognized commercial laboratory, including chemical and tensile properties of each shipment of structural steel or part thereof having common properties.

1.05 QUALITY ASSURANCE

A. Qualifications:
   1. Perform welding of structural metals with welders who have current AWS certificate for the type of welding to be performed.
   2. Steel fabricators shall be certified by the AISC or other certification as recognized and accepted by the local building official having jurisdiction.
   3. Notify Engineer 24 hours minimum before starting shop or field welding.
   4. Engineer may check materials, equipment, and qualifications of welders.
   5. Remove welders performing unsatisfactory Work, or require to requalification.
   6. Engineer may use gamma ray, magnetic particle, dye penetrant, trepanning, or other aids to visual inspection to examine any part of welds or all welds.
   7. Contractor shall bear costs of retests on defective welds.
   8. Contractor shall also bear costs in connection with qualifying welders.

B. Certification:
   1. Steel fabricators shall be certified by the AISC or other certification acceptable to the local building official having jurisdiction.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Packing and shipping: Deliver structural steel free from mill scale, rust, and pitting.

B. Storage and protection: Until erection and painting, protect from weather items not galvanized or protected by a shop coat of paint.

2.00 PRODUCTS

2.01 MATERIALS

A. Unless otherwise specified or indicated on the Drawings, materials shall conform to the following:

Item	ASTM Standard	Class, Grade, Type, or Alloy Number
Steel:		
Plate, bars, rolled shapes (except W and WT shapes), and miscellaneous items	A 36	--
Rolled W and WT shapes	A 992	Grade 50
Hollow structural sections (HSS): Round, square, or rectangular	A 500	Grade B
Round HSS	A 500	Grade B
Steel pipe	A 53	Grade B
Stainless steel:		
Plate, sheet, and strip	A 240	Type 304(1) or 316(2)
Bars and shapes	A 276	Type 304(1) or 316(2)
Notes: (1) Use Type 304L if material will be welded. (2) Use Type 316L if material will be welded.		

B. Where stainless steel is welded, use low-carbon stainless steel.

2.02 FASTENERS AND STRUCTURAL HARDWARE

A. General:
   1. Materials: Of domestic manufacture.
   2. Where fasteners and hardware are specified to be galvanized, galvanize in accordance with ASTM A 153 or ASTM F 2329.

B. All thread rods:
   1. Uncoated
      a. In accordance with ASTM A 36 unless otherwise indicated on the Drawings.
      b. High strength all thread rods: In accordance with ASTM A 193, Grade B7.
      c. Nuts: ASTM A 194.
      d. Washers: ASTM F 436.
   2. Galvanized:
      a. In accordance with ASTM A 36 unless otherwise indicated on the Drawings, and hot dip galvanized in accordance with ASTM A 123.
      b. High strength all thread rods: In accordance with ASTM A 193, Grade B7 and galvanized in accordance with ASTM A 123.
      c. Nuts: ASTM A 194, hot-dip galvanized in accordance with ASTM A 153.

d. Washers: ASTM F 436, hot-dip galvanized in accordance with ASTM A 153.

3. Stainless steel:
   a. Units descaled, pickled, and passivated as specified in “Fabrication” in this Section.
   b. Threaded rods and nuts to be the products of a single manufacturer/fabricator to ensure proper fit without galling. Ship threaded rods with properly fitting nuts attached.
   c. Alloy as indicated on the Drawings.
      1) Alloy 304/304L:
         a) Bolts: ASTM A 193, Grade B8, Class 1, heavy hex.
         b) Nuts: ASTM A 194, Grade 8, heavy hex.
         c) Washers: Type 304 stainless steel.
      2) Alloy 316/316L:
         a) Bolts: ASTM A 193, Grade B8M, Class 1, heavy hex.
         b) Nuts: ASTM A 194, Grade 8M, heavy hex.
         c) Washers: Type 316 stainless steel.

C. Anchor bolts, anchor rods, and post-installed steel anchors: As indicated on the Drawings and as specified in Section 05 05 19.

D. Forged steel structural hardware:
   1. Clevises and turnbuckles: Forged steel in accordance with AISI C-1035**.**
   2. Eye nuts / Eye bolts: Forged steel in accordance with AISI C-1030.
      a. Having geometric and strength characteristics (including proof load, breaking strength, tensile strength, bend test, and impact strength) of eyebolts in accordance with ASTM A 489, Type 1.
   3. Sleeve nuts: Forged steel in accordance with AISI C-1018 Grade 2.

E. High-strength bolts:
   1. Provide high-strength bolt assembly, with nuts, hardened flat washers, and compressible-washer-type direct tension indicators. Provide uncoated components unless galvanized coating is indicated on the Drawings.
   2. Uncoated:
      a. Bolts: Plain heavy hex structural bolts in accordance with ASTM A 325 Type 1 or ASTM A 490 Type 1 where indicated on the Drawings.
      b. Nuts: Heavy hex nuts in accordance with ASTM A 563, Grade C.
      c. Washers: Flat:
         1) Adjacent to normal, oversized, and short-slotted holes: Circular and square or rectangular beveled washers in accordance with ASTM F 436.
         2) Adjacent to long slotted holes: 5/16-inch thick plate washer fabricated from steel in accordance with ASTM A 36.
      d. Washers: Tension indicating: In accordance with ASTM F 959.
   3. Galvanized:
      a. Bolt and nut assemblies fabricated, galvanized, tested for rotational capacity, and shipped accordance with the provisions ASTM A 325 and the RCSC Specification.
      b. Bolts, nuts, and washers: Hot-dip galvanized and in accordance with ASTM A 153, Class C or ASTM F 2329.
      c. Bolts: Plain heavy hex structural bolts in accordance with ASTM A 325 Type 1 and galvanized as specified.

d. Nuts: Heavy hex nuts in accordance with ASTM A 563, Grade DH, galvanized as specified, and lubricated in accordance with ASTM A 563, Supplementary Requirement S1 to minimize galling.
e. Washers:
1) Adjacent to normal, oversized, and short-slotted holes: Circular and square or rectangular beveled washers in accordance with ASTM F 436 and galvanized as specified.
2) Adjacent to long slotted holes: 5/16-inch thick plate washer fabricated from steel in accordance with ASTM A 36, and galvanized in accordance with ASTM A 123.

4. Direct-tension indicators.
a. For each high-strength bolt at slip-critical connections, provide compressible washer type direct tension indicator in accordance with ASTM F 959.

F. Stainless steel bolts (for use in stainless steel structures):
1. General:
a. Alloy: Type 304/304L or Type 316/316L, to match alloy of structural members being connected
b. Units descaled, pickled and passivated as specified in “Fabrication of this Section”
c. Bolts and nuts shall be the products of a single manufacturer/fabricator to ensure proper fit without galling. Ship bolts with properly fitting nuts attached.
2. Alloy 304/304L:
a. Bolts: ASTM A 193, Grade B8, Class 1, heavy hex.
b. Nuts: ASTM A 194, Grade 8, heavy hex.
c. Washers: Type 304 stainless steel.
3. Alloy 316/316L:
a. Bolts: ASTM A 193, Grade B8M, Class 1, heavy hex.
b. Nuts: ASTM A 194, Grade 8M, heavy hex.
c. Washers: Type 316 stainless steel.
4. Welded studs: As indicated on the Drawings and as specified in Section 05 05 24.

2.03 ISOLATING SLEEVES AND WASHERS

A. As indicated on the Drawings and as specified in Section 05 05 24.

2.04 GALVANIZED SURFACE REPAIR

A. Manufacturers: One of the following or approved equal:
1. Galvinox.
2. Galvo-Weld.

2.05 THREAD COATING

A. Manufacturers: One of the following or approved equal:
1. Never Seez Compound Corporation, Never-Seez.
2. Oil Research, Inc., WLR No. 111.

2.06 SUPPLEMENTARY PARTS

A. Furnish as required for complete structural steel erection, whether or not such parts and Work are specified or indicated on the Drawings.

2.07 FABRICATION

A. Shop assembly:
   1. Fabricate structural steel in accordance with AISC 360 and AISC 303 unless otherwise specified or modified by applicable regulatory requirements.
   2. Where anchors, connections, or other details of structural steel are not specifically indicated on the Drawings or specified, their material, size and form shall be equivalent in quality and workmanship to items specified.
   3. Round off sharp and hazardous projections and grind smooth.
   4. Take measurements necessary to properly fit work in the field. Take responsibility for and be governed by the measurements and proper working out of all the details.
   5. Take responsibility for correct fitting of all metalwork.

B. Stainless steel shapes and assemblies:
   1. For structural members such as W shapes, S shapes, channels, angles, and similar rolled shapes not available in quantity, size, and type of stainless steel specified or indicated on the Drawings:
      a. Fabricate shapes using laser-fused, full penetration welds between pieces of plate to attain same or higher section modulus and moment of inertia as that of members indicated on the Drawings.
      b. Fabricate shapes from dual grade stainless steel.
      c. Fabricate beams and channels to ASTM A 6 tolerances.
      d. Manufacturers: The following, or equal:
         1) Stainless Structurals, LLC, Jacksonville, FL.
   2. Cleaning and passivation:
      a. Following shop fabrication of stainless steel members and bolts, clean and passivate fabrications at point of manufacture.
      b. Finish requirements: Remove free iron, heat tint oxides, weld scale and other impurities, and obtain a bright passive finished surface with no etching, pitting, frosting, or discoloration.
      c. Provide quality control testing to verify effectiveness of cleaning agents and procedures and to confirm that finished surfaces are clean and passivated.
         1) Conduct sample runs using test specimens with proposed cleaning agents and procedures as required to avoid adverse effects on surface finishes and base materials.
      d. Pre-clean, chemically de-scale (“pickle”), passivate, and final-clean fabrications in accordance with the requirements of ASTM A 380.
         1) If degreasing is required before cleaning (pickling) to remove scale or iron oxide, cleaning with citric acid treatments is permissible; however, such treatments shall be followed inorganic cleaners.
         2) Pickle and passivate stainless steel using a nitric acid solution in accordance with ASTM A 380, Annex A2, Table A2.1, Part II.
         3) Pickling by citric acid treatment or sulfuric acid treatment is not considered to satisfy the requirements of this Section.

e. Inspect after cleaning using methods specified for “gross inspection” in ASTM A 380.
f. Improperly or poorly cleaned and passivated materials shall not be shipped and will not be accepted at the site.

C. Galvanized steel:
1. Where galvanizing is required, hot-dip structural steel after fabrication in accordance with ASTM A 123:
2. Do not electro-galvanize or mechanically-galvanize unless specified or accepted by Engineer.
3. Re-straighten galvanized items that bend or twist during galvanizing.

3.00 EXECUTION

3.01 EXAMINATION

A. Verification of conditions: Examine Work in place to verify that it is satisfactory to receive the Work of this Section. If unsatisfactory conditions exist, do not begin this Work until such conditions have been corrected.

3.02 ERECTION

A. General:
1. Fabricate structural and foundry items to true dimensions without warp or twist.
2. Form welded closures neatly, and grind off smooth where weld material interferes with fit or is unsightly.
3. Install structural items accurately and securely, true to level, plumb, in correct alignment and grade, with all parts bearing or fitting structure or equipment for which intended.
4. Do not cock out of alignment, re-drill, re-shape, or force fit fabricated items.
5. Place anchor bolts or other anchoring devices accurately and make surfaces that bear against structural items smooth and level.
6. Rigidly support and brace structural items needing special alignment to preserve straight, level, even, and smooth lines. Keep structural items braced until concrete, grout, or dry pack mortar has hardened for 48 hours minimum.
7. Erect structural steel in accordance with AISC 360 unless otherwise specified or modified by applicable regulatory requirements.
8. Where anchors, connections, and other details of structural steel erection are not specifically indicated on the Drawings or specified, form, locate, and attach with equivalent in quality and workmanship to items specified.
9. Round off sharp or hazardous projections and grind smooth.
10. Paint or coat steel items as specified in Sections 09 91 00.

B. Stainless steel. Take all necessary precautions to avoid iron contamination of stainless steel during delivery, storage, and handling.
1. Segregate stainless steel from iron.
2. Tools and handling devices.
a. Do not use iron tools clamps, chokes, working surfaces, or brushes when fabricating, handling, and erecting stainless steel.
b. Do not use tools that have been contaminated by contact with iron.

c. Use stainless steel, polymer coated, or wood tools and handling equipment. Do not use tools that have been contaminated by contract with iron or steel.

C. Welding: General:
1. Make welds full penetration type, unless otherwise indicated on the Drawings.
2. Remove backing bars and weld tabs after completion of weld. Repair defective welds observed after removal of backing bars and weld tabs.

D. Welding stainless steel:
1. General: In accordance with AWS D1.6.
2. Field welding of stainless steel will not be permitted.

E. Welding carbon steel:
1. General: In accordance with AWS D1.1:
   a. Weld ASTM A 36 and A 992 structural steel, ASTM A 500 and A 501 structural tubing, and ASTM A 53 pipe with electrodes conforming to AWS A5.1, using E70XX electrodes; AWS A5.17, using F7X-EXXX electrodes; or AWS A5.20, using E7XT-X electrodes:
   b. Field repair cut or otherwise damaged galvanized surfaces to equivalent original condition using a galvanized surface repair.

F. Interface with other products:
1. Where steel members and fasteners come in contact with dissimilar metals (aluminum, stainless steel, etc), separate, or isolate the dissimilar metals with isolating sleeves and washers as specified in Section 05 05 19.

G. Fasteners: General:
1. Install bolts to project 2 threads minimum, but 1/2 inch maximum beyond nut.
2. Anchor bolts and anchor rods: Install as specified in Section 05 05 19.
   a. Unless otherwise specified, tighten nuts on anchor bolts and anchor rods specified in Section 05 05 19 to the "snug-tight" condition.
3. All thread rods in drilled holes and bonded to concrete with epoxy: Install as specified in Section 05 05 19.
4. All thread rods in drilled holes and bonded to masonry with epoxy: Install as specified in Section 05 05 19.

H. Fasteners: High-strength bolts:
1. Connections with high-strength bolts shall in accordance with RCSC Specification for Structural Joints Using High-Strength Bolts.
2. Provide slip-critical joints at bolted connections.
3. Joints: Slip-critical.
   a. Confirm that faying surfaces at connections are free of dirt and other foreign material, have been blast cleaned, and are free of coatings and inadvertent overspray in accordance with RCSC Specification.
   b. Furnish hardened flat washers in accordance with ASTM F 436:
      1) On outer plies with slotted holes.
      2) When 1 or more plies of the connected material has a yield strength less than 40 ksi.
      3) Under element, nut, or bolt head, turned in tightening.
   c. Install tension indicator washers, placed in accordance with ASTM F 959 Figure X1, to confirm adequate tightening of bolts.

d. Tighten bolts to full pretension.

I. Fasteners: Stainless steel bolts:
   1. Connections shall be snug-tight joints unless otherwise indicated on the Drawings.
   2. Prior to installing nuts, coat threads of stainless steel fasteners with thread coating to prevent galling of threads.
   3. Rotate nuts using a slow, smooth action without interruptions. Avoid over-tightening.

END OF SECTION

SECTION 06610
FRP LADDERS & LADDER CAGES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. This specification is for a pultruded fiberglass ladder system in compliance with BOCA 1993 and OSHA 1910-23 for strength requirements.

1.02 MEASUREMENT AND PAYMENT

A. No separate payment will be made for work required under this Section. Contractor will include all costs of the requirements of this Section in the appropriate bid item(s) on the Bid Form.

1.03 REFERENCES

A. The publications listed below (latest revision applicable) form a part of this specification to the extent referenced herein. The publications are referred to within the text by the designation of the AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) Test Methods:

1. ASTM D-638-Tensile Properties of Plastics

2. ASTM D-790-Flexural Properties of Unreinforced and Reinforced Plastics

3. ASTM D-2344-Apparent Interlaminar Shear Strength of Parallel Fiber Composites by Short Beam Method

4. ASTM D-495-High Voltage, Low-Current, Dry Arc Resistance of Solid Electrical Insulation

5. ASTM D-696-Coefficient of Linear Thermal Expansion for Plastics

6. ASTM E-84-Surface Burning Characteristics of Building Materials

7. BUILDING OFFICIALS AND CODE ADMINISTRATORS INTERNATIONAL The BOCA National Building Code, 1996

8. THE OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION (OSHA) Federal Register, Volume 39, No. 125, Section 1910.27

1.04 SUBMITTALS

A. Make submittals in accordance with Section 01330 – Submittal Procedures.

B. The CONTRACTOR shall furnish shop drawings of all fabricated ladder, cages and accessories in accordance with the provisions of this Section.

C. The CONTRACTOR shall furnish manufacturer's shop drawings clearly showing material sizes, types, styles, part or catalog numbers, complete details for the fabrication of and erection of components including, but not limited to, location, lengths, type and sizes of fasteners, clip angles, member sizes, and connection details.

D. The CONTRACTOR shall submit the manufacturer's published literature including structural design data, structural properties data, corrosion resistance tables, certificates of compliance, test reports as applicable, and design calculations for systems not sized or designed in the contract documents, sealed by a Professional Engineer.

E. The CONTRACTOR may be required to submit sample pieces of each item specified herein for acceptance by the ENGINEER as to quality and color. Sample pieces shall be manufactured by the method to be used in the WORK.

1.05 QUALITY ASSURANCE

A. All items to be provided under this Section shall be furnished only by manufacturers having experience in the design and manufacture of similar products and systems. If requested, experience shall be demonstrated by a record of at least five (5) previous, separate, similar successful installations in the last five (5) years.

1.06 PRODUCT DELIVERY AND STORAGE

A. Delivery of Materials: Manufactured materials shall be delivered in original, unbroken pallets, packages, containers, or bundles bearing the label of the manufacturer. Adhesives, resins and their catalysts and hardeners shall be crated or boxed separately and noted as such to facilitate their movement to a dry indoor storage facility.

B. Storage of Products: All materials shall be carefully handled to prevent them from abrasion, cracking, chipping, twisting, other deformations, and other types of damage. Store items in an enclosed area and free from contact with soil and water. Store adhesives, resins and their catalysts and hardeners in dry indoor storage facilities between 70 and 85 degrees Fahrenheit (21 to 29 degrees Celsius) until they are required.

PART 2 PRODUCTS

2.01 MANUFACTURER

A. Ladder and cage components shall be Dynarail™ or equal as manufactured by:

Fibergrate Composite Structures Incorporated
4115 Keller Springs Rd. Suite 224
Addison, Texas 75001 USA
(800) 527-4043 Phone
(972) 250-1530 Fax

2.02 GENERAL

A. All ladder side rails, rungs, ladder mounting brackets and cage straps are to be FRP structural shapes manufactured by the pultrusion process. Cage hoops and brackets shall be produced by the open molded hand lay-up method. All structural shapes shall be composed of fiberglass reinforcement and resin in qualities, quantities, properties, arrangements and dimensions as necessary to meet the design requirements and dimensions as specified in the Contract Documents.

B. Fiberglass reinforcement shall be a combination of continuous roving, continuous strand mat, bi-directional roving mat and surfacing veil in sufficient quantities as needed by the application and/or physical properties required.

C. Resins shall be DYNAFORM® ISOFR, an isophthalic polyester, with chemical formulation necessary to provide the corrosion resistance, strength and other physical properties as required.

D. All finished surfaces of FRP items and fabrications shall be smooth, resin-rich, free of voids and without dry spots, cracks, crazes or unreinforced areas. All glass fibers shall be well covered with resin to protect against their exposure due to wear or weathering.

E. All pultruded ladder components shall be further protected from ultraviolet (UV) attack with 1) integral UV inhibitors in the resin and 2) a synthetic surfacing veil to help produce a resin rich surface

F. All FRP products shall have a tested flame spread rating of 25 or less per ASTM E-84 Tunnel Test.

G. The ladder side rail shall be 1-3/4" square tube with a wall thickness of 1/4" or greater. The rungs shall be 1-1/4" diameter pultruded structural shapes, continuously fluted to provide a non-slip surface. Rungs that are gritted as a secondary operation shall not be permitted. Ladder wall and floor mount shall be fabricated from pultruded angles, 3/8" minimum thickness.

H. The ladder cage vertical bars shall be 2" wide by 9/16" pultruded channel shapes to offer protection to workers from exposed hardware. Cage hoops and cage brackets shall be manufactured by the open mold hand lay-up process. Top, intermediate, and bottom hoops shall be 3-3/4" wide by 1/4" thick minimum.

I. Type 316 stainless steel bolts shall be provided for attaching ladder cage vertical bars to hoops, ladder hoops to brackets, ladder cage brackets to the ladder, and wall brackets to the ladder.

J. All rungs shall be both mechanically attached to the ladder with stainless steel rivets and chemically bonded with epoxy.

K. Unless otherwise stated, all ladder and cage components are to be integrally pigmented yellow. All wall and floor mount brackets shall be Dynaform® ISOFR light gray.

L. Pultruded structural shapes used in the ladder system are to have the minimum longitudinal mechanical properties listed below:

Property	ASTM Method	Value	Units
Tensile Strength	D-638	30,000 (206)	psi (MPa)
Tensile Modulus	D-638	2.5 x 106 (17.2)	psi (GPa)
Flexural Strength	D-790	30,000 (206)	psi (MPa)
Flexural Modulus	D-790	1.8 x 106 (12.4)	psi (GPa)
Flexural Modulus (Full Section)	N/A	2.8 x 106 (19.3)	psi (GPa)
Short Beam Shear (Transverse)	D-2344	4,500 (31)	psi (MPa)
Shear Modulus (Transverse)	N/A	4.5 x 105 (3.1)	psi (GPa)
Coefficient of Thermal Expansion	D-696	8.0 x 10-6 (1.4 x 10 -6)	in/in/F (cm/cm/C)
Flame Spread	E-84	25 or less	N/A

M. All fasteners used in the ladder system are to be 316 SS. Rivets will be 18-8 metal.

PART 3 EXECUTION

3.01 FABRICATION

A. All ladders and cages shall be designed and laid out in strict accordance with OSHA 1910.27.

B. All rungs shall penetrate the wall of the tube side rails and shall be connected to the rails with both epoxy and rivets to provide both a chemical and mechanical lock, respectively.

C. Ladders shall be fully shop assembled. Ladder cages shall be test assembled and drilled to ensure a proper fit in the field. Ladder cage brackets shall remain attached to the ladder for shipping, but ladder cage components shall be disassembled, packaged, and shipped separately to ensure the lowest freight costs and to prevent damage in transit.

D. Cage components shall be bundled with each respective ladder.

E. The hoop brackets shall be shop attached to the ladder with bolts. The hoops shall be field attached to the hoop brackets.

F. All cut or machined edges, holes and notches shall be coated with vinyl ester resin to provide maximum corrosion resistance. All field fabricated cuts shall be coated similarly by the contractor in accordance with the manufacturer's instructions.

3.02 PERFORMANCE REQUIREMENTS

A. The completed ladder and cage system installation shall meet the following load requirements set forth in OSHA 1910.27 (latest edition). The ladder shall also be capable of supporting an ultimate concentrated vertical load of 1,200 pounds applied at

the mid-span of the rung. Manufacturer shall be required to provide supporting test data for rung capacity.

3.03 INSTALLATION

A. Contractor shall be required to assemble and install ladder in strict accordance with manufacturer’s assembly drawing and installation brochure.

B. Seal cut or drilled surfaces in accordance with manufacturer’s instructions. Follow manufacturer's instructions when cutting or drilling fiberglass products or using resin products; provide adequate ventilation.

END OF SECTION

SECTION 11311
SUBMERSIBLE PUMPS

PART 1 GENERAL

1.01 SCOPE

A. Furnish all labor, materials, equipment and incidentals required to install and test, complete and ready for operation, the submersible non-clog centrifugal pump system shown on the drawings and as specified herein.

Pumping Units							
No. Pumps	**Flow (gpm)**	**At TDH (ft.)**	**Min. TDH**	**Max. TDH**	**HP**	**Volts**	**Phase**
1	725	31.4	12.3	36.2	10	460 VAC	3

B. Duty point listed in table above is for a single pump running. Duty point for two pumps running in parallel shall be 1,090 gpm (total flow) at 35.5 feet, total dynamic head.

C. Pump supplier shall include, but not necessarily be limited to, explosion-proof pump, motor, cables discharge elbow, guide rails, all mounting hardware, and control panel.

D. The Contractor’s Equipment Manufacturer shall be responsible for coordinating the design, testing and installation of the pumps, motors, and their control systems. The Construction Contractor will install the pumping units under the supervision and guidance of the pump manufacturer’s representative.

1.02 SUBMITTALS

A. Bid Submittals: Include the following information with initial bid.

1. Manufacturer's certified rating curves showing pump characteristics of head, brake horsepower, discharge, efficiency, required net positive suction head, allowable suction lift, and solid handling capacity. Catalog sheets showing a family of curves will not be acceptable.

B. If the job is awarded to your firm, submit to the Engineer for approval the following:

1. Literature and drawings describing the equipment in detail, including parts list and materials and details of construction, to indicate full compliance with these specifications.

2. Certified dimensional drawings of each item of equipment and auxiliary apparatus to be furnished.

3. Schematic electrical wiring diagrams and other data as required for completion of each pump installation.

4. Installation manual.

5. Operation and maintenance manual.

6. Warranty documentation.

7. Equipment Installation Report including field measured pump curve for the installed pumps.

1.03 DELIVERY, STORAGE AND HANDLING

A. All equipment shall be crated, delivered and uncrated so as to protect against any damage. The pumps shall be cleaned and lubricated in preparation for installation and testing.

B. The Contractor is responsible to ensure that all parts are properly protected so that no damage or deterioration will occur during a prolonged delay from the time of shipment until installation is completed and the units and equipment are ready for operation.

C. Finished iron or steel surfaces not painted shall be properly protected to prevent rust and corrosion.

D. The finished surfaces of all exposed flanges shall be protected by wooden blank flanges, strongly built and securely bolted thereto.

E. Factory assembled parts and components shall not be dismantled for shipment unless permission is received in writing from the Engineer.

1.04 WARRANTY

A. Provide warranty in accordance with the conditions of the Maintenance Bond.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Pump shall be KSB model (KRT K 150-315/96XG-S) or equal.

B. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:

KSB or Flygt Products

C. A single supplier may submit multiple bids if more than one pump can meet the scope.

2.02 MATERIALS

A. SUBMERSIBLE PUMPS

1. Pump Case: Cast Iron, ASTM A48, Class 35B or 30B

2. Motor Housing: Cast Iron, ASTM A48, Class 35B or 30B

3. Impeller: ASTM A-532 (Alloy IIIA) 25% Chrome Cast Iron; Ductile Iron

4. Intermediate Housing (Backplate): Cast Iron, ASTM A48, Class 35B or 30B

5. Discharge Base Elbow: Cast Iron, ASTM A48, Class 35B

6. Pump/Motor Shaft: ASTM A479 S43100-T Stainless Steel. Carbon shafts with stainless steel shaft sleeves are not permitted. 300 series stainless steel shafts are not permitted.

7. Insert Ring, case: ASTM A-532 (Alloy IIIA) 25% Chrome Cast Iron; Ductile Iron

8. O-Rings: Nitrile Rubber (NBR); Buna-N

9. Fasteners (including impeller fastener): 300 Series Stainless Steel

10. Lower Seal Faces: Tungsten Carbide; Silicon Carbide

11. Upper Seal Faces: Tungsten Carbide stationary; Tungsten Carbide rotating; Silicon Carbide stationary; Silicon Carbide rotating

12. Guide rails/cables and mounting brackets: 316 Series Stainless Steel

13. Lifting Chain or cable: 316 Series Stainless Steel

14. Oil-all uses (seal lubrication, etc): Ecologically safe, paraffin or mineral base

15. Power/Control Cable Jacket: Chloroprene with non-wicking fillers; or SOOW power cable;

B. ACCESSORIES

1. Power Cable: Provide 50 ft of power/control cable with each pump, suitable for submersible wastewater application, sized in accordance with NEC requirements. The cable entry seal design shall preclude specific torque requirements to insure a watertight and submersible seal. The cable entry shall consist of dual cylindrical elastomer grommets, flanked by washers, all having a close tolerance fit against the cable outside diameter and the entry inside diameter. The grommets shall be compressed by the cable entry unit, thus providing a strain relief function. The assembly shall provide ease of changing the cable when necessary using the same entry seal. The cable entry junction chamber and motor shall be sealed from each other, which shall isolate the stator housing from foreign material gaining access through the pump top. Epoxies, silicones, or other secondary sealing systems shall not be considered equal. The cable entry

shall be rated by Factory Mutual (or UL) for submerged operating depths to 35 feet.

2. Temperature Protection: Each pump motor shall incorporate three thermal switches, one per stator phase winding and be connected in series to monitor the temperature of the motor. Should the thermal switches open, the motor shall stop and activate an alarm.

3. Seal Leak Detection:

   a. A float switch shall be installed in the seal leakage chamber and will activate if leakage into the chamber reaches 50% chamber capacity, signaling the need to schedule an inspection.

   b. MiniCAS or PSI PumpSafe Relay: Each pump shall be protected by a solid state relay to monitor motor winding temperature and seal leakage. The relays shall have an 11 pin octal base and shall be flanged for mounting on the inner door of the control panel. The relay shall be powered by 24VAC, 28VDC or 120VAC supply. LED indicators shall be provided on the relay for power on, overtemp and seal fail conditions. An overtemp reset pushbutton shall be mounted on the relay. The relay shall be capable of selectable manual or automatic reset following an overtemp alarm. The relay shall provide for automatic reset following a seal leakage event. The sensor input circuitry shall contain both hardware and software filters to provide noise immunity, as well as sensor input short circuit protection. The relay shall be MiniCAS-120, model 14-407129 by Xylem Water Solutions, Flygt Products or PSI PumpSafe by Pump Solutions, Inc.

C. FABRICATION

1. General: Provide pumps capable of handling raw, unscreened wastewater including rag-laden wastewater with sludge containing up to 5% solids content. The pump shall be supplied with a mating cast iron discharge connection and be automatically and firmly connected to the discharge connection guided by no less than two stainless steel guide bars or pipes extending from the top of the station to the discharge connection. Guide systems using cable rather than stainless steel bars or pipes shall not be considered equal. There shall be no need for personnel to enter the wet well. Sealing of the pumping unit to the discharge connection shall be accomplished by a machined metal to metal watertight contact. Sealing of the discharge interface with a diaphragm, O-ring or profile gasket will not be acceptable. No portion of the pump shall bear directly on the sump floor. Each pump shall be fitted with 300 series stainless steel lifting chain or cable. The working load of the lifting system shall be 50% greater than the pump unit weight.

2. Major Components: Furnish major components (pump case, impeller, intermediate housing, motor housing) of cast material as specified with smooth surfaces devoid of blow holes and other irregularities. Pump case design shall incorporate a centerline discharge for stability when mounted

on the base elbow.

3. Impeller and Insert Ring – The impeller shall be dynamically balanced, semi-open, multi-vane, back swept, screw-shaped, non-clog design. The impeller leading edges shall be mechanically self-cleaned automatically upon each rotation as they pass across a spiral groove located on the volute suction. The screw-shaped impeller shall be capable of handling solids, fibrous materials, heavy sludge and other matter normally found in wastewater. The screw shape of the impeller inlet shall provide an inducing effect for the handling of up to 5% sludge and rag-laden wastewater. The impeller to volute clearance shall be readily adjustable by the means of a single trim screw. The impellers shall be locked to the shaft and held by an impeller bolt, constructed of ASTM A-532 (Alloy IIIA) 25% chrome cast iron or ductile iron and coated with alkyd resin. The volute shall have a replaceable suction cover insert ring in which are cast a spiral-shaped, sharp-edged groove. The spiral groove shall provide trash release pathways and sharp edges across which each impeller vane leading edge shall cross during rotation so as to remain unobstructed. The insert ring shall be cast of ASTM A-532 (Alloy IIIA) 25% chrome cast iron and provide effective sealing between the multi-vane semi-open impeller and the volute housing.

4. Shaft: The pump and motor shaft shall be a single piece unit. The pump shaft is an extension of the motor shaft. Shafts using mechanical couplings shall not be acceptable. The shaft shall be stainless steel – ASTM A479 S43100-T. Shaft sleeves will not be acceptable.

5. Shaft Seal: Each pump shall be provided with a positively driven dual, tandem mechanical shaft seal system consisting of two seal sets, each having an independent spring. The lower primary seal, located between the pump and seal chamber, shall contain one stationary and one positively driven rotating corrosion resistant tungsten-carbide or silicon carbide ring. The upper secondary seal, located between the seal chamber and the seal inspection chamber shall be a leakage free seal. The upper seal shall contain one stationary and one positively driven rotating corrosion resistant tungsten-carbide or silicon carbide seal ring. The rotating seal ring shall have small back-swept grooves laser inscribed upon its face to act as a pump as it rotates, returning any lubricant that might enter the dry motor chamber back into the lubricant chamber. All seal rings shall be individual solid sintered rings. Each seal interface shall be held in place by its own spring system. The seals shall not depend on direction of rotation for sealing. Mounting of the lower seal on the impeller hub is not acceptable. Shaft seals without positively rotating members or double spring acting between the upper and lower seal faces are not acceptable. The seal springs shall be isolated from the pumped media to prevent materials from packing around them, limiting their performance.

   Each pump shall be provided with a lubricant chamber for the shaft sealing system. The lubricant chamber shall be designed to prevent overfilling and shall provide capacity for lubricant expansion. The seal lubricant chamber shall have one drain and one inspection plug that are accessible from the exterior of the motor unit. The seal system shall not rely upon the pumped

media for lubrication.

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

A separate seal leakage chamber shall be provided so that any leakage that may occur past the upper, secondary mechanical seal will be captured prior to entry into the motor stator housing. Such seal leakage shall not contaminate the motor lower bearing. The leakage chamber shall be equipped with a float type switch that will signal if the chamber should reach 50% capacity.

6. Bearings: The integral pump/motor shaft shall rotate on two bearings. The motor bearings shall be sealed and permanently grease lubricated with high temperature grease. The upper motor bearing shall be a single ball bearing type bearing to handle radial loads. The lower bearing shall be a two row angular contact ball bearing to handle the thrust and radial forces. The minimum L10 bearing life shall be 50,000 hours at any usable portion of the pump curve.

7. Motor: The pump motor shall be a NEMA B design, induction type with a squirrel cage rotor, shell type design, housed in an air filled, watertight chamber. The stator windings shall be insulated with moisture resistant Class H insulation rated for 180 degrees C (356 degrees F). The stator shall be insulated by the trickle impregnation method using Class H monomer-free polyester resin resulting in a winding fill factor of at least 95%. The motor shall be inverter duty rated in accordance with NEMA MG1, Part 31. The stator shall be heat-shrink fitted into the cast iron stator housing. The use of multiple step dip and bake type stator insulation process is not acceptable. The use of pins, bolts, screws or other fastening devices used to locate or hold the stator and that penetrate the stator housing are not acceptable. The motor shall be designed for continuous duty while handling pumped media of up to 104 degrees F. The motor shall be capable of no less than 30 evenly spaced starts per hour. The rotor bars and short circuit rings shall be made of aluminum. Three thermal switches shall be embedded in the stator end coils, one per phase winding, to monitor the stator temperature. These thermal switches shall be used in conjunction with and supplemental to external motor overload protection and shall be connected to the motor control panel.

The junction chamber shall be sealed off from the stator housing and shall contain a terminal board for connection of power and pilot sensor cables using threaded compression type terminals. The use of wire nuts or crimp type connectors is not acceptable. The motor and the pump shall be produced by the same manufacturer.

The motor service factor (combined effect of voltage frequency and specific gravity) shall be 1.15. The motor shall have a voltage tolerance of +/- 10%. The motor shall be designed for continuous operation in up to a 40 degrees C ambient environment and shall have a NEMA Class B maximum

operating temperature rise of 80 degrees C. A motor performance chart shall be provided upon request exhibiting curves for motor torque, current, power factor, input/output kW and efficiency. The chart shall also include data on motor starting and no-load characteristics.

Motor horsepower shall be sufficient so that the pump is non-overloading throughout its entire performance curve, from shut-off to run-out. The motor and cable shall be capable of continuous submergence underwater without loss of watertight integrity to a depth of 65 feet or greater.

8. Finish: Standard factory finish. Minimum 6 mil Dry Film Thickness (DFT) on inside and outside wetted surfaces.

2.03 CONTROL PANEL

The control panel, electrical components, and instrumentation for the pumps will be manufactured in accordance with all pertinent drawings and specifications for this project. This includes, but is not necessarily limited to, the RELATED SECTIONS listed above.

PART 3 EXECUTION

3.01 EQUIPMENT TESTS

A. Tests shall be performed in accordance with the Test Code for Centrifugal Pumps per the Standards of the Hydraulic Institute; Level A. Tests shall be performed on the actual assembled pumps to be supplied. Tests shall cover a range from shut-off to at minimum 20% beyond specified design capacity. Conduct test per above specification on all supplied pumps, generating a curve showing flow, head, BHP and hydraulic efficiency across the full operating range.

END OF SECTION

SECTION 15050
BASIC MECHANICAL MATERIALS AND METHODS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Basic mechanical requirements specifically applicable to all Divisions and Sections.

1.02 MEASUREMENT AND PAYMENT

A. No Separate Payment will be made for work required under this Section. Contractor shall include all costs of the requirements of this Section in the appropriate bid item(s) on the Bid Form.

1.03 REFERENCES

A. ANSI: American National Standards Institute.

B. ARI: American Refrigeration Institute.

C. ASHRAE: American Society of Heating Refrigeration and Air Conditioning Engineers.

D. ASME: American Society for Mechanical Engineers.

E. ASTM: American Society for Testing and Materials.

F. AWWA: American Water Works Association.

G. MSS: Manufacturer's Standardization Society of the Valve and Fitting Industry.

H. NEMA: National Electrical Manufacturers' Association.

I. NFPA: National Fire Protection Association.

J. SMACNA: Sheet Metal and Air Conditioning Contractors' National Association.

K. UL: Underwriters' Laboratories, Inc.

1.04 SUBMITTALS

A. Submit under provisions of Section 01330 - Submittal Procedures.

B. Submittals as specified in individual sections.

C. Submit shop drawings and product data grouped to include complete submittals of related systems, products, and accessories in a single submittal.

D. Mark dimensions and values in units to match those specified.

1.05 REGULATORY REQUIREMENTS

A. Conform to applicable Local Building Code.

B. Fire Protection: Conform to National Fire Prevention Association Code.

C. Plumbing: Conform to National Plumbing Code.

D. Obtain permits, and request inspections from authority having jurisdiction on of this Project.

1.06 PROJECT/SITE CONDITIONS

A. Install Work in locations shown on Drawings, unless prevented by Project conditions.

B. Prepare drawings showing proposed rearrangement of Work to meet Project conditions, including changes to Work specified in other Sections. Obtain permission of Engineer before proceeding.

1.07 SEQUENCING AND SCHEDULING

A. Construct Work in sequence under provisions of Section 01326 - Construction Schedule (Bar Chart).

1.08 PIPE INSULATION - WATER SERVICE

A. Furnish and install insulation system for water piping, chemical piping, and instrument tubing containing water, and piping subject to condensation. Piping and tubing less than 4 inches in diameter to be insulated when exposed to outside temperatures. Exterior insulation piping shall be protected with weather jacket.

B. All insulation system components to be asbestos free.

C. Pipe insulation: Molded heavy density one-piece insulation made from inorganic glass fibers bonded with a thermo-setting resin. Insulation shall be Owens Corning Fiberglass, Knauf Fiber Glass, Certainteed or equal. Insulation to include an all-service jacket (ASJ) with vapor barrier, a self-sealing lap (SSL) for longitudinal joint, and similar factory-furnished butt joint sealing strip. Minimum insulation thickness to be 1 inch for pipes 2 inches and smaller, and 2 inches for lines 2 1/2 inches and larger.

D. Weather Jacket: All exterior insulation to be protected by minimum 0.016-inch-thick aluminum jacket with laminated vapor barrier of polyethylene-surlyn or polyethylene-Kraft paper thermally bonded to the inside surface. Valve fittings and flanges shall have jacketing and moisture barrier protection. Weather jacket shall be by Premeteo, Childers Product Co., or equal.

E. Sealant: Non- shrink, permanently flexible, vapor barrier sealant: Childers CP-70 or equal.

F. Strapping: Stainless steel bands, minimum 0.020 inch thick by 3/4 inches wide with 0.034-inch-thick wing seals.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION - Not Used

END OF SECTION

SECTION 15102
VALVES FOR WASTEWATER FACILITIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Valves, gates and accessories for exposed, submerged and other types of piping.

1.02 MEASUREMENT AND PAYMENT

A. No separate payment will be made for work required under this section. Contractor shall include all costs of the requirements of this section in the appropriate bid item(s) on the bid form.

1.03 REFERENCES

A. ANSI B16.1 - Cast Iron Pipe Flanges and Flanged Fittings.

B. AWWA C509 - Resilient Seated Gate Valves.

C. AWWA C508 - Check Valves.

D. ASTM A126 - Gray Iron Castings for Valves, Flanges, and Pipe Fittings.

E. ASTM A395 - Ductile Iron Castings.

F. ASTM A48 - Gray Iron Castings.

G. ASTM A193 - Alloy-Steel and Stainless Steel Bolting Materials for High Temperature Service.

H. ASTM A194 - Carbon and Alloy Steel Nuts for Bolts for High Pressure and High Temperature Service.

1.04 QUALITY ASSURANCE

A. Manufacturer's Qualifications:

1. Valves and appurtenances provided under this Section shall be the standard product in regular production by manufacturers whose products have proven reliable in similar service for at least 5 years.

2. Insofar as possible all valves of the same specific type shall be the product of one manufacturer.

1.05 SUBMITTALS

A. Submit shop drawings and product data under provisions of Sections 01330 - Submittal Procedures.

Shop Drawings: Submit for review, detailed drawings, data and descriptive literature on valves and appurtenances, including:

1. Dimensions.

2. Size.

3. Materials of construction.

4. Weight.

5. Protective coating.

6. Actuator weight, where applicable.

7. Calculations for actuator torque, where applicable.

8. Wiring diagram, where applicable.

B. Submit manufacturer's valve sizing calculations for verification of sizing for air release valves, air and vacuum valves, and surge relief valves.

1. Manufacturer's Certifications.

C. Submit manufacturer's certificates of compliance with ANSI, AWWA and other listed standards.

1.06 OPERATION AND MAINTENANCE DATA

A. Submit operation and maintenance data under provisions of Section 01782 - Operations and Maintenance Data.

B. Submit a detailed operation and maintenance manual for valves and appurtenances provided under this Section.

1.07 DELIVERY, STORAGE AND HANDLING

A. Have products delivered, stored and protected. Store valves and appurtenances off the ground in enclosed shelter.

PART 2 PRODUCTS

2.01 BASIC REQUIREMENTS

A. Mark and identify valves in conformance with standards, these Specifications or to the manufacturer's standard.

B. Bolts, studs and nuts to be Type 316 stainless steel.

C. End connections of valves shall be flanged and drilled to ANSI Class 125 unless otherwise specified.

D. For handwheel operators on valves 4-inches or larger where located more than 5 feet above the operating floor, provide chain and chainwheel or extension operators. Use chainwheels fabricated of malleable cast iron with chain guides. Provide stainless steel chains of a length to extend to within 5 feet of the operating floor.

E. To exterior surfaces of valves, apply a shop coating in accordance with Section 09901 – Protective Coatings.

2.02 CHECK VALVES

A. Swing check valves 4-inches through 14-inches having a system pressure 30-psi or less shall be air cushioned with side mount lever and weight. The valve shaft shall extend through both sides of the body with minimum shaft diameters equal to APCO Series 6000. The cushion shall be totally enclosed, swivel mounted at the bottom, and equipped with a micrometer air control valve and air breather filters. Valves shall be APCO Series 6000, CCNE Series 9000 (Pneumatic), GA Industries 250-D, or equal.

B. Swing check valves 10-inches through 14-inches having a system pressure greater than 30 psi shall be oil cushioned with side mount lever and weight. Valves shall be similar to APCO Series 6100, CCNE Series 9000 (Oil Cushioned), or equal.

C. Swing check valves 16-inches and larger regardless of system operating pressure shall be oil cushioned with side mount lever and weight. Valves shall be similar to APCO Series 6100, CCNE Series 9000 (Oil Cushioned), GA Industries 250-DOC, or equal.

D. Check valves of special design utilizing controlled closing of the disc, such as APCO Series 6000B (Bottom-Buffer), GA Industries Fig. #25-DXH, CCNE Series 9000 (Decelerator), or equal, shall be used when specifically indicated on the Drawings. These valves are special valves used to control the surge pressure in the force main upon multiple pump shutdown during a power failure. Other surge control check valves utilizing ball or cone valve and power cylinder operator may also be used as approved by the Engineer.

E. All check valves shall have 300 series stainless steel hinge shafts, stainless steel body seats and stainless steel resilient seat retainer rings.

2.03 ECCENTRIC PLUG VALVES

A. Eccentric plug valves shall be the non-lubricated eccentric type with cast iron bodies, resilient-faced plugs or replaceable resilient seats in the bodies.

B. Operators: All valves for 4-inch and larger service shall have worm gear operators, nickel or stainless steel seats, and ANSI 125 psi flanged ends. Operators shall clearly indicate valve position. Operators on valves in submerged or buried service shall be lubricated and sealed to prevent entry of dirt and water into the operator.

C. Resilient facing shall be suitable for the intended service.

D. All shaft bearings shall be of stainless steel, furnished with permanently lubricated bearing surfaces.

E. Valves up to and including 20 inches in size shall have an unobstructed port area of no less than 80 percent of the full pipe area, and not less than 70 percent for larger valves.

F. Eccentric plug valves shall be manufactured by Crispin, Clow, De Zurik, Keystone, Val-Matic, Pratt, Milliken, or Victualic.

2.04 SEWAGE AIR RELEASE AND SEWAGE AIR AND VACUUM VALVES

A. Air Release and Air and Vacuum Valves: Provide when shown on Drawings.

B. Sewage Air Release Valve Design: Single float, single orifice, float operated with a compound lever mechanism to automatically release accumulated air and gases while the system is pressurized and operating.

C. Sewage Air and Vacuum Valve Design: Two float where the top float shuts off against the seat due to the lifting force of the bottom float as liquid enters the valve body. Once closed and pressurized the air and vacuum valve will not open to release air.

D. Fabricate valve body, cover and baffles of cast iron: Fabricate internal metal parts of stainless steel. Make valve seat of Buna-N nitrile rubber.

E. Fit valve with blow off valves, quick disconnect couplings and minimum 6-feet of hose to permit back flushing after installation with dismantling valve.

F. Provide air release valves equal to Vent-O-Mat, APCO, or G.A. Industries.

G. Provide air and vacuum valves equal to Vent-O-Mat, GA Industries, APCO, or Val-Matic.

2.05 SURGE RELIEF VALVES

A. Surge Relief Valves: Provide when shown on Drawings.

B. Operation: Surge relief valves shall protect piping systems from surges by opening quickly at a set pressure and throttling the flow to maintain line pressure at no more than

5 to 10 percent above the pressure setting indicated. Provide relief pressure adjustment by changing the tension on a spring holding the valve disc on its seat.

C. Valve Closing Control: By oil dashpots. Oil shall be drawn into the dashpot from a reservoir when the valve opens and return through a flow control valve when the relief valve closes.

D. Valve Construction: Fabricate valve bodies of cast iron with 300 series stainless steel seat rings. Provide seats that are renewable and resilient. Fabricate hinge shafts of stainless steel and the oil system of bronze. Unless otherwise indicated make the pressure setting 5 percent above normal line pressure.

E. Provide surge relief valves that are 90-degree elbow body configuration. Acceptable manufacturers include Ross Valve, APCO series 3000, GA Industries 625-D, or approved equal.

2.05 TELESCOPING VALVES

A. Telescoping valves shall be of stainless steel construction and consist of a drain tube sliding inside a stationary vertical pipe.

B. Lifting straps (bails) shall be welded to the inner tube and extend a minimum of 12 inches above the top of the flow tube.

C. Flow tube shall be flared. Flow tube shall be manufactured from seamless tube a minimum of 1/8 inch thick.

D. Pipe seal is provided by a wiper gasket and retaining flange. Wiper gasket shall be neoprene and provide a friction seal around the sliding tube. Retaining flange shall be stainless steel.

E. Stems shall be manufactured from solid type 304 stainless steel rod and be of a rising style. Operator shall be a threaded stem lift with hand wheel, mounted on an offset pedestal. Include position indication.

F. Acceptable manufacturers: Waterman Industries, Penn-Troy, Halliday Products or approved equivalent.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install valves and specialties in accordance with manufacturer's written instructions to permit intended performance.

B. Support and anchor valves and gates in accordance with Section 15140 - Pipe Hangars, Supports and Restraints.

C. Eccentric plug valves shall be installed according to the following:

1. Position the valves with the stem in the horizontal direction.

2. In horizontal pipelines, position the vales so that the plug swings upward when opening to permit flushing of solids.

3. Orient the vales to prevent the valve bodies from filling up with solids when closed; however, orient the valves such that the pressure differential forces the plug against the seat in cases where the pressure differential across a closed valve will exceed 25 psi.

3.02 PAINTING

A. Paint valves and specialties in accordance with applicable AWWA standards and with Section 09901 - Protective Coatings.

3.03 TESTING

A. Test valves using a hydrostatic pressure test in accordance with AWWA C-600.

B. Test valves and specialties in place. Correct defects in valves, specialties or connections.

END OF SECTION

SECTION 15140
PIPE HANGERS, SUPPORTS, AND RESTRAINTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Pipe and equipment hangers, supports, and associated anchors.

B. Equipment bases and supports.

C. Sleeves and seals.

1.02 MEASUREMENT AND PAYMENT

A. No Separate Payment will be made for work required under this section. Contractor shall include the cost for this work with appropriate items included in the bid form.

1.03 REFERENCES

A. ANSI/ASME B31.1 - Power Piping, Sections 120 and 121 of ASME B31.1.

1.04 SUBMITTALS

A. Submit shop drawings and product data under provisions of Section 01330 – Submittal Procedures.

B. As a minimum, submit the following items:

1. A layout of the systems including location on fixed and movable joints.

2. Details of design and fabrication of joints.

3. Details of support brackets, cradles, pads, thrust resisting elements, and other supporting elements.

4. Other pertinent elements necessary for a complete installation.

5. Design calculations for submitted items.

PART 2 PRODUCTS

2.01 HANGERS AND SUPPORTS

A. For uninsulated lines 2 inches and less and for drainage and downspout lines provide hangers, which are adjustable swivel ring type fabricated of malleable iron.

B. For uninsulated lines larger than 2 inches and for insulated lines, except drainage and downspout piping, provide adjustable clevis type hangers. Size hangers to allow insulation to extend unbroken through the hanger.

C. Fabricate hangers installed in valve vaults, wet wells, and other below grade areas of cadmium plated or stainless steel.

2.02 INSERTS

A. Make inserts for individual hangers of galvanized malleable iron; include removable nuts held in place by V-type teeth on the insert body and nut. Make continuous-slotted channel inserts of galvanized steel with integral anchors at 6-inch centers. Provide factory finished steel snap-on cover plates on channel inserts between support attachments.

2.03 EXPANSION BOLTS

A. Use expansion bolts for support which are stainless steel wedge type. Do not use expansion bolt anchors with lead.

2.04 PIPE SADDLES

A. Fabricate pipe saddles of hot dip galvanized steel. Saddles for supporting pipe from the floor shall be at least 9 inches in length and as wide as the outside diameter of the pipe. Make a bearing support of 120 degrees. Mount saddles on concrete pads at least 2-inches high.

2.05 FRAMING HANGERS

A. Use factory fabricated metal framing systems with factory applied primer paint as framing for wall type hangers, trapeze hangers, and tunnel stanchions. Attach supports to structures with inserts for new concrete, with surface mounting methods for masonry or existing concrete, and with welding or clamps for structural steel. Make pipe supports fabricated on the site of structural steel members with raw edges ground and dressed. Rest floor supports in areas with uncovered concrete floors on concrete pads not less than 2 inches high.

PART 3 EXECUTION

3.01 INSTALLATION

A. Hang piping inside structures supported from the floor or racked adjacent to walls.

B. Provide inserts cast in concrete walls or slabs for hanging and supporting pipe. If materials not galvanized or cadmium plated, paint them with primer before installation.

C. Design, fabricate, and install support components in general conformance with Sections 120 and 121 of ANSI B31.1, Power Piping, except as modified in this Section.

3.02 PIPE HANGERS AND SUPPORTS

A. Support, brace, and anchor interior piping to prevent movement in any direction because of pressure, temperature, flow, or water hammer, except at properly located expansion joints and fittings.

B. Provide two pipe guides on each side of expansion joints at which pipe movement occurs. The first guide shall be not more than 4-pipe diameters from the joint and the second not more than 14 diameters. Provide additional guides as required to maintain pipe alignment, spaced as required for the pipe size, fluid pressure and temperature inside the pipe, and as recommended by the expansion joint manufacturer or as shown.

C. Maximum support spacing and hanger rod sizes for metal pipe containing liquids are as follows:

Nominal Pipe Size (Inches)	Support Spacing (Feet)	Rod Diameter in Inches One Rod	Two Rods
1 and Smaller	7	3/8	3/8
1-1/4 and 1-1/2	8	3/8	3/8
2	10	3/8	3/8
2-1/2	11	1/2	3/8
3	12	1/2	3/8
4 and 5	14	1/2	3/8
6 and 8	17	1/2	3/8
10	17	5/8	1/2
12	17	3/4	1/2
14	17	3/4	5/8
16	17	7/8	5/8
18 and 20	17	1	3/4
24	17	1-1/8	7/8

D. For valves 4 inches and larger in unburied horizontal lines support the valve on both sides when located within 18 inches of the valve or meter. Provide additional supports where required so that piping loads do not place damaging stresses on supports, valves, and equipment. Where necessary, block up pipe at supports to permit installation of insulation.

E. Support unburied horizontal runs of rubber hose and non-metallic pipe for the entire length by means of troughs consisting of structural steel channels or angles supported at not more than 10-foot intervals.

F. Support piping not included in the foregoing tabulation as indicated or in accordance with the pipe manufacturer's recommendations, if not indicated.

G. Anchor buried pressure pipe at each fitting causing a change in direction of 10 degrees or more. Concrete thrust blocks or other restraining devices in any satisfactory combination may be used. Submit the details of the method proposed for use, together with design calculations, to the Engineer before installation.

END OF SECTION

SECTION 16010
BASIC ELECTRICAL REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Basic requirements specifically applicable to the work of Division 16 - Electrical Requirements.

B. The Contractor shall furnish equipment, materials, and labor for assembly and installation plus checkout and start-up of the complete electrical system as shown on the Drawings and stipulated in the Specifications.

1.02 REFERENCES

A. As a minimum requirement, the electrical system shall be constructed in accordance with:

1. American National Standards Institute/National Fire Protection Association (ANSI/NFPA), No. 70 - National Electrical Code (NEC).

2. City of Houston Building Code.

3. Other applicable Codes and Standards as referenced in other Master Specifications.

B. Comply with local, county, state and federal regulations and codes in effect as of date of purchase.

C. Equipment of foreign manufacture must meet U.S. codes and standards.

D. Equipment and materials shall conform to requirements of specification and to the criteria provided in data sheets for the project.

1.03 QUALITY ASSURANCE

A. Product Conformance Certificate and Quality Assurance Release.

1. Submit an overall conformance certificate for electrical components signed by the person responsible for product quality. Specifically identify the purchased material or equipment by project name and location, purchase order number, supplements, and item number where applicable, including materials and services provided by others. Indicate that all requirements have been met and identify any approved deviations.

2. Field Inspection:

a. Electrical work shall be inspected and approved by the local code inspector and the Engineer.

b. Contractor shall give a minimum of one-day notice to the Inspector that the installation is ready for inspection and two days notice to the Engineer.

c. Concealed work shall be inspected before it is covered:

(1) Conduit with stub-ups, underground in duct banks before concrete is poured.

(2) Conduit in slabs, walls and ceilings, complete with boxes.

d. Electrical equipment and materials shall be inspected upon arrival by the Engineer for compliance with specifications.

1.04 SITE CONDITIONS

A. Take the following site conditions into consideration when fabricating, erecting, installing and wiring electrical equipment under this contract:

1. Plant Location _____
_____

2. Plant Type and Size _____

3. Plant Site Elevation _____

4. Seismic Zone Zone 0

5. Wind Velocity 90 mph

6. Temperature, Min./Max.:

a.	Coldest Winter Month:	High 60 degrees F	Low 41 degrees F
b.	Warmest Summer Month:	High 94 degrees F	Low 73 degrees F
c.	Lowest Expected:	11 degrees F	
d.	Highest Expected:	107 degrees F	

7. Rainfall:

a.	Annual	45 inches
b.	Design hours	3.4 inches/hour, 8.4 inches/24 hours

8. Design Relative Humidity: 98%

9. Station Barometric Pressure:

   a. Average Annual 29.5 inches Hg Absolute.

10. Utility Water Systems:

		Design Pressure	Design Temp.
a.	River Water	_____ PSI	____ degrees F
b.	Well Water	_____ PSI	____ degrees F
c.	City Water	__55___ PSI	_70_ degrees F

11. Electric Power Supply Characteristics (Available to Contractor):

	Voltage	Phase	Hz	Wire	Delta or Wye
1	480	3	60	TBD	TBD
2					
3					

PART 2 PRODUCTS

2.01 COMPONENT DESIGN

A. Components utilized in the construction of the material or equipment shall be of the latest proven design, new and in current production. Do not use obsolete components or components to be phased out of production.

2.02 FACTORY INSPECTION

A. Provide free access with prior notice for the Engineer at all times to the shop where the material or equipment is being fabricated or tested. Provide reasonable facilities for inspection, witnessing tests, and examining records. Give 7-days notice prior to starting tests, which are scheduled for factory inspection.

PART 3 EXECUTION

3.01 PREPARATION

A. Verify dimensions and ratings of equipment and materials to ensure proper fit and performance.

3.02 INSTALLATION

A. Install equipment and materials in accordance with the Drawings and manufacturer's written instructions. If field conditions necessitate changes in electrical installation, obtain approval from the Engineer prior to making any changes in the Work.

B. All electrical equipment shall be mounted at an elevation of eighteen (18) inches above the base water surface flood elevation (100 YR WSEL) of the construction site. Should there be a difference in the mounting elevation on the construction Drawings that is in conflict with the previous directive the Contractor shall immediately bring such conflict to the attention of the Engineer for resolution.

3.03 DEMONSTRATION

A. Test the electrical system to specification requirements and to demonstrate correct installation and operation of equipment.

B. Before 7-days test, demonstrate the system to the Engineer. Show the system to be fully operational. All alarms, safety's, and communication points to central and locally must operate in both full-automatic and back-up modes. Use fresh water in the test medium.

C. Operate the system continuously for a period of 7 days in full automatic, without failure, to qualify as acceptable. "Failure" is considered any problem that requires correction by maintenance personnel, such as: high or low water level, any motor alarm, power failure, phase failure, communication failure, PLC failure, or UPS failure. This would exclude conditions not under the control of Contractor, such as: evident lightning strikes, 25-year rains, purchased power failure longer than the specified duration of service from UPS. Failures due to uncontrollable situations would allow the 7-day test to continue, as soon as test conditions are restored and the Engineer is notified.

D. The existing station shall remain in service during this test.

END OF SECTION

SECTION 16012
ELECTRICAL WORK

PART 1 GENERAL

1.01 DESCRIPTION

A. The work shall include providing materials and equipment required for installation of complete and functioning electrical system as specified and as shown on the drawings.

B. This section is an integral part of all Specification Sections related to electrical, control and instrumentation construction under this contract. Conditions of this section are paramount to all other conditions in applicable sections and shall supercede all other conditions and requirements.

C. Electrical Control and Instrumentation Plans & Specifications are representative of the design intent and may not contain minute details normally associated with normally accepted electrical construction, as described in applicable codes or as described in manufacturer's literature. Contractor shall provide all appurtenances normally associated with a particular equipment or device, and as required for a properly operating system.

1.02 MAJOR ITEMS OF WORK AS FOLLOWS

A. Installation of Control Panel

B. Installation of Wet Well Junction Boxes

C. Installation of Transducer Base Level Measurement System with Float Backup

D. Installation of new Electrical Service Equipment

E. Installation of Cellular Autodialer and Cellular Service

F. Installation of Lift Pumps

G. Connection back to existing SCADA system.

H. Installation of Diesel Generator and Automatic transfer switch

I. Verification of Complete and Operable system.

1.03 PLANT CONTROL SYSTEM

A. The Contractor shall furnish and install a complete Lift station control panel. The control panel shall include but shall not be limited to all circuit breakers, motor starter, contactors, indicating lights, selector switches, lightning arrestor, surge capacitor, phase failure relays, elapsed time meters, alarm horn, push button, control transformers,

system monitor, power supplies, interlock wiring, control piping, blocks, valves, nameplates, and all other associated items required to provide a workable system.

1.04 SUBMITTALS

A. Submit all products covered under this specification for Engineer's approval.

B. Where submittals for a particular equipment, device or material item vary from that specified or shown on plan drawings, and where that item is not specifically noted as acceptable and, where installation of submitted item results in improper or undesirable operation of the system, Contractor shall be liable for removal and/or replacement of that item with the item specified or shown on plan drawings at no additional cost to Owner.

C. In addition to submittals for products covered in these specifications, the Contractor shall submit a Duct Bank Plan submittal showing prospective routes of proposed duct banks with dimensions and depth of cover clearly shown, a Conduit Stub-up Plan Submittal showing dimensioned locations of conduit penetrations of slabs, walls, etc., conduit size, conduit function and contents, and an MCC Elevation submittal showing proposed arrangement of MCC components.

1.05 CONTRACTORS RESPONSIBILITIES

A. Electrical Contractor shall coordinate electrical power, telephone, data or special purpose line installation with utility companies. Within 30 days after award of contract, Electrical contractor shall contact utility company and owner and shall request service needed.

It is Electrical Contractors sole responsibility to assure that utility company and owner are notified and are kept aware of requirements.

B. Contractor shall provide all conduit, conductors and termination equipment as needed for utilities and shall coordinate with utility companies for installation requirements and shall provide installation constructed according to the utility company standards whether or not such is shown in detail or plans.

C. Electrical Contractor shall review all sections of the plans including Civil, Structural, Mechanical, Instrumentation, Process, Architectural, and Electrical and shall note all electrical and/or requirements for devices and equipment shown or implied, and shall provide service accordingly for a complete operating electrical system.

D. Electrical Contractor shall provide all programming set-up, adjustments and testing of devices or equipment included under this contract unless specifically excluded or unless equipment is not provided by Electrical Contractor.

E. General Contractor is specifically responsible for coordination of all electrical systems, devices and equipment provided or installed under this contract and shall assure that all requirements by all trades are met such as to insure a complete and operating electrical, control, process or instrumentation system.

F. Electrical Contractor shall be experienced with all types of electrical systems covered under this contract. No work shall be undertaken where Contractor's firm, project supervisors and project electrical workers have not had recent experience in similar projects in area or project location. Contractor will be required to furnish proof of experience where requested by Owner or Engineer or their Representatives.

G. General Contractors Project Manager or his Assistant shall be familiar with types of electrical construction required by this project in order to determine that all subcontractors work in conformance with the plans and specifications.

H. Contractor shall assure that all systems have been properly installed, adjusted and tested prior to final inspection, unless, Engineer has been duly notified in writing that certain equipments are not ready for final testing and such is acceptable with Engineer.

Additional site visits, inspections, and tests conducted by Engineer due to systems not being ready at designated time of final inspection may result in charges to Contractor by Engineer to pay for additional time of electrical inspectors not covered in Electrical Engineers scope of work. All charges will be at Engineers Standard rates.

I. Contractor shall fully inspect all motors and nameplates, controls, conduit, wiring devices and other items before starting work, ordering materials or submitting shop drawings in order to verify existing conditions are as shown on plans and shall immediately notify Engineer of any discrepancies between plans & specifications and existing conditions. Failure to do so may result in responsibility for any required changes in construction.

J. At completion of project and before final inspection, Contractor shall provide the Electrical Engineer with full size blue prints, red-lined to reflect the As-Built electrical installation. Any variation from plans shall be shown on each applicable plan sheet

PART 2 PRODUCTS

2.01 MATERIALS

A. All materials provided under all sections of the specifications shall be new and the standard products of manufacturers regularly engaged in the production of such equipment. All materials shall conform to the National Electrical Code and shall be approved and listed by the Underwriters' Laboratories. Materials described by manufacturer's name and catalog number are selected to set a definite standard of design and quality to be required. There is not any intention to discriminate against a product of another manufacturer, which is equally durable in construction, similar in design, and will serve the purpose for which it is intended. Within 30 days after award of the contract and before any materials and equipment are placed on order, the Contractor shall submit to the Engineer for approval a complete list including catalog numbers and descriptive matter, of all materials and equipment he proposes to provide.

B. Materials and equipment specifications are general in coverage and may contain reference to construction items that apply in only particular situations and may not apply as a general rule for materials installed on this project.

2.02 PLANS AND SPECIFICATIONS

A. Electrical plans and specifications are not intended to discriminate against any particular manufacturer. Specific values shown for a particular manufacturer's product may vary slightly for another product. The Electrical Engineer reserves the right to interpret the electrical specifications and to make judgement as to acceptance of a product, regardless of minute details in the specifications or on the Plans.

B. Specifications shall be reviewed for applicability of materials under certain conditions and in certain environments and, where not shown otherwise on plan drawings. These application directions shall be adhered to.

C. Where a particular reference on drawing plans does not conform to standard acceptable construction methods for a particular type project, the Contractor shall immediately notify the Engineer and request a clarification before ordering materials or starting construction.

PART 3 EXECUTION

3.01 WORKMANSHIP

A. All wiring shall be installed in accordance with current NEC and local codes. Conduits exposed to the weather shall be rigid galvanized steel (RGS) or, as noted on plans. Conduit placed underground shall be schedule 40 PVC or, as noted on plans.

B. A fish wire shall be left in all conduits in which the permanent wiring is not installed.

C. All fixtures, switch, and receptacle locations shall be approved by Engineer.

D. Refer to other sections of this specification for controls. Under this section of the specifications, the Contractor shall install the control devices and provide control wiring switches, outlet boxes, and shall make all final connections. Control wiring and interlocks shall conform to wiring diagrams furnished by equipment manufacturers.

E. The Contractor shall provide services of his Engineer or a factory trained technician to instruct plant-operating personnel for a period of at least one (1) full day after completion of the contract work.

F. All electrical equipment shall be mounted at an elevation of eighteen (18) inches above the base water surface flood elevation (100 YR WSEL) of the construction site. Should there be a difference in the mounting elevation on the Construction Drawings that is in conflict with the previous directive the Contractor shall immediately bring such conflict to the attention of the Engineer for resolution.

3.02 EXCAVATION AND BACKFILL

A. All underground conduits shall be buried to a minimum depth of 24-inches below finished grade. All trenches shall be uniform width and shall be backfilled and compacted to 95% that of original density. Any damage to underground conduits caused by other

Contractors shall be repaired by this Contractor and shall be compensated accordingly by the party or parties responsible for the damage.

3.03 CLEAN UP

A. The Contractor shall upon completion of the work, remove all materials, empty containers, and any other materials that are not incorporated into the work.

END OF SECTION

SECTION 16060
ELECTRICAL DEMOLITION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Electrical Demolition

1.02 REFERENCES

A. Temporary wiring of systems to maintain operation of facilities while undergoing modifications and demolition shall be provided in accordance with the American National Standards Institute/National Fire Protection Association (ANSI/NFPA), No.70 - National Electrical Code (NEC), Article No. 305- Temporary Wiring

1.03 SUBMITTALS

A. Annotate existing drawings to sequence the demolition of systems, equipment removal and temporary hook-ups.

B. Schedule with Engineer or required shutdowns to accommodate system demolition and installation of temporary facilities.

1.04 QUALITY ASSURANCE

A. Verify field measurements and circuiting arrangements are as shown Drawings.

B. Verify that abandoned wiring and equipment serve only abandoned facilities.

C. Demolition drawings are based on casual field observation and existing record documents. Report discrepancies to Engineer before disturbing existing installation.

D. By beginning demolition, installer accepts existing conditions and warrants that he will maintain service to equipment and items not scheduled or indicated for removal, and that he will return to the Owner all items and systems in good operating condition.

PART 2 PRODUCTS

2.01 MATERIALS AND EQUIPMENT

A. Materials and equipment for patching and extending work: As specified in individual Sections.

2.02 DESIGN AND CONSTRUCTION

A. The temporary electrical wiring and facilities shall be designed and constructed in strict compliance with NEC-Article No. 305.

PART 3 EXECUTION

3.01 PREPARATION

A. Disconnect electrical systems in walls, floors, and ceilings scheduled for removal.

B. Coordinate utility service mirages with Utility Company to provide continuous service to operating equipment.

C. Provide temporary wiring and connections to maintain existing systems in service during construction. When work must he performed on energized equipment or circuits. Use personnel experienced in such operations.

D. Existing Electrical Service: Maintain existing system in service until new system is complete and ready for service. Disable system only to make switchovers and connections. Obtain permission from the Engineer at least one week before partially or completely disabling system. Minimize outage duration.

3.02 DEMOLITION AND EXTENSION OF EXISTING ELECTRICAL WORK

A. Remove, relocate, and extend existing installations to accommodate new construction.

1. Remove abandoned wiring to source of supply.

2. Remove exposed abandoned conduit, including abandoned conduit above accessible ceiling finishes. Cut conduit flush with walls and floors, and patch surfaces.

3. Disconnect abandoned outlets and remove devices. Remove abandoned outlets if conduit servicing them is abandoned and removed. Provide blank cover for abandoned outlets, which are not removed.

4. Disconnect and remove abandoned panelboards and distribution equipment.

5. Disconnect and remove electrical devices and equipment serving utilization equipment that has been removed.

6. Repair adjacent construction and finished damaged work.

7. Maintain access to existing installations, which remain active. Modify installation or provide access panel as appropriate.

8. Extend existing installations using materials and methods as specified for new work.

3.03 DISPOSAL AND SALVAGE

A. Salvage electrical and instrumentation equipment removed from existing facilities for reuse as applicable.

B. Material and equipment, which can be reused or salvaged, remains the property of the Owner unless specifically indicated in the Specifications or Drawings or as designated by the Engineer.

C. Materials and equipment, which cannot he reused or salvaged will he removed and disposed of by the Contractor.

3.04 CLEANING AND REPAIR

A. Clean and repair existing materials and equipment, which remain or are to be reused.

B. Panelboards: Clean exposed surfaces amid check tightness of electrical connections. Replace damaged circuit breakers and provide closure plates for vacant positions. Provide sped circuit directory showing revised circuiting arrangement.

C. Install relocated materials and equipment under the provisions of Section 02220-Demolition.

END OF SECTION

[PAGE LEFT INTENTIONALLY BLANK]

SECTION 16100
BASIC MATERIALS AND METHODS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Raceway Systems
2. Wire, Cables and Connectors
3. Wiring Devices
4. Motor Starters
5. Motor and Circuit Disconnects
6. Fuses
7. Panelboards
8. Transformers

1.02 RELATED SECTIONS

A. Division 16 - Electrical Specifications that apply to the requirements of this project.

1.03 SUBMITTALS

A. Submit all products covered under this section for Engineer’s approval.

B. Product Data:

1. Submit for disconnects, motor starters, panelboards, circuit breakers, overcurrent protective devices, transformers, and mini-power centers.
2. Product data sheets with printed installation instructions.

C. Shop Drawings:

1. Submit for motor starters.
2. Show enclosure dimensions, nameplate nomenclature, electrical ratings, and thermal unit schedule.
3. Wiring diagrams and schematics.

D. Approval of equipment supplied in this section is contingent upon Contractor verification of available fault current from electric utility. Notify Engineer if available fault current is higher than specified equipment.

E. Operation and Maintenance (O&M) Data: Maintenance data for materials and products for inclusion in O&M Manual.

1.04 QUALITY ASSURANCE

A. Items provided under this section shall be listed or labeled by UL or other Nationally Recognized Testing Laboratory (NRTL).

1. Term "NRTL" shall be as defined in OSHA Regulation 1910.7.

2. Terms "listed" and "labeled" shall be as defined in National Electrical Code, Article 100.

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

C. Where materials or installation methods in this section conflict with other sections, those particular sections shall have precedence unless otherwise indicated.

PART 2 PRODUCTS

2.01 RACEWAY SYSTEMS

A. Galvanized rigid steel conduits (GRS):

1. Manufacturers:

a. Allied Steel

b. Wheatland

c. Omega

d. Columbia

2. Manufacturer's standard lengths and size.

3. Protected inside and out by hot dipped galvanized or electro-galvanized coating.

B. Plastic conduit (PVC):

1. Manufacturers:

a. Carlon

b. Genova

c. Certainted

2. Standard lengths and sizes.

3. Schedule 40 or 80, heavy wall rigid plastic (PVC) conduit manufactured to NEMA TC2 standards, UL listed, and as required by current NEC.

4. Rated for 90C cable.

C. PVC coated galvanized rigid steel conduit (PVC-GRS):

1. Manufacturers:

a. Perma-Coat Plastics, Inc.

b. Robroy Industries

2. NEMA RN1.

3. Galvanized rigid steel conduit with PVC coating.

4. Full weight 40-mil thick PVC coating, bonding to galvanized metal shall be stronger than plastic tensile strength.

D. Flexible conduit:

1. Manufacturers:

a. Triangle PWC, Inc.

b. Flexsteel

c. Anaconda

d. American Flexible Conduit

2. Galvanized flexible steel.

3. Standard conduit sizes.

4. Minimum Size: ½-in.

E. Liquidtight flexible conduit:

1. Manufacturers:

a. O-Z/Gedney Company

b. Flex-Guard, Inc.

c. Anaconda

d. American Flexible Conduit

e. Liquidtight

2. Galvanized flexible steel.

3. Standard conduit sizes.

4. Minimum Size: ½-in.

5. Heavy wall PVC jacket.

F. Fittings:

1. Manufacturers:

a. Appleton Electric Company

b. Steel City, American Electric

c. Oz-Gedney Company

2. Steel or malleable iron, zinc galvanized or cadmium plated.

3. Do not use setscrew or indentor type fittings.

4. Do not use aluminum or die cast fitting.

5. GRS Connectors and Couplings:

a. Threaded

b. Insulated throat

c. Gland compression type

d. Rain and concrete type

6. Flexible Conduit Connectors and Couplings:

a. Threaded

b. Grounding type

c. Insulated throat

d. Gland compression type

7. Liquidtight Flexible Conduit Fittings:

    a. Liquidtight

    b. Threaded

    c. Grounding type

    d. Insulated throat

    e. Gland compression type

8. Expansion Joints:

    a. Conduit expansion fittings complete with copper bonding jumper, Crouse-Hinds Type XJ.

    b. Conduit expansion/deflection fittings with copper bonding jumper, Crouse-Hinds Type XD.

9. Seals: Wall entrance, Appleton Type FSK or FSC.

10. Drain Fittings:

    a. Automatic Drain Breather.

        (1) Explosionproof: Safe for Class I, Groups C and D.

        (2) Capable of passing minimum 25cc water/min and minimum 0.05 cu ft air/min at atmospheric pressure.

    b. Condensate Drain:

        (1) Conduit outlet body, Type T.

        (2) Threaded, galvanized plug with 3/16-in. drilled holed through plug.

11. Hazardous Areas:

    a. Explosionproof.

    b. Horizontal seal fittings, Crouse-Hinds Type EYS.

    c. Vertical seal fittings, Crouse-Hinds Type EYD.

    d. Vertical seal fittings shall have drain plug.

G. Boxes:

1. Manufacturers:

a. Interior Outlet Boxes:

(1) Appleton Electric Company

(2) Raco

(3) Steel City, American Electric

(4) Crouse-Hinds

(5) Hubbell

b. Weatherproof Outlet Boxes:

(1) Appleton Electric Company

(2) Crouse-Hinds Company

(3) O-Z/Gedney Company

(4) Perfect-Line, American Electric

c. Junction and Pull Boxes:

(1) Hoffman Engineering Company

(2) Keystone Columbia, Inc.

(3) Electromate

d. Outlet Boxes - Flush Mounted:

(1) Wall Outlets: Square corner, galvanized masonry type with internally mounted ears or 4-in. sq. with raised cover having square corners and internally mounted ears.

(2) Ceiling Lighting Fixture Outlet Boxes: 4-in. sq. galvanized box with raised cover set flush with finished surface, complete with 3/8-in. fixture stud.

e. Outlet Boxes - Surface Mounted:

(1) General Use: 4-in. sq. with raised device cover.

(2) Weatherproof: Cast galvanized with threaded hub.

(3) Hazardous Locations: Cast galvanized approved for classification of area.

f. Junction and Pull Boxes:

(1) Fabricate from code gauge galvanized steel, with covers held in place by corrosion resistant machine screws.

(2) Size as required by code for number of conduits and conductors entering and leaving box.

(3) Provide with welded seams where applicable, and equip with corrosion resistant nuts, bolts, screws, and washers.

(4) Finish with rust inhibiting primer.

2.02 WIRES, CABLES, AND CONNECTORS

A. Manufacturers:

1. Wire and Cable:

a. Collier

b. Southwire

c. Rome Cable

d. Houston Wire and Cable

e. Beldon

f. Dekoron

2. Connectors:

a. Burndy

b. Thomas and Betts

c. Blackburn, American Electric

B. Copper wire only.

C. 600v insulation (ASTM standard compounds) and color-code conductors for low voltage (secondary feeders and branch circuits) as required by current NEC.

1. Type THWN Stranded: Single conductor No. 14 AWG minimum for branch circuit and feeder conductors size No. 8 AWG and smaller.

2. Type XHHW Stranded: Single conductor for branch circuits, feeders, and service conductors larger than No. 8 AWG.

3. Provide grounding conductor when run with circuit conductors with same insulation as circuit conductors.

4. Type UE Stranded: Single conductor for under-ground direct burial.

5. Type THWN Stranded: Single conductor No. 12 AWG minimum for 120v control wiring and No. 14 AWG minimum for graphic indication, nonshielded instrumentation and other control wiring operating at less than 120v, unless otherwise indicated. Provide high-density polyethylene jacketed multi-wire cable assemblies in underground conduit or duct.

6. Polyethylene insulated, tinned copper (19 by 27) stranding, No. 16 AWG, two conductors cabled with aluminum polyester electrostatic shielding, stranded tinned copper drain wire, and chrome vinyl outer jacket for interference sensitive instrumentation wiring. Additional high-density neoprene jacket on cables installed below ground and in duct encasements.

7. Vinyl insulated, tinned copper, solid, twisted pair, cabled conductors and silver gray vinyl jacket for telephone inter-communications.

   a. Up to 4 conductors/cable, 22 AWG solid wire.

   b. Over 4 conductors/cable, 24 AWG solid wire.

   c. Provide high-density polyethylene jacketed multi-wire cable assemblies in underground conduit or duct.

D. Joints, Taps, and Splices:

1. Joints, Taps, and Splices in Conductors No. 10 AWG and Smaller: UL listed compression spring-type solderless connectors with plastic cover.

2. Joints, Taps, and Splices in Conductors No. 8 AWG and Larger: Solderless two or four-bolt compression type connectors of type that will not loosen under vibration or normal strains.

3. Terminations: Compression-type crimp lugs.

2.03 WIRING DEVICES

A. Manufacturers:

1. Arrow-Hart, Inc.

2. Hubbell Wiring Device Division

3. Pass and Seymour, Inc.

4. Appleton Electric Company

5. Sierra Electric

6. Crouse-Hinds Company

B. Fabricated Devices:

1. Factory fabricated, specification grade wiring devices in type, color, and electrical rating for service indicated.

2. Wiring devices of one manufacturer.

C. Switches:

1. General Use Lighting Switches: 20-amp toggle, equal to Hubbell No. 1221-I series.

2. Switches controlling equipment, operation of which is not evident from switch position, shall include flush neon pilot light in conjunction with proper switch. Each switch shall be complete with engraved plate to identify equipment being controlled (white letters on black, 1/8-in. high minimum).

D. Receptacles:

1. General use duplex receptacles: NEMA No. 5-20R, grounding type, 20-amp Hubbell No. 5362 Specification Grade.

2. Special purpose receptacles.

E. Ground-fault circuit interrupter receptacles (GFCI):

1. Ratings: 120-vac., 20-amp.

2. Tripping Requirement: UL Class A.

3. Construction:

a. Shallow depth.

b. Line and load terminal screws.

c. Noise suppression.

d. Feed through.

e. Standard duplex wall plates shall fit.

f. NEMA 5-20R configuration.

4. Meet requirements of UL 943 ground-fault circuit interrupters.

F. Wiring Device Plates and Covers:

1. Wall plates for wiring devices with ganging and cut outs as indicated, provided with metal screws for securing plates to devices, screw heads colored to match finish of plate.

2. Plates for Flush Mounted Devices: Equal to Sierra P line specifications grade Type No. 430 brushed stainless steel or color as selected by Owner.

3. Telephone outlet configuration to match telephone outlet jack or cable.

4. Device plates for surface mounted Type FS or FD boxes to be Type FSK galvanized steel.

5. Device plates for surface mounted, 4-in. sq. boxed to be ½-in. raised galvanized steel covers.

6. Weatherproof plates and covers for exterior devices or devices in damp locations to be galvanized gray cast malleable with gasketed, lift cover plate.

G. Explosionproof Devices:

1. Wiring devices for use in hazardous areas shall be explosion proof approved for Class I, Division 1, Group D areas.

2. Receptacles: Appleton Cat. No. EFS B175-2023M, Crouse-Hinds Cat. No. ENR 21201 or equal NEMA 5-20R.

3. Plugs: Match receptacles. Furnish 1 plug for each receptacle installed.

4. Switches: Appleton EFS series, Crouse-Hinds EDS series or equal.

2.04 MOTOR STARTERS

A. Manufacturers:

1. Allen Bradley

2. Eaton/Cutler-Hammer

3. Furnas Electric Controls

4. Siemens

5. Square D

6. Westinghouse

B. Manual Starters: Minimum short circuit withstand rating in combination with motor circuit protective device shall be 10,000 symmetrical amps, unless indicated otherwise.

C. Manual Motor Starter Construction:

1. Quick make and break toggle action.

2. Double break silver alloy contacts.

3. One piece melting alloy type thermal overload units.

4. Starter inoperative unless thermal unit in position.

5. Padlock provision.

6. Pilot light.

7. NEMA standards for size and hp rating.

D. Magnetic Starters: Minimum short circuit withstand rating in combination with motor circuit protective device shall be 22,000 symmetrical amps or as otherwise indicated.

E. Magnetic Motor Starter Construction:

1. Mounted in vertical position, gravity dropout.

2. Double break silver alloy contacts.

3. Molded coil.

4. Contacts and/or coil replacement without removing starter from enclosure or power wiring from starter.

5. Straight through wiring.

6. Overload Relay:

a. 1 piece thermal unit construction.

b. One melting alloy type overload relay per phase, manually reset.

c. Interchangeable thermal units.

d. Thermal units must be in place to operate starter.

e. Replaceable overload relay circuit contacts.

f. Trip at 6 times LRC in 20 sec.

7. Overload relay submersible pumps and hermetically sealed motors: Same as above except trip at 6 times LRC in 3 to 5 sec.

8. NEMA standards for size and hp rating.

9. NEMA Size 1 minimum.

F. 2-Speed Motor Starters - (Where Applicable):

1. Provide separate winding type with two 3-pole starters unless otherwise specified.

2. For remote 2-stage thermostat control, provide cutout of low speed signal on high-speed operation.

G. Reduced Voltage Motor Starter Construction - (Where Applicable): Closed transition autotransformer type, 2-coil construction with 50%, 65%, and 80% starting voltage taps.

H. Combination Starter - (Where Applicable):

1. Motor circuit protector type.

2. Three-pole, three-phase NEMA size as indicated with three melting alloy overload relays.

3. Hand-Off-Auto selector switch.

I. Control Circuits:

1. Voltage not to exceed 120v.

2. Control transformer mounted in starter enclosure.

3. Fuses on one secondary line.

4. One secondary line grounded.

5. Transformer sized for device, accessories connected thereto, and 25% extra capacity minimum.

J. Controls:

1. Reset button mounted in enclosure cover.

2. Heavy duty, oil-tight green push to test pilot lights mounted in enclosure cover when indicated.

3. Heavy duty, oil-tight pushbuttons and selector switches mounted in enclosure when indicated.

4. 6-digit type elapsed time meters in tenths of hr mounted in enclosure cover when indicated.

K. Enclosures:

1. Manual Starters:

a. General-purpose flush mounted in finished areas.

b. NEMA 1-in unfinished areas.

c. NEMA 4 outdoors and wet locations.

2. Magnetic Starters:

a. NEMA 12 indoors.

b. NEMA 4 outdoors and wet locations.

2.05 MOTOR AND CIRCUIT DISCONNECTS

A. Manufacturers:

1. Eaton/Cutler-Hammer

2. Square D

3. Westinghouse

B. Enclosed Circuit Breaker Construction:

1. Dual cover interlock.

2. External trip indication.

3. Provisions for control circuit interlock.

4. Padlock provisions for padlock in Off position.

5. Handle attached to box, not cover.

6. Handle position indicates On, Off or Tripped.

7. Provisions for insulated or groundable neutral.

C. Permanent Trip Circuit Breakers:

1. Thermal and magnetic protection.
2. Magnetic protection only in combination with motor starters and motor circuit protectors (MCP).
3. Single magnetic trip adjustment.
4. Single-handle common trip, 2 and 3-poles (handle ties not acceptable).
5. Push to trip test button.
6. Bolt on type.
7. Quick make and break toggle action.
8. Handle trip indication.
9. Handle position indication, On, Off, and Tripped centered.
10. UL listed for type of wire specified.
11. UL listed short circuit rating (integrated equipment rating).
    a. Up to 240v: 10,000 RMS symmetrical amp minimum.
    b. Up to 480v: 14,000 RMS symmetrical amp minimum.

D. Safety Switches:

1. NEMA heavy duty Type HD.
2. Dual cover interlock.
3. Visible blades.
4. Provisions for control circuit interlock.
5. Pin type hinges.
6. Tin-plated current carrying parts.
7. Quick make and break operator mechanism.
8. Handle attached to box, not cover.
9. Handle position indication, On in up position and Off in down position.
10. Padlock provisions for up to 3 padlocks in Off position.

11. UL listed lugs for type and size of wire specified.

12. Spring reinforced fuse clips for Class R fuses.

13. Provisions for insulated or groundable neutral.

14. UL listed short circuit rating 200,000 RMS amp with Class R fuses.

E. Enclosures:

1. Indoor: NEMA 12 code gauge steel with rust inhibiting primer and baked enamel finish.

2. Outdoor: NEMA 4 code gauge zinc coated steel with baked enamel finish.

2.06 FUSES

A. Manufacturers:

1. Bussmann

2. Gould Shawmut

3. Littlefuse

B. 250-V Fuses:

1. Class RK 1, 1 end rejection or to fit mountings specified, 1/10 to 600-amps, 200,000-amp interrupting rating.

2. Bussmann Low-Peak. LPN-R, dual element, time delay with short circuit protection for motor, transformer, welder, feeder, and main service protection.

C. 600-V Fuses:

1. Class RK1:

a. One end rejection or to fit mountings specified, 1/10 to 600-amps, 200,000-amp interrupting rating.

b. Bussmann Low-Peak: LPS-R, dual element, time delay with short circuit protection for motor, transformer, welder, feeder and main service protection.

2. Class L:

a. Bolt in, 601 to 6,000-amps, 200,000-amp interrupting rating.

b. Bussmann HI-CAP: KRP-C, time delay for overload and short circuit protection for motor, transformer, feeder, and main service protection.

3. Class CC:

a. Fast acting, single element, 1/10 to 30-amps, 200,000-amp interrupting rating.

b. Bussmann Limitron: KTK-R, UL listed for motor control circuits, lighting ballasts, control transformers, and street lighting fixtures.

D. Spare Fuses: 10%, minimum of 3, of each type and rating of installed fuses.

E. Spare Fuse Cabinet:

1. Cabinet: Wall-mounted, 18ga minimum steel unit with full-length, recessed piano-hinged door with key coded cam lock and pull.

2. Size: Provide for orderly storage of spare fuses of this project plus 15% spare capacity, minimum.

3. Finish: Gray baked enamel.

4. Cabinet Door: Bear legend in stenciled 1 ½-in. high letters, "Spare Fuses".

2.07 PANELBOARDS

A. Manufacturers:

1. Eaton/Cutler-Hammer

2. Square D

3. Westinghouse

B. Panelboard Ratings. UL listed short circuit rating (integral equipment rating):

1. Up to 240v: 10,000 RMS symmetrical amp minimum.

2. Up to 480v: 14,000 RMS symmetrical amp minimum.

C. Panelboard Construction:

1. Main breaker or main lugs only, per panelboard schedule.

2. Molded case circuit breakers.

3. Terminals:

a. UL listed for type of wire specified.

b. Anti-turn solderless compression type.

4. Bussing:

    a. Distributed phase sequence type.

    b. 225-amps, 98% conductivity hard drawn copper or as shown on panelboard schedule.

    c. Copper.

    d. Mounting hardware behind usable space.

5. Gutters adequate for wire size used, 4-in. minimum.

6. Boxes:

    a. Code gauge galvanized steel.

    b. Without knockouts.

6. Fronts:

    a. Rust inhibiting primer, baked enamel finish.

    b. Dead front safety type.

    c. Concealed hinges.

    d. Flush stainless steel cylinder tumbler type locks with spring loaded door pulls.

    e. Circuit Directory:

        (1) Suitable for complete descriptions.

        (2) Clear plastic cover.

        (3) Typewritten card.

7. Special features as indicated.

8. Engraved laminated nameplate:

    a. Stock melamine plastic laminate.

    b. Legend in black letters on white face and punched for mechanical fasteners.

    c. Except as otherwise indicated, provide single line of text, with ½-in. high lettering on 1 ½-in. high label (2-in. high where two lines are required).

Text shall match terminology and numbering of Contract Documents and Shop Drawings.

D. Panelboard Circuit Breakers:

1. Thermal and magnetic protection.

2. Single-handle common trip, 2 and 3-poles (handle ties not acceptable).

3. Bolt on type unless otherwise specified.

4. Quick make and break toggle action.

5. Handle trip indication.

6. Handle position indication, On, Off, and Tripped centered.

7. UL listed for type of wire specified.

8. UL listed short circuit rating (integrated equipment rating).

   a. Up to 240v: 10,000 RMS symmetrical amp minimum.

   b. Up to 480v: 14,000 RMS symmetrical amp minimum.

9. UL SWDL switching duty on 120v circuits for switched circuits.

10. Switch neutral common trip per NEC 514-5 for fuel pumps.

2.08 TRANSFORMERS

A. Manufacturers:

1. Eaton/Cutler-Hammer

2. Square D

3. Westinghouse

B. Materials and Equipment:

1. Dry type, air-cooled.

2. Insulation:

   a. Below 30kVa: Class F or better, having 1150C rise, average maximum over 400C ambient temperature.

   b. 30kVa and Above: Class H or better, having 1500C rise, average maximum over 400C ambient temperature.

3. Copper windings.

4. Cores: High grade, non-aging, sheet silicone steel laminations having core-plating insulation on both sides of each lamination.

5. Terminal boards.

6. Taps: Two 2 1/2% taps above and below.

7. Overload Capacity: Not less that 10% for intermittent operation.

8. Size: kVa as indicated.

9. Transformers shall be quiet type for installation in areas of low ambient noise levels. Maximum sound levels shall not exceed NEMA standards.

10. Cabinets: Sheet steel, phosphatized having one prime coat and two finish coats of baked enamel. Wall mounting brackets through 75kVa when indicated as wall mounted.

11. Nameplate: Metal nameplate listing manufacturer's name, serial number, type, class, kVa voltage, frequency, and showing internal wiring diagram.

12. Comply with UL 506.

2.09 MINI-POWER CENTER (WHERE APPLICABLE)

A. Manufacturers:

1. Westinghouse

2. Square D

3. Or equal

B. Materials and Equipment:

1. UL listed, 10,000 AIC rated.

2. NEMA 3R enclosure with padlock provision.

3. 240v, 30A, 2-pole single phase primary main circuit breaker.

4. 5kva 240-120/240v encapsulated core and coil assembly.

5. 240v, 25A, 2-pole single phase secondary main circuit breaker.

6. 4-20A single pole branch circuit breakers.

7. Neutral bar grounded to case.

8. Ground bar with terminals.

PART 3 EXECUTION

3.01 GENERAL

A. Install products in accordance with current NEC, manufacturer's instructions, applicable standards, and recognized industry practices to ensure products serve intended function.

3.02 RACEWAY SYSTEMS

A. Complete conduit installation prior to installing cables.

B. Unless specifically indicated otherwise, use rigid galvanized steel conduit for general wiring.

C. Provide watertight conduit system where installed in wet places, underground or where buried in masonry or concrete.

D. Use PVC coated rigid steel conduit when conduit is run below slabs on grade or in earth, unless otherwise specified.

1. Exterior underground conduit shall be minimum of 1-in., buried at depth of not less than 24-in. below grade.

2. Provide conduits or ducts terminating below grade with means to prevent entry of dirt or moisture.

E. Use rigid galvanized steel conduit.

F. Conduit shall be run concealed except exposed surface conduit may be installed where concealment found to be impractical or impossible, and only with approval of Engineer.

G. Continuous from outlet to outlet and from outlets to cabinets, junction or pull boxes.

H. Enter and secure to boxes ensuring electrical continuity from point of service to outlets.

I. Conduit runs extending through areas of different temperature or atmospheric conditions or partly indoors and partly outdoors shall be sealed, drained, and installed in manner preventing drainage of condensed or entrapped moisture into cabinets, motors or equipment enclosures.

J. Run conduits within concrete structures parallel to each other and spaced on center of at least three times conduit trade dia with minimum 2-in. concrete covering.

K. Route conduit runs above suspended acoustical ceilings not interfering with tile panel removals.

L. Secure conduit in-place with not less than 1 malleable corrosionproof alloy strap or hanger, 8-ft of conduit. Do not use perforated strapping.

M. Connections to Motors and Equipment Subject to Vibration:

1. Flexible steel conduit not over 3-ft long or where exposed in mechanical and utility areas and not subjected to moisture, dirt, and fumes.

2. Liquidtight flexible conduit not over 3-ft long where exposed in finished areas or where subject to moisture, dirt, fumes, oil, corrosive atmosphere, exposed or concealed, with connectors to ensure liquidtight, permanently grounded connection. Locate where least subject to physical abuse.

N. Use double locknuts and insulated bushings with threads fully engaged.

O. Connectors at fixture bodies and boxes shall be rigidly secured with galvanized lock nut and bushing.

P. Cap conduits after installation to prevent entry of debris.

Q. Use explosionproof fittings and seals in hazardous areas in accordance with current NEC.

R. Install conduit expansion fittings complete with bonding jumper in following locations.

1. Conduit runs crossing structural expansion joint.

2. Conduit runs attached to two separate structures.

3. Conduit runs where movement perpendicular to axis of conduit may be encountered.

S. Install 4-ft 0-in. to 6-ft 0-in. flexible steel conduit drops from independent junction box mounted above ceiling and accessible from below ceiling to recessed ceiling mounted equipment. Allow for positioning of equipment to tile increments.

T. Multi-outlet raceway system:

1. Mount to surface with approved support clips.

2. Do not pinch wires.

3. Remove metal burrs and sharp edges.

4. Install in accordance with manufacturer's recommendations.

3.03 BOXES

A. Install knockout closures to cap unused knockout holes where blanks have been removed.

B. Locate boxes to ensure accessibility of electrical wiring.

C. Secure boxes rigidly to surface or solidly embed boxes in concrete or masonry. Do not support from conduit.

D. Do not burn holes, use knockout punches or saw.

E. Provide outlet box accessories as required for each installation such as mounting brackets, fixture studs, cable clamps, and metal straps for supporting outlet boxes compatible with outlet boxes being used and meeting requirements of individual wiring situations.

F. Verify exact location of outlets.

G. Minor modification in location of outlets and equipment is considered incidental up to distance of 10-ft with no additional compensation, provided notification of modification is given prior to roughing in of outlet.

H. Flush outlets shall have edges or plaster flush with finished wall or ceiling surfaces so plates can be drawn tightly to wall or ceiling surfaces.

I. Mounting height as follows:

1. Switches: 48-in. above floor.

2. AC Receptacles and Telephone Outlets: 12-in. above floor or 6-in. above counters, counter back-splashes, and baseboard radiators in finished areas, 48-in. above floor in unfinished areas.

3. Wall Bracket Lighting Fixtures: 8-in. above mirrors or 6-ft 6-in. above floor.

4. Pushbuttons: 48-in. above floor.

5. Motor Starters and Disconnect Switches: 60-in. above floor.

6. Thermostats: 60-in. above floor.

7. Bells and Horns: 8-ft 0-in. above floor.

8. Clocks: 8-ft 0-in. above floor.

J. Do not install boxes back to back or through wall. Offset outlet boxes on opposite sides of wall, minimum 12-in.

K. Where emergency switches occur adjacent to normal light switches, install in separate boxes in accordance with current NEC and device plate color coding separation.

L. Lighting Fixture Outlet Boxes:

1. Securely mount with approved type bar hangers spanning structural members to support weight of fixture.

2. Do not support from conduit.

3. Equip with 3/8-in. fixture stud and tapped fixture ears.

M. Floor boxes:

1. Adjust box to align with finish floor.

2. Install in accordance with manufacturer's recommendations.

N. Fire rated through floor fittings:

1. Spacing and location as indicated.

2. Install in accordance with manufacturer's instructions.

3.04 WIRE AND CABLE

A. Run wire and cable in conduit unless otherwise indicated.

B. On branch circuits, use standard colors.

C. Each tap, joint or splice in conductors No. 8 AWG and larger shall be taped with 2 half-lap layers of vinyl plastic electrical tape and finish wrap of color coding tape, where required by code.

D. Run ground wire with power circuits; conduit shall not be grounding path.

E. Provide separate conduit systems for the following:

1. Exit lights.

2. Line voltage control.

3. Low voltage control.

4. Shielded instrumentation.

5. Telephone and sound system.

6. Utility telephone cables.

7. As required by current NEC.

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

G. Run instrumentation cable into control cabinets or MCC only if terminated therein.

H. Terminate control, instrumentation, and communication cables on terminal strips in separate terminal cabinets located near conduit entrances of buildings.

I. Color Coding: Conductors for lighting and power wiring as indicated below:

Phase	120/240v 1 Phase	240/120v 3 Phase	480/277v 3 Phase
A	Black	Black	Brown
B	Red	Orange	Purple
C		Blue	Yellow
Travelers	Pink	Pink	Red
Neutral	White	White	Gray
Ground	Green	Green	Green

J. Color coding for intrinsically safe systems shall be light blue.

3.05 JOINTS, TAPS, AND SPLICES

A. Where pre-insulated spring connectors are used for motor and equipment connections, tape connector to wire to prevent loosening under vibration.

B. Each tap, joint or splice in conductors No. 8 AWG and larger shall be taped with two half-lap layers of vinyl plastic electrical tape and finish wrap of color coding tape where required by code.

C. Cable splices shall be made only in manholes, handholes, wireways, distribution boxes, and junction boxes.

3.06 WIRING DEVICES

A. Do not install devices until wiring is complete.

B. Do not use terminals on wiring devices (hot or neutral) for feed-through connections, looped or otherwise. Make circuit connections by using wire connectors and pigtails.

C. Install gasket plates for devices or system components having light emitting features such as switch with pilot light and dome lights. Where installed on rough textured surfaces, seal with black self-adhesive polyfoam.

D. Ground receptacles with insulated green ground wire from device ground screw to bolted outlet box connection.

E. Install GFCI receptacles as required by current NEC.

3.07 MOTOR STARTERS

A. Examine area to receive motor starters to ensure adequate clearance for starter installation.

B. Install on equipment rack in MCC or anchor firmly to wall or structural surface.

3.08 MOTOR AND CIRCUIT DISCONNECTS (WHERE APPLICABLE)

A. Locate disconnect switches as required by current NEC.

B. Provide control circuit interlock as required by current NEC.

C. Overcurrent protective devices:

1. Install fuses just prior to energizing equipment.

2. Locate circuit breakers.

3.09 PANELBOARDS

A. Flush or surface mount.

B. Support panel cabinets independently to structure with no weight bearing on conduits.

C. Install recessed panelboards to allow cover to be drawn tight against wall to provide neat appearance.

D. Install panelboards so top breaker is not higher than 6-ft 0-in. above floor.

E. Adjacent panel cabinets shall be same size and mounted in horizontal alignment.

F. Install typewritten directory in each panelboard, accurately indicating rooms or equipment being served after final circuit changes have been made to balance circuit loads.

G. Install two spare 1-in. conduits from top of each flush mounted panelboard to area above ceiling for future use. On flush mounted panelboards located on first and higher level floors, provide two spare 1-in. conduits from bottom of panelboard to ceiling area of floor below for future use.

3.10 TRANSFORMER

A. Install wall mounted transformers on prefabricated brackets designed for that purpose.

B. Install floor mounted transformers on 4-in. high concrete housekeeping pads.

C. Tighten bus connections and mechanical fasteners.

D. Adjust voltage taps for required system voltage and check grounding requirements.

3.11 MINI-POWER CENTERS (WHERE APPLICABLE)

A. Install on prefabricated brackets designed for the purpose.

B. Tighten bus connections and mechanical fasteners.

C. Adjust voltage taps for required system voltage and check grounding requirements.

3.12 FIELD QUALITY CONTROL

A. Control Circuits, Branch Circuits, Feeders, Motor Circuits, and Transformers:

1. Megger check of phase-to-phase and phase-to-ground insulation levels. Do not megger check solid state equipment.

2. Continuity.

3. Short circuit.

4. Operational check.

B. Wiring Devices. Test receptacles with Hubbell 5200, Woodhead 1750 or equal tester for correct polarity, proper ground connection, and wiring faults.

3.13 ADJUSTMENT AND CLEANING

A. Motor Starters and Disconnects:

1. Adjust covers and operating mechanisms for free mechanical movement.

2. Tighten wire and cable connections.

3. Verify overcurrent protection thermal unit size with motor nameplate to provide proper operation and compliance with current NEC.

4. Clean interior of enclosures.

5. Touch up scratched or marred surfaces to match original finish.

B. Circuit Breakers: Adjustable settings shall be set to provide selective coordination, proper operation, and compliance with current NEC.

END OF SECTION

SECTION 16110
RACEWAYS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:

1. Galvanized rigid steel conduit (GRS).

2. Liquidtight flexible metal conduit (LFMC).

3. Rigid nonmetallic polyvinyl chloride conduit (PVC).

4. Wireway (WW).

1.02 DEFINITIONS

A. Underfloor Conduits: Conduit that runs underground within perimeter of building walls under building floor. This may consist of one conduit, or several conduits grouped together.

B. Duct Bank Conduits: Conduit that runs under ground outside perimeter of building walls. This may consist of one conduit, or several conduits grouped together.

C. Underground Conduits: Underground conduits are both under floor conduits and duct bank conduits.

1.03 SUBMITTALS

A. Submit all products covered under this specification for Engineer’s approval.

B. Submittals are not required if Contractor supplies materials or equipment of specified or named manufacturers. If Contractor proposes substitutions to material or equipment of specified or named manufacturers, submittals identified below are required.

1.04 QUALITY ASSURANCE

A. Items provided under this section shall be listed or labeled by UL or other Nationally Recognized Testing Laboratory (NRTL).

1. Term "NRTL" shall be as defined in OSHA Regulation 1910.7.

2. Terms "listed" and "labeled" shall be as defined in National Electrical Code, Article 100.

B. Regulatory Requirements. National Electrical Code: Components and installation shall comply with NFPA 70.

C. Comply with NECA "Standard of Installation."

PART 2 PRODUCTS

2.01 METAL CONDUIT AND TUBING

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

B. Liquidtight Flexible Metal Conduit: Flexible steel conduit with PVC jacket.

2.02 NONMETALLIC CONDUIT

A. Rigid Nonmetallic Polyvinyl Chloride (PVC) Conduit: NEMA TC 2, Schedule 40 or 80 PVC.

B. PVC Conduit Fittings: NEMA TC 3; match to conduit type and material.

2.03 FITTINGS

A. Fittings for steel conduits:

1. Cast aluminum or malleable iron with galvanized finish.

2. Synthetic inserts for sealing or insulation as required.

3. Comply with ANSI C80.4.

4. Comply with NEMA FB 1, compatible with conduit materials.

B. Conduit bodies: Malleable iron with galvanized finish.

C. Fittings for liquidtight flexible metal conduit.

1. Insulated throat type.

2. One piece sealing "O" rings with connectors when entering boxes or enclosures.

2.04 WIREWAYS

A. Material: Sheet metal sized and shaped as indicated.

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

C. Select features where not otherwise indicated, as required to complete wiring system and to comply with current NEC.

D. Wireway Covers:

1. Hinged type for dry locations.

2. Bolted cover with gasket for wet locations.

E. Finish: Manufacturer's standard enamel finish unless other wise noted.

2.05 RACEWAY/DUCT SEALING COMPOUND

A. Non-hardening, putty-like consistency workable at temperatures as low as 35 F.

B. Compound shall not slump at temperature of 300 F and shall readily adhere to clean surfaces of plastic ducts, metallic conduits, conduit coatings, concrete, masonry, lead, cable sheaths, cable jackets, insulation materials, and common metals.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine surfaces to receive raceways, wireways, and fittings for compliance with installation tolerances and other conditions affecting performance of raceway system.

B. Coordinate layout and installation of raceway and boxes with other construction elements to ensure adequate headroom, working clearance, and access.

3.02 WIRING METHODS

A. Outdoors, Damp or Wet Locations: Use following wiring methods unless otherwise noted on Drawings:

1. Exposed: Galvanized rigid steel.

2. Concealed: Galvanized rigid steel.

3. Underground Power, Single Run: Rigid nonmetallic (PVC) conduit: Concrete encased except for area lighting branch circuits or as otherwise noted on Drawings.

4. Underground Power, Grouped: Rigid nonmetallic (PVC) conduit: Concrete encased.

5. Underground Shielded Instrumentation Cables, Single Run or Grouped: Galvanized rigid steel: Concrete encased.

6. Connection to Vibrating Equipment (including transformers and hydraulic, pneumatic, or electric solenoid or motor-driven equipment): Liquidtight flexible metal conduit.

B. Indoor Dry Locations: Use following wiring methods unless otherwise noted.

1. Connection to Vibrating Equipment (including transformers and hydraulic, pneumatic, or electric solenoid or motor-driven equipment): Liquid tight flexible metal conduit.

2. Exposed: Galvanized rigid steel conduit.

3. Concealed: Steel Conduit

C. Unless specifically indicated otherwise on Drawings, use galvanized rigid steel for general wiring.

D. Encase galvanized rigid steel conduits installed underground in at least 3-in. of concrete. PVC conduit may be used without encasing in concrete for under floor conduit or where specifically indicated on Drawings.

1. Underground conduit shall be minimum of 1-in., buried at depth of not less than 24-in. below grade.

2. Provide conduits or ducts terminating below grade with means to prevent entry of dirt and moisture.

E. Raceways Embedded in Slabs: Install in middle third of slab thickness where practical, and leave at least 1-inch (25-mm) concrete cover.

1. Secure raceways to reinforcing rods to prevent sagging or shifting during concrete placement.

2. Space raceways laterally to prevent voids in concrete.

3. Run conduit larger than 1-in. trade size parallel to or at right angles to main reinforcement and spaced on center of at least 3 times conduit trade dia. with minimum 2-in. concrete covering.

4. When at right angles to reinforcement, place conduit close to slab support.

3.03 INSTALLATION

A. Install raceways level and square and at proper elevations. Provide adequate headroom.

B. Complete raceway installation before starting conductor installation.

C. Support raceway with approved methods.

D. Use temporary closures to prevent foreign matter from entering raceway.

E. Run concealed raceways with minimum of bends in shortest practical distance considering type of building construction and obstructions, except as otherwise indicated.

F. Install exposed raceways parallel to or at right angles to nearby surfaces or structural members, and follow surface contours as much as practical.

1. Mount exposed horizontal runs as high above floor as possible, and in no case lower than 7-feet above floors, walkways, or platforms in passage areas.

2. Run parallel or banked raceways together, on common supports where practical.

3. Make bends in parallel or banked runs from same centerline to make bends parallel. Use factory elbows only where they can be installed parallel; otherwise, provide field bends for parallel raceways.

G. Join raceways with fittings designed and approved for purpose and make joints tight.

1. Make raceway terminations tight. Use bonding bushings or wedges at connections subject to vibration. Use bonding jumpers where joints cannot be made tight.

2. Use insulating bushings to protect conductors.

H. Tighten set screws of threadless fittings with suitable tool.

I. Terminations: Where raceways are terminated with locknuts and bushings, align raceway to enter squarely, and install the locknuts with dished part against the box. Use two locknuts, one inside and one outside the box. Use insulating bushings. Provide insulated grounding bushings to terminate ground wire.

J. Where terminating in threaded hubs, screw raceway or fitting tight into the hub so the end bears against the wire protection shoulder. Where chase nipples are used, align the raceway so the coupling is square to box, and tighten chase nipple so no threads are exposed.

K. Install pull wires in empty raceways. Use monofilament plastic line having not less than 200-lb (90-kg) tensile strength. Leave not less than 12-inches (300-mm) of slack at each end of pull wire.

L. Telephone and Signal System Raceways 2-Inch Trade Size and Smaller: In addition to the above requirements, install maximum lengths of 150-feet (45-m) with a maximum of two 90-deg bends or equivalent. Install pull or junction boxes where necessary to comply with these requirements.

M. PVC Externally Coated Galvanized Rigid Steel Conduit: Use only fittings approved for use with that material. Patch nicks and scrapes in PVC coating after installing conduit.

3.04 CONDUIT STUB-UPS

A. Protect stub-ups from damage where conduits rise through floor slabs. Arrange so curved portion of bends is not visible above finished slab.

B. Transition under floor conduit to galvanized rigid steel conduit, before rising above floor. Wrap with plastic tape to provide 40-mil thick cover to height of 6-in. above floor.

C. Stub-Up Connections: Extend conduits for connection to freestanding equipment with an adjustable top or coupling threaded inside for plugs, and set flush with finished floor. Extend conductors to equipment with rigid steel conduit; flexible metal conduit may be used starting at 6-inches (150-mm) above floor. Where equipment connections are not made under this Contract, install screwdriver-operated threaded flush plugs, flush with floor.

3.05 CONDUIT BENDS

A. Make bends and offsets so inside diameter is not reduced. Unless otherwise indicated, keep legs of bend in same plane and straight legs of offsets parallel.

3.06 FLEXIBLE CONNECTIONS

A. Terminate conduits at motor terminal boxes, motor operated valve stations or pipe-mounted instruments and other equipment subject to vibration with maximum of 3-feet (915-mm) liquidtight flexible metal conduit, unless other wise shown on Drawings.

B. Use liquidtight flexible conduit in all locations.

C. Install separate ground conductor inside flexible conduit connections.

3.07 GROUNDING

A. Provide grounding connections for raceway, boxes, and components as indicated and instructed by manufacturer. Tighten connectors and terminals, including screws and bolts, according to equipment manufacturer's published torque-tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals according to tightening torques specified in UL 486A.

B. Ground in accordance with Section 16452.

3.08 PROTECTION

A. Provide final protection and maintain conditions, in manner acceptable to manufacturer and Installer, to ensure that coatings, finishes, and cabinets are without damage or deterioration at Substantial Completion.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.

2. Repair damage to PVC or paint finishes with matching touch-up coating recommended by manufacturer.

3.09 CLEANING

A. Upon completion of installation of system, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finish, including chips, scratches, and abrasions.

END OF SECTION

[PAGE LEFT INTENTIONALLY BLANK]

SECTION 16111
CONDUIT, FITTINGS, AND BODIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Specification for conduit, fittings, and bodies.

1.02 REFERENCES

A. American National Standards Institute (ANSI):

1. ANSI C80.1: Rigid Steel Conduit - Zinc Coated.

2. ANSI C80.4: Fittings for Rigid Metal Conduit.

B. Federal Specifications:

1. W-C-58C: Conduit Outlet Boxes, Bodies Aluminum and Malleable Iron.

2. W-C-1094: Conduit and Conduit Fittings Plastic, Rigid.

3. WW-C-566C: Flexible Metal Conduit.

4. WW-C-581D: Coatings on Steel Conduit.

C. National Electrical Manufacturers Association (NEMA):

1. NEMA RN1: Polyvinyl-Chloride Externally Coated Galvanized Rigid Steel Conduit and Electrical Metallic Tubing.

2. NEMA TC2: Electrical Plastic Tubing (EPT) and Conduit (EPC-40 and EPC-80).

3. NEMA TC3: PVC Fittings for Use with Rigid PVC Conduit and Tubing.

D. National Fire Protection Association (NFPA), ANSI/NFPA 70 - National Electrical Code (NEC).

E. Underwriters' Laboratories (UL):

1. UL 1: Flexible Metal Electrical Conduit.

2. UL 6: Rigid Metal Electrical Conduit.

3. UL 514B: Fittings for Conduit and Outlet Boxes.

4. UL 651: Schedule 40 and 80 Rigid PVC Conduit.

5. UL 651A: Type EB and A Rigid PVC Conduit and HDPE Conduit.

6. UL 886: Electrical Outlet Boxes and Fittings for Use in Hazardous Locations.

1.03 SUBMITTALS

A. Submit all products covered under this specification for Engineer’s approval.

1. Manufacturer's cut sheets, catalog data, with selected products clearly marked.

2. Installation, terminating and splicing procedure.

3. Instruction for handling and storage.

4. Dimensions and weight.

1.04 QUALITY ASSURANCE

A. Tests:

1. Rigid steel conduit shall pass the bending, ductility, and thickness of zinc coating tests described by ANSI C80.1.

2. Flexible conduit shall pass the tension, flexibility, impact, and zinc-coating test described by UL 1.

3. Nonmetallic conduit and fittings shall pass the test requirements of NEMA TC2, UL 651 and 651A and Federal Specification W-C-1094A.

1.05 DELIVERY STORAGE AND HANDLING

A. Package conduit in 10-foot bundles maximum with conduit and coupling thread protectors suitable for indoor and outdoor storage. Package fittings in manufacturer's standard quantities and packaging suitable for indoor storage. Package plastic-coated rigid conduit, fittings, and bodies in such a manner as to protect the coating from damage during shipment and storage.

B. Store conduit above ground on racks to prevent corrosion and entrance of debris.

C. Protect plastic conduit from sunlight.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Rigid Steel Conduit:

1. Allied Tube and Conduit

2. Triangle Wire and Cable, Inc.

3. Wheatland Tube Company

B. PVC Coated Steel Conduit:

1. Occidental Coating Company (O-Cal Blue)

2. Robroy Industries, Inc. (Rob-Roy Red)

C. PVC Rigid Conduit:

1. Cantex

2. Carlon Industries, Inc.

3. Robroy Industries, Inc.

D. Conduit Fittings and Bodies:

1. Appleton Electric

2. Crouse-Hinds

3. Killark Electric Manufacturing Company

4. O-Z/Gedney

E. Liquidtight Flexible Conduit:

1. Anamet, Inc.

2. Electriflex Company

3. Triangle Wire and Cable, Inc.

2.02 MATERIALS AND EQUIPMENT

A. Design Conditions: Use electrical conduit, fittings, and bodies designed for service in areas as specified within this section to form a continuous support system for power, control, and instrument cables.

B. Conduit and Fittings:

1. Rigid Steel Conduit and Fittings:

a. Rigid steel conduit, rigid steel conduit bends, nipples, and bodies shall be hot-dipped galvanized and shall comply with the latest ANSI C80.1, UL 6, Federal Specification WW-C-581D, and NEC Article 346-15.

b. Mild steel tubing shall be used for conduit, nipples, and couplings, and shall be free of defects on both the inner and outer surfaces.

c. Fittings, bodies, and covers for rigid steel conduit shall be steel or cast-iron and shall comply with ANSI C80.4, UL 514B, and Federal Specification W-C-58C.

2. PVC-Coated Rigid Steel Conduit and Fittings:

a. PVC-coated conduit, fittings, bodies, and covers shall conform to NEMA RN1 (Type A). Rigid steel galvanized conduit and fittings before coating shall conform to Federal Specification WW-C-581D, ANSI C80.1, and UL 6. Conduit bodies shall conform to UL 514B and Federal Specification W-C-58C. Provide sufficient coating for touch up after installation.

b. PVC-coated couplings shall be of the ribbed type.

c. Conduit covers shall have encapsulated stainless steel thumbscrews.

d. Conduits and covers shall be of malleable iron or feraloy material before coating.

e. PVC coating shall be a minimum of 2-mil thickness on the interior of the conduit and the interior of fittings, conduits, covers and bodies.

3. Flexible and Liquidtight Flexible Metal Conduit and Fittings:

a. Use liquidtight flexible metal conduit manufactured in accordance with UL 1 and Federal Specification WW-C-566C.

b. Fittings used with liquidtight flexible metal conduit shall be the PVC-coated type and of such design as to thoroughly ground the conduit to the fittings, and through it to the box or enclosure to which it is attached.

c. Flexible couplings and fittings for use in hazardous areas shall comply with UL 886, NEC Article 501-4 (a&b), and Federal Specification W-C-586C.

4. PVC Conduit and Fittings. Use PVC conduit, bends, and fittings, which comply with NEMA TC2, W-C-A, and NEC Article 347-17 for above ground and underground installation. Conduit shall be schedule 80, unless noted otherwise in other specifications.

PART 3 EXECUTION

3.01 PREPARATION

A. Confirm submittal of shop drawing with conduit and conduit fitting sizes, types and routing shown.

B. Ensure that the conduit system to be installed is sized properly for the cable and wire requirements.

C. Verify the actual physical conduit route and prepare the conduit support system.

D. Verify the equipment locations to which the conduit will be connected and determine detail requirements for connections.

3.02 INSTALLATION

A. Install PVC-coated conduits in all outdoor locations at wastewater facilities, inside valve vaults, in wet well slabs, in corrosive and wet environments.

B. Install rigid galvanized steel (RGS) conduits in dry inside locations and in all outdoor locations for water facilities.

C. Install PVC conduits in duct banks. For stub-ups, use PVC-coated rigid steel elbows or rigid steel elbows as applicable in A and B above.

D. Run exposed conduit parallel or perpendicular to walls, ceilings or main structural members. Group multiple conduits together where possible. Do not install conduit where it interferes with the use of passageways, doorways, overhead cranes, monorails, equipment removal areas or working areas. In no case shall conduit routing present a safety hazard or interfere with normal plant operating and maintenance procedures. Maintain a minimum overhead clearance of 8'-0" in passageways.

E. Installation and support of conduit shall be from steel or concrete structures. Furnish necessary conduit straps, clamps, fittings and support for the conduit in accordance with the standard details and consistent with the grade and type of conduit being installed.

F. Identify conduit at termination points like MCC, light fixtures, control panels, receptacles, and junction boxes.

G. Not more than 3 equivalent 90-degree bends will be permitted between outlets. Provide bonded expansion fittings at building expansion joints.

H. Install conduit runs so that they are mechanically secure, mechanically protected from physical harm, electrically continuous, and neat in appearance. The interiors of conduit shall provide clean, smooth raceways through which conductors may he drawn without damage to the insulation. Make threaded connections wrench tight.

I. Cut conduit square with a power saw or a rotary type conduit cutter designed to leave a flat face. Do not use plumbing pipe cutters for cutting conduit. Ream the cut ends of conduit with a reamer, designed for the purpose to eliminate rough edges and burrs. Cut threads with standard conduit dies providing 3/4-inch taper per foot, allowing the proper length so that joints and terminals may be made up tight and the ends of the conduit not deformed. Keep dies sharp and use a good quality threading oil continuously during the threading operation. Remove metal cuttings and oil from the conduit ends after the threads are cut and paint threads before connections are made. Use zinc rich, brush-on compound on the threads of steel conduit before connections are made. Use only tools specifically made for bending and installing PVC-coated or PVC conduit when installing these materials.

J. Use strap wrenches only to tighten joints in plastic coated rigid steel conduit. Replace all conduit and fittings with damage to the plastic coating, such as cuts, nicks and threader chuck jaw marks.

K. Make up changes in direction of conduit using elbows or fittings. Do not use pull boxes to make direction changes unless specifically designated otherwise.

L. Field fabricated bends shall be free of indentations or elliptical sections. The radius of the bend shall not be less than 6 times the smallest diameter of the raceway.

M. Protect all conduit terminations from mechanical injury. Prevent the entry of moisture and foreign mater into the conduit system by properly capping terminations.

N. Avoid trapped runs of conduit, if possible. When they are necessary, provide drainage using a "tee" conduit equipped with a drain. Conduit is likely to pass through areas with a temperature differential of 20 degrees F or more. Seal penetrations with a proper seal fitting at the wall or barrier between such areas. For conduit passing through walls separating pressurized areas from non-pressurized areas, install sealing fittings at the wall on the non-pressurized side.

O. Fit conduit crossing building or structure expansion joints with approved expansion fittings, except that fittings will not be required when conduit crossing an expansion joint is supported on trapeze hangers in such a way that at no time will the conduit be under stress due to expansion. Install bonding jumpers around expansion joint fittings.

P. Where conduit terminates in sheet metal enclosures and where no threaded hubs are provided, fit the conduit with double locknuts and bushings. Sheet metal enclosures located outside or in any other wet, damp or corrosive areas shall be furnished with threaded hubs. Restrict side penetrations to the lower one third of the enclosure.

Q. Provide flexible metallic conduit where necessary to allow for movement or to localize sound or vibration, at transformers, at motors and any other rotating equipment unless otherwise indicated.

R Seal openings or holes where conduits pass through walls or floors. When conduits are passing through a firewall or fire-rated floor into different rooms, cabinets, or enclosures, use a fire-rated seal. Certain walls require environmental (airtight) seals; seal as shown.

S. Install explosion-proof seals in conduit runs crossing or entering a hazardous classified area. Install type CSBE removable sealing fittings to seal pump cables in the wet well and at the first junction box outside the well.

T. Unless otherwise indicated install expansion fittings every 300 feet within a straight conduit run and where conduit crosses building expansion joints, using bonding straps to ensure ground continuity.

U. Parallel runs of conduit may be supported by structural steel racks. When two or more racks are arranged one above the other, provide vertical separation of not less than 12 inches between racks. Space conduits on the racks at least enough to provide 1/4-inch

clearance between hubs on adjacent conduits at terminations and to allow room for fittings.

V. Fill conduit racks no more than 75 percent of their capacity, providing usable space for future conduit. To ensure this, conduits leaving the rack horizontally shall be offset up or down so those future conduits may be installed in the space remaining. Construct conduit racks to permit access for wire or cable pulling at all pull points, even when future conduits are added to fill the racks.

W. Where conduit racks are supported on rods from beam clamps or by some other non-rigid suspension system, install rigid supports at no more than 50-foot intervals to give lateral stability to the rack.

X. Conduit racks or hangers must in no way interfere with machinery (or its operation), piping, structural members, process equipment, or access to anticipated future equipment. Refer to architectural, structural and equipment layout to ensure that this requirement is met. Label high voltage conduit with the circuit phase-to-phase voltage by means of a firmly attached tag or label of approved design at each conduit termination, on each side of walls or barriers pierced and at intervals not exceeding 200 feet along the entire length of the conduit.

Y. Support conduit sizes 2 inches and larger at spacings not exceeding 10 feet and conduit sizes 1-1/2 inches and smaller at spacings not exceeding 8 feet.

Z. The means of fastening conduit to supports shall be: by one hole malleable iron conduit straps secured by wood screws to wood and by bolts with expansion anchors to concrete or masonry; by "Korn" clamps or U-bolts to other surfaces. Use "clamp backs" when strapping conduits to walls, column faces, or other such surfaces.

AA. Support conduit runs with conduit clamps, hangers, straps and metal framing channel attached to structural steel members. Conduits of 1-1/2 inch size or less may be supported by one-hole conduit straps on concrete, tile or steel work, but for larger size conduit, use 2-hole straps. Use clamps of galvanized malleable iron for rigid galvanized conduit and PVC-coated or stainless steel for PVC-coated conduit. Metal framing channel straps used for PVC-coated conduit shall be type 3/16 stainless steel.

AB. Install conduits supported from building walls with at least 1/4-inch clearance from the wall to prevent the accumulation of dirt and moisture behind conduit.

AC. Size and space embedded conduits in structural slabs in accordance with the Uniform Building Code. Conduits should occupy no more than one-third the thickness of the slab and should not be closer than 3 times the largest diameter on center without additional reinforcement.

END OF SECTION

[PAGE LEFT INTENTIONALLY BLANK]

SECTION 16120
600-VOLT BUILDING WIRE AND CABLE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Specifications for 600-volt building wire and cable.

1.02 REFERENCES

A. American National Standards Institute/National Fire Protection Association (ANSI/NFPA), NFPA 70 - National Electrical Code (NEC), Article 310 - Conductors for General Wiring.

B. Underwriter's Laboratories (UL)

1. UL 83: Thermoplastic Insulated Wires and Cables

2. UL 1063: Machine Tool Wires and Cables

C. American Society for Testing and Materials (ASTM)

1. ASTM B3: Soft or Annealed Copper Wires

2. ASTM B8: Concentric-Lay-Stranded Copper Conductors, Hard, Medium Hard, Soft

D. Insulated Cable Engineers Association (ICEA), ICEA S-61-402: Thermoplastic-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy (NEMA WC-5).

1.03 SUBMITTALS

A. Submit the following for Engineer’s approval.

1. Manufacturer's cut sheets and catalog data

2. Instruction for handling and storage

3. Dimensions and weight

1.04 QUALITY ASSURANCE

A. Tests. Cable shall meet all the requirements of Part 6 of ICEA S-61-402.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Ship wire and cable on manufacturer's standard reel sizes unless otherwise specified. Where cut lengths are specified, mark reel footage accordingly. Each reel shall contain

one continuous length of cable. Provide impact protection by wood lagging or suitable barrier across the traverse of the reel. Provide moisture protection by using manufacturer's standard procedure or heat shrinkable self-sealing end caps applied to both ends of the cable.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. American Insulated Wire Corporation

B. Carol Cable Company, Inc.

C. General Cable Company

D. Okonite Company

E. Rome Cable Company

F. Triangle Wire and Cable, Inc.

G. Service Wire Company

2.02 MATERIALS AND EQUIPMENT

A. Design. Provide cable designated as THWN/THHN or XHHW single conductor type and UL 83 and UL 1063 listed, rated 600 volts and certified for continuous operation at maximum conductor temperature of 90 degrees C in dry locations and 75 degrees C in wet locations while installed in underground duct, conduit or in control panels (MTW).

B. Conductors. Provide conductors, which are Class B, concentric, stranded, annealed un-coated copper with physical and electrical properties complying with ASTM B3 and B8 and Part 2 of ICEA S-61-402.

C. Insulation. Each conductor shall be PVC insulated and nylon jacketed to meet the requirements of Part 3 of ICEA S-61-402. The insulation thickness shall match the dimensions listed in NEC Table 310-13 for type THHN and THWN wire.

D. Wire Marking

1. Wire marking shall be in accordance with NEC Article 310-11 and shall be printed on the wire insulation at 2-foot intervals.

2. The printing method used shall be permanent and the color shall sharply contrast with the jacket color.

E. The single conductor color-coding shall be as follows:

System Voltage	A	B	C	Neutral
120/208 Volt 3Ph/4w	Black	Red	Blue	White
120/240 Volt 3Ph/4w	Black	Orange	Blue	White
277/480 Volt 3Ph/4w	Black	Purple	Yellow	Grey

Motor Control	1	Black
	2	Red
	3	Blue
Ground	Green	

PART 3 EXECUTION

3.01 PREPARATION

A. Complete the cable raceway systems and underground duct banks before installing cables.

B. Verify sizing of raceways and pullboxes to ensure proper accommodation for the cables.

C. Check the length of the cable raceway system against the length of cable on the selected reel.

D. Clean conduits of foreign matter before cables are pulled.

3.02 INSTALLATION

A. Wiring Methods

1. Use wiring methods indicated on the Drawings

2. In general, use THHN/THWN or XHHW building wire for lighting, power and control wiring were conductors are enclosed in raceways such as above ground conduit system, underground duct banks, or inside control panels.

3. Do not use solid conductors.

4. Use conductors not smaller than No. 12 AWG stranded for lighting circuits.

5. Use conductors not smaller than No. 14 AWG for control circuits, except when part of a multiconductor cable or internal panel wiring.

6. In general, do not splice conductors unless approved by the Engineer.

7. Splices associated with taps for lighting and control circuits are allowed without approval.

8. Make splices in accessible junction boxes.

9. Use wire nuts with insulated caps for lighting wiring splices. Splice control circuit with insulated crimp connectors.

B. Single Conductor in Conduit and Ductbank

1. Install cables in accordance with the manufacturer's instructions and NEC Chapter 3 - Wiring Methods and Materials. Do not exceed maximum wire tension, maximum insulation pressure and minimum bending radius.

2. Pull cables into conduits using adequate lubrication to reduce friction. Lubricants must not be harmful to the conductor insulation.

C. Preparation for Termination

1. Make 600-volt power cable terminations and splices with heat shrinkable sleeves and seals.

2. Terminal lugs and connectors for all sizes of conductors shall be crimp-on type.

3. For size 1/0 AWG and larger, crimp-on lugs shall have the long barrel with 2-hole tongues except in places where termination space is limited.

D. Tests

1. In general, test insulation integrity of the wiring system before terminating.

2. Make sure to disconnect sensitive electronic equipment before testing insulation.

3. Use a 500 VDC megohmmeter and perform the wire system insulation test in accordance with the operating instructions.

E. Termination. After the 600-volt wiring system has been tested with satisfactory results, reconnect wire.

END OF SECTION

SECTION 16131
DEVICE, PULL AND JUNCTION BOXES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Specifications for device, pull, and junction boxes.

1.02 REFERENCES

A. American National Standards Institute/National Electrical Manufacturers Association (ANSI/NEMA).

1. FB1 - Fittings and Support for Conduits and Cable Assemblies

2. 250 - Enclosures for Electrical Equipment (1000 volts maximum)

B. American National Standards Institute/National Fire Protection Association (ANSI/NFPA), NFPA70 - National Electrical Code (NEC) - Article 370 - Outlet Device, Pull and Junction Boxes, Conduit Bodies and Fittings.

C. Underwriters Laboratories (UL):

1. 50 - Safety Cabinets and Boxes

2. 508 - Safety Industrial Control Equipment

3. 514B - Safety Fittings for Conduit and Outlet Boxes

4. 886 - Safety Outlet Boxes and Fittings for Use in Hazardous Areas

1.03 SUBMITTALS

A. Submit all products covered under this specification for Engineer’s approval.

B. Manufacturer's cut sheets, catalog data

C. Instruction for handling and storage

1. Installation instructions

2. Dimensions and weights

1.04 DELIVERY, STORAGE AND HANDLING

A. Pack and crate boxes to permit ease of handling and to provide protection from damage during shipping, handling and storage.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Cast Device Boxes:

1. Appleton Electric Company

2. Crouse-Hinds, Division of Cooper Industries

3. Killark Electric Manufacturing Company

2.02 MATERIALS AND EQUIPMENT

A. Device Boxes:

1. Provide UL-approved boxes designed and manufactured to house electrical devices like receptacles and switches, and in conformance with NEMA FB1 and NEC Article 370.

2. Supply boxes that are hot-dip galvanized on cast iron suitable for corrosive and 0 wet atmosphere.

B. Hardware:

1. Mounting Hardware: Stainless steel

2. Conduit Connectors: Watertight as manufactured by Myers Hubs, or equal.

PART 3 EXECUTION

3.01 PREPARATION

A. Review the drawings and determine how many boxes of each kind are required and check if supplied quantity is sufficient.

3.02 INSTALLATION

A. Boxes described in this specification shall be used both in dry and wet, corrosive areas, both inside and outside locations.

B. Install boxes in accordance with NEC Article 370 in locations indicated on the Drawings.

C. Install junction and pull boxes in readily accessible places to facilitate wire pulls, maintenance and repair.

D. Plug unused conduit openings.

E. Make conduit connections to sheet metal boxes with watertight conduit connectors.

END OF SECTION

[PAGE LEFT INTENTIONALLY BLANK]

SECTION 16140
WIRING DEVICES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Specifications for wiring devices including:

1. Receptacles.
2. Wall switches.
3. Wall plates and cover plates.

1.02 REFERENCES

A. American National Standards Institute/National Electrical Manufacturers Association (ANSI/NEMA).

1. NEMA WD1 - General Purpose Wiring Devices.
2. NEMA WD6 - Dimensional Requirements.

B. Federal Specifications (WC-596F).

C. American National Standards Institute/National Fire Protection Association (NFPA): NFPA No. 70 - National Electrical Code (NEC), Articles 210 Branch Circuits, 250 Grounding and 410, Paragraphs 56, 57 and 58.

1.03 SUBMITTALS

A. Submit all products covered under this specification for Engineer’s approval, including manufacturer’s product literature and specifications including dimensions, weights, certifications and instructions for handling, storage and installation.

1.04 DELIVERY, STORAGE AND HANDLING

A. Pack and crate devices to permit ease of handling and protect from damage during shipping, handling and storage.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Bryant Electric

B. Crouse-Hinds, Arrow Hart Division

C. Hubbel Inc. Wiring Devices Division

D. Leviton Manufacturing Company

E. Pass & Seymour/Legrand.

2.02 MATERIALS AND EQUIPMENT

A. Standards: Conform to NEMA WD1 for general requirements and NEMA WD6 for dimensional requirements.

B. Manufacture devices to heavy-duty industrial specification grade with brown nylon bodies (orange for isolated-ground receptacles) back and side wiring provisions and green-colored grounding screws.

C. Receptacles:

1. Duplex-type receptacles: Rated 20 amps at 120 volts.

2. Contacts: Brass or phosphor bronze.

3. Receptacle grounding system: Extend to the mounting strap unless isolated ground is indicated or required.

4. GFI or GFCI (ground fault circuit interrupter) receptacles: Provide feed-through type with test and reset button.

D. Wall Switches:

1. Toggle switches: Rated 20 amps at 120/277 volts AC rated for both resistive and inductive loads.

2. Contacts: Silver cadmium oxide construction to prevent sticking, welding and excessive pitting.

E. Cover Plates:

1. In outdoor, corrosive and wet areas, provide cover plates of cast metal, gasketed with spring-loaded hinged covers and stainless steel hardware.

2. All other plates: Type 302 stainless steel.

PART 3 EXECUTION

3.01 PREPARATION

A. Verify that device boxes are correctly placed.

B. Verify that the correct quantity, size and type of wires are pulled to each device box.

C. Verify that wiring has been checked at both ends.

D. Prepare wire ends for connection to devices.

E. Inspect each wiring device for defects.

3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install devices plumb and level.

C. Install switches with OFF position down.

D. Install receptacles with grounding pole on top.

E. Connect wiring device grounding terminal to outlet box with bonding jumper.

F. Connect wiring devices by wrapping conductors clockwise around screw terminals.

G. Install cover plates on switch, receptacle and blank outlets in finished areas.

H. Energize and test devices for proper operation.

END OF SECTION

[PAGE LEFT INTENTIONALLY BLANK]

SECTION 16165
DISCONNECT SWITCHES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Specifications for disconnect switches including:

1. Fusible disconnect switches
2. Non-fusible disconnect switches
3. Circuit breaker type disconnect switches
4. Fuses
5. Circuit breakers

1.02 REFERENCES

A. American National Standards Institute/National Electrical Manufacturers Association (ANSI/NEMA)

1. NEMA AB1: Molded Case Circuit Breakers
2. NEMA KS1: Enclosed Switches

B. Underwriters Laboratories (UL)

1. UL 98: Standard for safety enclosed switches and Dead Front Switches
2. UL 198C: High Interrupting Capacity Fuses, Current Limiting type
3. UL 198E: Class R Fuses

C. American National Standards Institute/National Fire Protection Association (ANSI/NFPA), NFPA No. 70 - National Electrical Code (NEC), Article 380 - Switches.

1.03 SUBMITTALS

A. Submit all products covered under this specification for Engineer’s approval:

1. Manufacturer's cut sheets and catalog data
2. Switch internal arrangement
3. Breaker or fuse characteristic curves
4. Instructions for handling and storage

5. Installation instructions

6. Dimensions and weights

1.04 DELIVERY, STORAGE AND HANDLING

A. Have disconnect switches packed and crated to permit ease of handling and to provide protection from damage during shipping, handling and storage.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Disconnect Switches and Circuit Breakers:

1. Cutler-Hammer Products

2. General Electric

3. Siemens Energy and Automation

4. Square D Company

5. Westinghouse Electric

B. Fuses:

1. Bussman Division, Cooper Industries

2. Gould Shawmut

3. Littelfuse Incorporated

2.02 MATERIALS AND EQUIPMENT

A. Disconnect Switches:

1. Characteristics: Horsepower rated, 300-volt, heavy-duty type with an interlocked door, positive quick-make, quick-break mechanism and visible blades.

2. Use switches and components designed, manufactured and tested in accordance with NEMA AB1, NEMA KS1, UL 98, and NEC Article 380.

3. Enclose switch in a NEMA 12 type enclosure for indoor application and NEMA 4X (type 316 stainless steel) in outdoor locations or other wet or corrosive areas.

4. Provide switches with provisions for padlocking the operating lever in OFF position and door in closed position.

5. Select switches having the number of poles and general size conforming to the Drawings.

6. Conform to fusible, non-fusible or circuit breaker type switch requirements as shown on Drawings or one-line diagrams.

7. Provide an auxiliary contact, shown on the Drawings.

8. Select fuses or circuit breakers with current interrupting duty as calculated for the points of switch application or as indicated on the Drawings or one-line diagrams.

B. Fuses: Unless otherwise noted on Drawings, for fuses used in disconnect switches, provide the dual-element, time-delay type with the maximum interrupting rating of 200,000 amperes, conforming to the current NEC.

C. Circuit Breakers: When circuit breakers are used in disconnect switches, provide the thermal-magnetic type with current interruption ratings as required at the point of application.

D. Conduit Connectors: Watertight as manufactured by Myers Hubs, or equal.

PART 3 EXECUTION

3.01 PREPARATION

A. Review the Drawings and verify the disconnect switches are correct for the applications.

B. Make sure that the correct fuses or breakers are being used regarding size and short circuit interrupting capability.

C. Prepare adhesive labels on the inside door of each switch indicating UL fuse class and size or breaker type and size for replacement.

3.02 INSTALLATION

A. Install disconnect switches in accordance with and NEC Article 380.

B. Mount switches 6'-6" (to top of cabinet) above finished floor or grade.

C. In wet and corrosive areas, including outdoor locations, install switches on spacers to provide a space of approximate 1/4-inch between the back of cabinet and the mounting surface.

D. In wet and corrosive areas, including outdoor locations, connect conduit to the bottom of enclosure and to the lower 30 percent of the sides using watertight connectors.

END OF SECTION

[PAGE LEFT INTENTIONALLY BLANK]

SECTION 16195
ELECTRICAL IDENTIFICATION

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes: Identification of electrical materials, equipment, and installations.

1.02 SUBMITTALS

A. Submit all products covered under this specification for Engineer’s approval.

B. Product Data: Submit for each type of product specified.

C. Samples: Submit for each color, lettering style, and or graphic representation required for identification materials, samples of labels and signs.

D. Miscellaneous: Schedule of identification nomenclature to be used for identification signs and labels.

1.03 QUALITY ASSURANCE

A. Regulatory Requirements. National Electrical Code: Components and installation shall comply with NFPA 70.

B. Comply with ANSI C2.

PART 2 PRODUCTS

2.01 RACEWAY AND CABLE LABELS

A. Manufacturer's Standard Products: Where more than one type is listed for specified application, selection is Installer's option, but provide single type for each application category. Use colors prescribed by ANSI A13.1, NFPA 70, or as specified elsewhere.

B. Conform to ANSI A13.1, Table 3, for minimum size of letters for legend and minimum length of color field for each raceway or cable size.

1. Color: Black legend on orange field.

2. Legend: Indicates voltage.

C. Adhesive Labels: Preprinted, flexible, self-adhesive vinyl. Legend is over-laminated with clear, wear and chemical resistant coating.

D. Pre-tensioned, Wraparound Plastic Sleeves: Flexible, preprinted, color-coded, acrylic bands sized to suit diameter of line it identifies and arranged to stay in place by pre-tensioned gripping action when placed in position.

E. Colored Adhesive Tape: Self-adhesive vinyl tape not less than 3-mils thick by 1 to 2-in. wide (0.08-mm thick by 25 to 51-mm wide).

F. Underground Line Warning Tape: Permanent, bright-colored, continuous printed, vinyl tape with following features:

1. Size: Not less than 6-in. wide by 4-mils thick (152-mm wide by 0.102-mm thick).

2. Compounded for permanent direct burial service.

3. Embedded continuous metallic strip or core.

4. Printed Legend: Indicates type of underground line.

G. Tape Markers: Vinyl or vinyl cloth, self-adhesive, wraparound type with preprinted numbers and letters.

H. Aluminum, Wraparound Marker Bands: Bands cut from 0.014-in. (0.4-mm) thick aluminum sheet, with stamped or embossed legend, and fitted with slots or ears for permanently securing around wire or cable jacket or around groups of conductors.

I. Plasticized Card Stock Tags: Vinyl cloth with preprinted and field printed legends. Orange background, except as otherwise indicated, with eyelet for fastener.

J. Aluminum Faced Card Stock Tags: Wear resistant, 18-point minimum card stock faced on both sides with embossable aluminum sheet, 0.002-in. (0.05-mm) thick, laminated with moisture resistant acrylic adhesive, and punched for fastener. Preprinted legends suit each application.

K. Brass or Aluminum Tags: Metal tags with stamped legend, punched for fastener. Dimensions: 2 by 2-in. (51 by 51-mm) by 0.05-in. (1.3-mm).

2.02 ENGRAVED NAMEPLATES AND SIGNS

A. Manufacturer's Standard Products: Where more than one type is listed for specified application, selection is Installer's option, but provide single type for each application category. Use colors prescribed by ANSI A13.1, NFPA 70, or as specified elsewhere.

B. Engraving stock, melamine plastic laminate, 1/16-in. (1.6-mm) minimum thick for signs up to 20-sq. in. (129-sq. cm), 1/8-in. (3.2-mm) thick for larger sizes.

1. Engraved Legend: Black letters on white face.

2. Punched for mechanical fasteners.

C. Baked Enamel Signs for Interior Use: Preprinted aluminum signs, punched for fasteners, with colors, legend, and size as indicated or as otherwise required for application. 1/4-in. (6.4-mm) grommets in corners for mounting.

D. Exterior, Metal Backed, Butyrate Signs: Wear resistant, non-fading, preprinted, cellulose acetate butyrate signs with 0.0396-in. (1-mm), galvanized steel backing, with colors, legend, and size appropriate to application. 1/4-in. (6.4-mm) grommets in corners for mounting.

E. Fasteners for Plastic Laminated and Metal Signs: Self-tapping stainless steel screws or No. 10/32 stainless steel machine screws, with nuts, flat washers and lock washers.

2.03 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Cable Ties: Fungus inert, self-extinguishing, 1 piece, self-locking, Type 6/6 nylon cable ties with following features:

1. Minimum Width: 3/16-in. (5-mm).

2. Tensile Strength: 50-lb (22.3 kg) minimum.

3. Temperature Range: Minus 40 to 185°F (Minus 4 to 85°C).

4. Color: As indicated where used for color-coding.

B. Paint: Alkyd-urethane enamel. Primer as recommended by enamel manufacturer.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install identification devices according to manufacturer's written instructions.

B. Install labels where indicated and at locations for best convenience of viewing without interference with operation and maintenance of equipment.

C. Lettering, Colors, and Graphics: Coordinate names, abbreviations, colors, and or designations used for electrical identification with corresponding designations used in Contract Documents or required by codes and standards. Use consistent designations throughout Project.

D. Sequence of Work: Where identification is to be applied to surfaces that require finish, install identification after completion of finish work.

E. Self Adhesive Identification Products: Clean surfaces of dust, loose material, and oily films before applying.

F. Identify feeders over 600 V with "DANGER HIGH VOLTAGE" in black letters 2-in. (51-mm) high, stenciled with paint at 10-ft (3-m) intervals over continuous, painted orange background. Identify following:

1. Entire floor area directly above conduits running beneath and within 12-in. (305-mm) of basement or ground floor that is in contact with earth or is framed above unexcavated space.

2. Wall surfaces directly external to conduits concealed within wall.

3. All accessible surfaces of concrete envelope around conduits in vertical shafts, exposed in building, or concealed above suspended ceilings.

4. Entire surface of exposed conduits.

G. Install painted identification as follows:

1. Clean surfaces of dust, loose material, and oily films before painting.

2. Prime Surfaces: For galvanized metal, use single component, acrylic vehicle coating formulated for galvanized surfaces. For concrete masonry units, use heavy duty, acrylic resin block filler. For concrete surfaces, use clear, alkali resistant, alkyd binder type sealer.

3. Apply one intermediate and one finish coat of silicone alkyd enamel.

4. Apply primer and finish materials according to manufacturer's instructions.

H. Identify Raceways and Exposed Cables of Certain Systems with Color Banding: Band exposed and accessible raceways of systems listed below for identification.

1. Bands: Pre-tensioned, snap around, colored plastic sleeves; colored adhesive tape; or combination of both. Make each color band 2-in. (51-mm) wide, completely encircling conduit, and place adjacent bands of 2 color markings in contact, side by side.

2. Locate bands at changes in direction, at penetrations of walls and floors, at 50-ft (15 m) maximum intervals in straight runs, and at 25-ft (7.6 m) in congested areas.

3. Colors: As follows:

a. Fire Alarm System: Red.

b. Fire Suppression Supervisory and Control System: Red and yellow.

c. Combined Fire Alarm and Security System: Red and blue.

d. Security System: Blue and yellow.

e. Mechanical and Electrical Supervisory System: Green and blue.

f. Telecommunications System: Green and yellow.

I. Install Caution Signs for Enclosures Over 600 V: Use pressure sensitive, self-adhesive label indicating system voltage in black, preprinted on orange field. Install on exterior of door or cover.

J. Install Circuit Identification Labels on Boxes: Label externally as follows:

1. Exposed Boxes: Pressure sensitive, self-adhesive plastic label on cover.

2. Concealed Boxes: Plasticized card stock tags.

3. Labeling Legend: Permanent, waterproof listing of panel and circuit number or equivalent.

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

L. Color Code Conductors:

1. Secondary service, feeder, and branch circuit conductors throughout secondary electrical system.

a. Field applied, color coding methods may be used in lieu of factory coded wire for sizes larger than No. 10 AWG.

b. Colored, pressure sensitive plastic tape in half-lapped turns for distance of 6-in. (150-mm) from terminal points and in boxes where splices or taps are made. Apply last 2 turns of tape with no tension to prevent possible unwinding. Use 1-in. (25-mm) wide tape in colors as specified. Adjust tape bands to avoid obscuring cable identification markings.

2. Colored cable ties applied in groups of 3 ties of specified color to each wire at each terminal or splice point starting 3-in. (76-mm) from terminal and spaced 3-in. (76-mm) apart. Apply with special tool or pliers, tighten to snug fit, and cut off excess length.

System Voltage	A	B	C	Neutral
120/240 Volt 1Ph/3w	Black	Red		White
120/208 Volt 3Ph/4w	Black	Red	Blue	White
120/240 Volt 3Ph/4w	Black	Orange	Blue	White
277/480 Volt 3Ph/4w	Brown	Purple	Yellow	Gray
Motor Control	1	Black		
	2	Red		
	3	Blue		
Ground				Green

M. Power Circuit Identification: Use metal tags or aluminum wraparound marker bands for cables, feeders, and power circuits in vaults, pull boxes, junction boxes, manholes, and switchboard rooms.

1. Legend: ¼-in. (6.4-mm) steel letter and number stamping or embossing with legend corresponding to indicated circuit designations.

2. Fasten tags with nylon cable ties; fasten bands using integral ears.

N. Apply identification to conductors as follows:

1. Conductors to Be Extended in Future: Indicate source and circuit numbers.

2. Multiple Power or Lighting Circuits in Same Enclosure: Identify each conductor with source, voltage, circuit number, and phase. Use color coding for voltage and phase indication of secondary circuit.

3. Multiple Control and Communications Circuits in Same Enclosure: Identify each conductor by its system and circuit designation. Use consistent system of tags, color-coding, or cable marking tape.

O. Apply warning, caution, and instruction signs and stencils as follows:

1. Install warning, caution, and instruction signs where indicated or required to ensure safe operation and maintenance of electrical systems and of items to which they connect. Install engraved plastic laminated instruction signs with approved legend where instructions or explanations are needed for system or equipment operation. Install butyrate signs with metal backing for outdoor items.

2. Emergency Operating Signs: Install engraved laminate signs with white legend on red background with minimum 3/8-in. (9-mm) high lettering for emergency instructions on power transfer, load shedding, and or emergency operations.

P. Install identification as follows:

1. Apply equipment identification labels of engraved plastic laminate on each major unit of equipment, including central or master unit of each system. This includes communication, signal, and alarm systems, unless units are specified with their own self-explanatory identification. Except as otherwise indicated, provide single line of text with ½-in. (13-mm) high lettering on 1-1/2-in. (38-mm) high label; where 2 lines of text are required, use lettering 2-in. (51-mm) high. Use black lettering on white field. Apply labels for each unit of following categories of equipment:

a. Panelboards, electrical cabinets, and enclosures.

b. Access doors and panels for concealed electrical items.

c. Electrical switchgear and switchboards.

d. Electrical substations.

e. Motor control centers.

f. Motor starters.

g. Push button stations.

h. Power transfer equipment.

i. Contactors.

j. Remote controlled switches.

k. Dimmers.

l. Control devices.

m. Transformers.

n. Inverters.

o. Rectifiers.

p. Frequency converters.

q. Battery racks.

r. Power generating units.

s. Telephone switching equipment.

t. Clock/program master equipment.

u. Call system master station.

v. TV/audio monitoring master station.

w. Fire alarm master station or control panel.

x. Security monitoring master station or control panel.

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

END OF SECTION

[PAGE LEFT INTENTIONALLY BLANK]

SECTION 16210
DIESEL ENGINE GENERATOR AND CONTROLS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. This section specifies the furnishing and installation of a packaged electric generating plant.

B. The packaged, diesel engine-electric generating plant shall be pre-wired, pre-piped, assembled, and aligned on a single skid type base. The packaged system of new, unused equipment of the manufacturer's latest design includes all necessary instruments, devices, switches, and other appurtenances for proper operation of the unit: supplies steel safety guards around all external rotating parts, and provides a unit on which adjustments, repairs, and normal maintenance are possible without the use of special tools. The supplier will be responsible for the proper performance of the complete unit and support systems. Only manufacturers with a minimum of 5 years experience will be considered. The supplier of the complete package must have complete parts and service available on a 24 hour basis in the area of the job site. Parts stock must be maintained on engine/generator by the supplier of the package.

C. The successful bidder of this equipment shall herein be referred to as vendor.

D. Any failure to take exception to any part of this specification in the initial bid by the vendor shall imply complete compliance to the specification and will subject the vendor to complete liability for any omitted items.

E. All equipment provided shall be manufactured by a single source of supply, and supplied by a manufacturer who has been continuously engaged in the manufacture of industrial grade Power System products for a minimum of 25 years. The manufacturer shall have test facilities available to test the proposed equipment and demonstrate the equipment will meet the project specifications.

1.02 GUARANTEE

A. All systems and components supplied under this specification shall be guaranteed against defective material, poor workmanship, design deficiencies, and failure during normal usage for a minimum of 12 months after the date of acceptance by Engineer. Vendor shall make necessary corrections to all deficiencies noted within this time, without expense to purchaser. Satisfactory warranty documents must be provided.

1.03 STANDARDS AND CODES

A. All material and equipment supplied under this specification shall be designed, assembled, and tested in full compliance with the latest edition of the following codes and standards:

1. NEC - National Electric Code

2. IEEE - Institute of Electrical and Electronic Engineers

3. UL - Underwriters' Laboratories

4. NEMA - National Electronic Manufacturers Association

5. ASA - American Standards Association

6. ANSI - American National Standards Institute

B. All components used shall be UL labeled or listed whenever such recognition is available.

1.04 DRAWINGS AND DATA

A. Six copies of the following items shall be submitted with vendor's proposal:

1. Outline dimensions and weights.

2. Descriptive literature describing the standard series specified (not a one-of-a-kind fabrication).

3. Drawing submittal schedule with approval allowance requirements.

4. Shipping time after receipt of order.

5. Exceptions and clarifications to this specification.

6. Factory testing procedures.

7. Submit manufacturer’s detailed sizing report indicating compliance with the parameters and load starting sequence as indicated in Section 2.02. Genset size indicated in Section 2.02B is allowed only if manufacturer’s sizing report produced by generator manufacturer’s representative indicates full compliance with all aspects of the parameters and loads listed in section 2.02. In addition, manufacturer’s sizing report is required to meet or exceed parameters of voltage drop, frequency drop, and starting KVA for each step and in total of that achieved by the Cummins model number indicated on the plans and its’ associated sizing report that is included as an appendix to this specification. Manufacturer’s sizing report assumptions of motor code number, loaded or unloaded, and starting power factor shall be clearly stated and equivalent to those assumptions included in the appendix.

****NOTE TO SPECIFIER**: Include appendix to this specification in Project Manual.

B. Six copies of the following items are required of the successful bidder prior to manufacture:

1. Certified dimensional drawings showing weight, outline dimensions, bolting and drilling details, clearances for installation, operation and maintenance, and required ventilation.

2. Elevation views, showing and identifying all items furnished and section views as required to locate all components.

3. Bill of material describing all components and recommended spare parts with pricing and delivery.

4. Brochures on engine, generator, muffler, batteries, charger, fuel tank, control panel, and any accessory equipment showing ratings, construction features, and performance characteristics.

5. Schematic and wiring diagrams of the electrical system showing all factory wiring and clearly indicating wiring and voltage of any electrical strip heaters. Also, submit fully detailed inter-connection drawings indicating each individual connection to any remote equipment, including a separate connection drawing to show point to point electrical wiring connections.

6. Submit documentation indicating compliance with EPA/TCEQ emission requirements for the location and EPA “Tier” rating.

1.05 SUBMITTALS AFTER MANUFACTURE

1. Factory and Field Tests - Deliver to the purchaser six copies of each factory and field test report on the actual packaged electric generating plant provided, indicating results for all tests described herein.

2. Operation and Maintenance Manuals - Two weeks prior to final inspection, deliver to the purchaser six sets of the manufacturer's operation and maintenance manuals pertaining directly to the unit provided. Bind each set in a substantial binder, with each item properly indexed. Include the following information:

a. Project record drawings clearly indicating operating features and including as-built shop drawings, outline drawings, schematic and wiring diagrams.

b. Instructions for erection and alignment, including tolerances and preparation for use.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Diesel Engine Driven Generator Set, complete with accessories, shall be Onan, Caterpillar, Stewart & Stephenson, or Pre-Approved equal. Engine shall be by Caterpillar, Cummins, or Detroit Diesel Allison.

2.02 RATINGS

A. VOLTAGE AND CONNECTION – 480V/277V, 3 Phase, 4 Wire, 60 Hertz, 0.8 Power Factor.

B. POWER – 50KW, 62.5KVA

C. LOADS & STARTING SEQUENCE – Generator set shall be capable of starting the following loads in the sequence shown:

1. Lighting and control loads of 7.5KVA, single phase.

2. One 10 HP motor, 1.15 service factor, code letter G, full voltage starting.

3. One 10 HP motor, 1.15 service factor, code letter G, full voltage starting.

D. Generator shall be capable of starting loads in the above sequence with not more than 15% instantaneous terminal voltage drop, and not more than 10% sustained terminal voltage drop with the specified KVA load at near zero power factor applied to the generator set. See section 1.04 A 7.

E. Generator shall be capable of starting loads in the above sequence with not more than 5% instantaneous terminal frequency drop. See section 1.04 A 7.

F. Site operating parameters shall be 100 ft. altitude and an ambient temperature of 95 degrees F.

G. Contractor will be responsible for verifying generator operations by executing procedures in the generator checklist attached to this specification. The checklist includes a load bank test.

2.03 ENGINE

A. Type - Liquid cooled, full diesel compression ignition engine, either naturally aspirated or turbocharged. 4-cycled engine required, or as approved by the ENGINEER.

B. Rating - Provide an engine with brake horsepower not less than required by the full load rating of the generator, including losses, and with all accessories attached.

C. Speed - The engine speed will be suitable for direct connection to the generator without exceeding engine manufacturer's published curves. Speed must not exceed 1800 PRM.

D. BMEP - The engine BMEP will not exceed 351 PSI, when producing rated load. Piston speed shall be 2250 feet per minute or less.

E. Construction:

1. Replaceable liners.

2. Two (2) valves per cylinder.

3. Full pressure lube system with crank shaft driven oil pump.

4. Unit injectors.

5. Full flow replaceable oil filter.

6. Primary and secondary fuel oil filters.

7. Replaceable fuel transfer pump suitable for a maximum of 4 feet suction lift.

8. Oil bath or dry type air intake cleaner.

F. Starting System

1. Heavy duty, battery driven electric starter motor.

2. A fully charged 24 volt lead acid, impact resistant, storage battery or batteries mounted on the unit. Make battery capacity sufficient for four cranking cycles at firing speed of 10 seconds duration each, with 15 seconds rest periods- Provide all battery cables, connections, electrolyte, and a hydrometer.

G. Cooling System - The generator set will be furnished with a unit mounted radiator having sufficient capacity for cooling the engine when delivering full rated horsepower at the design ambient. The fan is to be engine driven pusher type. An immersion heater shall be furnished in the jacket water system.

H. Exhaust System - High degree, critical-rated stainless steel muffler with maximum silencing capacity mounted on unit. Include a suitable length of flexible stainless steel exhaust tubing for mounting between engine and muffler. When V type engines are used, a wye type flex will be furnished.

I. Fuel System

1. Engine driven, self priming fuel pump suitable for unassisted transfer of fuel from the fuel tank to the engine.

2. Subbase fuel tank to be UL 142 listed, double-wall, with leak detector system.

3. Subbase fuel tank capacity shall be sufficient for 48 hours of continuous operation at full plant load of the generator but not less than 100 Gallons.

4. Full flow replaceable element fuel filter.

5. Fuel connection lines between tank and engine.

6. Contractor shall provide a full fuel tank at project acceptance.

7. Fuel tank shall be regional style fuel tank without extend emergency air vent or provide equivalent tank structure that shall not be of a height greater than 3'.

J. Governor - Provide governor of the electric type, Woodward, Onan or an approved equal, to maintain frequency stability at any constant load, including no load, within plus or minus ¼ percent, and to maintain frequency regulation between no load steady state and full load steady within .5 percent.

K. Battery Charger - A static, solid state type battery charger unit which automatically controls the charge rate. Include a charging rate ammeter, thermal overload circuit and transformer. The charge shall be suitable for operation at 120 volts single phase, 60 Hertz. The maximum charging time to bring the batteries up to full charge will be 12 hours. Mount charger on unit, using adequate vibration devices. Charger shall be of the dual rate type.

L. Emissions – Engines used in proposed generator set to be certified to comply with current US EPA and CARB Mobile Off-Highway emission limits when tested per ISO 8178 D2. Engines used shall also comply with TCEQ air quality regulations at the project location and time of installation.

2.04 GENERATOR

A. Type - Furnish a direct coupled, synchronous, brushless type generator with amortisseur windings, revolving field, exciter, and built-in static rectifier and statically regulated excitation system.

B. Insulation System - Class F, minimum, with temperature rise limited to 80C over a 40C ambient under the application of full plant load conditions.

C. Instantaneous Voltage Dip - Less than 15 percent when sequenced load is applied to the unit.

D. Voltage Stability - Maintain within plus or minus 1 percent of rated voltage at any constant from no load to full load.

E. Voltage Regulation - Maintain within plus or minus 1 percent deviation from rated voltage between no load steady state and full load steady state.

F. Enclosure - Weatherproof, with locking side panels, unless otherwise specified.

G. Coupling - From engine, drive rotor through a semi-flexible coupling to ensure permanent alignment.

H. Strip Heaters - Provide thermostatically controlled, low surface temperature space heaters to prevent condensation.

I. Generator Set Control and Protection - Provide comprehensive monitoring and control system integral to the Generator Set control to guard the electrical integrity of the alternator and power system. Provide single and 3-phase fault current regulation, so that downstream protective devices have the maximum current available to quickly clear fault conditions, without subjecting the alternator to potentially catastrophic failure conditions. Include provisions to either prevent over voltage due to single phase faults, or to shut down the generator set if line to neutral voltage on any phase exceeds 115% for more than 0.5 seconds. Acceptable methods are a fully rated (100%) 600 volt Circuit Breaker, mounted in the generator enclosure, GE or Cutler-Hammer Programmable Digitrip/VersaTrip of size as indicated on drawings with handheld programmer or inherent protection provided by microprocessor-based GenSet AmpSentry protection. Submittals shall demonstrate that the protective device provides proper protection for the alternator by a comparison of the trip characteristic of the breaker with the thermal damage characteristic of the alternator. Field circuit breakers shall not be acceptable for generator overcurrent protection.

2.05 CONTROL PANEL

A. General - Provide a control panel mounted to unit which includes, but is not limited to, the following instruments and protective devices.

1. A C ammeter.

2. Phase selector switch.

3. Current transformers.

4. A C voltmeter.

5. Automatic solid state voltage regulator.

6. Rheostat for adjusting voltage plus or minus 5 percent of rated voltage.

7. Engine Malfunction Warning Lights:

   a. Low oil pressure.

   b. High water temperature.

   c. Engine overcrank.

   d. Engine overspeed.

8. Frequency meter.

9. Non-resetable elapsed time meter with a 9,999.9 hour maximum indication.

10. Coolant temperature gage.

11. Oil pressure gage.

12. Main circuit breaker.

13. Combination alarm-shutdown system with manual reset and indicating lights for high engine temperature, low oil pressure, engine overspeed, and engine fail-to-start. Include an additional set of contacts for remote alarms.

14. Manual start/stop switch for control of engine.

15. Alarm dry contact closures as follows:

    a. Low oil pressure

    b. High water temperature

    c. Engine overcrank

    d. Engine run

    e. Fuel low level

    f. Leak in subbase tank

16. Remote control contacts as follows: Engine start via transfer switch (which will include power transfer).

17. Provide latest electronic control panel at engine and with remote control panel at transfer switch. Remote panel to have full functions.

B. All interface wiring connections shall be made in the control panel.

2.06 ENGINE START/STOP CONTROLS

A. The engine controls shall be provided with bypassing of the low oil pressure shutdown circuitry during start-up.

B. If unit fails to start in an appropriate time (normally 30 seconds), the starting circuit shall shut down for an appropriate time (approximate 10 seconds) and then repeat the start cycle. If the unit still fails to start after approximately four start attempts, the overcrank alarm shall activate and the starting circuit shall shut down.

C. The engine start/stop control shall be static solid state.

2.07 BASE

A. Mount the assembled packaged unit on a base of welded structural steel, box type construction. Prime all exposed metal parts with a rust inhibitor and finish in durable machinery enamel (Design for mounting on subbase tank).

B. Vibration isolators shall be of the steel spring type.

2.08 WEATHERPROOF SOUND ATTENUATING HOUSING

A. Construction - Provide an overall weatherproof prefabricated sound attenuating enclosure with removable side panels and a hinged, padlockable meter panel door to make the engine generator plant suitable for outdoor installation. Noise levels shall be equivalent to Onan “Quiet Site II” enclosure.

B. Painting - Prime all exposed metal parts with a suitable rust inhibitor applied to the clean, bare metal, followed by two coats of an epoxy paint for exterior weather.

C. All doors and access panels shall be lockable.

D. Contractor to coordinate with manufacturer on housing size prior to constructing concrete pad.

2.09 TESTING

A. Units shall be factory tested under design conditions. Purchaser, at his option, may witness test. Vendor shall give one (1) week notice before test is made.

2.10 FIELD TESTS

A. Perform field tests at the site after installation is complete and in the presence of the Owner’s representative.

B. Perform sequence start-up of plant and demonstrate compliance with specifications.

2.11 TRAINING

A. The equipment supplier shall provide training for the facility operating personnel covering operation and maintenance of the equipment provided. The training program shall be not less than 4 hours in duration and the class size shall be limited to 3 persons. Training date shall be coordinated with the facility owner.

2.12 SERVICE AND SUPPORT

A. The manufacturer of the generator set shall maintain service parts inventory at a central location which is accessible to the service location 24 hours per day, 365 days per year.

B. The generator set shall be serviced by a local service organization that is trained and factory certified in generator set service. Within 50 mile of the job site, the supplier shall maintain; a minimum of 6 factory trained and qualified field technicians; a proper supply of spare parts for the supplied equipment; a shop with overhaul capabilities; and be able to provide 24 hour, 7 day per week, 365 day per year field service capability.

C. The manufacturer shall maintain model and serial number records of each generator set provided for at least 20 years.

END OF SECTION

RATINGS (Fill Blanks per generator Specification)

☐ Accepted ☐ Rejected

Comments:

☐ Accepted ☐ Rejected

Comments:

☐ Accepted ☐ Rejected

Comments:

☐ Accepted ☐ Rejected

Comments:

GENERATOR CHECK LIST
Project:_____

Date:_____
Job No._____

☐ Accepted ☐ Rejected

Comments:

ENGINE

☐ Accepted ☐ Rejected

Comments:

☐ Accepted ☐ Rejected

Comments:

Verify Voltage And Connection – _____V/_____A, ___ Phase, ___ Wire, 60 Hertz, 0.8 Power Factor.

_____
_____
_____

Verify Size: Power – _____KW, _____KVA

_____
_____
_____

Verify that the generator will start and run all loads

☐ Accepted ☐ Rejected

Comments:

☐ Accepted ☐ Rejected

in the sequence shown in the specifications:

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____

_____

Verify Generator is capable of starting loads in the above sequence with not more than 15% instantaneous terminal voltage drop, and not more than 10% sustained terminal voltage drop with the specified KVA load at near zero power factor applied to the generator set. (See Generator Specification Section 1.04 A 7)

_____

Verify Generator is capable of starting loads in the above sequence with not more than 5% instantaneous terminal frequency drop. (See Generator Specification Section 1.04 A 7)

_____

Have contractor verify with the operator all fluid levels for the engine.

_____

Verify all battery cables, connections, electrolyte, and a hydrometer provided.

_____

Verify Exhaust System is High degree, critical-rated stainless steel muffler and/or catalytic converter assembly with maximum silencing capacity.

_____

Fuel System -Verify the following: Natural Gas

1. Full flow replaceable element fuel filter.

Diesel

1. Full flow replaceable element fuel filter.
2. Fuel connection lines between tank and engine.
3. Subbase fuel tank is UL listed, double-wall, with leak detector

system.
4. A full fuel tank provided by Contractor at acceptance.

Comments: _____

☐ Accepted ☐ Rejected

Battery Charger – Verify the following:
1. Static, solid state battery charger unit which automatically controls the charge rate.
2. Includes charging rate ammeter, thermal overload circuit and transformer.
3. Mounted on unit using adequate vibration devices.
4. Dual rate type.

Comments: _____

GENERATOR

☐ Accepted ☐ Rejected

Verify that the generator is solidly grounded from the frame of the generator to a close by ground well and rod.

Comments: _____

☐ Accepted ☐ Rejected

Verify flexible conduit installation in at least the last 12” of conduit through the slab and terminated at the generator.

Comments: _____

CONTROL PANEL

☐ Accepted ☐ Rejected

Verify Control panel mounted to unit includes at a minimum:
1. A C ammeter.
2. Phase selector switch.
3. Current transformers.
4. A C voltmeter.
5. Automatic solid state voltage regulator.
6. Rheostat for adjusting voltage plus or minus 5 percent of rated voltage.
7. Engine Malfunction Warning Lights:
    a. Low oil pressure
    b. High water temperature
    c. Engine overcrank
    d. Engine overspeed
8. Frequency meter.
9. Non-resetable elapsed time meter with a 9,999.9 hour maximum indication.
10. Coolant temperature gage.
11. Oil pressure gage.
12. Main circuit breaker.

13. Combination alarm-shutdown system with manual reset and Indicating lights for:
    a. high engine temperature
    b. low oil pressure,
    c. engine overspeed
    d. engine fail-to-start
    e. remote alarms
14. Manual start/stop switch for control of engine.
15. Alarm dry contact closures as follows:
    a. Low oil pressure
    b. High water temperature
    c. Engine overcrank
    d. Engine run
16. Remote control contacts: Engine start via transfer switch (which will include power transfer).
17. Latest electronic control panel at engine and with remote control panel at transfer switch. Remote panel to have full functions.

Comments: _____

☐ Accepted ☐ Rejected Verify all interface wiring connections are made in the control panel.

Comments: _____

ENGINE START/STOP CONTROLS

☐ Accepted ☐ Rejected Verify and consult with the operator the exerciser setting of day and time. (Noon Monday for 30 minutes is preferred. Avoid weekends.)

Comments: _____

☐ Accepted ☐Rejected Verify and consult with the operator the setting for “Power loss delay for engine start.” Setting should be two minutes minimum to avoid momentary loss starts.

Comments: _____

BASE

☐ Accepted ☐ Rejected Verify that anchor bolts are adequately installed and bolted down, four corners minimum.

Comments: _____

☐ Accepted ☐Rejected Verify all exposed metal parts of welded structural steel base are primed with a rust inhibitor and top coated with durable machinery enamel.

Comments: _____

GENERATOR CHECK LIST
Project:_____

Date:_____
Job No._____

☐ Accepted ☐ Rejected Verify steel spring type vibration isolators.

Comments: _____

WEATHERPROOF SOUND ATTENUATING HOUSING

☐ Accepted ☐ Rejected Verify Enclosure has Thermostatically controlled, low surface temperature space heaters.

Comments: _____

☐ Accepted ☐ Rejected Verify weatherproof sound attenuating enclosure has:
1. removable side panels
2. all doors and access panels are lockable
3. meter panel door is hinged and lockable

Comments: _____

FIELD TESTS

☐ Accepted ☐ Rejected Field tests were completed in the presence of the Owner's representor

Comments: _____

☐ Accepted ☐ Rejected On site resistive load bank testing to the full capacity of the generator set for a minimum of 30 minutes.

Comments: _____

☐ Accepted ☐ Rejected Verify adequate generator cooling, fuel flow, metering, and operation.

Comments: _____

SECTION 16290
COMBINATION LIGHTNING AND SURGE PROTECTION

PART 1 GENERAL

1.01 SUMMARY

A. This specification covers over-voltage transient and lightning protection of low-voltage power applications for service entrances and sub-distribution panels used to power a facility or equipment. The enclosure includes a hybrid circuit consisting of a self-extinguishing spark-gap component and a TVSS component.

1.02 SECTION INCLUDES

A. Performance Specifications

B. Approved Manufacturers and Model Numbers

C. Functional and Operational Guidelines

1.03 REFERENCE

A. IEC 1024-1: 1990/ENV 61 024-1:1995/DIN V ENV 61 024-1/VDE V0185 Part 100: 1996-08. Protection of Structures Against Lightning - Part 1: General Principles

B. NEC, The National Electrical Code

C. EN50022: 1977/DIN EN 50 022: 1978-05. Low Voltage Switchgear and Control Gear for Industrial Use; Mounting Rails for Fixing Terminal Blocks

D. ANSI/IEEE (C62.41-1991) IEEE Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits and ANSI/IEEE (C62.45-1992) IEEE Guide on Surge Testing for Equipment Connected to Low-Voltage AC Power Circuits.

E. IEC 529: 1989/EN 60 529: 1991/DIN VDE 0470-1: 1992-11. Type of Protection Through Housing (IP Code).

F. DIN VDE 0675-6: 1989-11, draft. Surge Arresters for use in AC Supply Systems with Rated Voltages Ranging from 100 to 1000V.

G. UL 1449 Transient Voltage Surge Suppressors 2nd Edition.

PART 2 PRODUCTS

2.01 GENERAL

A. Equipment power protection shall be accomplished by two-stage protection.

B. All wiring, hardware, and connection means shall be in compliance with the National Electrical Code and/or applicable local codes.

2.02 MOUNTING

A. All suppressors components shall have integral mounting brackets to attach to 35mm DIN rail conforming to DIN EN50022. The suppressors may be pre-mounted on a rail or electrical enclosure. The DIN rail and enclosure will be electrically grounded.

B. The suppressor shall be mounted as close as possible to the equipment.

C. Mounting guidelines will be followed as indicated in installation instruction provided by manufacturer.

2.03 WIRE CONNECTIONS

A. Wires shall be attached to the suppressor by means of a cable-clamping terminal block activated by a screw. Connections shall be gas-tight, and the terminal block shall be fabricated of non-ferrous, non-corrosive materials.

B. All wiring points and plug connections shall be "touch safe" with no live voltages that can make contact with a misplaced finger in accordance with IEC 529.

C. Service Entrance and Sub-Distribution protection devices shall be wired on the load side of the Service Entrance Disconnect or Sub-Distribution Disconnect.

2.04 EQUIPMENT

A. Lightning Arrester and Transient Voltage Suppressor

1. The enclosure shall consist of two-stage protection. The lightning arrester components shall have a protection level of 900 volts.

2. The lightning arrester components shall have a maximum rated operating voltage of at least 330 VAC from line to ground.

3. The lightning arrester components shall be tested to withstand at least 50 kA of lightning test current of a (10/350) µs waveform described by IEC 1024/Appli Guide A.

4. The lightning arrester components shall be able to quench 50 kA of follow (short circuit) current without properly sized over-current devices opening.

5. The lightning arrester components shall have a response time of 1 us or faster.

6. The lightning arrester components shall have an operating temperature range of at least -40oC to +85oC.

7. The lightning arrester components shall be wired in series with a 100 amp rated fuse specifically designed for use with surge protection devices.

8. The transient voltage suppressors shall be designed to withstand a one time surge of up to a 40 kA test current of a (8/20)µs waveform according to IEC 1024 Application Guide A and ANSI/IEEE C62.41 Category C Area.

9. The transient voltage suppressors shall have a SPDT contact rated for 250 VAC, 1 amp used for remote indication/visual indicator of circuit integrity.

10. The transient voltage suppressors shall have a rating of IP20 according to IEC 529. Replacing a plug shall not require the removal of any wires nor shall it interrupt the power to the protected. Bases shall have the ability to be coded to accept only the correct voltage plug.

11. The transient voltage suppressors shall have integral label holder to mark each terminal block.

12. The transient voltage suppressors shall have an operating temperature range of at least -25oC to +75oC.

2.05 MANUFACTURERS

A. Phoenix Contact Inc., P.O. Box 4100, Harrisburg, PA 17111, 717-944-1300

2.06 EXISTING PRODUCTS

A. Combination Service Entrance Lightning Protection AND Transient Voltage Surge Suppressor (TVSS), with External Fuse Status Indicating Lights and Enclosed in a NEMA 4X Stainless Steel Enclosure. Unit shall be suitable for outdoor installation at service entrance equipment or water well pump motors.

1. For 480/277 VAC 3-Phase WYE Systems: Phoenix Contact “COMBOTRAP” Model No. 2800718.

2. For 480 VAC Ungrounded 3-Phase Delta Systems: Phoenix Contact “COMBOTRAP” Model No. 2800722.

3. For 240 VAC 3-Phase High Delta Systems: Phoenix Contact “COMBOTRAP” Model No. 2800721.

4. For 208/120 VAC 3-Phase WYE Systems: Phoenix Contact “COMBOTRAP” Model No. 2800719.

5. For 120/240 VAC Split Single Phase Systems: Phoenix Contact “COMBOTRAP” Model No. 5603417.

6. Others as pre-approved by Engineer.

B. Installers of low-voltage lightning arresters shall be knowledgeable, and if required, certified, in all applicable electrical practices, standards, codes and wiring techniques as they pertain to installing surge suppressors.

C. Installers shall follow all applicable safety standards.

D. Installers shall follow manufacturer's installation instructions.

E. Installer shall mount SPD devices as close to the equipment as possible to keep phase and ground conductor as short as possible and free of sharp bends in conductors. Phase conductors to be #2 minimum and of equal length. Ground to system ground or to a separately installed ground rod with well for service entrance equipment or to ground rod with well for sub-distribution protected equipment such as a well motor. Installer shall make corrections to installation as directed by Engineer.

END OF SECTION

SECTION 16401
ELECTRIC SERVICE

PART 1 GENERAL

1.01 SUMMARY

A. Electric Utility Charges: Electric Utility charges for extension of distribution system to point of service termination and meters will be paid by Owner.

1.02 DEFINITIONS

A. Electric Utility: Local Electric Power Company.

1.03 QUALITY ASSURANCE

A. Regulatory Requirements. National Fire Protection Association (NFPA): NFPA No. 70-93 - National Electrical Code (NEC).

PART 2 PRODUCTS

2.01 ELECTRIC SERVICE

A. Electric Service Characteristics: As indicated on Drawings and provided by Electric Utility.

PART 3 EXECUTION

3.01 PREPARATION

A. Confirmation of Electric Service:

1. Consult with Electric Utility to verify service information specified and shown on Drawings.

2. Include deviations required by Electric Utility from contract documents to comply with Electric Utility standards and requirements.

B. Metering:

1. Consult with Electric Utility regarding service entrance requirements and metering equipment.

2. Install metering equipment and empty conduit for metering conductors to meet standards and requirements of Electric Utility.

C. Application for Electric Service.

1. Obtain required forms from Electric Utility.

2. Assist OWNER in completion of forms and deliver completed forms to Electric Utility.

3. Coordinate schedule for installation of electric service with Electric Utility.

END OF SECTION

SECTION 16402
UNDERGROUND DUCT BANKS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Underground electrical duct banks.

1.02 REFERENCES

A. National Fire Protection Association (NFPA). No. 70 - National Electrical Code (NEC) Appendix B.

1.03 SUBMITTALS

A. Submit all products covered under this specification, including catalog cut sheets of the ducts and spacers, for Engineer’s approval.

B. Submit a plan showing duct bank routing including conduits, width, depth, and cover of duct banks. Not required for lift station only projects.

1.04 DELIVERY, STORAGE AND HANDLING

A. Have duct spacers and associated hardware packed and crated to avoid damage during shipment and handling.

B. Clearly mark packages or crates stating that the material is for electrical duct banks only.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Thomas and Betts

B. Underground Devices Inc.

C. Walker Division, Butler Manufacturing Company

2.02 MATERIALS AND EQUIPMENT

A. Conduit: Construct ducts using schedule 40 rigid PVC conduit. Refer to Section 16111 - Conduit, Fittings and Bodies.

B. Spacers: Secure conduit with non-magnetic, universal, interlocking-type spacers for both horizontal and vertical duct arrangements on 2” and larger conduit.

C. Concrete: Use steel reinforced, red concrete, minimum 3,000# compressive strength at 28 days, as duct encasement.

PART 3 EXECUTION

3.01 PREPARATION

A. Verify from field survey that the location of ductbanks does not interfere with any existing or new underground facilities.

B. Verify that materials are on site in proper condition and that sufficient quantity is on hand for the work.

C. Verify that trenches are in the correct places and prepared with sufficient depth and width to accommodate the ductbanks, reinforcing rod, and concrete.

D. Be prepared for inspection of the duct banks before reinforcing rod is installed.

E. Before pouring concrete, verify that the ducts are free of debris and properly installed in the support and spacer systems and that the ducts are properly fitted together and firmly held in place by the hold down hardware.

F. Provide 24-hour notice to Engineer and the Local Code Inspector for cover-up inspection before pouring electrical conduit ductbanks.

3.02 INSTALLATION

A. Use the size and types of conduit as indicated for the various duct banks required for the project.

B. Make duct bank installations and penetrations through foundation walls watertight.

C. Assemble duct banks using saddles, spacers and separators. Position separators to provide 2-inch minimum concrete separation between the outer surfaces of the conduits.

D. Provide a 3-inch minimum concrete covering on both sides, top and bottom of concrete envelopes around conduits. Add red dye at the rate of 5 pounds per cubic yard to concrete used for envelopes for easy identification during subsequent excavation.

E. Firmly fix ducts in place during pouring of concrete. Carefully spade the concrete to ensure filling of spaces between ducts.

F. Make bends with sweeps of radius not less than 6 times the smallest diameter of the raceway.

G. Make a transition from non-metallic to metallic rigid conduit where duct banks enter structures or turn upward for continuation above grade.

H. Reinforce duct banks throughout:

1. Unless otherwise noted, reinforce with No. 5 longitudinal steel bars placed at each corner and along each face at a maximum parallel spacing of 12 inches on centers, and No. 3 tie-bars transversely placed as required for stability of longitudinal bars.

2. Maintain a minimum clearance of 2 inches from bars to the edge of the concrete encasement.

I. Where ducts enter structures such as handholes, manholes, pullboxes, or buildings, terminate the ducts in suitable end bells, insulated L-bushings, Meyers hubs or couplings on steel conduits. Tag conduit entering pull boxes. Identify as designated in cable and conduit schedule.

J. Do not backfill with material containing large rock, paving materials, cinders, large or sharply angular substances, corrosive material, or other materials which can damage or prevent adequate compaction of fill.

K. After completion of the duct bank and prior to pulling cable, pull a mandrel, not less than 12 inches long and with a cross section approximately one-fourth inch less than the inside cross section of the duct, through each duct. Then pull a rag swab or sponge through to remove any particles of earth, sand or gravel that may have been left in the duct. Repull the rag or sponge swab until the swab emerges clean.

L. Use polyester braided rope to pull conductors into PVC conduit. Do not use nylon or wire cable for this purpose.

M. Install a warning ribbon approximately 12 inches below finished grade over underground duct banks. Refer to Section 16195 - Electrical Identification.

N. For manholes and pull boxes below grade and greater than 5 feet wide, install wire racks to support cables properly around the perimeter and keep them dry.

END OF SECTION

[PAGE LEFT INTENTIONALLY BLANK]

SECTION 16452
GROUNDING

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:

1. Solid grounding of electrical systems and equipment.

2. Basic requirements for grounding for protection of life, equipment, circuits, and systems.

3. Grounding requirements specified in this Section may be supplemented in other sections of these Specifications.

1.02 REFERENCES

A. American Society for Testing and Materials (ASTM):

1. B3-90: Standard Specification for Soft or Annealed Copper Wire.

2. B8-90: Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft.

3. B33-91: Standard Specification for Tinned Soft or Annealed Copper Wire for Electrical Purposes.

4. E699 E1-79 - Standard Criteria for Evaluation of Agencies Involved in Testing, Quality Assurance, and Evaluating Building Components in Accordance with Test Methods Promulgated by ASTM committee E-6.

B. National Fire Protection Association (NFPA): NFPA 78-89 - Lightning Protection Code.

C. Underwriter's Laboratories (UL): 467 84 - UL Standard for Safety Grounding and Bonding Equipment.

1.03 SUBMITTALS

A. Submit all products covered under this specification for Engineer’s approval.

B. Test Results: Report of field tests and observations certified by Contractor.

1.04 QUALITY ASSURANCE

A. Items provided under this section shall be listed OR labeled by UL or other Nationally Recognized Testing Laboratory (NRTL).

1. Term "NRTL" shall be as defined in OSHA Regulation 1910.7.

2. Terms "listed" and "labeled" shall be as defined in National Electrical Code, Article 100.

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

PART 2 PRODUCTS

2.01 GROUNDING AND BONDING PRODUCTS

A. Products: Of types indicated and of sizes and ratings to comply with current NEC. Where types, sizes, ratings, and quantities indicated are in excess of current NEC requirements, more stringent requirements and greater size, rating, and quantity indications govern.

B. Conductor Materials: Copper.

2.02 WIRE AND CABLE CONDUCTORS

A. Comply with Section 16120. Conform to NEC Table 8, except as otherwise indicated, for conductor properties, including stranding.

B. Equipment Grounding Conductor: Green insulated.

C. Grounding Electrode Conductor: Stranded cable.

D. Bare Copper Conductors:

1. Solid Conductors: ASTM B3.

2. Assembly of Stranded Conductors: ASTM B8.

3. Tinned Conductors: ASTM B33.

2.03 MISCELLANEOUS CONDUCTORS

A. Ground Bus: Bare annealed copper bars of rectangular cross section.

B. Braided Bonding Jumpers: Copper tape, braided No. 30 gauge bare copper wire, terminated with copper ferrules.

C. Bonding Strap Conductor/Connectors: Soft copper, 0.05 in. thick and 2 in. wide, except as indicated.

2.04 CONNECTOR PRODUCTS

A. General: Listed and labeled as grounding connectors for materials used.

B. Pressure Connectors: High-conductivity-plated units.

C. Bolted Clamps: Heavy-duty units listed for application.

D. Exothermic Welded Connections: Provide in kit form and select for specific types, sizes, and combinations of conductors and other items to be connected.

2.05 GROUNDING ELECTRODES

A. Ground Rods: Copper-clad steel with high-strength steel core and electrolytic-grade copper outer sheath, molten welded to core, 3/4 inch by 20 feet unless otherwise indicated.

B. Plate Electrodes: Copper plates, minimum 0.10 in. thick, size as indicated.

PART 3 EXECUTION

3.01 APPLICATION

A. Equipment Grounding Conductor Application: Comply with NEC Article 250 for sizes and quantities of equipment grounding conductors, except where larger sizes or more conductors are indicated. Install separate insulated equipment grounding conductors with circuit conductors.

1. Raceway may be used as equipment ground conductor where feasible in non-hazardous areas and permitted by current NEC for lighting circuits and receptacle circuits.

2. Install insulated equipment ground conductor in nonmetallic raceways unless designated for telephone or data cables.

B. Underground Conductors: Bare, tinned, stranded copper except as otherwise indicted.

C. Signal and Communications: For telephone, alarm, instrumentation and communication systems, provide #4 AWG minimum green insulated copper conductor in raceway from grounding electrode system to each terminal cabinet or central equipment location.

D. Ground separately derived systems required by NEC to be grounded in accordance with NEC paragraph 250-26.

E. Metal Poles Supporting Outdoor Lighting Fixtures: Ground pole to grounding electrode as indicated in addition to separate equipment grounding conductor run with supply branch circuit.

F. Connections to Lighting Protection System: Bond grounding conductors or grounding conductor conduits to lighting protection down conductors or grounding conductors in compliance with NFPA 78.

G. Common Ground Bonding With Lighting Protection System:

1. Bond electric power system ground directly to lighting protection system grounding conductor at closest point to electric service grounding electrode.

2. Use bonding conductor sized same as system ground conductor and installed in conduit.

3.02 INSTALLATION

A. General: Ground electrical systems and equipment in accordance with current NEC requirements except where Drawings or Specifications exceed NEC requirements.

B. Ground Rods:

1. Locate minimum of one-rod length from each other and at least same distance from any other grounding electrode.

2. Interconnect ground rods with bare conductors buried at least 24 in. below grade.

3. Connect bare-cable ground conductors to ground rods by means of exothermic welds except as otherwise indicated.

4. Make connections without damaging copper coating or exposing steel.

5. Use ¾-inch by 20-ft. ground rods except as otherwise indicated.

6. Drive rods until tops are 6 inches below finished floor or final grade except as otherwise indicated.

C. Metallic Water Service Pipe:

1. Provide insulated copper ground conductors, sized as indicated, in conduit from building main service equipment, or ground bus, to main metallic water service entrances to building.

2. Connect ground conductors to street side of main metallic water service pipes by means of ground clamps.

3. Bond ground conductor conduit to conductor at each end.

D. Braided-type Bonding Jumpers: Use elsewhere for flexible bonding and grounding connections.

E. Route grounding conductors along shortest and straightest paths possible without obstructing access or placing conductors where they may be subjected to strain, impact, or damage, except as indicated.

F. Test Wells: Locate as indicated, and fabricate in accordance with details indicated.

G. UFER Ground:

1. Fabricate with 20 feet of conductor laid lengthwise in excavation for foundation or footings.

2. Install so conductor is within 2 in. of bottom of concrete.

3. Where base of foundation is less than 20 feet in length, coil excess conductor at base of foundation.

4. Bond conductor to reinforcing steel at four locations, minimum.

5. Extend conductor below grade and connect to building grounding grid or grounding electrode.

3.03 CONNECTIONS

A. General:

1. Make connections to minimize possibility of galvanic action or electrolysis.

2. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.

a. Use electroplated or hot-tin-coated materials to assure high conductivity and make contact points closer in order of galvanic series.

b. Make connections with clean bare metal at points of contact.

c. Aluminum to steel connections: stainless steel separators and mechanical clamps.

d. Aluminum to galvanized steel connections: tin-plated copper jumpers and mechanical clamps.

e. Coat and seal connections involving dissimilar metals with inert material such as red lead paint to prevent future penetration of moisture to contact surfaces.

B. Exothermic Welded Connections:

1. Use for connections to structural steel and for underground connections except those at test wells.

2. Install at connections to ground rods and plate electrodes.

3. Comply with manufacturers written recommendations.

4. Welds that are puffed up or that show convex surfaces indicating improper cleaning are not acceptable.

C. Terminations:

1. Terminate insulated equipment-grounding conductors for feeders and branch circuits with pressure-type grounding lugs.

2. Where metallic raceways terminate at metallic housings without mechanical and electrical connection to housing, terminate each conduit with grounding bushing.

3. Connect grounding bushings with bare grounding conductor to ground bus in housing.

4. Bond electrically noncontinuous conduits at both entrances and exits with grounding bushings and bare grounding conductors.

D. Tighten grounding and bonding connectors and terminals, including screws and bolts, in accordance with manufacturer's published torque-tightening values for connectors and bolts. Where manufacturer's torquing requirements are not indicated, tighten connections to comply with torque tightening values specified in UL 486A and UL 486B.

E. Connections at Test Wells: Use compression-type connectors on conductors and make bolted- and clamped-type connections between conductors and ground rods.

F. Compression-Type Connections: Use hydraulic compression tools to provide correct circumferential pressure for compression connectors. Use tools and dies recommended by manufacturer of connectors. Provide embossing die code or other standard method to make visible indication that connector has been adequately compressed on ground conductor.

G. Moisture Protection: Where insulated ground conductors are connected to ground rods or ground buses, insulate entire area of connection and seal against moisture penetration of insulation and cable.

3.04 OVERHEAD LINE GROUNDING

A. General: Comply with ANSI C2, "National Electrical Safety Code" for "Single-Grounded Systems," using two electrodes in parallel if single electrode resistance to ground exceeds 25 ohms.

B. Ground Rod Connections: Use exothermic welds for underground connections and connections to rods.

C. Lightning Arresters: Separate arrester grounds from other ground conductors.

D. Secondary Neutral and Tank of Transformer: Interconnect and connect to ground.

E. Grounding Conductor Protection: Protect grounding conductors running on surface of wood poles with molding of a type manufactured for this purpose. Extend from grade level up to and through communications and transformer spaces.

3.05 UNDERGROUND DISTRIBUTION SYSTEM GROUNDING

A. Manholes and Handholes:

1. Install ¾-inch by 20-ft. driven ground rod close to wall and set rod depth such that 4 inches will extend above finished floor.

2. Where necessary, install ground rod before manhole is placed and provide No. 1/0 bare tinned-copper conductor from ground rod into manhole through waterproof sleeve in manhole wall.

3. Protect ground rods passing through concrete floor with double wrapping of pressure-sensitive tape or heat-shrunk insulating sleeve from 2 in. above to 6 in. below concrete.

4. Seal floor opening with waterproof non-shrink grout.

B. Connections at Manholes:

1. Connect exposed metal parts, such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole to ground rod or ground conductor.

2. Make connections with minimum No. 4 AWG stranded hard-drawn copper wire.

3. Train conductors plumb or level around corners and fasten to manhole walls.

4. Connect to cable armor and cable shields by means of tinned terminals soldered to armor or shield, or as recommended by manufacturer of splicing and termination kits.

C. Grounding System: Ground non-current carrying metallic items associated with manholes, substations, and pad-mounted equipment by connecting them to bare underground cable and grounding electrodes arranged as indicated.

3.06 FIELD QUALITY CONTROL

A. Test:

1. Subject completed grounding system to megger test at each location where maximum ground resistance level is specified, at service disconnect enclosure ground terminal, and at ground test wells.

2. Measure ground resistance without soil being moistened by any means other than natural precipitation or natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.

3. Perform tests by 2-point method in accordance with Section 9.03 of IEEE 81, "Guide for Measuring Earth Resistivity, Ground Impedance and Earth Surface Potentials of a Grounding System."

B. Ground/resistance maximum values shall be as follows:

1. Equipment rated 500 kVA and less: 10 Ohms.

2. Equipment rated 500 kVA to 1000 kVA: 5 Ohms.

3. Equipment rated over 1000 kVA: 3 Ohms.

4. Unfenced substations and pad-mounted equipment: 5 Ohms.

5. Manhole grounds: 10 Ohms.

C. Deficiencies: Where ground resistances exceed specified values, notify Engineer, and if directed by Engineer, modify grounding system to reduce resistance values. Where measures are directed that exceed those indicated, provisions of Contract covering changes will apply.

D. Report: Prepare test reports, certified by testing organization, of ground resistance at each test location. Include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.

3.07 RESTORATION

A. Restore surface features at areas disturbed by excavation and reestablish original grades except as otherwise indicated.

B. Where sod has been removed, replace it as soon as possible after backfilling is completed.

C. Restore areas disturbed by trenching, storing of dirt, cable laying, and other Work to their original condition.

D. Include necessary topsoiling, fertilizing, liming, seeding, sodding, sprigging, or mulching.

E. Restore disturbed paving as indicated.

END OF SECTION

SECTION 16460
TRANSFORMERS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes: General purpose, dry type transformers.

1.02 REFERENCES

A. Underwriters Laboratories, Inc. (UL):

1. UL 486A-80 - Wire Connectors and Soldering Lugs for Use with Copper Conductors.

2. UL 506-89 - Specialty Transformers.

1.03 SUBMITTALS

A. Submit the following for Engineer’s approval.

B. Product Data:

1. Dimensional plans and sections.

2. Wiring diagrams.

3. Manufacturer's nameplate data and electrical ratings.

1.04 QUALITY ASSURANCE

A. Items provided under this section shall be listed or labeled by UL or other Nationally Recognized Testing Laboratory (NRTL).

1. Terms "NRTL" shall be as defined in OSHA Regulation 1910.7.

2. Terms "listed" and "labeled" shall be as defined in National Electrical Code, Article 100.

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

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Square D.

B. General Electric.

C. Or equal.

2.02 TRANSFORMERS, GENERAL

A. Transformers:

1. Factory-assembled and tested, air-cooled units of types specified, having characteristics and ratings as indicated.

2. Design unit for 60 Hz service.

B. Cores: Grain-oriented, non-aging silicon steel.

C. Coils: Continuous windings without splices, except for taps.

D. Internal Coil Connections: Brazed or pressure type.

E. Bolt coil/core to bottom of enclosure for transformers larger than 15 kVA.

1. Isolated by rubber, vibration absorbing mounts.

2. Metal-to-metal contact between coil/core and enclosure not allowed.

F. Provide copper windings.

G. Nameplates: Provide metal nameplate listing manufacturer's name, serial number, type, class, kVA voltage, frequency, and showing internal wiring diagram.

H. Sound Level: Minimum 3 dB less than sound levels for transformer type and size indicated when factory-tested in accordance with NEMA ST 20.

2.03 GENERAL PURPOSE, DRY TYPE TRANSFORMERS

A. Comply with NEMA ST 20.

B. Windings: 2-winding type. 3-phase transformers shall use 1 coil/ phase in primary and secondary.

C. Transformers shall have following features and ratings.

1. Enclosure: Indoor, ventilated unless otherwise shown on Drawings.

2. Insulation Class: 185C or 220C class for transformers 15 kVA or smaller; 220EC class for transformers larger than 15 kVA.

3. Insulation Temperature Rise: 80EC maximum rise above 40EC for 15 kVA and larger; 115EC maximum rise above 40EC below 15kVA

4. Taps: For transformers 3 kVA and larger, full capacity taps in high voltage winding as follows.

a. 3 through 10 kVA: Two 5% taps below rated high voltage.

b. 15 through 500 kVA: Six 2-1/2% taps, 2 above and 4 below rated high voltage.

c. 750 through 1,000 kVA: Four 2-1/2% taps, 2 above and 2 below rated high voltage.

D. Accessories:

1. Accessory items are required where shown on Drawings.

2. Wall Mounting Brackets: Manufacturer's standard brackets for transformers sized up to 75 kVA where wall mounting indicated.

2.04 CONTROL AND SIGNAL TRANSFORMERS

A. Comply with NEMA ST 1 and UL 506.

B. Ratings:

1. As indicated and for continuous duty.

2. Where rating not indicated, provide 125% of load.

C. Type: Self-cooled, 2-winding dry type.

D. Enclosure: Indoor, except as indicated.

PART 3 EXECUTION

3.01 INSTALLATION

A. Arrange equipment to provide adequate spacing for cooling air circulation.

B. Tighten electrical connectors and terminals in accordance with manufacturer's published torque-tightening values. Where manufacturer's torque values not indicated, use those specified in UL 486A and 486B.

C. Install wall-mounted transformers on prefabricated brackets designed for purpose.

D. Touch up scratched or marred surfaces to match original finish.

E. Identify transformers as specified herein.

F. Install lightning arresters as shown on Drawings.

3.02 GROUNDING

A. Ground in accordance with Section 16452.

3.03 FIELD QUALITY CONTROL

A. Test and permanently record as follows.

1. Prior to energization of transformers, test phase-to-phase and phase-to-ground insulation resistance levels.

2. Test transformers for continuity of circuits and short-circuits.

3.04 ADJUSTING

A. Adjust transformer taps to provide optimum voltage conditions at utilization equipment.

3.05 CLEANING

A. Upon completion of installation, inspect interiors and exteriors of accessible components.

1. Remove paint splatters and other spots, dirt, and construction debris.

2. Touch up scratches and mars of finish to match original.

3.06 PROTECTION

A. Temporary Heating: Comply with manufacturer's written recommendations within enclosure of each transformer throughout periods during which equipment is not in a space continuously under normal control of temperature and humidity.

END OF SECTION

SECTION 16470
PANELBOARDS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes: Lighting and power panelboards and associated auxiliary equipment rated 600 V or less.

1.02 REFERENCES

A. National Electrical Manufacturers Association (NEMA):

1. NEMA PB.1-90 - Panelboards.

2. NEMA PB1.1-91 - General Instructions for Proper Installation, Operation and Maintenance of Panelboards Rated 600 volts or less.

B. Underwriter's Laboratory (UL):

1. UL 486A-86- Wire Connectors and Soldering Lugs for Use with Copper Conductors, 7th Edition.

2. UL 870-85 - Wireways, Auxiliary Gutters, and Associated Fittings, 5th Edition.

1.03 DEFINITIONS

A. Load Center: Panelboard with thermal magnetic circuit-breaker branches, primarily of plug-in type, designed for residential and light commercial projects, operating at 240 V and below, available in both single and 3-phase versions, and equipped with combination flush/surface mounting trim.

B. Overcurrent Protective Device (OCPD): Device operative on excessive current that causes and maintains interruption of power in circuit it protects.

1.04 SUBMITTALS

A. Submit all products covered under this specification for Engineer’s approval.

B. Product Data:

1. For each type panelboard, accessory item, and component specified.

2. Identification materials.

C. Shop Drawings:

1. Dimensioned plans, sections, and elevations.

2. Tabulations of installed devices, major features, and voltage rating.

3. Include:

a. Enclosure type with details for types other than NEMA Type 1.

b. Bus configuration and current ratings.

c. Short-circuit current rating of panelboard.

d. Features, characteristics, ratings, and factory settings of individual protective devices and auxiliary components.

D. Wiring diagrams detailing schematic diagram including control wiring, and differentiating between manufacturer-installed and field- installed wiring.

1.05 QUALITY ASSURANCE

A. Items provided under this section shall be listed or labeled by UL or other Nationally Recognized Testing Laboratory (NRTL).

1. Terms "NRTL" shall be as defined in OSHA Regulation 1910.7.

2. Terms "listed" and "labeled" shall be as defined in National Electrical Code, Article 100.

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

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Square D Co.

B. General Electric

C. Eaton Corp.

D. Or equal.

2.02 PANELBOARDS, GENERAL REQUIREMENTS

A. Construction in accordance with NEMA PB1.

B. Overcurrent Protective Devices (OCPD):

1. Provide type, rating, and features as indicated.

2. Comply with Section 16475 with OCPD adapted to panelboard installation.

3. Tandem circuit breakers shall not be used.

4. Multipole breakers shall have common trip.

C. Enclosures: Cabinets, flush or surface mounted as indicated. NEMA Type 1 enclosure, except where other enclosure requirements are indicated.

D. Front:

1. Secure to box with concealed trim clamps except as indicated.

2. Front for surface-mounted panels shall be same dimensions as box.

3. Fronts for flush panels shall overlap box except as otherwise specified.

E. Directory Frame: Metal, mounted inside each panel door.

F. Bus: Hard drawn copper of 98 percent conductivity.

G. Main and Neutral Lugs: Mechanical type.

H. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment ground conductors. Bonded to box.

I. Provision for Future Devices: Equip with mounting brackets, bus connections, and necessary appurtenances, for the OCPD ampere ratings indicated for future installation of devices.

J. Special Features: Provide following features for panelboards as indicated.

1. Isolated Equipment Ground Bus: Adequate for branch-circuit equipment ground conductors; insulated from box.

2. Auxiliary Gutter: Conform to UL 870.

2.03 LOAD CENTERS

A. Provide load-center-type panelboards only where specifically indicated.

B. OCPD: Plug-in full module (nominal 1-in. width) circuit breaker.

C. Circuit Breakers for Switching Lights at Panelboards: Indicated type SWD.

D. Circuit Breakers for Equipment Marked HCAR Type: Indicated HCAR type.

E. Interiors: Provide physical means to prevent installation of more OCPD than quantity for which enclosure was listed.

F. Main, Neutral, and Ground Lugs and Buses: Mechanical connectors for conductors.

2.04 IDENTIFICATION

A. General: Provide nameplates for all panelboards.

B. Panelboard Nameplates: Engraved laminated plastic for each panelboard.

PART 3 EXECUTION

3.01 INSTALLATION

A. General: Install panelboards and accessory items in accordance with NEMA PB 1.1, and manufacturers' written installation instructions, and approved submittals.

B. Mounting Heights: Top of trim 6 ft 2-in. above finished floor, except as indicated.

C. Mounting:

1. Plumb and rigid without distortion of box.

2. Mount flush panels uniformly flush with wall finish.

D. Circuit Directory: Typed and reflective of final circuit changes required to balance panel loads. Obtain approval before installing.

E. Install filler plates in unused spaces.

F. Wiring in Panel Gutters: Train conductors neatly in groups, bundle, and wrap with wire ties after completion of load balancing.

3.02 GROUNDING

A. Connections: Make equipment-grounding connections for panelboards as indicated.

B. Provide ground continuity to main electrical ground bus indicated.

C. Ground in accordance with Section 16452.

3.03 CONNECTIONS

A. Tighten electrical connectors and terminals, including grounding connections, in accordance with manufacturer's published torque- tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A.

3.04 FIELD QUALITY CONTROL

A. Perform tests on low-voltage power panelboards and accessories.

B. Upon completing installation of system, perform following tests:

1. Make insulation resistance tests of panelboard buses, components, and connecting supply, feeder, and control circuits.

2. Make continuity tests of circuits.

C. Quality Control Program Procedures: Make field tests and inspections and prepare panelboard for satisfactory operation in accordance with manufacturer's recommendations and these specifications.

D. Visual and Mechanical Inspection: Include following inspections and related work:

1. Inspect for defects and physical damage, labeling, and nameplate compliance with requirements of up-to-date drawings and panelboard schedules.

2. Exercise and perform operational tests of all mechanical components and other operable devices in accordance with manufacturer's instruction.

3. Check panelboard mounting, area clearances, and alignment and fit of components.

4. Check tightness of bolted electrical connections with calibrated torque wrench. Refer to manufacturer's instructions for proper torque values.

5. Perform visual and mechanical inspection and related work for OCPD as within this section.

E. Electrical tests: Include following items performed in accordance with manufacturer's instruction:

1. Insulation resistance test of buses and portions of control wiring that disconnected from solid-state devices. Insulation resistance less than 100 megohms is not acceptable.

2. Ground resistance test on system and equipment ground connections.

3. Test main and subfeed OCPD in accordance within this section.

F. Retest: Correct deficiencies identified by tests and observations and provide retesting of panelboards. Verify by system tests that total assembly meets specified requirements.

3.05 CLEANING

A. Upon completion of installation, inspect interior and exterior of panelboards.

B. Remove paint splatters and other spots, dirt, and debris.

C. Touch up scratches and mars of finish to match original finish.

D. Clean interior of panelboard.

3.06 ADJUSTING

A. Adjust doors and operating mechanisms for free mechanical movement.

3.07 COMMISSIONING

A. Balancing Loads: After Substantial Completion, but before Final Acceptance, conduct load-balancing measurements and circuit changes as follows:

1. Perform measurements during period of normal working load as advised by Owner.

2. Perform load-balancing circuit changes outside the normal occupancy/working schedule of the facility. Make special arrangements with Owner to avoid disrupting critical 24-hour services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.

3. Recheck loads after circuit changes during normal load period. Record load readings before and after changes and submit test records.

4. Tolerance: Difference between phase loads exceeding 20 percent at any one panelboard is not acceptable. Re-balance and recheck as required to meet this minimum requirement.

END OF SECTION

SECTION 16475
OVERCURRENT PROTECTIVE DEVICES

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes: Overcurrent protective devices (OCPD) rated 600 V and below and switching devices commonly used with them.

1.02 REFERENCES

A. National Electrical Manufacturers Association (NEMA). NEMA AB1-86 - Molded Case Circuit Breakers and Molded Case Switches.

B. National Fire Protection Association (NFPA): NFPA 70-90 - National Electrical Code (NEC).

C. Underwriters Laboratory (UL):

1. UL 98-87 - Enclosed and Dead Front Switches.

2. UL 486A-80 - Wire Connectors and Soldering Lugs for Use with Copper Conductors. Seventh Edition.

3. UL 489-86 - Molded-Case Circuit Breakers and Circuit-Breaker Enclosures. Seventh Edition.

1.03 DEFINITIONS

A. Overcurrent Protective Device (OCPD): Device operative on excessive current that causes and maintains interruption of power in circuit it protects.

B. Ampere-Squared-Seconds: Expression of available thermal energy resulting from current flow. With regard to current-limiting fuses and circuit breakers, ampere-squared-seconds during fault current interruption represents energy allowed to flow before fuse or breaker interrupts fault current within its current limiting range.

1.04 QUALITY ASSURANCE

A. Items provided under this section shall be listed and labeled by UL or other Nationally Recognized Testing Laboratory (NRTL).

1. Term"NRTL" shall be as defined in OSHA Regulation 1910.7.

2. Terms "listed" and "labeled" shall be as defined in National Electrical Code, Article 100.

B. Regulatory Requirements. Components and Installation:

1. NFPA 70 "National Electrical Code (NEC)."

2. Local codes and ordinances.

C. Single-Source Responsibility: Obtain similar OCPD from single manufacturer.

PART 2 PRODUCTS

2.01 OVERCURRENT PROTECTIVE DEVICES (OCPD), GENERAL

A. General: Provide OCPD in indicated types, as integral components of panelboards, switchboards, and motor control centers; and also as individually enclosed and mounted single units.

2.02 MOLDED-CASE CIRCUIT BREAKERS

A. Manufacturers except as Indicated:

1. Square D Co.

2. General Electric

3. Eaton Corp.

4. Or equal.

B. UL 489 and NEMA AB 1.

C. Construction: Bolt-in type, except breakers in load-center-type panelboards and breakers 225-ampere frame size and larger may be plug-in type if held in place by positive locking device requiring mechanical release for removal.

D. Tripping Device: Quick-make, quick-break toggle mechanism with inverse-time delay and instantaneous overcurrent trip protection for each pole.

E. Adjustable Instantaneous Trip Devices: Factory adjusted to low-trip-setting current values.

F. Enclosure for Switchboard or Panelboard Mounting: Suitable for panel mounting in switchboard or panelboards where indicated.

G. Enclosure for Switchboard or Motor Control Center Mounting: Provide individual mounting where indicated.

H. Enclosure for Independent Mounting: NEMA Type 1 enclosure, as indicated or required to suit environment where located.

I. Combination Circuit Breakers and Ground-Fault Circuit Interrupters: UL 943 arranged for sensing and tripping for ground-fault current in addition to overcurrent and short-circuit current.

1. Match features and module size of panelboard breakers and provide clear identification of ground fault trip function.

2. Trip Setting for Ground Fault: 4 to 6 milliamperes, listed and labeled as Class A, Type 1 device.

3. Trip Setting for Ground Fault: 30 milliamperes.

J. Current-Limiting Circuit Breakers: Arranged to limit let-through ampere-squared-seconds during fault conditions to value less than ampere-squared-seconds of one-half-cycle wave of prospective symmetrical fault current. Circuit breaker shall use no fusible devices in its operation. Current-limiting characteristic shall be in addition to normal time-delay and instantaneous-trip characteristics and other features as indicated.

K. Circuit Breakers With Solid-State Trip Devices: Provide indicated circuit breakers with solid-state trip devices having following features:

1. Ambient Compensation: Trip device insensitive to temperature changes between minus 20C and plus 55C.

2. Adjustability: Breaker ratings and trip settings shall be changeable by operation of controls on front panel of breaker, by change of plug-in element without removing breaker from mounting, or by combination of 2 methods.

3. Ground-Fault Tripping: Adjustable for pick-up and time-delay values. Provide for indicated units.

4. Provide clear plastic shield limiting access to rating plug and adjustments on solid state trip circuit breaker. Seal by attaching sealing wire through hole in posts provided. With wire seal installed, circuit breaker rating plug and adjustments shall not be "readily accessible."

2.03 INSULATED-CASE CIRCUIT BREAKERS

A. Manufacturers:

1. Square D Co.

2. General Electric

3. Or equal.

B. UL 489 and NEMA AB 1.

C. Ratings: Continuous-current, interrupting, and short-time-current ratings, and voltage and frequency ratings as indicated.

D. Operating Mechanism: Mechanically and electrically trip-free, stored-energy operating mechanism with the following features:

1. Moving Contacts Closing Speed: Independent of both control and operator.

E. Circuit-Breaker Trip Devices: Solid-state overcurrent trip device system that includes one integrally mounted current transformer or sensor per phase, release mechanism, and following features:

1. Functions: Long-time-delay, short-time-delay, and instantaneous-trip functions, which are independent of each other in both action and adjustment.

2. Temperature compensation to assure accuracy and calibration stability from minus 20Celsuis to plus 55Celsuis.

3. Field-adjustable, time-current characteristics.

4. Current Adjustability: Effected by operating controls on front panel or by changing plug-in elements or current transformers or sensors.

5. Three bands for long time and short time-delay functions marked "minimum," "intermediate," and "maximum."

6. Five pickup points, minimum, for long time and short time-trip functions.

7. Six pickup points, minimum, for instantaneous-trip functions.

8. Ground fault protection with at least 3 short-time-delay settings and 37 trip-time-delay bands; adjustable current pickup.

9. Trip Indication: Labeled lights or mechanical indicators on trip device shall indicate type of fault causing breaker trip. If lights are used, integral power source shall maintain indication for 60 hours minimum.

F. Auxiliary Contacts for Remote Indication: Where remote indication of breaker position is indicated, provide spare auxiliary switch in addition to other auxiliary switches required for normal breaker operation. Spare auxiliary switch shall consist of 2 Type "a" and 2 Type "b" stages (contacts), wired to terminal block in breaker housing.

G. Circuit-Breaker Features and Accessories:

1. Padlocking Provisions: For installing at least two padlocks on each breaker to secure its enclosure and prevent movement of draw out mechanism.

2. Operating Handle: Provide one for each manually operated breaker. No handle ties are permitted.

3. Electric Close Button: Provide one for each electrically operated breaker.

4. Indicating Lights: Contacts for "Breaker Open" and "Breaker Closed," for main and bus tie circuit breakers, and for other indicated breakers.

PART 3 EXECUTION

3.01 CONNECTIONS

A. Check connectors, terminals, bus joints, and mountings for tightness.

B. Tighten field-connected connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values. Where manufacturer's torque requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL 486A and UL 486B.

3.02 GROUNDING

A. Provide equipment grounding connections for individually mounted OCPD units as indicated and as required by NEC. Tighten connectors to comply with tightening torques specified in UL Standard 486A to assure permanent and effective grounding.

B. Ground in accordance with Section 16452.

3.03 FIELD QUALITY CONTROL

A. Testing:

1. Reports: Prepare certified written reports on tests and observations. Report defective materials and workmanship and unsatisfactory test results. Include complete records of repairs and adjustments made.

2. Labeling: Upon satisfactory completion of tests and related effort, apply label to tested components indicating test results, date, and responsible person.

3. Schedule visual and mechanical inspections and electrical tests with at least 1 week's advance notification.

4. Pretesting. Upon completing installation of system, perform following preparations for tests:

a. Make insulation resistance tests of OCPD buses, components, and connecting supply, feeder, and control circuits.

b. Make continuity tests of circuits.

c. Include full updating on final system configuration and parameters where they supplement or differ from those indicated in original Contract Documents.

d. Comply with manufacturer's instructions for installation and testing of OCPD.

5. Visual and mechanical inspection: Include following inspections and related work.

   a. OCPD Ratings and Settings: Verify indicated ratings and settings to be appropriate for final system arrangement and parameters. Where discrepancies are found, test organization shall recommend final protective device ratings and settings. Use accepted revised ratings or settings to make final system adjustments.

   b. Inspect for defects and physical damage, NRTL labeling, and nameplate compliance with current single line diagram.

   c. Exercise and perform operational tests of mechanical components and other operable devices in accordance with manufacturer's instruction manual.

   d. Check tightness of electrical connections of OCPD with calibrated torque wrench. Refer to manufacturer's instructions for proper torque values.

   e. Clean OCPD using manufacturer's approved methods and materials.

   f. Verify installation of proper fuse types and ratings in fusible OCPD.

6. Electrical Tests: Include following items performed in accordance with manufacturer's instructions:

   a. Insulation resistance test of OCPD conducting parts. Insulation resistance less than 100 megohms is not acceptable.

   b. Verify trip unit reset characteristics for insulated-case circuit breakers.

   c. Make adjustments for final settings of adjustable-trip devices.

   d. Activate auxiliary protective devices such as ground fault or undervoltage relays, to verify operation of shunt-trip devices.

   e. Check stored-energy charging motors for proper operation of motor, mechanism, and limit switches.

   f. Check operation of electrically operated OCPD in accordance with manufacturer's instructions.

   g. Check key and other interlock and safety devices for operation and sequence. Make closing attempts on locked-open and opening attempts on locked-closed devices including moveable barriers and shutters.

7. Retest: Correct deficiencies identified by tests and observations and retest. Verify by system tests that specified requirements are met.

3.04 CLEANING

A. Upon completion of installation, inspect OCPD. Remove paint splatters and other spots, dirt, and debris. Touch up scratches and mars of finish to match original finish.

END OF SECTION

[PAGE LEFT INTENTIONALLY BLANK]

SECTION 16476
DISCONNECTS AND CIRCUIT BREAKERS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Service disconnects.
2. Feeder and equipment disconnects.
3. Enclosed circuit breakers.

1.02 SUBMITTALS

A. Submit the following for Engineer’s approval.

B. Product Data:

1. Submit for switches, circuit breakers, and accessories.
2. Descriptive data and time-current curves for protective devices and let through current curves for those devices with current-limiting characteristics. Include coordination charts and tables, and related data.

C. Shop Drawings: Wiring diagrams detailing power and control wiring and differentiating clearly between manufacturer-installed wiring and field-installed wiring.

D. Test Results: Field test reports indicating and interpreting test results.

E. Operating and Maintenance Data: Maintenance data for tripping devices.

1.03 QUALITY ASSURANCE

A. Items provided under this section shall be listed or labeled by UL or other Nationally Recognized Testing Laboratory (NRTL).

1. Term "NRTL" shall be as defined in OSHA Regulation 1910.7.
2. Terms "listed" and "labeled" shall be as defined in National Electrical Code, Article 100.

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

C. Single-Source Responsibility: Enclosed switches and circuit breakers shall be product of single manufacturer.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Fusible Switches:

1. Square D Co.

2. Cutler-Hammer Products/Westinghouse Electric Co.

B. Fused Power Circuit Devices:

1. Square D Co.

2. Boltswitch.

C. Molded-Case Circuit Breakers:

1. Square D Co.

2. Cutler-Hammer Products

D. Combination Circuit Breaker and Ground Fault Trip:

1. Square D Co.

2. Cutler-Hammer Products/Westinghouse Electric Co.

3. General Electric

E. Molded-Case Current-Limiting Circuit Breakers:

1. Square D Co.

2. Cutler-Hammer Products/Westinghouse Electric Co.

2.02 ENCLOSED SWITCHES

A. Enclosed Non-fusible Switch: NEMA KS 1, Type HD handle lockable with 2 padlocks.

B. Enclosed Fusible Switch, 800 Amperes and Smaller: NEMA KS 1, Type KD, clips to accommodate specified fuses, enclosure consistent with environment where located, handle lockable with 2 padlocks, and interlocked with cover in CLOSED position.

C. Enclosed Fusible Switch Larger than 800 Amperes: Bolted-pressure or high-pressure contact switch, bus drilled to accommodate specified fuses, enclosure consistent with environment where located. Minimum Fault Current Rating: 100,000 symmetrical rms amperes.

2.03 ENCLOSED CIRCUIT BREAKERS

A. Enclosed Molded-Case Circuit Breaker: NEMA AB 1, handle lockable with 2 padlocks.

B. Characteristics:

1. Frame size, trip rating, number of poles, and auxiliary devices as indicated

2. Interrupting capacity rating to meet available fault current, 10,000 symmetrical rms amperes minimum

3. Appropriate application listing when used for switching fluorescent lighting loads or heating, air conditioning, and refrigeration equipment.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install enclosed switches and circuit breakers in locations as indicated, according to manufacturer's written instructions.

B. Install enclosed switches and circuit breakers level and plumb.

C. Install wiring between enclosed switches and circuit breakers and control/indication devices.

D. Connect enclosed switches and circuit breakers and components to wiring system and to ground as indicated and instructed by manufacturer. Tighten connectors and terminals, including screws and bolts according to equipment manufacturer's published torque-tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals according to tightening torques specified in UL Standard 486A.

3.02 FIELD QUALITY CONTROL

A. Manufacturer’s Field Services: Supplier’s or manufacturer’s representative for equipment specified herein shall be present at job site or for assistance during plant construction, plant startup, and training of Owner’s personnel for plant operation.

B. Testing: After installing enclosed switches and circuit breakers and after electrical circuitry has been energized, demonstrate product capability and compliance with requirements.

1. Procedures: Perform each visual and mechanical inspection and electrical test stated in NETA Standard ATS, Section 7.5 for enclosed switches and Section 7.6 for molded-case circuit breakers. Certify compliance with test parameters.

2. Correct malfunctioning units at site, where possible, and retest to demonstrate compliance: otherwise, remove and replace with new units, and retest.

C. Training:

1. Train Owner's maintenance personnel on procedures and schedules for startup and shutdown, troubleshooting, servicing, and preventive maintenance.

2. Review operating and maintenance data.

3.03 ADJUSTING

A. Set field-adjustable enclosed switches and circuit breaker trip ranges as indicated.

3.04 CLEANING

A. After completing system installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finish including chips, scratches, and abrasions.

END OF SECTION

SECTION 16481
MOTOR CONTROLLERS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes: AC motor control devices rated 600v and below.

B. Overcurrent protective devices and disconnect switches used with motor controllers are specified in Section 16475.

1.02 DEFINITIONS

A. Motor Controller: Device that controls, protects, and energizes electric motor, and where required, controls its speed or torque or power delivered by it.

1.03 SUBMITTALS

A. Submit the following for Engineers approval:

1. Product Data: Include dimensions, ratings, and data on features and components.

2. Test Results: Certified reports of field tests and observations.

3. Miscellaneous: Load Current and Overload Relay Heater List: Compiled by Contractor after motors have been installed. Arrange list to demonstrate selection of heaters to suit actual motor nameplate full load currents.

4. Operation and Maintenance (O&M) Data: Manufacturer's data on maintenance and operation of equipment.

1.04 QUALITY ASSURANCE

A. Single-Source Responsibility: Obtain similar motor-control devices from single manufacturer.

B. Manufacturer Qualifications: Provide controllers from manufacturers regularly engaged in manufacture of equipment of types and capacities indicated, with such products in satisfactory use in similar service for not less than 5 yrs.

C. Items provided under this section shall be listed or labeled by UL or other Nationally Recognized Testing Laboratory (NRTL).

1. Term "NRTL" shall be as defined in OSHA Regulation 1910.7.

2. Terms "listed" and "labeled" shall be as defined in National Electrical Code (NEC), Article 100.

D. Regulatory Requirements. National Electrical Code (NEC): Components and installation shall comply with National Fire Protection Association (NFPA) No. 70.

1.05 COORDINATION

A. Coordinate features of controllers and control devices with pilot devices and control circuits provided under other sections of Specifications covering control systems.

1.06 MAINTENANCE

A. Extra Materials. Spare Fuses and Incandescent Indicating Lamps: Furnish one spare for every five installed units, but not less than one set of three of each kind.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Manual and Magnetic Motor Controllers:

1. Square D Company
2. Westinghouse Electric Corporation
3. Eaton Corporation
4. Furnas Electric Controls
5. Approved equal

2.02 MOTOR CONTROLLERS, GENERAL

A. Coordinate features of each motor controller with ratings and characteristics of supply circuit, motor, required control sequence, duty cycle of motor, drive, and load, and pilot device, and control circuit affecting controller functions. Provide controllers horsepower rated to suit motor controlled.

B. NEMA Size 1 minimum.

C. Contacts shall open each ungrounded connection to motor.

D. Overload Relays:

1. Ambient-compensated type with inverse-time-current characteristic.
2. Provide with heaters or sensors in each phase matched to nameplate full load current of specific motor to which connected with appropriate adjustment for duty cycle.

3. Enhanced Protection Overload Relay: Provide overload relays with NEMA Class 10 tripping characteristics for submersible equipment or where indicated. Select to protect motor against voltage unbalance and single phasing.

E. Enclosures:

1. For individually mounted motor controllers and control devices, comply with NEMA 250.

2. Provide enclosures suitable for environmental conditions at controller location.

3. Provide NEMA Type enclosures as indicated or required to suit environment where located.

2.03 MANUAL MOTOR CONTROLLERS

A. Quick-make, quick-break toggle action.

B. Doublebreak silver alloy contacts.

C. Pilot light.

D. Padlocking provision.

2.04 MAGNETIC MOTOR CONTROLLERS

A. Full voltage, non-reversing, across the line, magnetic controller, except where another type indicated.

B. Control Circuit: 120v. Control power transformer integral with controller where no other supply of 120v control power to controller indicated. Control power transformer with adequate capacity to operate connected pilot, indicating and control devices, plus 100% spare capacity.

C. Combination Controller: Switch type; fused or nonfused as indicated; quick-make, quick-break switch; factory assembled with controller and arranged to disconnect it. For fused switches, provide rejection type fuse clips and fuses rated as indicated.

D. Combination Controller: Motor circuit protector; molded case circuit breaker type with magnetic only trip element calibrated to coordinate with actual locked rotor current of connected motor and controller overload relays. Provide breakers factory-assembled with controller, interlocked with unit cover or door, and arranged to disconnect controller. Provide motor circuit protectors with field-adjustable trip elements.

E. Overvoltage/Undervoltage/Phase-Failure Relays: Solid-state sensing circuit with isolated output contacts for hard-wired connection. Provide adjustable undervoltage setting.

1. Provide in starter enclosure for Size 2 and larger starters.

2. Delay initial motor start.

3. Delay motor restart due to starter dropout caused by undervoltage or starter coil circuit interruption for maintained control circuits.

4. Adjustable on delay from 0.15 to 30.0 sec set at 10.0 sec.

5. Connect control relay in motor starter coil circuit.

6. Coordinate control relay selection with motor starter to cause motor starter to drop out at voltage slightly higher than dropout voltage of starter and have dropout time slightly faster than motor starter to ensure if motor starter drops out, relay will drop out.

2.05 AUXILIARY CONTROL DEVICES

A. General: Furnish auxiliary control device as specified. Factory-install in controller enclosure except as otherwise indicated.

B. Pushbutton Stations, Pilot Lights, and Selector Switches: Heavy-duty type.

C. Stop Pushbutton Station: Momentary break pushbutton station with factory-applied hasp arranged so padlock can be used to lock pushbutton in depressed position with control circuit open.

D. Lockout Pushbutton Station: Maintained contact red mushroom pushbutton station with factory-applied hasp arranged so padlock can be used to lock pushbutton in depressed position with control circuit open.

E. Control Relays: Auxiliary and adjustable time-delay relays.

F. Elapsed Time Meters: Heavy duty with digital readout in hrs.

G. Ammeters, Voltmeters, and Frequency Meters: Panel type, 2 ½-in. minimum size with 90 or 120 degree scale, and ±2% accuracy. Where indicated, provide transfer device with off position.

H. Current Sensors: Rated to suit application.

I. Current-Sensing Phase-Failure Relays: Solid-state sensing circuit with isolated contacts for hard-wired connection. Arranged to operate on phase failure, phase reversal, current unbalance of from 5% to 30%, or loss of supply voltage. Provide adjustable response delay.

PART 3 EXECUTION

3.01 INSTALLATION

A. General: Install motor controllers and auxiliary motor control devices in accordance with manufacturer's written instructions and approved submittals.

B. Mounting:

1. For control equipment at walls, bolt single units to wall. Mount multiple units on lightweight structural steel channels bolted to wall.

2. For controllers not at walls, provide freestanding racks fabricated of structural steel members and lightweight slotted structural steel channels. Use feet consisting of 3/8-in. thick steel plates, 6-in. square, bolted to floor. Use feet for welded attachment of 1-1/2-in. by 1-1/2-in. by ¼-in. vertical angle posts not over 3-ft oc. Connect posts with horizontal lightweight slotted steel channels and bolt control equipment to channels.

C. Motor Controller Fuses and Circuit Breakers: Conform to requirements of Section 16475.

3.02 IDENTIFICATION

A. Comply with Section 16195.

3.03 CONTROL WIRING INSTALLATION

A. Install wiring as specified in Section 16120.

B. Install wiring in enclosures bundled, trained, and supported.

3.04 CONNECTIONS

A. Tighten connectors, terminals, and mountings. Tighten field-connected connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque-tightening values. Where manufacturer's torquing requirements not indicated, comply with tightening torques specified in UL 486A and 486B.

3.05 FIELD QUALITY CONTROL

A. Manufacturer's Field Services: Supplier's or manufacturer's technician for equipment specified herein shall be present at job site or classroom designated by Owner for minimum mandays indicated, travel time excluded, for equipment adjustment, and training of Owner’s personnel for plant operation. Include minimum of ½ manday for Instructional Services.

B. Testing:

1. Reports: Notify Engineer in writing indicating defective materials and workmanship and unsatisfactory test results. Include records of repairs and adjustments made.

2. On completing installation of system, perform following tests:

a. Make insulation resistance tests of conducting parts of motor control components; and of connecting supply, feeder, and control circuits. For devices containing solid-state components, use test equipment and methods recommended by manufacturer.

b. Make continuity tests of circuits.

c. Review updating of final system configuration and parameters where they supplement or differ from those indicated in original Contract Documents.

d. Review manufacturer's written instructions for installation and testing of motor control devices.

3. Visual and Mechanical Inspection: Include following inspections and related work.

a. Motor Control Device Ratings and Settings: Verify ratings and settings as installed are appropriate for final loads and final system arrangement and parameters. Recommend final protective device ratings and settings where differences found. Use accepted revised ratings or settings to make final system adjustments.

b. Inspect for defects and physical damage and nameplate.

c. Exercise and perform operational tests of mechanical components and other operable devices in accordance with manufacturer's written instructions.

d. Check tightness of electrical connections of devices with calibrated torque wrench. Use manufacturer's recommended torque values.

e. Clean devices using manufacturer's approved methods and materials.

f. Verify proper fuse types and ratings in fusible devices.

4. Electrical Tests: Perform following in accordance with manufacturer's written instructions.

a. Insulation resistance test of motor control devices conducting parts to extent permitted by manufacturer's written instructions. Insulation resistance less than 100-megohms not acceptable.

b. Use primary current injection to check performance characteristics of motor circuit protectors and for overload relays of controllers for motors 15 hp and larger. Trip characteristics not within manufacturer's published time-current tolerances not acceptable.

c. Make adjustments for final settings of adjustable trip devices.

d. Test auxiliary protective features such as loss of phase, phase unbalance, and undervoltage to verify operation.

e. Check for improper voltages at terminals in controllers having external control wiring when controller disconnect opened. Voltage over 30v unacceptable.

5. Correct deficiencies and retest motor control devices. Verify by system tests that specified requirements are met.

3.06 ADJUSTING

A. Overvoltage/Undervoltage/Phase Failure Control Relay: Adjust control relay to cause motor starter to drop out at voltage slightly higher than dropout voltage of starter and have dropout time slightly faster than motor starter to ensure if motor starter drops out, relay will drop out.

3.07 CLEANING

A. Remove paint splatters and other spots, dirt, and debris. Touch up scratches and mars of finish to match original finish. Clean devices internally using manufacturer's recommended methods and materials.

END OF SECTION

[PAGE LEFT INTENTIONALLY BLANK]

SECTION 16496
AUTOMATIC TRANSFER SWITCH

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes: Delayed transition automatic transfer switches to automatically transfer between normal and standby power sources.

1.02 REFERENCES

A. National Fire Protection Association (NFPA): NFPA 70 - National Electrical Code (NEC)

B. National Electrical Manufacturer's Association (NEMA): NEMA ICS 2-447- AC Automatic Transfer Switches

C. Underwriters Laboratories (UL): UL 1008 - Standard for Automatic Transfer Switches

1.03 SUBMITTALS

A. Submit all products covered under this specification for Engineer's approval.

B. Manufacturer shall submit shop drawings for review, which shall include the following, as a minimum:

1. Descriptive literature

2. Plan, elevation, side, and front view arrangement drawings, including overall dimension, weights and clearances, as well as mounting or anchoring requirements and conduit entrance locations.

3. Schematic diagrams.

4. Wiring diagrams.

5. Accessory list.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Zenith

B. ASCO

C. Onan

D. Russelectric

E. Pre-approved equal

2.02 CONSTRUCTION

A. General:

1. The delayed transition automatic transfer switch shall be furnished as shown on the drawings. Voltage and continuous current ratings and number of poles shall be as shown. Switches shall be UL listed in accordance with UL-1008.

2. The transfer switch shall be mounted in a NEMA 1 enclosure for indoors and NEMA 4X S.S. for outdoors, unless otherwise indicated. Enclosures shall be fabricated from 12-gauge steel. The enclosure shall be sized to exceed minimum wire bending space required by UL 1008. Outdoor enclosures shall have no exposed controls.

3. The transfer switch shall be equipped with an internal welded steel pocket, housing an operations and maintenance manual.

4. The transfer switch shall be top and bottom accessible.

5. The main contacts shall be capable of being replaced without removing the main power cables.

6. The main contacts shall be visible for inspection without any major disassembly of the transfer switch.

7. All bolted bus connections shall have Belleville compression type washers.

8. When a solid neutral is required, a fully rated bus bar with required AL-CU neutral lugs shall be provided.

9. Control components and wiring shall be front accessible. All control wires shall be multiconductor 18 gauge 600-volt SIS switchboard type point to point harness. All control wire terminations shall be identified with tubular sleeve-type markers.

10. The switch shall be equipped with 90 degrees C rated copper/aluminum solderless mechanical type lugs.

11. The complete transfer switch assembly shall be factory tested to ensure proper operation and compliance with the specification requirements. A copy of the factory test report shall be available upon request.

12. Transfer time shall be of sufficient duration to allow motor run controls to drop out or, Contractor shall provide additional time delay controls to accomplish this function.

B. Automatic Transfer Switch:

1. The transfer switch shall be double throw, actuated by two electric operators momentarily energized, and connected to the transfer mechanism by a simple over center type linkage.

2. The normal and emergency contacts shall be positively interlocked mechanically and electrically to prevent simultaneous closing. Main contacts shall be mechanically locked in both the normal and emergency positions without the use of hooks, latches, magnets, or springs, and shall be silver-tungsten alloy. Separate arcing contacts with magnetic blowouts shall be provided on all transfer switches. Interlocked, molded case circuit breakers or contactors are not acceptable unless specifically shown on plans.

3. The transfer switch shall be equipped with a safe external manual operator, designed to prevent injury to operating personnel. The manual operator shall be front accessible and shall provide “quick make-quick break” operation, offering the same contact to contact transfer speed as the electrical operator to prevent switching the main contacts slowly. The external manual operator shall be UL listed for operation, under load, from the outside of the transfer switch while the door is closed.

C. Automatic Transfer Switch Controls:

1. The transfer switch shall be equipped with a microprocessor based control system, to provide all the operational functions of the automatic transfer switch. The controller shall have two asynchronous serial ports. The controller shall have a real time clock with Nicad battery back-up.

2. The CPU shall be equipped with self diagnostics, which perform periodic checks of the memory I/O and communication circuits, with a watchdog/power fail circuit

3. The controller shall use industry standard open architecture communication protocol for high speed serial communications via multidrop connection to other controllers and to a master terminal with up to 4000 ft of cable, or further, with the addition of a communication repeater. The serial communication port shall be RS422/485 compatible.

4. The serial communication port shall allow interface to either the manufacturer’s or the owner’s furnished remote supervisory control.

5. The controller shall have password protection required to limit access to qualified and authorized personnel.

6. The controller shall include a 20-character, LCD display, with a keypad, which allows access to the system.

7. The controller shall include three-phase over/under voltage, over/under frequency, phase sequence detection and phase differential monitoring on both normal and emergency sources.

8. The controller shall be capable of storing the following records in memory for access either locally or remotely:

   a. Number of hours transfer switch is in the emergency position (total since record reset).

   b. Number of hours emergency power is available (total since record reset).

   c. Total transfer in either direction (total since record reset).

   d. Date, time, and description of the last four source failures.

   e. Date of the last exercise period.

   f. Date of record reset.

D. Sequence of Operation:

1. When the voltage on any phase of the normal source drops below 80% or increases to 120%, or frequency drops below 90%, or increase to 110%, or 20% voltage differential between phases occurs, after a programmable time delay period of 0-9999 seconds factory set at 3 seconds to allow for momentary dips, the engine starting contacts shall close to start the generating plant.

2. The transfer switch shall transfer to emergency when the generating plant has reached specified voltage and frequency on all phases.

3. After restoration of normal power on all phases to a preset value of at least 90% to 110% of rated voltage, and at least 95% to 105% of rated frequency, and voltage differential is below 20%, an adjustable time delay period of 0-9999 seconds (factory set at 300 seconds) shall delay retransfer to allow stabilization of normal power. If the emergency power source should fail during this time delay period, the switch shall automatically return to the normal source.

4. After retransfer to normal, the engine generator shall be allowed to operate at no load for a programmable period of 0-9999 seconds, factory set at 300 seconds.

E. Automatic Transfer Switch Accessories:

1. Programmable three phase sensing of the normal source set to pickup at 90% and dropout at 80% of rated voltage and overvoltage to pickup at 120% and dropout out at 110% of rated voltage. Programmable frequency pickup at 95% and dropout at 90% and over frequency to pickup at 110% and dropout at 105% of rated frequency. Programmable voltage differential between phases, set at 20%, and phase sequence monitoring.

2. Programmable three phase sensing of the normal source set to pickup at 90% and dropout at 80% of rated voltage and overvoltage to pickup at 120% and dropout out at 110% of rated voltage programmable frequency pickup at 95% and dropout at 90% and over frequency to pickup at 110% and dropout at 105% of rated frequency. Programmable voltage differential between phases set at 20%, and phase sequence monitoring.

3. Time delay for override of momentary normal source power outages (delays engine start signal and transfer switch operation). Programmable 0-9999 seconds. Factory set at 3 seconds, if not otherwise specified.

4. Time delay to control contact transition time on transfer to either source. Programmable 0-9999 seconds, factory set at 10 seconds.

5. Time delay on retransfer to normal, programmable 0-9999 seconds, factory set at 300 seconds if not otherwise specified, with overrun to provide programmable 0-9999 second time delay, factory set at 300 seconds, unloaded engine operation after retransfer to normal.

6. Time delay on transfer to emergency, programmable 0-9999 seconds, factory set at 10 seconds.

7. A maintained type load test switch shall be included to simulate a normal power failure, keypad initiated.

8. A remote type load test switch shall be included to simulate a normal power failure, remote switch initiated.

9. A time delay bypass on retransfer to normal shall be included. Keypad initiated.

10. Contact, rated 10 Amps 30 volts DC, to close on failure of normal source to initiate engine starting.

11. Contact, rated 10 Amps 30 volts DC, to open on failure of normal source for customer functions.

12. Light emitting diodes shall be mounted on the microprocessor panel to indicate: switch is in normal position, switch is in emergency position and controller is running.

13. A plant exerciser shall be provided with (10) 7 day events, programmable for any day of the week and (24) calendar events, programmable for any month/day, to automatically exercise generating plant programmable in one minute increments. Also include selection of either "no load" (switch will not transfer) or "load" (switch will transfer) exercise period. Keypad initiated.

14. Provision to select either "no commit" or "commit" to transfer operation in the event of a normal power failure shall be included. In the "no commit position," the load will transfer to the emergency position unless normal power returns before the emergency source has reach 90% of its rated values (switch will remain in normal). In the "commit position" the load will transfer to the emergency position after any normal power failure. Keypad initiated.

15. Two auxiliary contacts rated 10 Amp, 120 volts AC (for switches 100 to 800 amps) 15 amp, 120 volts AC (for switches 1000 to 4000 amps), shall be mounted on the main shaft, one closed on normal, the other closed on emergency. Both contacts will be wired to a terminal strip for ease of customer connections.

16. A three phase digital LCD voltage readout, with 1% accuracy shall display all three separate phase-to-phase voltages simultaneously, for both the normal and emergency source.

17. A digital LCD frequency readout with 1% accuracy shall display frequency for both normal and emergency source.

18. An LCD readout shall display normal source and emergency source availability.

19. Contacts for “Transfer Impending”, adjustable 0-120 SEC.

20. Outdoor installations shall include one or more space heaters designed to prevent condensation in the enclosure.

F. Ratings:

1. Delayed transition automatic transfer switches shall have the following 3 cycle short circuit closing and withstand as follows:

RMS Symmetrical Amperes 480 VAC

Amperes	Closing and Withstand	Current Limiting Fuse Rating
100-400	42,000	200,000
600-800	65,000	200,000
1000-1200	85,000	200,000
1600-4000	100,000	200,000

2. During the 3 cycle closing and withstand tests, there shall be no contact welding or damage. The 3 cycle tests shall be performed without the use of current limiting fuses. The test shall verify that contacts separation has not occurred, and there is contact continuity across all phases. Test procedures shall be in accordance with UL-1008, and testing shall be certified by Underwriters' Laboratories, Inc.

3. When conducting temperature rise tests to UL-1008, the manufacture shall include post-endurance temperature rise tests to verify the ability of the transfer switch to carry full rated current after completing the overload and endurance tests.

4. The microprocessor controller shall meet the following requirements:

   a. Storage conditions - 25 degrees C to 85 degrees C

   b. Operation conditions - 20 degrees C to 70 degrees C ambient

   c. Humidity 0 to 99% relative humidity, noncondensing

   d. Capable of withstanding infinite power interruptions

   e. Surge withstand per ANSI/IEEE C-37.90A-1978

5. Manufacturer shall provide copies of test reports upon request.

G. Manufacturer:

1. The transfer switch manufacturer shall employ a nationwide factory-direct, field service organization, available on a 24-hour a day, 365 days a year, call basis.

2. The manufacture shall include an 800-telephone number, for field service contact, affixed to each enclosure.

3. The manufacturer shall maintain records of each transfer switch, by serial number, for a minimum 20 years.H. Warranty: Provide 5 year standard manufacturer's warranty consisting of 2 years parts and labor, and an additional 3 years of replacement parts. Warranty shall be "on site" and warranty service shall be available by the factory service department on an emergency basis if required. Depot or non-site warranties are not acceptable.

H. Warranty: Provide 5 year standard manufacturer's warranty consisting of 2 years parts and labor, and an additional 3 years of replacement parts. Warranty shall be "on site" and warranty service shall be available by the factory service department on an emergency basis if required. Depot or non-site warranties are not acceptable.

PART 3 EXECUTION

3.01 INSTALLATION

A. Automatic Transfer Switches shall be provided with adequate lifting means for ease of installation of wall or floor mounted enclosures.

B. Provide access and working space as indicated or as required.

3.02 ADJUSTMENTS

A. Tighten assembled bolted connections with appropriate tools to manufacturer's torque recommendations prior to first energization.

3.03 START-UP AND TESTING

A. Provide the services of a factory representative to checkout, test, and start-up the automatic transfer switch in conjunction with the standby generator. Fully function test the automatic transfer switch to verify proper operation.

END OF SECTION

SECTION 16525
EXTERIOR LIGHTING

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes: Exterior lighting fixtures, lamps, ballasts, poles standards, and accessories.

1.02 REFERENCES

A. American Association of State Highway and Transportation AASHTO LTS-1-Standard Officials (AASHTO). Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals.

B. American National Standards Institute (ANSI):

1. ANSI C2-90 - National Electrical Safety Code.

2. ANSI C78.1-91 to C78.1502 - Electric Lamps.

3. ANSI C82.4-85 - Ballasts for High-Intensity-Discharge and Low-Pressure Sodium Lamps (Multiple-Supply Type).

C. American Society for Testing and Materials (ASTM): ASTM A500 - REV A-90 - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.

1.03 DEFINITIONS

A. Fixture: Complete lighting unit. Fixtures include lamp or lamps and parts required to distribute light, position and protect lamps, and connect lamps to power supply.

B. Lighting Unit: Fixture, or assembly of fixtures with common support, including pole or bracket plus mounting and support accessories.

C. Luminaire: Fixture.

1.04 SUBMITTALS

A. Submit all products covered under this specification for Engineer’s approval.

B. Product Data.

1. Describe fixtures, lamps, ballasts, poles, and accessories.

2. Arrange Product Data in order of fixture designation.

3. Include data on features, poles, accessories, and following:

   a. Outline drawings of fixtures and poles indicating dimensions and principal features.

   b. Electrical ratings and photometric data with certified results of independent laboratory tests.

1.05 QUALITY ASSURANCE

A. Items provided under this section shall be listed and labeled by UL or other Nationally Recognized Testing Laboratory (NRTL).

   1. Term "NRTL" shall be as defined in OSHA Regulation 1910.7.

   2. Terms "listed" and "Labeled" shall be as defined in National Electrical Code, Article 100.

B. Regulatory Requirements:

   1. National Electrical Code: Components and installation shall comply with NFPA 70.

   2. Comply with ANSI C2, "National Electrical Safety Code."

C. Fixtures for Hazardous Locations: Conform to UL 844 or get Factory Mutual Engineering and Research Corporation (FM) certification for the class and division of hazard.

D. Manufacturers' Qualifications: Firms experienced in manufacturing lighting units that are similar to those indicated for this Project and that have record of successful in-service performance.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Poles:

   1. General: Store poles on decay-resistant treated skids at least 1 ft above grade and vegetation. Support pole to prevent distortion and arrange to provide free air circulation.

   2. Metal Poles: Retain factory-applied pole wrappings until just before pole installation. For poles with nonmetallic finishes, handle with web fabric straps.

1.07 WARRANTY

A. Special Project Warranty: Submit warranty, mutually executed by manufacturer and the Installer, agreeing to replace external parts of lighting fixtures exhibiting failure of finish as specified below. This warranty is in addition to, and not limitation of, other rights and remedies Owner may have under Contract Documents.

1. Protection of Metal from Corrosion: Warranty against perforation or erosion of finish due to weathering.

2. Color Retention: Warranty against fading, staining, and chalking due to effects of weather and solar radiation.

3. Project Warranty Period: 1 yr, beginning on the date of Substantial Completion.

PART 2 PRODUCTS

2.01 FIXTURE COMPONENTS, GENERAL

A. Metal Parts: Free from burrs and sharp edges and corners.

B. Sheet Metal Components: Corrosion-resistant aluminum, except as indicated. Form and support to prevent warping and sagging.

C. Housings: Rigidly formed, weather- and light-tight enclosures that will not warp, sag, or deform in use. Provide filter/breather for enclosed fixtures.

D. Doors, Frames, and Other Internal Access Provisions: Smooth operating, free from light leakage under operating conditions, and arranged to permit relamping without use of tools. Arrange doors, frames, lenses, diffusers, and other pieces to prevent accidental falling during relamping and when secured in the operating position. Provide for door removal for cleaning or replacing lens. Arrange for door opening to disconnect ballast.

E. Exposed Hardware Material: Stainless steel.

F. Reflecting Surfaces: Minimum reflectances as follows, except as otherwise indicated:

1. White Surfaces: 85%.

2. Specular Surfaces: 83%.

3. Diffusing Specular Surfaces: 75%.

G. Plastic Parts: Resistant to yellowing and other changes due to aging and exposure to heat and UV radiation.

H. Lenses and Refractors: Materials as indicated. Use heat- and aging-resistant, resilient gaskets to seal and cushion lens and refractor mounting in fixture doors.

2.02 HIGH-INTENSITY DISCHARGE (HID) FIXTURES

A. Fixtures: Conform to UL 1572.

B. Ballasts: Conform to UL 1029 and ANSI C82.4; provide constant wattage autotransformer (CWA) or regulating high-power factor type, unless otherwise indicated.

1. Operating voltage matches system voltage.

2. Single-Lamp Ballasts: Minimum starting temperature of -30EC.

3. Construct ballasts so open circuit operation will not reduce average life.

2.03 FIXTURE SUPPORT COMPONENTS

A. Pole-Mounted Fixtures: Conform to AASHTO LTS-1.

B. Wind-Load Strength: 100 mph and 1.3 gust factor for total support assembly, including pole, base, and anchorage, where used, to carry fixtures, supports, and appurtenances at indicated heights above grade without deflection or whipping.

C. Arm, Bracket, and Tenon Mount Materials: Match the poles.

D. Mountings, Fastenings, and Appurtenances: Corrosion-resistant components compatible with poles and fixtures that will not cause galvanic action at contact points. Provide mountings that will correctly position luminaire to provide indicated light distribution.

E. Pole Shafts: As shown on Plans.

F. Pole Bases: Anchor type with galvanized steel hold-down or anchor bolts, leveling nuts, and bolt covers.

G. Steel Poles: Steel tubing conforming to ASTM A500, Grade B, carbon steel with minimum yield of 46,000 psi. Poles are 1-piece construction up to 40 ft in length and have access handhole in wall.

H. Steel Mast Arms: Fabricated from 2-in. pipe, continuously welded to pole attachment plate and having span and rise as indicated.

I. Metal Pole Brackets: Designed to match pole metal. Provide cantilever brackets without underbrace, in the sizes and styles indicated, with straight tubular end section to accommodate the fixture.

J. Pole-Top Tenons: Fabricated to support fixture indicated and securely fastened to the pole top.

K. Metal Pole Grounding Provisions: Welded 1/2-in. threaded lug, accessible through handhole.

2.04 LAMPS

A. Conform to ANSI Standards, C78 series, applicable to each type of lamp. Provide fixtures with indicated lamps. Where lamps are not indicated, provide lamps recommended by manufacturer.

2.05 FINISH

A. Metal Parts: Manufacturer's standard finish except as otherwise indicated. Finish applied over corrosion-resistant primer, free of streaks, runs, holidays, stains, blisters, and similar defects. Remove poles, fixtures, and accessories showing evidence of corrosion or finish failure during Project warranty period and replace with new items.

B. Other Parts: Manufacturer's standard finish except as otherwise indicated.

PART 3 EXECUTION

3.01 INSTALLATION

A. Set units plumb, square, level, and secure according to manufacturer's written instructions and approved submittals.

3.02 CONCRETE FOUNDATIONS

A. Construct concrete foundations with 3,000-lb, 28-day concrete.

B. Embedded Poles: Set poles to indicated depth, but not less than 1/6 of pole length below finish grade. Dig holes large enough to permit use of tampers full depth of hole. Backfill in 6-in. layers and thoroughly tamp each layer so compaction of backfill is equal to or greater than that of undisturbed earth.

C. Pole Installation: Use fabric web slings (not chain or cable) to raise and set poles.

D. Fixture Attachment: Fasten to indicated structural supports.

E. Fixture Attachment with Adjustable Features or Aiming: Attach fixtures and supports to allow aiming for indicated light distribution.

F. Lamp fixtures with indicated lamps according to manufacturer's instructions. Replace malfunctioning lamps.

3.03 GROUNDING

A. Ground fixtures and metal poles as specified in Section 16452.

1. Poles: Install 10-ft driven ground rod at each pole.

2. Nonmetallic Poles: Ground metallic components of lighting unit and foundations. Connect fixtures to grounding system with No. 6 AWG conductor.

3.04 FIELD QUALITY CONTROL

A. Inspect installed units for damage.

B. Provide advance notice of dates and times for field tests.

C. Provide instruments to make and record test results.

D. Tests: Verify normal operation of lighting units after installing fixtures and energizing circuits with normal power source.

E. Replace or repair damaged and malfunctioning units and retest.

3.05 ADJUSTING AND CLEANING

A. Clean components on completion of installation. Use methods and materials recommended by manufacturer.

B. Adjust aimable fixtures to provide required light intensities.

END OF SECTION

SECTION 16935
TELEPHONE AUTOMATIC DIALER SYSTEM

PART 1 GENERAL

1.01 SYSTEM DESCRIPTION

A. Design Requirements:

1. Electronic system shall interface plant alarms to public telephone system on preselected basis.

2. Upon receipt of one or more critical alarm trips, electronic system will automatically dial out onto public phone system (up to 16 specified telephone numbers) with preprogrammed messages.

3. System shall continue calling until call completed and acknowledged.

4. Description & Phone Number Dialing: The dialer shall be a solid state component capable of dialing up to 16 phone numbers, each up to 24 digits in length. Phone numbers and Standard pulse dialing or Touch Tone DTMF dialing are user programmable via the system keyboard or Touch Tone Phone.

5. Solid State Voice Message Recording and Playback:

a. The unit shall have two different categories of speech message capability, all implemented with permanent non-volatile solid-state circuitry with no mechanical tape mechanisms. The unit shall allow for message recording from a remote telephone as well as from the front panel.

b. User Field Recorded Messages: The user may record and re-record his own voice messages, for each input channel and for the Station ID.

c. There shall be no limit on the length of any particular message, within the overall available message recording time, which shall be 40 seconds for 4 channel units; 80 seconds for 8 channel units, and 160 seconds for 16 or more channels.

d. The unit shall allow selective recording of both Normal and Alarm advisory messages for each input channel.

e. The unit shall provide for automatic setting of the optimum speech memory usage rate for the total set of messages recorded, in order to achieve optimum recording sound quality.

f. Circuit board switches or jumper straps shall not be acceptable means of manipulating message length or recording rates.

g. Permanent Resident Non Recorded Messages: Permanent built-in messages shall be included to support user programming operations, to provide supplemental warning messages such as advising that the alarms have been disabled, and to allow the unit to be fully functional even when the installer has not recorded any messages of his own.

6. Nonvolatile Program Memory Retention: User-entered programming and voice message shall be kept intact even during power failures or when all power is removed for up to ten years.

7. Acknowledgment: Acknowledgment of an alarm phone call is to be accomplished by pressing a Touch Tone “9” as the alarm call is being received, and /or by returning a phone call after received an alarm call.

8. Input Monitoring Function: The unit shall continuously monitor the presence of AC power and the status of multiple contact closure inputs. Unit shall optionally be field upgradeable to incorporate a total of 8, 16, 24, or 32 dry contact inputs. AC power failure, or violation of the alarm criteria at any input, shall cause the unit to go into alarm status and begin dial-outs. Unit shall, upon a single program entry, automatically accept all input states as the normal non-alarm state, eliminating possible confusion about Normally Open versus Normally Closed inputs. Further, as a diagnostic aid, unit shall have the capability of directly announcing the state of any given input as currently an open circuit or a closed circuit, without disturbing any message programming. Each input channel shall also be independently programmable, without need to manipulate circuit board switches or jumpers, as Normally Open or Normally Closed, or for No Alarm (status only), or for Pulse Totalizing, or for Run Time Metering.

9. Alarm Message: Upon initiating an alarm phone call, the system is to speak only those channels that are currently in alarm status.

10. Diagnostics: The unit shall provide a complete verbal report of all programmable functions and their programmed values on command from any remote Touch Tone phone.

11. Speakerphone: The unit shall be capable of dialing any phone number on command and function as a speakerphone.

12. Inquiry Message and Function: Inquiry phone calls can be made directly to the unit at any time from any telephone, locally or long distance, for a complete status report of all variables being monitored, including power status.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Raco.

1. Raco Verbatim 8-channel minimum for lift station applications or as indicated on the plans.

2. Raco Verbatim 16-channel minimum for water plant and wastewater treatment plant applications or as indicated on the plans.

3. Raco Verbatim Gateway with 16 channel minimum and 32 PLC address monitoring continuously for applications requiring direct PLC monitoring as indicated on the plans. Supported protocols shall include Modbus Plus, Modbus RTU, Allen Bradley DFI, and Allen Bradley DH485. Plant PLC shall be designated Master and autodialer shall be configured to monitor I/O points, PLC addresses, or data tables and any auto dialer function to alter or change PLC settings shall be inhibited.

B. Or equal.

2.02 DIALER

A. Enclosure: NEMA 12 indoor and NEMA 4X outdoor surface mount.

B. Remote Reset: Alarm acknowledged by either depressing touch-tone key or calling dialer back when alarm acknowledged from non-touch-tone telephone.

C. The dialer is to use a standard rotary pulse or Touch Tone dial-up phone line (direct leased line not to be required) and is to be FCC approved. Connection to the telephone is through a 4-pin modular jack (RJ-11).

D. All power, phone line, dry contact, and analog signal inputs shall be protected at the circuit board IEEE Standard 587, category B (6,000 volts open circuit/3,000 amps closed circuit). Gas tubes followed by solid-state protectors shall be integral to the circuit board for each such line. Protectors mounted external to the main circuit board shall not be an acceptable substitute. The installer shall provide a good electrical ground connection point near the unit to maximize the effectiveness of the surge protection.

E. The dialer shall be covered by a two-year warranty cover parts and labor performed at the factory.

F. Operating Temperature: 32 F to 160 F.

G. Operating Humidity: 0% to 90%.

H. Output: To standard phone line through integral FCC approved alarm coupler.

I. Power: 120 VAC, 60 Hz.

J. 20-hour battery backup.

K. All features per manufacturers catalog data.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's written instructions and as indicated on the drawings.

END OF SECTION

Power Generation

Recommended Generator Report - C50 D6

Project - 7648_FBOP_LS

Comments -

Project Requirements

Frequency, Hz	: 60.0	**Generators Running in Parallel**	: 1
Duty	: Standby	**Site Altitude, ft(m)**	: 617(188)
Voltage	: 277/480, Series Wye	**Site Temperature, °C**	: 35
Phase	: 3	**Max. Altr Temp Rise, °C**	: 105
Fuel	: Diesel	**Project Voltage Distortion Limit, %**	:
Emissions	: EPA, stationary emergency application		

Calculated Individual Generator Set Load Running and Peak Requirements

Running kW	: 24.8	**Max. Step kW**	: 35.5 In Step 2	**Cumulative Step kW**	: 51.7
Running kVA	: 27.4	**Max. Step kVA**	: 67.0 In Step 2	**Cumulative Step kVA**	: 84.5
Running PF	: 0.91	**Peak kW**	: None	**Cumulative Peak kW**	: None
Running NLL kVA	: 0.0	**Peak kVA**	: None	**Cumulative Peak kVA**	: None
Alternator kW	: 24.84			**Pct Rated Capacity**	: 50.0

Generator Set Configuration

Alternator	: CA125-L14	**Engine**	: 4BTAA3.3-G7
BCode	: BB95	**Fuel**	: Diesel
Excitation	: PMG	**Displacement, cu in. (Litre)**	: 199.0(3.3)
Voltage Range	: 480/277V	**Cylinders**	: 4
Number of Leads	: 12	**Altitude Knee, ft(m)**	: 4100(1250)
Reconnectable	: Yes	**Altitude Slope, % per 985ft(300.2m)**	: 6
Full Single Phase Output	: No	**Temperature Knee, °F(°C)**	: 104(40)
Increased Motor Starting	: No	**Temperature Slope, % per 18°F(10.0°C)**	: 10
Extended Stack	: No	**Emissions**	: Tier 3
		Cooling Package	: High Ambient

Set Performance

Running At	: 50.0% Rated Capacity
Max. Step Voltage Dip, %	: 15
Max. Step Frequency Dip, %	: 3
Peak Voltage Dip, %	:
Peak Frequency Dip, %	:
Site Rated Standby kW/kVA	: 50 / 63
Site Rated Max. SkW	: 59
Max. SkVA	: 225
Temp Rise at Full Load, °C	: 105
Voltage Distortion	:
Site Rated Max Step kW Limit	:

Load Requirements

Max. Allowed Step Voltage Dip	: 15 In Step 2
Max. Allowed Step Frequency Dip	: 10 In Step 2
Peak Voltage Dip Limit %	: 15.0
Peak Frequency Dip Limit %	: 10
Running kW	: 24.8
Running kVA	: 27.4
Effective Step kW	: 42.6
Effective Step kVA	: 84.5
Percent Non-Linear Load	: 0.0
Voltage Distortion Limit	:
Max Step kW	:

*Note: Higher temperature rise at full rated load.

*Note: All generator set power derates are based on open generator sets.

Loads Summary Report

Project - 7648_FBOP_LS

Comments -

Project Requirements

Frequency, Hz	:	60.0	**Generators Running in Parallel**	:	1
Duty	:	Standby	**Site Altitude, ft(m)**	:	617(188)
Voltage	:	277/480, Series Wye	**Site Temperature, °C**	:	35
Phase	:	3	**Max. Altr Temp Rise, °C**	:	105
Fuel	:	Diesel	**Project Voltage Distortion Limit, %**	:	
Emissions	:	EPA, stationary emergency application			

Loads Summary List

***Note: Detailed Loads and Step Report available below**

Step No.	Load Name	Quantity	Running		Starting		Peak		Dip Limits, %		VTHD% Limit
			kW	kVA	kW	kVA	kW	kVA	Vdip	Fdip	
Step01	Light Load 1	1	7.5	7.5	7.5	7.5	None	None	15.0	10.0	0.0
Step Summary			8.0	8.0	8.0	8.0	None	None	15.0	10.0	0.0
Step02	Lift Pump No. 1	1	8.67	9.97	35.51	67.0	None	None	15.0	10.0	0.0
Step Summary			9.0	10.0	36.0	67.0	None	None	15.0	10.0	0.0
Step03	Lift Pump No. 2	1	8.67	9.97	35.51	67.0	None	None	15.0	10.0	0.0
Step Summary			9.0	10.0	36.0	67.0	None	None	15.0	10.0	0.0

Project Summary	Running		Max Starting		Cumulative Step		Cumulative Peak		Project VTHD% Limit
	kW	kVA	kW	kVA	kW	kVA	kW	kVA	
	24.8	27.4	35.5	67.0	51.7	84.5	0.0	0.0	0.0

***Note: Detailed Loads and Step Report available below**

Power Generation

Loads and Steps Detail Report

Project - 7648_FBOP_LS

Comments -

Project Requirements

Frequency, Hz	: 60.0	**Generators Running in Parallel**	: 1
Duty	: Standby	**Site Altitude, ft(m)**	: 617(188)
Voltage	: 277/480, Series Wye	**Site Temperature, °C**	: 35
Phase	: 3	**Max. Altr Temp Rise, °C**	: 105
Fuel	: Diesel	**Project Voltage Distortion Limit, %**	:
Emissions	: EPA, stationary emergency application		

Calculated Individual Generator Set Load Running and Peak Requirements

Running kW	: 24.8	**Max. Step kW**	: 35.5 In Step 2	**Cumulative Step kW**	: 51.7
Running kVA	: 27.4	**Max. Step kVA**	: 67.0 In Step 2	**Cumulative Step kVA**	: 84.5
Running PF	: 0.91	**Peak kW**	: None	**Cumulative Peak kW**	: None
Running NLL kVA	: None	**Peak kVA**	: None	**Cumulative Peak kVA**	: None
Alternator kW	: 24.84				

Step1

Calculated Individual Generator Set Step Load Requirements

Running kW	: 8.0	**Starting kW**	: 8.0	**Cumulative Step kW**	: 8.0
Running kVA	: 8.0	**Starting kVA**	: 8.0	**Cumulative Step kVA**	: 8.0
Running Amps	: 9.0	**Starting Non-linear kVA**	: 0.0		
Running Non-linear kVA	: 0.0				
Alternator kW	: 7.5				
Voltage Distortion Limit for step	: 0				

Light Load 1 Single Phase Quantity : 1 In this Step

Category : Light - Incandescent

Running kW	: 7.5	**Starting kW**	: 7.5	**Peak kW**	: None
Running kVA	: 7.5	**Starting kVA**	: 7.5	**Peak kVA**	: None
Running PF	: 1.0	**Starting PF**	: 1.0	**Cyclic**	: No
Running Amps	: 15.62	**Max. % Voltage Dip**	: 15.0	**Max. % Frequency Dip**	: 10.0
Alternator kW	: 7.5			**Voltage**	: 480

Step2

Calculated Individual Generator Set Step Load Requirements

Running kW	: 9.0	**Starting kW**	: 36.0	**Cumulative Step kW**	: 43.0
Running kVA	: 10.0	**Starting kVA**	: 67.0	**Cumulative Step kVA**	: 75.0
Running Amps	: 12.0	**Starting Non-linear kVA**	: 0.0		

Running Non-linear kVA	: 0.0				
Alternator kW	: 8.67				
Voltage Distortion Limit for step	: 0				

Lift Pump No. 1 Three Phase Quantity : 1 In this Step

Category : Motor

Running kW	: 8.67	**Starting kW**	: 35.51	**Peak kW**	: None
Running kVA	: 9.97	**Starting kVA**	: 67.0	**Peak kVA**	: None
Running PF	: 0.87	**Starting PF**	: 0.53	**Cyclic**	: No
Running Amps	: 12.01	**Max. % Voltage Dip**	: 15.0	**Max. % Frequency Dip**	: 10.0
Alternator kW	: 8.67			**Voltage**	: 480

Shaft Hp	: 10.0	**Method**	: Across the line
Shaft kW	: 7.46	**Low Inertia**	: No
Efficiency (%)	: 0.86	**LRkVA Factor**	: 6.7
Design	: Standard NEMA Design B,C or D	**LRkVA Code**	: H
Load Factor	: 100.0		

Step3

Calculated Individual Generator Set Step Load Requirements

Running kW	: 9.0	**Starting kW**	: 36.0	**Cumulative Step kW**	: 52.0
Running kVA	: 10.0	**Starting kVA**	: 67.0	**Cumulative Step kVA**	: 84.0
Running Amps	: 12.0	**Starting Non-linear kVA**	: 0.0		
Running Non-linear kVA	: 0.0				
Alternator kW	: 8.67				
Voltage Distortion Limit for step	: 0				

Lift Pump No. 2 Three Phase Quantity : 1 In this Step

Category : Motor

Running kW	: 8.67	**Starting kW**	: 35.51	**Peak kW**	: None
Running kVA	: 9.97	**Starting kVA**	: 67.0	**Peak kVA**	: None
Running PF	: 0.87	**Starting PF**	: 0.53	**Cyclic**	: No
Running Amps	: 12.01	**Max. % Voltage Dip**	: 15.0	**Max. % Frequency Dip**	: 10.0
Alternator kW	: 8.67			**Voltage**	: 480

Shaft Hp	: 10.0	**Method**	: Across the line
Shaft kW	: 7.46	**Low Inertia**	: No
Efficiency (%)	: 0.86	**LRkVA Factor**	: 6.7
Design	: Standard NEMA Design B,C or D	**LRkVA Code**	: H
Load Factor	: 100.0		

Power Generation

Steps and Dips Details Report

Project - 7648_FBOP_LS

Project Requirements

Frequency, Hz	: 60.0	**Generators Running in Parallel**	: 1
Duty	: Standby	**Site Altitude, ft(m)**	: 617(188)
Voltage	: 277/480, Series Wye	**Site Temperature, °C**	: 35
Phase	: 3	**Max. Altr Temp Rise, °C**	: 105
Fuel	: Diesel	**Project Voltage Distortion Limit, %**	:
Emissions	: EPA, stationary emergency application		

Calculated Individual Generator Set Load Running and Peak Requirements

Running kW	: 24.8	**Max. Step kW**	: 35.5 In Step 2	**Cumulative Step kW**	: 51.7
Running kVA	: 27.4	**Max. Step kVA**	: 67.0 In Step 2	**Cumulative Step kVA**	: 84.5
Running PF	: 0.91	**Peak kW**	: None	**Cumulative Peak kW**	: None
Running NLL kVA	: 0.0	**Peak kVA**	: None	**Cumulative Peak kVA**	: None
Alternator kW	: 24.84				

Generator Set Configuration

Model	: C50 D6	**Alternator**	: CA125-L14
Engine Model	: 4BTAA3.3-G7	**Excitation**	: PMG
Fuel	: Diesel		High Ambient

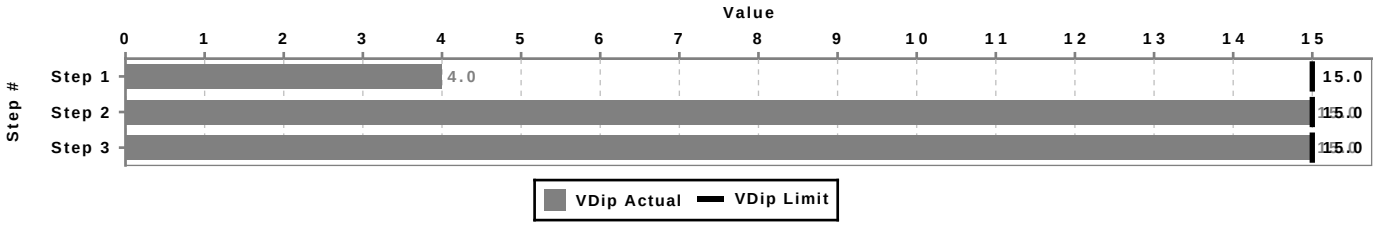
Step Level Dips Summary

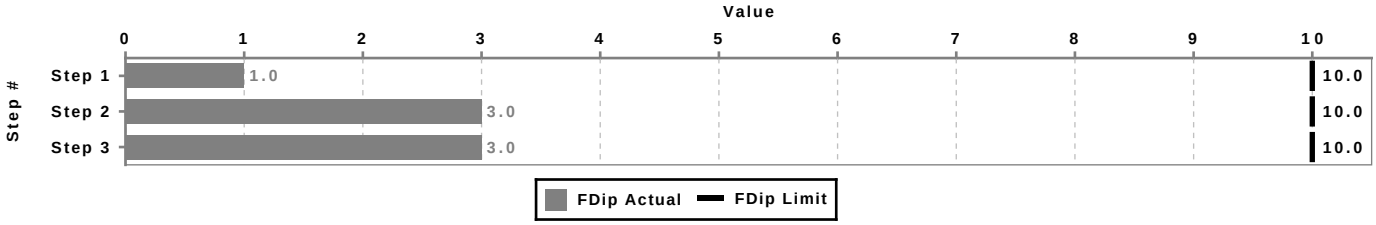
Step #	Voltage Dip Limit (%)	Expected Step Voltage Dip (%)	Voltage Recovery Time (s) **	Frequency Dip Limit (%)	Expected Frequency Dip (%)	Frequency recovery Time (s) **
1*	15	4	0.9	10	1	0.3
2	15	15	2.6	10	3	0.6
3	15	15	2.6	10	3	0.6

Note: Please refer to the model Spec. sheet for bandwidths used to report recovery times. For products manufactured in the United Kingdom it may be assumed that recovery times are based on ISO8528-5 G2 class bandwidths. Voltage and frequency recovery times are estimates. Typically, allow five to ten seconds between application of load steps when designing your system.

*Caution: The starting PF for this step exceeds 0.8 lagging. The actual transient performance of the generator for these steps may vary compared to the results predicted by GenSize.Contact your Cummins Distributor for Guidance.

**Please note that in some cases the voltage and frequency recovery time estimates are not shown in list. This is a result of "dummy" data points temporarily being used to fill data gaps in the GenSize database. Please disregard these blank results.

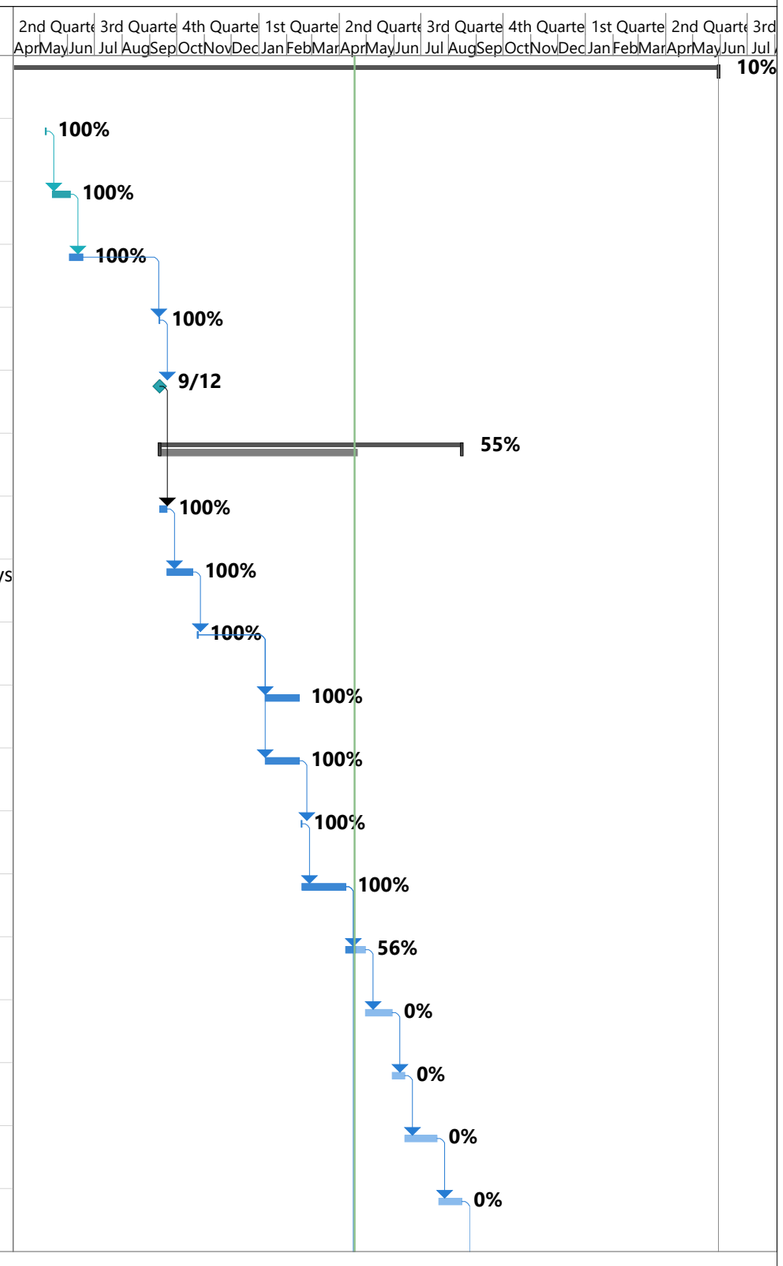

Value
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
Step #
Step 1
Step 2
Step 3
4.0
15.0
15.0
15.0
VDip Actual
VDip Limit


Value
0 1 2 3 4 5 6 7 8 9 10
Step #
Step 1
Step 2
Step 3
1.0
3.0
3.0
10.0
10.0
10.0
FDip Actual
FDip Limit

Project Schedule

2138 - Farmers Branch Schedule Update - 2025.04.18

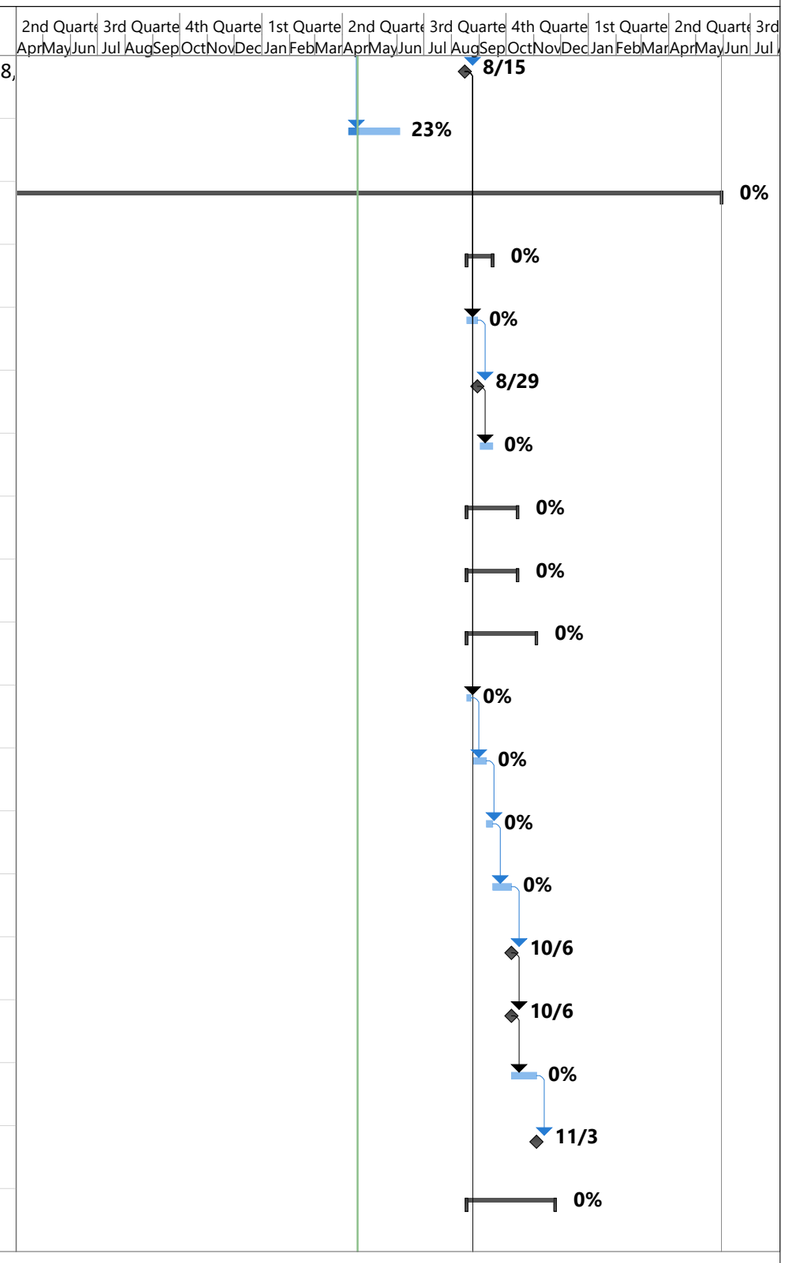
ID	Task Name	Duration	Start	Actual Start	Finish	Actual Finish	Predecessors	Total Slack	Successors
1	**Farmers Branch OPLS - Project Duration**	**1432 days**	**Mon 10/26/20**	**Mon 10/26...**	**Fri 5/29/26**	**NA**		**0 days**	
2	CMAR Proposals Due	1 day	Tue 5/7/24	Tue 5/7/24	Tue 5/7/24	Tue 5/7/24		0 days	3
3	CMAR Selection	13 days	Wed 5/15/24	Wed 5/15/24	Mon 6/3/24	Mon 6/3/24	2	0 days	4
4	Proposal Submission	11 days	Mon 6/3/24	Mon 6/3/24	Mon 6/17/24	Mon 6/17/24	3	0 days	5
5	Project Kickoff Meeting	1 day	Wed 9/11/24	Wed 9/11/24	Wed 9/11/24	Wed 9/11/24	4	0 days	6
6	NTP for Preconstruction	0 days	Thu 9/12/24	NA	Thu 9/12/24	NA	5	437 days	8
7	**Design & Preconstruction**	**237 days**	**Thu 9/12/24**	**Thu 9/12/24**	**Fri 8/15/25**	**NA**		**200 days**	
8	60% Design & Engineer's OPCC Delivery to Felix	6 days	Thu 9/12/24	Thu 9/12/24	Thu 9/19/24	Thu 9/19/24	6	0 days	9
9	60% Design Review / VE Evaluation & Cost Model	21 days	Fri 9/20/24	Fri 9/20/24	Fri 10/18/24	Fri 10/18/24	8	0 days	10FS+3 days
10	60% Project Review Meeting	1 day	Thu 10/24/24	Thu 10/24/24	Thu 10/24/24	Thu 10/24/24	9FS+3 days	0 days	11,12
11	90% Design & Engineer's OPCC Development	28 days	Wed 1/8/25	Wed 1/8/25	Fri 2/14/25	Fri 2/14/25	10	0 days	
12	90% Design Review / VE Evaluation & Cost Model	28 days	Wed 1/8/25	Wed 1/8/25	Fri 2/14/25	Fri 2/14/25	10	0 days	13
13	90% Project Review Meeting	1 day	Mon 2/17/25	Mon 2/17/25	Mon 2/17/25	Mon 2/17/25	12	0 days	14
14	100% Design	35 days	Tue 2/18/25	Tue 2/18/25	Mon 4/7/25	Mon 4/7/25	13	0 days	21,15
15	Develop Bid Packages	16 days	Tue 4/8/25	Tue 4/8/25	Tue 4/29/25	NA	14	35 days	16
16	Advertise Bid Packages	21 days	Wed 4/30/25	NA	Thu 5/29/25	NA	15	35 days	17
17	Select Bid Package Proposer	10 days	Fri 5/30/25	NA	Thu 6/12/25	NA	16	35 days	18
18	GMP Development	25 days	Fri 6/13/25	NA	Fri 7/18/25	NA	17	35 days	19
19	GMP Approval & Contract	20 days	Mon 7/21/25	NA	Fri 8/15/25	NA	18	35 days	20



Critical
Critical Split
Critical Progress
Task
Split
Task Progress
Manual Task
Start-only
Finish-only
Duration-only
Baseline
Baseline Split
Baseline Milestone
Milestone
Summary Progress
Summary
Manual Summary
Project Summary
External Tasks
External Milestone
Inactive Task
Inactive Milestone
Inactive Summary
Deadline

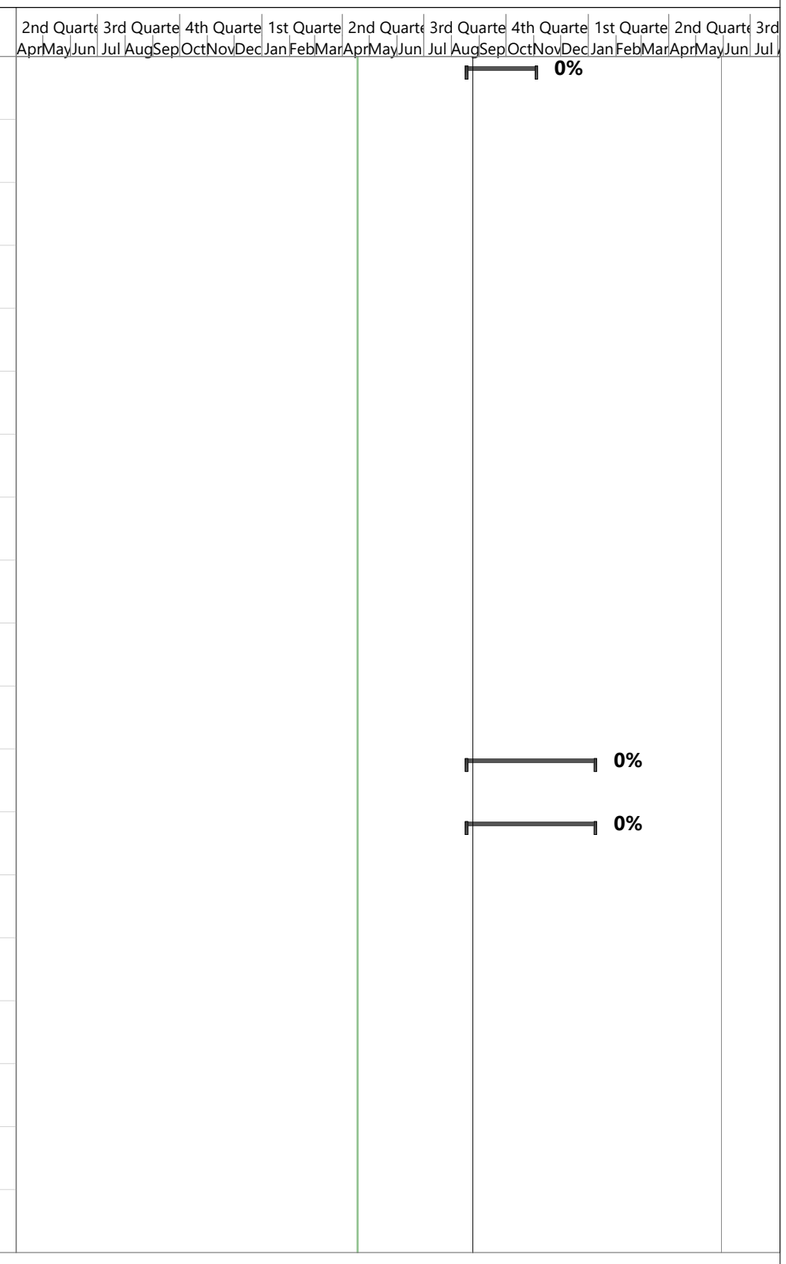
2138 - Farmers Branch Schedule Update - 2025.04.18

ID	Task Name	Duration	Start	Actual Start	Finish	Actual Finish	Predecessors	Total Slack	Successors
20	NTP for Construction	0 days	Fri 8/15/25	NA	Fri 8/15/25	NA	19	35 days	24,29,38,48,
21	Permitting	40 days	Tue 4/8/25	Tue 4/8/25	Tue 6/3/25	NA	14	252 days	
22	**Submittals**	**1432 days**	**Mon 10/26/20**	**NA**	**Fri 5/29/26**	**NA**		**0 days**	
23	**Division 1 - General Requirements**	**20 days**	**Mon 8/18/25**	**NA**	**Mon 9/15/25**	**NA**		**180 days**	
24	In-House Submittal Preparation Time	10 days	Mon 8/18/25	NA	Fri 8/29/25	NA	20	180 days	25
25	Submit to Owner / Engineer	0 days	Fri 8/29/25	NA	Fri 8/29/25	NA	24	180 days	26
26	City / Engineer Review	10 days	Tue 9/2/25	NA	Mon 9/15/25	NA	25	180 days	
27	**Division 2 - Site Work**	**40 days**	**Mon 8/18/25**	**NA**	**Mon 10/13/25**	**NA**		**160 days**	
28	**Aggregates**	**40 days**	**Mon 8/18/25**	**NA**	**Mon 10/13/25**	**NA**		**160 days**	
37	**Division 3 - Concrete**	**55 days**	**Mon 8/18/25**	**NA**	**Mon 11/3/25**	**NA**		**145 days**	
38	Issue PO to Vendor	5 days	Mon 8/18/25	NA	Fri 8/22/25	NA	20	145 days	39
39	Vendor Submittal Prep Time	10 days	Mon 8/25/25	NA	Mon 9/8/25	NA	38	145 days	40
40	Felix In-House Review	5 days	Tue 9/9/25	NA	Mon 9/15/25	NA	39	145 days	41
41	City / Engineer Review	15 days	Tue 9/16/25	NA	Mon 10/6/25	NA	40	145 days	42
42	Resubmittal Time (If Required)	0 days	Mon 10/6/25	NA	Mon 10/6/25	NA	41	145 days	43
43	Release for Fabrication	0 days	Mon 10/6/25	NA	Mon 10/6/25	NA	42	145 days	44
44	Manufacture & Deliver	20 days	Tue 10/7/25	NA	Mon 11/3/25	NA	43	145 days	45
45	Material Available for Installation	0 days	Mon 11/3/25	NA	Mon 11/3/25	NA	44	145 days	
46	**Division 5 - Metals**	**70 days**	**Mon 8/18/25**	**NA**	**Mon 11/24/25**	**NA**		**130 days**	



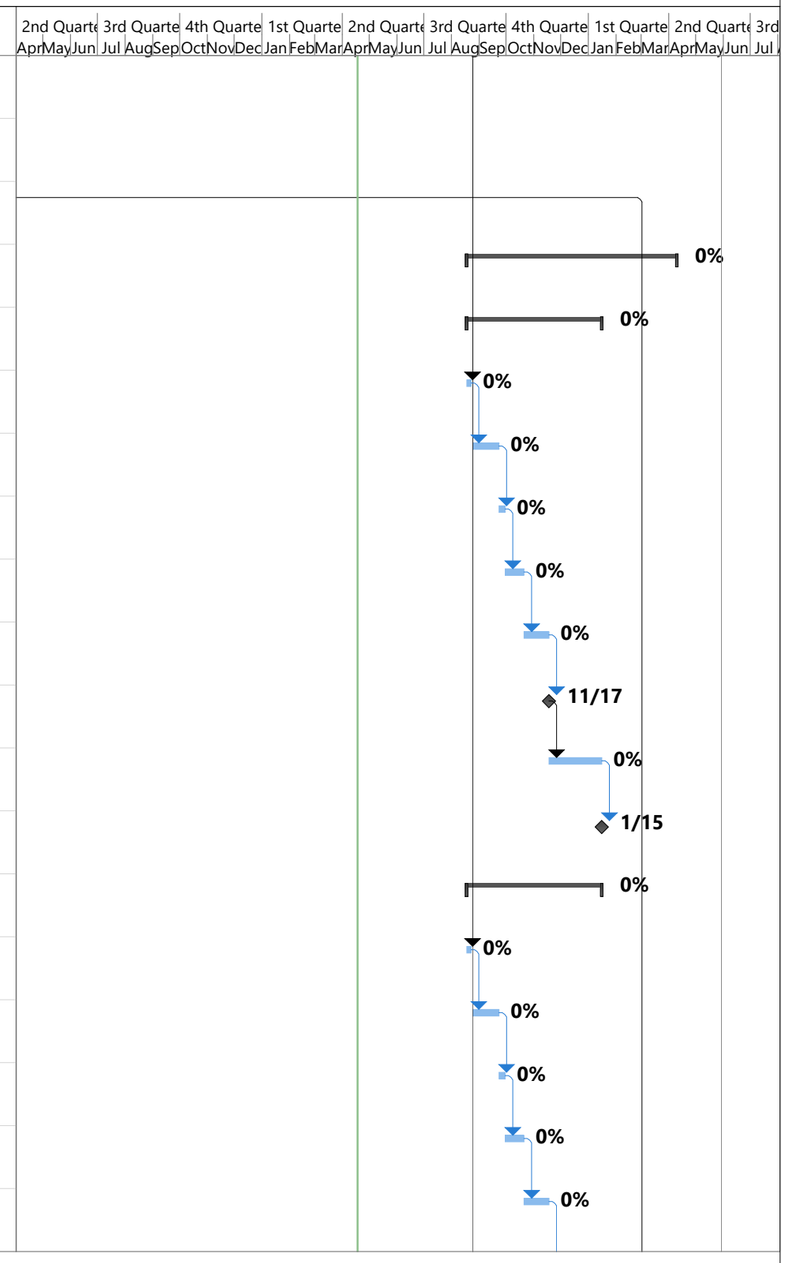
Critical	Split	Finish-only	Baseline Milestone	Manual Summary	Inactive Task
Critical Split	Task Progress	Duration-only	Milestone	Project Summary	Inactive Milestone
Critical Progress	Manual Task	Baseline	Summary Progress	External Tasks	Inactive Summary
Task	Start-only	Baseline Split	Summary	External Milestone	Deadline

ID	Task Name	Duration	Start	Actual Start	Finish	Actual Finish	Predecessors	Total Slack	Successors
56	**Division 9 - Finishes (Coatings)**	**55 days**	**Mon 8/18/25**	**NA**	**Mon 11/3/25**	**NA**		**145 days**	
65	**Division 11 - Equipment**	**120 days**	**Fri 3/19/21**	**NA**	**Fri 9/3/21**	**NA**		**1211 days**	
66	**Submersible Pumps**	**120 days**	**Fri 3/19/21**	**NA**	**Fri 9/3/21**	**NA**		**1211 days**	
67	Issue PO to Vendor	5 days	Fri 3/19/21	NA	Thu 3/25/21	NA		1211 days	68
68	Vendor Submittal Prep Time	15 days	Fri 3/26/21	NA	Thu 4/15/21	NA	67	1211 days	69
69	Felix In-House Review	5 days	Fri 4/16/21	NA	Thu 4/22/21	NA	68	1211 days	70
70	City / Engineer Review	15 days	Fri 4/23/21	NA	Thu 5/13/21	NA	69	1211 days	71
71	Resubmittal Time (If Required)	0 days	Thu 5/13/21	NA	Thu 5/13/21	NA	70	1211 days	72
72	Release for Fabrication	0 days	Thu 5/13/21	NA	Thu 5/13/21	NA	71	1211 days	73
73	Manufacture & Deliver	80 days	Fri 5/14/21	NA	Fri 9/3/21	NA	72	1211 days	74
74	Material Available for Installation	0 days	Fri 9/3/21	NA	Fri 9/3/21	NA	73	1211 days	
75	**Division 15 - Mechanical**	**100 days**	**Mon 8/18/25**	**NA**	**Thu 1/8/26**	**NA**		**100 days**	
76	**General Mechanical Material (Pipe, Valves, Fittings)**	**100 days**	**Mon 8/18/25**	**NA**	**Thu 1/8/26**	**NA**		**100 days**	
85	**Division 16 - Electrical Gear**	**350 days**	**Mon 10/26/20**	**NA**	**Mon 3/7/22**	**NA**		**1018 days**	
86	Issue PO to Vendor	5 days	Mon 10/26/20	NA	Fri 10/30/20	NA		1018 days	87
87	Vendor Submittal Prep Time	45 days	Mon 11/2/20	NA	Wed 1/6/21	NA	86	1018 days	88
88	Felix In-House Review	5 days	Thu 1/7/21	NA	Wed 1/13/21	NA	87	1018 days	89
89	City / Engineer Review	15 days	Thu 1/14/21	NA	Wed 2/3/21	NA	88	1018 days	90
90	Resubmittal Time (If Required)	20 days	Thu 2/4/21	NA	Wed 3/3/21	NA	89	1018 days	91



Critical
Critical Split
Critical Progress
Task
Split
Task Progress
Manual Task
Start-only
Finish-only
Duration-only
Baseline
Baseline Split
Baseline Milestone
Milestone
Summary Progress
Summary
Manual Summary
Project Summary
External Tasks
External Milestone
Inactive Task
Inactive Milestone
Inactive Summary
Deadline

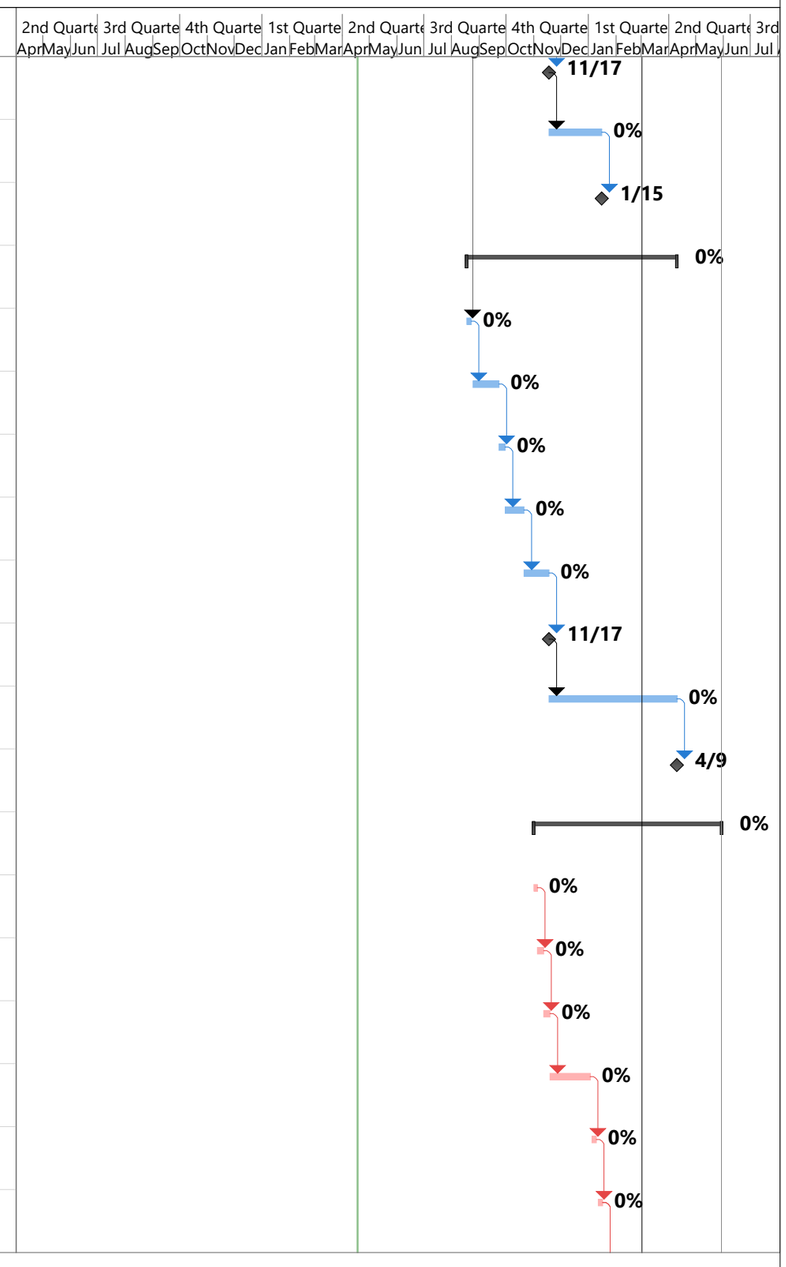
ID	Task Name	Duration	Start	Actual Start	Finish	Actual Finish	Predecessors	Total Slack	Successors
91	Release for Fabrication	0 days	Wed 3/3/21	NA	Wed 3/3/21	NA	90	1018 days	92
92	Manufacture & Deliver	260 days	Thu 3/4/21	NA	Mon 3/7/22	NA	91	1018 days	93
93	Material Available for Installation	0 days	Mon 3/7/22	NA	Mon 3/7/22	NA	92	1018 days	137
94	**Division 17 - Instrumentation and Controls**	**165 days**	**Mon 8/18/25**	**NA**	**Thu 4/9/26**	**NA**		**35 days**	
95	**General Electrical Commodities**	**105 days**	**Mon 8/18/25**	**NA**	**Thu 1/15/26**	**NA**		**95 days**	
96	Issue PO to Vendor	5 days	Mon 8/18/25	NA	Fri 8/22/25	NA	20	95 days	97
97	Vendor Submittal Prep Time	20 days	Mon 8/25/25	NA	Mon 9/22/25	NA	96	95 days	98
98	Felix In-House Review	5 days	Tue 9/23/25	NA	Mon 9/29/25	NA	97	95 days	99
99	City / Engineer Review	15 days	Tue 9/30/25	NA	Mon 10/20/25	NA	98	95 days	100
100	Resubmittal Time (If Required)	20 days	Tue 10/21/25	NA	Mon 11/17/25	NA	99	95 days	101
101	Release for Fabrication	0 days	Mon 11/17/25	NA	Mon 11/17/25	NA	100	95 days	102
102	Manufacture & Deliver	40 days	Tue 11/18/25	NA	Thu 1/15/26	NA	101	95 days	103
103	Material Available for Installation	0 days	Thu 1/15/26	NA	Thu 1/15/26	NA	102	95 days	
104	**Instrumentation**	**105 days**	**Mon 8/18/25**	**NA**	**Thu 1/15/26**	**NA**		**95 days**	
105	Issue PO to Vendor	5 days	Mon 8/18/25	NA	Fri 8/22/25	NA	20	95 days	106
106	Vendor Submittal Prep Time	20 days	Mon 8/25/25	NA	Mon 9/22/25	NA	105	95 days	107
107	Felix In-House Review	5 days	Tue 9/23/25	NA	Mon 9/29/25	NA	106	95 days	108
108	City / Engineer Review	15 days	Tue 9/30/25	NA	Mon 10/20/25	NA	107	95 days	109
109	Resubmittal Time (If Required)	20 days	Tue 10/21/25	NA	Mon 11/17/25	NA	108	95 days	110



Critical	Split	Finish-only	Baseline Milestone	Manual Summary	Inactive Task
Critical Split	Task Progress	Duration-only	Milestone	Project Summary	Inactive Milestone
Critical Progress	Manual Task	Baseline	Summary Progress	External Tasks	Inactive Summary
Task	Start-only	Baseline Split	Summary	External Milestone	Deadline

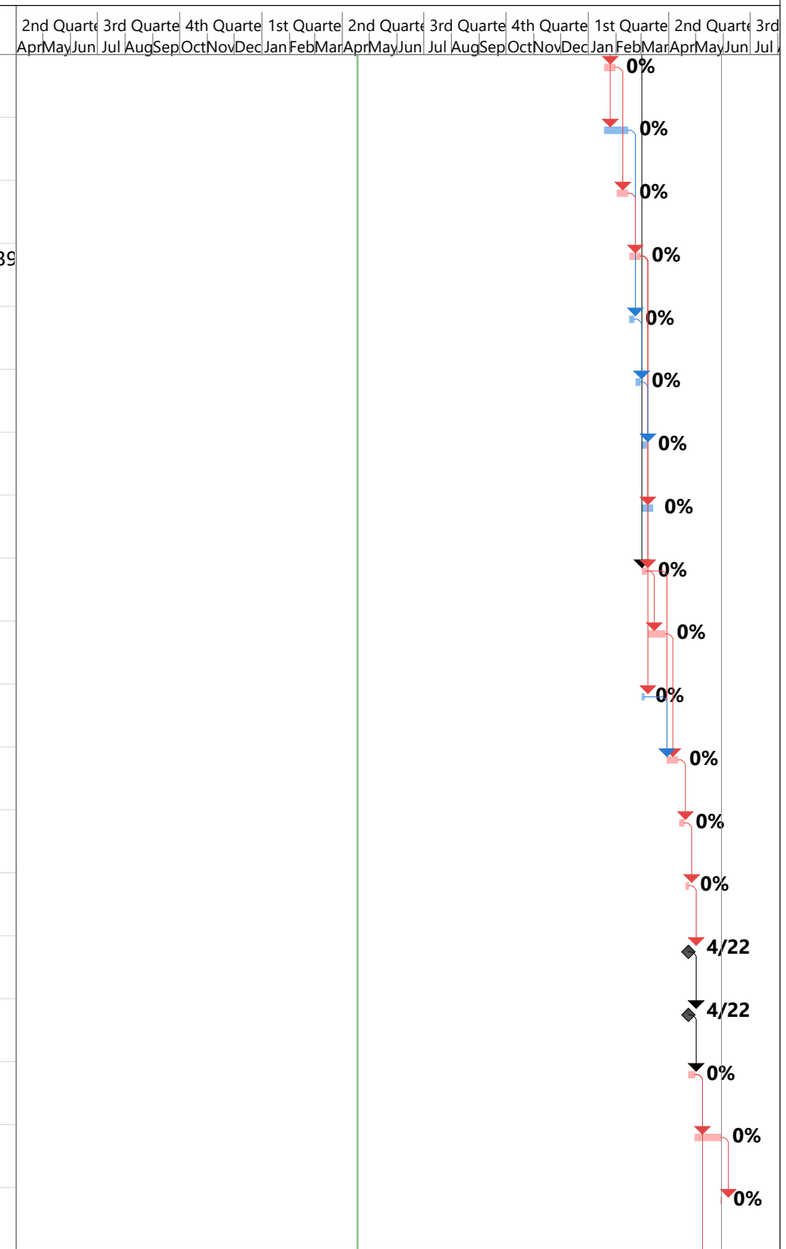
2138 - Farmers Branch Schedule Update - 2025.04.18

ID	Task Name	Duration	Start	Actual Start	Finish	Actual Finish	Predecessors	Total Slack	Successors
110	Release for Fabrication	0 days	Mon 11/17/25	NA	Mon 11/17/25	NA	109	95 days	111
111	Manufacture & Deliver	40 days	Tue 11/18/25	NA	Thu 1/15/26	NA	110	95 days	112
112	Material Available for Installation	0 days	Thu 1/15/26	NA	Thu 1/15/26	NA	111	95 days	
113	**Control Panels**	**165 days**	**Mon 8/18/25**	**NA**	**Thu 4/9/26**	**NA**		**35 days**	
114	Issue PO to Vendor	5 days	Mon 8/18/25	NA	Fri 8/22/25	NA	20	35 days	115
115	Vendor Submittal Prep Time	20 days	Mon 8/25/25	NA	Mon 9/22/25	NA	114	35 days	116
116	Felix In-House Review	5 days	Tue 9/23/25	NA	Mon 9/29/25	NA	115	35 days	117
117	City / Engineer Review	15 days	Tue 9/30/25	NA	Mon 10/20/25	NA	116	35 days	118
118	Resubmittal Time (If Required)	20 days	Tue 10/21/25	NA	Mon 11/17/25	NA	117	35 days	119
119	Release for Fabrication	0 days	Mon 11/17/25	NA	Mon 11/17/25	NA	118	35 days	120
120	Manufacture & Deliver	100 days	Tue 11/18/25	NA	Thu 4/9/26	NA	119	35 days	121
121	Material Available for Installation	0 days	Thu 4/9/26	NA	Thu 4/9/26	NA	120	35 days	
122	**Construction Activities**	**146 days**	**Sat 11/1/25**	**NA**	**Fri 5/29/26**	**NA**		**0 days**	
123	Mobilization	3 days	Sat 11/1/25	NA	Tue 11/4/25	NA		0 days	124
124	Remove Existing Landscaping	5 days	Wed 11/5/25	NA	Tue 11/11/25	NA	123	0 days	125
125	Excavation for Valve Vault	5 days	Wed 11/12/25	NA	Tue 11/18/25	NA	124	0 days	126
126	F/P/S Valve Vault	30 days	Wed 11/19/25	NA	Fri 1/2/26	NA	125	0 days	127
127	Set-Up Bypass System	5 days	Mon 1/5/26	NA	Fri 1/9/26	NA	126	0 days	128
128	Demo Lift Station Equipment & Pipe	5 days	Mon 1/12/26	NA	Fri 1/16/26	NA	127	0 days	129,130



Critical	Split	Finish-only	Baseline Milestone	Manual Summary	Inactive Task
Critical Split	Task Progress	Duration-only	Milestone	Project Summary	Inactive Milestone
Critical Progress	Manual Task	Baseline	Summary Progress	External Tasks	Inactive Summary
Task	Start-only	Baseline Split	Summary	External Milestone	Deadline

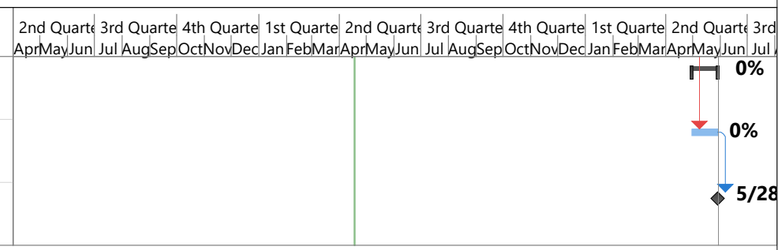
ID	Task Name	Duration	Start	Actual Start	Finish	Actual Finish	Predecessors	Total Slack	Successors
129	Demo Existing Electrical Vault	10 days	Mon 1/19/26	NA	Fri 1/30/26	NA	128	0 days	131
130	Wet Well Interior Rehabilitation	20 days	Mon 1/19/26	NA	Fri 2/13/26	NA	128	59 days	133
131	Underground Electrical	10 days	Mon 2/2/26	NA	Fri 2/13/26	NA	129	0 days	132
132	Slabs on Grade	10 days	Mon 2/16/26	NA	Fri 2/27/26	NA	131	0 days	136,137,139
133	Wet Well Piping and Pumps	5 days	Mon 2/16/26	NA	Fri 2/20/26	NA	130	59 days	134
134	Install New Valve Vault Piping	5 days	Mon 2/23/26	NA	Fri 2/27/26	NA	133	59 days	135
135	Pipe & Valve Coatings	5 days	Mon 3/2/26	NA	Fri 3/6/26	NA	134	59 days	
136	Site Wall & Gates	10 days	Mon 3/2/26	NA	Fri 3/13/26	NA	132	54 days	
137	Install Electrical Gear & Control Panels	5 days	Mon 3/2/26	NA	Fri 3/6/26	NA	93,132	0 days	138,140
138	Above Ground Electrical	15 days	Mon 3/9/26	NA	Fri 3/27/26	NA	137	0 days	140
139	Install Generator	2 days	Mon 3/2/26	NA	Tue 3/3/26	NA	132	18 days	140
140	Programming	10 days	Mon 3/30/26	NA	Fri 4/10/26	NA	139,137,138	0 days	141
141	Contractor Testing	5 days	Mon 4/13/26	NA	Fri 4/17/26	NA	140	0 days	142
142	Site functional testing	3 days	Mon 4/20/26	NA	Wed 4/22/26	NA	141	0 days	143
143	Substantial Completion	0 days	Wed 4/22/26	NA	Wed 4/22/26	NA	142	0 days	144
144	End Bypass Operations	0 days	Wed 4/22/26	NA	Wed 4/22/26	NA	143	0 days	145
145	Remove Bypass System	5 days	Thu 4/23/26	NA	Wed 4/29/26	NA	144	0 days	149,146
146	Landscaping	20 days	Thu 4/30/26	NA	Thu 5/28/26	NA	145	0 days	147
147	Painting & Striping	1 day	Fri 5/29/26	NA	Fri 5/29/26	NA	146	0 days	



Critical		Split		Finish-only		Baseline Milestone		Manual Summary		Inactive Task	
Critical Split		Task Progress		Duration-only		Milestone		Project Summary		Inactive Milestone	
Critical Progress		Manual Task		Baseline		Summary Progress		External Tasks		Inactive Summary	
Task		Start-only		Baseline Split		Summary		External Milestone		Deadline	

2138 - Farmers Branch Schedule Update - 2025.04.18

ID	Task Name	Duration	Start	Actual Start	Finish	Actual Finish	Predecessors	Total Slack	Successors
148	**Project Closeout Activities**	**20 days**	**Thu 4/30/26**	**NA**	**Thu 5/28/26**	**NA**		**1 day**	
149	Commissioning	20 days	Thu 4/30/26	NA	Thu 5/28/26	NA	145	1 day	150
150	Final Completion	0 days	Thu 5/28/26	NA	Thu 5/28/26	NA	149	1 day	



Critical		Split		Finish-only		Baseline Milestone		Manual Summary		Inactive Task	
Critical Split		Task Progress		Duration-only		Milestone		Project Summary		Inactive Milestone	
Critical Progress		Manual Task		Baseline		Summary Progress		External Tasks		Inactive Summary	
Task		Start-only		Baseline Split		Summary		External Milestone		Deadline	