LAKE HAVASU CITY

INVITATION TO BID

CONTRACT DOCUMENTS

AND

TECHNICAL SPECIFICATIONS

Park Avenue Lift Station Renovation
B24-PW-107019-500397

LAKE HAVASU CITY

CONTRACT DOCUMENTS
VOLUME 1

Revised 5/12/2023

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The remaining applicable specifications can be accessed at:
https://www.lhcaz.gov/public-works/engineering
Please scroll down to the bottom of the webpage and notice there are clickable page numbers to access all specification documents.

SECTION 00020

NOTICE INVITING BIDS

Lake Havasu City

PROJECT NO.: **B24-PW-107019-500397**

PROJECT NAME: **Park Avenue Lift Station Renovation**

PRE-BID MEETING: A **NON-MANDATORY Pre-Bid Meeting** will be held at 900 London Bridge Road, LAKE HAVASU CITY, AZ. Room Ops A101 at 10:00 AM, Arizona Time, on Monday, August 21, 2023

BID DUE DATE: **September 6, 2023**

BID DUE TIME: **3:00 p.m., ARIZONA TIME**

PROJECT DESCRIPTION:

This project consists of the renovation of the Park Avenue Lift Station, associated site and electrical system improvements, and construction of 600 feet of 8-inch force main. Specific elements include site work, concrete foundations, new lift station pumps and piping, wet well coating, replacement and addition of certain valves and piping, temporary bypass system, new force main, full electrical system rehabilitation including pump panels, main service upgrade, lighting, main switchgear, SCADA/RTU, standby diesel generator, associated conduits and wiring, new metal shade canopy, along with related civil/site upgrades as necessary.

QUESTIONS: All questions that arise relating to this solicitation shall be directed in writing to purchasing@lhcaz.gov with a copy to Engineeringinfo@lhcaz.gov. To be considered, written inquiries shall be received at the above-referenced email address by August 25, 2023, 3:00 p.m. Arizona Time. Inquiries received will then be answered in an Addendum.

Sealed bids for the project specified will be received by the **City Clerk's Office, 2330 N. McCulloch Boulevard, Lake Havasu City, Arizona, 86403** until the time and date stated. **Bids received by the correct time and date will be opened and read aloud immediately thereafter in Room 109 of Lake Havasu City Hall.** Public openings may be attended virtually by accessing the following video conferencing system:

To join the meeting on a computer or mobile phone:
https://bluejeans.com/2330864044?src=calendarLink
Meeting ID: 233 086 4044
Phone Dial-in
+1.408.740.7256 (US (San Jose))
+1.888.240.2560 (US Toll Free)

+1.888.240.2560 (US Toll Free)

Bids must be clearly addressed to the City Clerk's Office, 2330 McCulloch Blvd. N, Lake Havasu City, Arizona, 86403, and received no later than the exact time and date indicated above. Late bids will not be considered under any circumstances.

Bids must be submitted in a sealed envelope with the Project Number and the bidder's name and address clearly indicated on the envelope. All bids must be completed in ink or typewritten on a form to be obtained from the specifications and a complete Invitation for Bid returned along with the offer no later than the time and date cited above.

Bid documents and specifications are available on Lake Havasu City's website at www.lhcaz.gov or on DemandStar at www.demandstar.com. For documents obtained outside of DemandStar please contact purchasing@lhcaz.gov to be added to the planholders' list.

For technical information, contact Philip Porter, Project Manager, at porterp@lhcaz.gov with a copy to purchasing@lhcaz.gov .

BONDS:

Bid Bond:	10%
Labor and Material Bond:	100%
Faithful Performance Bond:	100%

Project Completion Date: 270 calendar days after Notice to Proceed.

Lake Havasu City reserves the right to accept or reject any or all bids or any part thereof and waive informalities deemed in the best interest of the City.

Pursuant to the Americans with Disabilities Act (ADA), Lake Havasu City endeavors to ensure the accessibility of all of its programs, facilities and services to all persons with disabilities. If you need an accommodation for this meeting, please contact the City Clerk's office at (928) 453-4142 at least 24 hours prior to the meeting so that an accommodation may be arranged.

Publication Dates: TODAY'S NEWS HEARLD - August 8, 2023 and August 15, 2023
ARIZONA BUSINESS GAZETTE - August 10, 2023 and August 17, 2023

** END OF SECTION **

SECTION 00100
INFORMATION FOR BIDDERS

1. RECEIPT AND OPENING OF BIDS

The City of Lake Havasu City, Arizona, (hereinafter called the "Owner") invites Bids on the form attached hereto**.** All blanks must be appropriately filled in. The Bidder shall also complete and submit a form listing proposed subcontractors as enclosed herein. Any subcontractors proposed to be used on the project but not listed on this form shall not be considered when evaluating the Contractor's qualifications and ability to perform the work. Bids **Park Avenue Lift Station Renovation, Project No. B24-PW-107019-500397 will** be received by the **City Clerk's office, 2330 N. McCulloch Boulevard, Lake Havasu City, Arizona 86403 no later than 3:00 P.M., Arizona Time, September 6, 2023,** where said Bids will be publicly opened and virtually read aloud immediately thereafter in the Room 109 of Lake Havasu City Hall.

The Owner may consider informal any Bid not prepared and submitted in accordance with the provisions hereof and may waive any informalities or reject any and all Bids. Any Bid may be withdrawn prior to the above scheduled time for the opening of Bids or authorized postponement thereof. Any Bid received after the time and date specified shall not be considered. No Bidder may withdraw a Bid within ninety (90) days after the actual date of the opening thereof.

2. PREPARATION OF BID

Each Bid must be submitted on the prescribed Form. Each Document must be submitted with an original signature of the Bidder, as well as all witnesses indicated therein. All blank spaces for Bid prices must be filled in, in ink or typewritten, in both words and figures.

Each Bid must be submitted in a sealed envelope bearing on the outside the name of the Bidder, the Bidder's address, and the name and number of the project for which the Bid is submitted. If forwarded by mail, the sealed envelope containing the Bid must be enclosed in another envelope addressed as specified in the Bid form.

3. FACSIMILE BIDS OR MODIFICATIONS

No facsimile ("FAX") Bids or bid modifications will be accepted. Any modifications to the Bid shall be made by an authorized representative of the bidding company in person.

4. QUALIFICATIONS OF BIDDER

The Owner may make such investigations as he deems necessary to determine the qualifications of and the ability of the Bidder to perform the Work, and the Bidder shall furnish the Owner such information and data for this purpose as the Owner may request.
The Owner may request that the Bidder provide a list of key people for the project with their related work experience.

The Owner reserves the right to reject any Bid if the evidence submitted by or investigation of such Bidder fails to satisfy the Owner that such Bidder is properly qualified to carry out the obligations of the Contract and to complete the work contemplated therein in a timely manner.

Conditional Bids will not be accepted.

All Bidders and listed subcontractors must be valid Arizona Licensed Contractors at the time of Bidding, approved by the Arizona State Registrar of Contractors to do the type and amount of work specified in these documents. In accordance with the Arizona State Registrar of Contractors, the Bidder must possess a minimum of a Class A Arizona Contractor's License to perform the type and amount of work specified in these documents. **Failure of any bidder to possess all contractors' licenses as listed in the bid packet, at the time of bidding, shall result in the bid being considered non-responsive and not in substantial compliance, and any such bid shall not be considered.** Refer to Section 00420, page 3, item 13.

5. ARITHMETIC DISCREPANCIES IN THE BID

A. For the purpose of the evaluation of Bids, the following will be utilized in resolving arithmetic discrepancies found on the face of the Bid Schedule as submitted by Bidders:

1. Obviously misplaced decimal points will be corrected;

2. In case of discrepancy between unit price and extended price, the unit price will govern;

3. Apparent errors in extension of unit prices will be corrected;

4. Apparent errors in addition of lump sums and extended prices will be corrected; and

5. In case of discrepancy between words and figures in unit prices, the amount shown in words shall govern.

B. For the purpose of Bid evaluation, the Owner will evaluate the bids on the basis of the unit prices, extensions, and totals arrived at by resolution of arithmetic discrepancies as provided above.

6. INCOMPLETE BIDS

Failure to submit a Bid on all items in the Schedule will result in an incomplete Bid and the Bid may be rejected. **UNIT OR LUMP SUM PRICES MUST BE SHOWN FOR EACH BID ITEM WITHIN THE SCHEDULE.**

NOTE: FAILURE TO INDICATE UNIT OR LUMP SUM PRICES IN THE APPROPRIATE COLUMN, WITH THE EXTENSION OF THE PRICES IN THE FAR RIGHT COLUMN, WILL CAUSE THE BID TO BE "NON-RESPONSIVE".

All forms indicated in the Bid Proposal, Section 00300, must be completely filled out, executed, and submitted with the Bid. Failure to do so will render the bid "non-responsive" and the bid will not be accepted.

7. BID SECURITY

Each Bid must be accompanied by certified check, cashier's check, or a Bid Bond prepared on the form attached hereto or on a similar form acceptable to the Owner, duly executed by the Bidder as principal and having as surety thereon a surety company approved by the Owner, in the amount of ten percent (10%) of the Bid. Bid Bonds shall be valid for at least ninety (90) days after the date of the receipt of Bids. Such cash, check or Bid Bond will be returned to all except the three (3) lowest Bidders within fifteen (15) business days after the opening of Bids. The remaining checks or Bid Bonds will be returned promptly after the Owner and the accepted Bidder have executed the Contract, or if no award has been made within ninety (90) days after the date of the opening of Bids, upon demand of the Bidder at any time thereafter, so long as he has not been notified of the acceptance of his Bid.

8. LIQUIDATED DAMAGES FOR FAILURE TO ENTER INTO CONTRACT

The successful Bidder, upon his failure or refusal to execute and deliver the Contract, Bonds, and certificates required within ten (10) calendar days from the date of the Notice of Award, shall forfeit to the Owner, as liquidated damages for such failure or refusal, the difference between his bid and the amount of the contract actually entered into with another party should he not enter into a contract at the bid price and provide the required payment and performance bonds and certificates of insurance. Liquidated damages for failure to enter into the contract shall not exceed the amount of the Bid Bond.

9. SECURITY FOR FAITHFUL PERFORMANCE AND PAYMENT

Simultaneously with his delivery of the executed Contract, the Bidder shall furnish **on the forms provided herein**, in 100% of the amount of this Contract, 1) a surety bond as security for faithful performance of this Contract, and 2) a surety bond as security for the payment of all persons performing labor on the project under this Contract and persons furnishing materials in connection with this Contract, and 3) a listing of all subcontractors who will be performing or providing more than one-half percent (0.50%) of the contract work, as specified in the General Conditions included herein. The surety on such bond or bonds shall be a duly authorized surety company satisfactory to the Owner, listed on the Treasury Department's most current list (Circular 570 as amended), and authorized to transact business in the State of Arizona.

10. POWER OF ATTORNEY

Attorneys-in-fact who sign Bid Bonds or Contract bonds must file with each bond a certified and effectively dated copy of their power-of-attorney.

11. LAWS AND REGULATIONS

The Bidder's attention is directed to the fact that all applicable Federal Laws, State Laws, municipal ordinances, and the rules and regulations of all authorities having jurisdiction over construction of the project shall apply to the Contract throughout, and they will be deemed to be included in the Contract the same as though herein written out in full.

12. METHOD OF AWARD

A. The City will award the Contract on the basis of the Bid or Bids most advantageous to the City. In determining whether a Bid is most advantageous, in addition to price, the City may consider the following:

1. The ability, capacity, and skill of the Bidder to perform the Contract or provide the service indicated;

2. Whether the Bidder can perform the Contract or provide the service promptly, and within the time specified without delay or interference;

3. The character, integrity, reputation, judgment, experience, and efficiency of the Bidder;

4. The quality of performance on previous contracts;

5. The previous compliance with laws and ordinances by the Bidder;

6. The financial responsibility of the Bidder to perform under the Contract or provide the service;

7. The limitations of any license the Bidder may be required to possess;

8. The quality, availability, and adaptability of the product or service;

9. The ability of the Bidder to provide future maintenance and/or service;

The number and scope of any conditions attached to the Bid; and

The life cycle, maintenance, and performance of the equipment or product being offered.

13. OBLIGATION OF THE BIDDER

At the time of the opening of Bids, each Bidder will be presumed to have inspected the site and to have read and to be thoroughly familiar with the Plans and Contract documents (including all Addenda, if applicable). The failure or omission of the Bidder to examine any form, instrument or document, or site changes due to natural causes, shall in no way relieve any Bidder from any obligation in respect to his Bid. Site changes due to natural causes prior to Bid opening shall not be cause for Bid alteration or withdrawal.

14. TIME OF COMPLETION AND LIQUIDATED DAMAGES

The Bidder must agree to commence work on or before a date to be specified in a written "Notice to Proceed" from the Owner, and to complete the work within **270 calendar days** of the date of the Notice to Proceed.

The Bidder further agrees to pay as liquidated damages, the sum indicated in the following Schedule of Liquidated Damages for each consecutive calendar day thereafter, plus any additional costs incurred by the Engineer as provided in Section 17 of the General Conditions, that the Contract remains incomplete. For the purposes of determining the Liquidated Damages for the project, the Original Contract Amount shall be that which is included in the Contract between the Owner and the Contractor for the project.

SCHEDULE OF LIQUIDATED DAMAGES		
Original Contract Amount		Daily Charges
From More Than	To and Including	Calendar Day or Fixed Rate
0	25,000	210
25,000	50,000	250
50,000	100,000	280
100,000	500,000	430
500,000	1,000,000	570
1,000,000	2,000,000	710
From More Than	To and Including	Calendar Day or Fixed Rate
2,000,000	5,000,000	1,070
5,000,000	10,000,000	1,420
10,000,000	---0---	1,780

15. CONDITIONS OF WORK

Each Bidder must inform himself fully of the conditions relating to the construction of the project and the employment of labor thereon. Failure to do so will not relieve a successful Bidder of his obligation to furnish all material and labor necessary to carry out the provisions of his Contract. Insofar as possible, the Contractor, in carrying out his work, must employ such methods or means as will not cause any interruption of or interference with the work of any other Contractor.

16. ADDENDA AND INTERPRETATIONS

For technical information and all questions that arise relating to this solicitation shall be directed in writing to:
Phil Porter at porterp@lhcaz.gov with a copy to purchasing@lhcaz.gov and engineeringinfo@lhcaz.gov.
OR

Purchasing
Administrative Services Department, Procurement Division
Lake Havasu City
2330 McCulloch Blvd. North
Lake Havasu City, AZ 86403

To be considered, written inquiries shall be received by the above-referenced contact by **August 25, 2023, 3:00 p.m. Arizona Time**. Inquiries received will then be answered in an Addendum. Any and all such interpretations and any supplemental instructions will be in the form of written Addenda to the Specifications which, if issued, will be available to all prospective Bidders, not later than five (5) calendar days prior to the date fixed for the opening of Bids. Failure of any Bidder to incorporate any such Addendum or interpretation shall not relieve such Bidder from any obligation under his/her Bid as submitted. All Addenda so issued shall become part of the Contract documents.

No informal contact initiated by offerors on this solicitation will be allowed with members of City staff from the date of distribution of this solicitation until after the closing date and time for the submissions of quotations. All questions or issues related to this solicitation shall be submitted in writing.

17. CONFLICT OF INTEREST

Pursuant to A.R.S. Section 38-511, this Contract is subject to cancellation by Buyer if any person significantly involved initiating, negotiating, securing, drafting or creating the Contract on behalf of Lake Havasu City is, at any time while the Contract is in effect, an employee of any other party to the Contract in any capacity or a consultant to any other party of the Contract with respect to the subject matter of the Contract.

18. NO COLLUSION

The bidder will be required to complete, notarize and submit as part of this bid package the "No Collusion Affidavit" form, as attached herein. Failure of the bidder to submit a properly executed affidavit may be grounds for rejection of the bid.

19. EMPLOYMENT ELIGIBILITY VERIFICATION

The bidder will be required to complete, notarize and submit as part of this bid package the "Employer Verification of Employment Eligibility" form, as attached herein. Failure of the bidder to submit a properly executed verification of eligibility form may be grounds for rejection of the bid.

20. EXAMINATION OF THE PLANS AND SPECIFICATIONS

Each Bid shall be made in accordance with the Plans and Specifications which may be examined at the following locations:

Lake Havasu City, 2330 N. McCulloch Boulevard, Lake Havasu City, AZ 86403, 928.453.4188, https://www.lhcaz.gov/budget-and-finance/bids-rfps

Dodge Data & Analytics, 3315 Central Avenue, Hot Springs, AR, 71913, 871.375.2946, FAX: 501.625.3544, www.construction.com, dodge.bidding@construction.com

Northern AZ Home Builders, 1500 E. Cedar Avenue, Suite 86, Flagstaff AZ 86004, 928.779.3071, FAX: 928.779.4211, www.nazba.org, info@nazba.org

Performance Graphics Blueprinting, 4140 Lynn Drive, Suite 107, Fort Mohave, AZ, 86426, 928.763.6860, FAX 928.763.6835, prints@pgblueprinting.net

Construction Market Data, 30 Technology Parkway South, Suite 500, Norcross, GA 30092-2912, 800.876.4045, FAX: 800.303.8629, www.cmdgroup.com, projects@cmdgroup.com

ISqFt, 3301 N 24th Street, Phoenix, AZ, 85016, 800.364.2059, FAX: 800.792.7508, www.isqft.com, arizonaplanroom@isqft.com

Integrated Digital Technologies, LLC, 4633 E Broadway Blvd., Tucson, AZ 85711,
PO Box 13086, Tucson AZ,85732, 520.319.0988, FAX: 520.319.1430,
www.contractorsplanroom.com, content@idtplans.com

Yuma/Southwest Contractors Association, 350 W. 16th Street, Suite 207, Yuma, AZ 85364, Phone: 928-539-9035, FAX: 928-539-9036, www.yswca.com, plans@yswca.com

Arizona Builders Exchange, 1700 N. McClintock Drive, Tempe, AZ, 85281,
(480) 227-2620, www.azbex.com, rkettenhofen@azbex.com

Construction Reports.com, 4110 N Scottsdale Road, Suite 335, Scottsdale, AZ, 85251, 480.994.0020, FAX: 480.994.0030, www.constructionreports.com, jess@constructionreports.com

Construction Reporter, 4901 McLeod Rd NE #200a, Albuquerque, NM, 87109, 505.243.9793, FAX: 505.242.4758, www.constructionreporter.com, rebecca@constructionreporter.com

PlanRoom Central at A&E Reprographics, 1030 Sandretto Drive, Suite F, Prescott, AZ, 86305, 928.442.9116, www.a-erepro.com, planroom1@a-erepro.com

Shirley's Plan Service, 425 S. Plumer Ave, Tucson, AZ, 85719, 520.791.7436, FAX: 520.882.9208, www.shirleysplanservice.com, bids@shirleysplanservice.com

Construction Notebook Nevada, 3131 Meade Ave, Suite B, Las Vegas, NV, 89102-7885, 702.876.8660, FAX: 702.876.5683, www.constructionnotebook.com

The Blue Book Building & Construction Network, Jefferson Valley, NY 10535, 800.431.2584, www.thebluebook.com, info@thebluebook.com, tdizon@mail.thebluebook.com

Integrated Marketing Systems (IMS), 945 Hornblend Street, Suite G, San Diego, CA 92109, 888.467.3151, FAX: 858.490.8811, www.imsinfo.com , ims@imsinfo.com

** END OF SECTION **

SECTION 00300
BID PROPOSAL

Lake Havasu City, Arizona

The undersigned, as bidder, declares that we have received and examined the documents entitled "**Park Avenue Lift Station Renovation, Project No. B24-PW-107019-500397**" and will contract with the Owner, on the form of Contract provided herewith, to do everything required for the fulfillment of the contract for the construction of the **Park Avenue Lift Station Renovation, Project No. B24-PW-107019-500397** at the prices and on the terms and conditions herein contained.

We agree that the Contract Documents include Volumes I and II of the Contract Documents as well as the referenced documents.

We agree that the following shall form a part of this proposal and are included herein as our submittal:

		Enclosed
Section	**Title**	✓
00300	**Bid Proposal**	___
00310	**Bid Schedule**	___
00400	**Arizona Statutory Bid Bond**	___
00420	**Bidder's Statement of Qualifications**	___
00430	**Affidavit of Contractor Certifying That There Was No Collusion In Bidding For Contract**	___
00450	**Hazard Communication Program**	___
00460	**Employment Eligibility Verification**	___

We acknowledge that addenda numbers _____ through _____ have been received and have been examined as part of the Contract Documents.

We certify that our proposal is genuine, and not sham or collusive, nor made in the interest or behalf of any undisclosed person, organization, or corporation, and that we have not directly or indirectly induced or solicited any other bidder to put in a sham bid, or directly or indirectly inducted or solicited any other potential bidder to refrain from bidding, and that we have not in any manner sought by collusion to secure an advantage over any other bidder.

The bidder agrees that this Bid shall be good and may not be withdrawn for a period of ninety (90) calendar days after the scheduled closing time for receiving Bids.

Upon receipt of written notice of the acceptance of this bid, Bidder shall execute the formal Contract attached within 10 days and deliver a Performance Bond, Payment Bond, and Certificates of Insurance as required by Paragraph 25 of the General Conditions and the Special Provisions.

We hereby declare that we have visited the site and have carefully examined the Contract Documents relating to the work covered by the above bid or bids.

Enclosed herewith is a certified or cashier's check or bid bond, payable to Lake Havasu City, Arizona, in the amount of ten percent (10%) of the total bid. This check or bond is submitted as a guarantee that we will enter into a Contract, and furnish the required bonds in the event a contract is awarded us. The bid security attached, without endorsement, is to become the property of Lake Havasu City, Arizona, in the event the Contract and Bonds are not executed within the time set forth, as liquidated damages for delay and additional work caused thereby.

Cooperative Use of Contract

This solicitation is being prepared by the City of Lake Havasu, Arizona ("City") for the use of the City. While this solicitation is for the use of the City, other eligible public agencies may have an interest in utilizing the resulting contract. After an award, and with the approval of the bidder, this solicitation may be utilized by eligible public agencies. Any such usage by other entities must be in accordance with the ordinance, charter and/or procurement rules and regulations of the respective political entity.

Please indicate below your acceptance or rejection regarding such participation of other governmental entities. Your response will not be considered a bid response requirement in awarding a contract. If you do not wish to grant such access to other eligible public agencies, please so state in your bid response below. In the absence of a statement to the contrary, the City will assume that you do wish to grant access to any contract that may result from this solicitation.

Bidder hereby grants _____, or does not grant_____, cooperative purchase access to other eligible public agencies.

We understand that Lake Havasu City, Arizona reserves the right to reject any and/or all bids, or to waive any informalities in any bid, deemed by them to be for the best interests of Lake Havasu City, Arizona.

Dated in _____ this _____ day of _____,___.

Respectfully Submitted By:

By: _____

Title: _____

Name of Firm:_____

Address: _____

Phone: _____ FAX: _____

Email Address: _____

Seal - If bid by a Corporation:

Arizona Contractor's License No.: _____Type: _____

Federal Tax ID No.:_____

** END OF SECTION **

BID SCHEDULE
LAKE HAVASU CITY

Park Avenue Lift Station Renovation
B24-PW-107019-500397

Lake Havasu City Council
Lake Havasu City
2330 N. McCulloch Boulevard
Lake Havasu City, AZ 86403

The City Council:

Pursuant to request for bids to be opened the September 6, 2023 at 3:00 P.M., Arizona Time, at Room 109 of Lake Havasu City Hall, for the above project, the Contractor proposes to complete work, including furnishing all labor and materials, per the Specifications and Plans at the Following prices.

This Schedule of Items and Prices shall be completed in ink or typed by the Bidding Contractor. In case of discrepancy between the word and figure amount description, the word description shall control extensions.

Prices must be entered for each item and the appropriate subtotal and total blank shall be filled out. Bid prices shall include sales tax and all other applicable taxes and fees.

Bidder agrees to perform all the necessary work to complete the **Park Avenue Lift Station Renovation, Project No. B24-PW-107019-500397**

SECTION 310

BID SCHEDULE – Park Avenue Lift Station Renovation B24-PW-107019-500397

ITEM NO.	DESCRIPTION	EST QTY	UNIT OF MEASURE	UNIT PRICE[1] (Word)	UNIT PRICE (Figure)	ITEM TOTAL[2] COSTS
BASE BID						
1	Mobilization/Demobilization, Bonds, permitting and Insurance.	1	L.S.		$	$
2	All Mechanical, demolition & concrete work including Piping, Valves & Meters	1	L.S.		$	$
3	Shade Canopy	1	L.S.		$	$
4	Painting & Coating, All Mechanical Equipment, Canopies & Piping	1	L.S.		$	$
5	Force Main and Appurtenances	1	L.S.		$	$
6	All Electrical & Instrumentation Work	1	L.S.		$	$
7	Wet Well Recoating	1	L.S.		$	$
8	Temporary Bypass Setup & Operations	1	L.S.		$	$
9	Force Account	1	L.S.	Eighty Thousand Dollars	$ 80,000.00	$ 80,000.00
	BID TOTAL[3] + FORCE ACCOUNT				$	$

Above line items and totals shall include all work shown on the plans and specified herein, including taxes, insurance and bonding.

[1] The "Unit Price" column shall indicate unit or lump sum prices for each bid item and shall be indicated in written and numerical form.
[2] The "Item Total Costs" column shall indicate the extension of the unit prices, which is obtained by multiplying the "Estimated Quantity" column by the "Unit Price" column.
[3] The "Bid Total" amount shall be the sum of all costs listed in the "Item Total Costs" column.

The unit prices for **Park Avenue Lift Station Renovation, Project No. B24-PW-107019-500397,** shall include all labor, materials, water disposal, bailing, shoring, removal, disposal, overhead, profit, insurance, and all other related costs and work to cover the finished work of the several kinds called for. Changes in the Contract shall be processed in accordance with Paragraph 16 of the General Conditions.

Bidder understands that the Owner reserves the right to reject any or all Bids, or portions thereof, and to waive any informalities in the bidding.

The Bidder agrees that this Bid shall be good and may not be withdrawn for a period of ninety (90) calendar days after the scheduled closing time for receiving Bids.

Upon receipt of written notice of the acceptance of this Bid, Bidder shall execute the formal Contract attached within 10 days and deliver a Performance Bond, Payment Bond, and Certificates of Insurance as required by Paragraph 25 of the General Conditions and the Special Provisions.

The Bid security attached in the sum of $_____ is to become the property of the Owner in the event the Contract and Bond(s) are not executed and provided within the time above set forth, as liquidated damages for the delay and additional expense to the Owner caused thereby.

Bidder hereby acknowledges receipt of the following Addenda: ___, ___, ___.

RESPECTFULLY SUBMITTED BY:

BY: _____

TITLE: _____

FIRM: _____

ADDRESS: _____

_____

PHONE: _____FAX_____

EMAIL: _____

Seal - if Bid by a corporation

AZ Contractor's License No:_____Type_____

** END OF SECTION **

SECTION 00400

ARIZONA STATUTORY BID BOND

PURSUANT TO TITLES 28, 34 AND 41, ARIZONA REVISED STATUTES
(Penalty of this bond must not be less than 10% of the bid amount)

KNOW ALL MEN BY THESE PRESENTS:

That, _____(hereinafter "Principal"), as Principal, and _____, (hereinafter "Surety"), a corporation organized and existing under the laws of the State of _____, with its principal offices in the City of _____, holding a certificate of authority to transact surety business in Arizona issued by the Director of the Department of Insurance pursuant to Title 20, Chapter 2, Article 1, as Surety, are held and firmly bound unto Lake Havasu City, Arizona, (hereinafter "Obligee"), as Obligee, in the amount of Ten Percent (10%) of the amount of the bid of Principal, submitted by Principal to the Obligee for the work described below, for the payment of which sum, the Principal and Surety bind themselves, and their heirs, administrators, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS, the Principal has submitted a bid for

Park Avenue Lift Station Renovation, B24-PW-107019-500397

NOW, THEREFORE, if the Obligee shall accept the proposal of the Principal and the Principal shall enter into a contract with the Obligee in accordance with the terms of the proposal and give the bonds and certificates of insurance as specified in the standard specifications with good and sufficient surety for the faithful performance of the contract and for the prompt payment of labor and materials furnished in the prosecution of the contract, or in the event of the failure of the Principal to enter into the contract and give the bonds and certificates of insurance, if the Principal pays to the Obligee the difference not to exceed the penalty of the bond between the amount specified in the proposal and such larger amount for which the Obligee may in good faith contract with another party to perform the work covered by the proposal then this obligation is void. Otherwise it remains in full force and effect provided, however, that this bond is executed pursuant to the provisions of Section 34-201, Arizona Revised Statutes, and all liabilities on this bond shall be determined in accordance with the provisions of that section to the extent as if it were copied at length herein.

Witness our hands this ___day of_____, _____.

PRINCIPAL SEAL	SURETY SEAL
By: _____ Principal	By: _____ Attorney-in-Fact
Its: _____ Principal's Title	_____ Agency of Record
	_____ Agency Address

SECTION 00420
BIDDER'S STATEMENT OF QUALIFICATIONS

The Undersigned certifies the truth and correctness of all statements and of all answers to questions made hereinafter.

SUBMITTED TO: Lake Havasu City, Arizona
2330 N. McCulloch Boulevard
Lake Havasu City, AZ 86403

SUBMITTED BY: NAME:_____

ADDRESS:_____

PRINCIPAL OFFICE: _____

[ ] Corporation
[ ] Partnership
[ ] Individual
[ ] Joint Venture
[ ] Other

(NOTE: Attach separate sheets as required)

1. How many years has your organization been in business as a Contractor?

2. How many years has your organization been in business under its present business name?

3. If a Corporation, answer the following:
Date of Incorporation: _____
State of Incorporation:_____
President: _____
Vice President(s): _____
_____
Secretary: _____
Treasurer: _____

4. If a Partnership, answer the following:
Date of organization: _____
Type of Partnership: _____
(General/Limited/Assoc.)
Name and Address of all partners.
_____
_____
_____

5. If other than a Corporation or Partnership, describe Organization and name Principals:
_____

What percent of the work do you normally perform with your own forces?

List trades:

_____	_____	_____
_____	_____	_____

Have you ever failed to complete any work awarded to you? If so, indicate when, where and why:

_____

_____

_____

8. Has any Officer or Partner of your Organization ever been an Officer or Partner of another Organization that failed to complete a construction contract? _____If so, state circumstances:

_____

_____

9. List major construction projects your Organization has under contract on this date:

Project Name	Name, Email Address & Telephone Number of Owner	Project Location	Contract Amount	Contract Date	Percent Complete	Scheduled Completion

10. List similar construction projects your Organization has completed in the past five years:

Project Name	Name, Email Address & Telephone Number of Owner	Project Location	Contract Amount	Date Awarded	Date Completed	Percent with Own Forces

11. List the construction experience of the principal individuals in your Organization:

Individual's Name	Construction Experience - Years	Within Your Organization		
		Present Position & Years Experience	Dollar Volume Responsibility	Previous Position & Years Experience

12. List states and categories in which your Organization is legally qualified to do business:

_____
_____
_____

13. List all Arizona Contractor licenses currently held by your Organization; the status of each license; and provide a photocopy of each license with your bid proposal.

	License Class / #	Status
1.	_____	_____
2.	_____	_____
3.	_____	_____
4.	_____	_____

Please attach a list of additional Arizona Contractor licenses, if any.

14. Bank References:

_____
_____
_____

15. Trade References:

_____
_____
_____

16. Name of Bonding and Insurance Companies and Name and Address of Agents: Maximum Bonding Capacity _____

17. The Undersigned agrees to furnish, upon request by the Owner, within seven days after

the Bid Opening, a current Statement of Financial Conditions, including Contractor's latest regular dated financial statement or balance sheet which must contain the following items:

Current Assets: (Cash, joint venture accounts, accounts receivable, notes receivable, accrued interest on notes, deposits, and materials and prepaid expenses), net fixed assets and other assets.

Current Liabilities: (Accounts payable, notes payable, accrued interest on notes, provision for income taxes, advances received from owners, accrued salaries, accrued payroll taxes), other liabilities, and capital (capital stock, authorized and outstanding shares par values, earned surplus).

Date of statement or balance sheet: _____

Name of firm preparing statement: _____

By: _____
(Agent and Capacity)

18. List of Subcontractors. In accordance with paragraph 1.0 of Instructions to Bidders, the following is a breakdown of all subcontractors anticipated to be used for completing this project and their approximate percentage of work to be performed.

The Bidder certifies that all Subcontractors listed are eligible to perform Work on public works projects pursuant to ARS 34-241.

Subcontractor	Description of Work	% of Total Project
	Total % of all Subcontractor's work on project	
	Total % for Prime Contractor	

19. Dated at _____ this _ day of _____, _____

Name of Organization: _____

By: _____

Title: _____

** END OF SECTION **

SECTION 00430

AFFIDAVIT OF CONTRACTOR CERTIFYING THAT THERE WAS NO COLLUSION IN BIDDING FOR CONTRACT

STATE OF)
) ss
CITY OF)

(NAME OF INDIVIDUAL)

BEING DULY SWORN, DEPOSES AND SAYS:

THAT HE IS_____
(TITLE)

OF _____
(NAME OF BUSINESS)

THAT PURSUANT TO SECTION 34-253 OF THE ARIZONA REVISED STATUTES, HE CERTIFIES AS FOLLOWS:

THAT NEITHER HE NOR ANYONE ASSOCIATED WITH SAID

_____
(NAME OF BUSINESS)

HAS DIRECTLY, OR INDIRECTLY, ENTERED INTO ANY CONTRACT, PARTICIPATED IN ANY COLLUSION OR OTHERWISE TAKEN ANY ACTION IN RESTRAINT OF FREE COMPETITIVE BIDDING IN CONNECTION WITH THIS PROJECT.

_____
NAME

_____
TITLE

_____
NAME OF BUSINESS

SUBSCRIBED AND SWORN TO BEFORE ME THIS __ DAY OF _____, _____

MY COMMISSION EXPIRES: _____

NOTARY PUBLIC: _____

** END OF SECTION **

HAZARD COMMUNICATION PROGRAM FOR_____
(*Name of Company*)
The purpose of this program is to ensure that potential hazards and hazard control measures for chemicals used by this company are understood by company employees.

The written program is available for employee review at any time. It is located _____. A copy of the program will be provided to any employee or employee representative, upon request.

CONTAINER LABELING:
_____ will verify that all containers received for use by this company will: (name/title of individual)

* be clearly labeled as to the contents, matching identification on MSDS;
* note the appropriate hazard warnings;
* List the name and address of the manufacturer.

No containers will be released for use until the above data is verified.

MATERIAL SAFETY DATA SHEETS:
Copies of MSDS's for all hazardous chemicals to which employees may be exposed will be kept
_____.
_____ will be responsible for ensuring that:
(name/title of individual)

* MSDS's for the new chemicals are available;
* MSDS's will be available for review to all employees during each work shift;
* Copies will be available on request.

EMPLOYEE TRAINING AND INFORMATION:
Each employee will be provided the following information and training before working in areas where hazardous chemicals exist. In addition, if a new hazardous material is introduced into the workplace, affected employees will be given new information and training concerning that material.

A. Minimum Information Provided:

(1) All operations and locations in the work area where hazardous chemicals are present.

GENERAL INDUSTRY

A. Minimum Information Provided:

(1) The location and availability of the written hazard communication program, including list(s) of hazardous chemicals used and related material safety data sheets;
(2) The method the company will use to inform employees of potential hazards of non-routine tasks (jobs that are not routine for an individual because of infrequency, location or type.)

B. Minimum Training Provided:

(1) Methods and observations used to detect the presence or release of a hazardous chemical in the work area (such as company monitoring programs, continuous monitoring device, visual appearance, odor or to other characteristics of hazardous chemicals;

(2) The physical and health hazards of chemicals in the assigned work area;

(3) The measures to take to protect against such hazards, including specific company procedures concerning work practices, emergencies and care and use of protective equipment.

(4) Details of the company hazard communication program, including explanation of the labeling system, the material safety data sheets, and how to obtain and use the appropriate hazard information.

(OPTIONAL) Upon completion of the training, each employee will sign a form acknowledging receipt of the written hazard communication program and related training.

HAZARDOUS NON-ROUTINE TASKS: (If applicable.)
If company employees are required to do hazardous non-routine tasks, such as welding in confined spaces, or cleaning of tanks, the employer must address how the employees doing the work will be informed about the specific hazards to which they will be exposed, what personal protective equipment will be provided and who will be responsible to oversee the operation or operations. If the company does not have any hazardous non-routine tasks, line through this section and state "NO HAZARDOUS NON-ROUTINE TASKS".

CHEMICALS IN UNLABELED PIPES: (If applicable.)
If the company has chemicals in unlabeled pipes, the company must inform the employees of the hazards associated with those chemicals. If the company does not have any chemicals in unlabeled pipes, line through this section and state "NO CHEMICALS IN UNLABELED PIPES".

INFORMING CONTRACTORS:
Providing contractors and their employees with the following information is the responsibility of _____.
(Name/title of individual)

(1) Hazardous chemicals to which they may be exposed while on the job site;
(2) Measures the employees may take to lessen the possibility of exposure;
(3) Steps the company has taken to lessen the risks;
(4) Where the MSDS's are for chemicals to which they may be exposed;
(5) Procedures to follow if they are exposed.

CONTRACTORS INFORMING EMPLOYERS:

Contractors entering this workplace with hazardous materials will supply this employer with MSDS's covering those particular products the contractor may expose this company's employees to while working at this site.

LIST OF HAZARDOUS CHEMICALS IN THIS WORKPLACE

_____
_____
_____
_____

CONTRACTOR:

By: _____

Name: _____

Title: _____

Address: _____

END OF SECTION

LAKE HAVASU CITY
EMPLOYMENT ELIGIBILITY VERIFICATION & FORM

INSTRUCTIONS FOR COMPLETION OF EMPLOYMENT ELIGIBILITY VERIFICATION FORM

WHO MUST COMPLETE THIS FORM:
In accordance with Lake Havasu City Code Chapter 3.30, Employment of Unauthorized Aliens, all contractors and subcontractors furnishing labor, time, or effort for construction or maintenance of any structure, building, transportation facility, or improvements of real property must complete this form.

Contractors or subcontractors, as described above, must certify that they have complied, in good faith, with the applicable requirements of the Federal Immigration Control and Reform Act with respect to the hiring of covered employees. This certification must be executed by an authorized representative.

WHEN THIS FORM MUST BE COMPLETED:
This form must be completed by all contractors and subcontractors and submitted to the City department awarding the contract, license agreement, or lease no later than notification of successful direct selection, bid, request for proposals, request for qualification, or any similar competitive or noncompetitive procurement or bidding process.

LAKE HAVASU CITY
EMPLOYMENT ELIGIBILITY VERIFICATION & FORM

LIST OF ACCEPTABLE DOCUMENTS:

LIST A		LIST B		LIST C
Documents that Establish Both		**Documents that Establish**		**Documents that Establish**
U.S. Passport (unexpired or expired)	**OR**	Driver's license or ID Card issued by a state or outlying possession of the United States provided it contains a photograph or information such as name date of birth	**AND**	U.S. social security card issued by the Social Security Administration
Certificate of U.S. Citizenship		ID card issued by a federal, state or local government agencies or entities, provided it contains a photograph or information		Certification of Birth Abroad issued by the Department of State
Certificate of Naturalization		School ID card with photograph		Original or certified copy of a birth certificate issued by a state, county, municipal authority or outlying
Unexpired foreign passport with I-551 stamp or attached federal Form I-94		Voter's registration card		Native American tribal document
Permanent Resident Card or Alien		U.S. Military card or draft record		U.S. Citizen ID Card
Unexpired Temporary		Military dependent's ID card		ID Card for the use of Resident Citizen in the
Unexpired Employment		U.S. Coast Guard Merchant Mariner Card		Unexpired employment authorization document issued by DHS
Unexpired Reentry		Native American tribal		
Unexpired Refugee Travel Document		Driver's license issued by a		
Unexpired Employment Authorization Document issued by DHS that contains a		**For persons under age 18 who are unable to present a document listed above:** School record or report card; Clinic,		

EMPLOYER VERIFICATION OF EMPLOYMENT ELIGIBILITY & FORM

The undersigned attests under penalty of perjury, that they have reviewed the documents presented to them by their employees, and that the documents provided to the undersigned by their employees, as more particularly identified in the attached exhibit entitled "list of acceptable documents" appear to be genuine and appear to relate to the employee name, and to the best of the undersigned's knowledge, the employee is eligible to work in the United States based upon the undersigned's review of the documents presented.

Signature of Authorized Representative of Covered Employer/Contractor/ Subcontractor	**Print Name**	**Title**
Business or Organization Name	**Business Phone Number**	**Date (month/date/year)**
Address (Street Name and Number)		
City, State, Zip Code		

SECTION 00500
CONTRACT

THIS CONTRACT is entered into by and between LAKE HAVASU CITY, ARIZONA, a municipal corporation ("OWNER"), and _____a(n) ARIZONA corporation,
Federal I.D. # ("CONTRACTOR").

WHEREAS, OWNER has developed plans for and desires to commence the Park Avenue Lift Station Renovation, Project No. B24-PW-107019-500397 ("PROJECT"); and

WHEREAS, CONTRACTOR represents that it possesses the experience, competence, equipment and financing to properly complete the PROJECT, and has formally proposed to do so, and to furnish all necessary labor, materials, and equipment and services therefore in accordance with said plans, and subject to the terms and conditions hereof.

NOW, THEREFORE, in consideration of these promises and the mutual covenants herein, it is hereby agreed as follows:

1. CONTRACTOR shall commence and complete the construction of the PROJECT;

2. CONTRACTOR shall furnish all of the material, supplies, tools, equipment, labor and other services necessary for the construction and completion of the PROJECT.

3. CONTRACTOR shall commence the PROJECT in accordance with the CONTRACT DOCUMENTS within TEN (10) calendar days after the date of the Notice to Proceed. Final completion of the PROJECT shall occur within **XX calendar days** of the date of the Notice to Proceed. The period for completion may be extended through the authorized and approved change order process.

4. Liquidated Damages: OWNER and CONTRACTOR recognize that time is of the essence of this CONTRACT and that OWNER will suffer financial loss if the PROJECT is not completed within the time specified in paragraph 3 above, plus any extensions thereof allowed in accordance with the General Conditions. They also recognize the delays, expense and difficulties involved in proving in a legal or arbitration proceeding the actual losses or damages (including special, indirect, consequential, incidental and any other losses or damages) suffered by OWNER if a complete acceptable PROJECT is not delivered on time.

   Accordingly, and instead of requiring proof of such losses or damages, OWNER and CONTRACTOR agree that as liquidated damages for delay (but not as a penalty) CONTRACTOR shall pay the OWNER **$XXX** for each calendar day that expires after the time specified in paragraph 3 for delivery of acceptable Bid Items, plus any costs incurred by the Engineer as provided in Section 17 of the General Conditions.

5. CONTRACTOR agrees to complete the PROJECT in accordance with all of the terms and conditions of the CONTRACT DOCUMENTS for the sum of **$XXXXX** as shown

in the Bid Schedule.

6. CONTRACTOR shall submit a completed Section 00450 entitled Hazard Communication Program with the executed copy of this CONTRACT.

7. The term "CONTRACT DOCUMENTS" means and includes the following:
00020 Notice Inviting Bids
00100 Information for Bidders
00300 Bid Proposal
00310 Bid Price Schedule
00400 Bid Bond
00420 Bidder's Statement of Qualifications
00430 Bidder's Affidavit of No Collusion
00450 Hazard Communication Program
00460 Employment Eligibility Verification
00500 CONTRACT
00500A Indemnification and Insurance Requirements
00500B Contractor Claim Handling Procedure
00510 Arizona Statutory Performance Bond
00520 Arizona Statutory Payment Bond
00670 Notice of Award
00680 Notice to Proceed
00685 Certificate of Substantial Completion
00690 Certificate of Final Completion
00700 General Conditions
00800 Special Provisions
Technical Specifications and Details
Construction Contract Drawings
Change Orders
Lien Releases (Conditional and Final)
Addenda

8. OWNER shall pay CONTRACTOR in the manner and at such times as set forth in the General Conditions and in such amounts as required by the CONTRACT DOCUMENTS.

9. In the event CONTRACTOR fails to perform any portion of the PROJECT or satisfy any term or condition of the CONTRACT DOCUMENTS, OWNER may at its sole discretion file notice and/or claim of such failure with CONTRACTOR'S surety.

10. Israel. If applicable, Contractor certifies that it is not currently engaged in, and agrees for the duration of this Contract that it will not engage in, a boycott of goods and services from Israel, as defined in A.R.S. § 35-393.

11. Conflict of Interest. The Contract may be cancelled in accordance with Arizona Revised Statutes Section 38-511.

12. Forced Labor of Ethnic Uyghurs Certification. If applicable, Contractor certifies that it does not currently, and agrees for the duration of the Contract that it will not, use: (1) the forced labor of ethnic Uyghurs in the People's Republic of China; (2) any goods or services produced by the forced labor of ethnic Uyghurs in the People's Republic of China; or (3) any contractors, subcontractors, or suppliers that use the forced labor or any goods or services produced by the forced labor of ethnic Uyghurs in the People's Republic of China. If Contractor becomes aware it is not in compliance with this certification, it shall notify the City within five business days after becoming aware. This Contract will terminate upon failure to remedy the noncompliance within 180 days of the notification. (A.R.S. § 35-394)

13. Export Administration Act. The CONTRACTOR warrants compliance with the Export Administration Act.

14. Recyclable Products. The CONTRACTOR shall use recyclable products and products which contain recycled content to the maximum extent economically feasible in the performance of the work set forth in the CONTRACT.

15. Asbestos License. The CONTRACTOR shall possess an asbestos abatement license if required under A.R.S. Title 32 or 49.

16. Assignment. No right or interest in this CONTRACT shall be assigned by CONTRACTOR without prior, written permission of the OWNER signed by the City Manager; and no delegation of any duty of CONTRACTOR shall be made without prior written permission of the OWNER signed by the City Manager. Any attempted assignment or delegation by CONTRACTOR in violation of this provision shall be a breach of this CONTRACT by CONTRACTOR.

[SIGNATURES ON FOLLOWING PAGE]

IN WITNESS WHEREOF, the parties hereto have executed, or caused to be executed by their duly authorized officials, this CONTRACT in two (2) copies, each of which shall be deemed an original. The last date of signature shall be the effective date of this CONTRACT.

OWNER:
Lake Havasu City, Arizona

By: _____ Date: _____

Name: _____
Title: _____

APPROVED AS TO FORM:
Lake Havasu City Attorney's Office

By: _____ Date: _____

CONTRACTOR:

By: _____ Date: _____

Name/Title: _____

Address: _____

ATTEST:

BY: _____

Name/Title: _____

** END OF SECTION **

LAKE HAVASU CITY CONSTRUCTION CONTRACT
INDEMNIFICATION AND INSURANCE REQUIREMENTS
(long form)

I. INDEMNIFICATION

CONTRACTOR agrees to indemnify, defend, save, and hold harmless the City, its departments, agencies, boards, commissions, officers, officials, agents, volunteers, and employees ("INDEMNITEE'") from and against any and all claims, actions, liabilities, damages, losses, or expenses (including court costs, attorney's fees, and costs of claim processing, investigation, and litigation) ("Claims") for bodily injury or personal injury (including death), or loss or damage to tangible or intangible property caused, or alleged to be caused, in whole or in part, by the CONTRACTOR or any of its owners, officers, directors, agents, employees, or contractors. This Indemnity includes any claim or amount arising out of or recovered under Workers' Compensation law or arising out of the failure of CONTRACTOR to conform to any federal, state, or local law, statute, ordinance, rule, regulation, or court decree. It is the specific intention of the parties that the INDEMNITEE shall, in all instances, except for Claims arising solely from the negligent or willful acts or omissions of the INDEMNITEE, be indemnified by CONTRACTOR from and against any and all claims. It is agreed that Permittee will be responsible for primary loss investigation, defense, and judgment costs where this indemnification is applicable.

II. INSURANCE REQUIREMENTS

A. CONTRACTOR and its subcontractors shall procure and maintain until all of their obligations have been discharged, including any warranty periods under this CONTRACT, are satisfied, insurance against claims for injury to persons or damage to property which may arise from or in connection with the performance of the work hereunder by the CONTRACTOR, its agents, representatives, employees or subcontractors.

B. The insurance requirements herein are minimum requirements for this CONTRACT and in no way limit the indemnity covenants contained in this CONTRACT. City in no way warrants that the minimum limits contained herein are sufficient to protect the CONTRACTOR from liabilities that might arise out of the performance of the work under this CONTRACT by the CONTRACTOR, its agents, representatives, employees or subcontractors, and CONTRACTOR is free to purchase additional insurance.

C. MINIMUM SCOPE AND LIMITS OF INSURANCE: CONTRACTOR shall provide coverage with limits of liability not less than those stated below.

1. **Commercial General Liability – Occurrence Form**
   Policy shall include bodily injury, property damage, personal injury and broad form contractual liability coverage.

a.	General Aggregate	$4,000,000
b.	Products – Completed Operations Aggregate	$1,000,000
c.	Personal and Advertising Injury	$1,000,000
d.	Blanket Contractual Liability – Written and Oral	$1,000,000
e.	Fire Legal Liability	$ 50,000
f.	Each Occurrence	$1,000,000

i. The policy shall be endorsed to include the following additional insured language: ***"Lake Havasu City, its departments, agencies, boards, commissions, and its officers, officials, agents, volunteers and employees shall be named as additional insureds with respect to liability arising out of the activities performed by or on behalf of the CONTRACTOR".***

ii. Policy shall contain a waiver of subrogation against Lake Havasu City, its departments, agencies, boards, commissions, and its officers, officials, agents, volunteers and employees for losses arising from work performed by or on behalf of the CONTRACTOR.

iii. Completed operations coverage shall remain effective for at least two years following expiration of CONTRACT.

2. **Business Automobile Liability**

a. Bodily Injury and Property Damage for any owned, hired, and/or non-owned vehicles used in the performance of this CONTRACT.

Combined Single Limit (CSL)	$1,000,000

i. The policy shall be endorsed to include the following additional insured language: "Lake Havasu City, its departments, agencies, boards, commissions, and its officers, officials, agents, volunteers and employees shall be named as additional insureds with respect to liability arising out of the activities performed by or on behalf of the CONTRACTOR, involving automobiles owned, leased, hired or borrowed by the CONTRACTOR."

ii. Policy shall contain a waiver of subrogation against Lake Havasu City, its departments, agencies, boards, commissions, and its officers, officials, agents, volunteers and employees for losses arising from work performed by or on behalf of the CONTRACTOR.

3. **Workers' Compensation and Employers' Liability**

a. Workers' Compensation	Statutory
b. Employers' Liability Each Accident	$ 500,000
Disease – Each Employee	$ 500,000
Disease – Policy Limit	$1,000,000

i. Policy shall contain a waiver of subrogation against Lake Havasu City, its departments, agencies, boards, commissions, and its officers, officials, agents, volunteers and employees for losses arising from work performed by or on behalf of the CONTRACTOR.

ii. This requirement shall not apply if exempt under A.R.S. Section 23-901.

4. **Professional Liability (Errors and Omissions Liability)***
***If Applicable**

a. Each Claim	$2,000,000
b. Annual Aggregate	$4,000,000

i. In the event that the professional liability insurance required by this CONTRACT is written on a claims-made basis, CONTRACTOR warrants

that any retroactive date under the policy shall precede the effective date of this CONTRACT; and that either continuous coverage will be maintained or an extended discovery period will be exercised for a period of two (2) years beginning at the time work under this CONTRACT is completed.

ii. The policy shall cover professional misconduct or lack of ordinary skill for those positions defined in the Scope of Work of this CONTRACT.

5. **Builders' Risk (Property) Insurance (Vertical Construction Only)**

a. CONTRACTOR shall purchase and maintain, on a replacement cost basis Builders' Risk insurance in the amount of the initial CONTRACT amount as well as subsequent modifications thereto, including modifications through Change Order, for the entire work at the site. Such Builders' Risk insurance shall be maintained until final payment has been made or until no person or entity other than CITY has an insurable interest in the property required to be covered, whichever is earlier. This insurance shall include interests of CITY, CONTRACTOR and any tier of CONTRACTOR's subcontractors in the work during the life of the CONTRACT and course of construction, and shall continue until the work is completed and accepted by CITY. For new construction projects, CONTRACTOR agrees to assume full responsibility for loss or damage to the work being performed and to the buildings or structures under construction. For renovation construction projects, CONTRACTOR agrees to assume responsibility for loss or damage to the work being performed at least up to the full CONTRACT amount, unless otherwise required by the Contract documents or amendments thereto.

b. Builders' Risk insurance shall be on an all-risk policy form and shall also cover false work and temporary buildings or structures and shall insure against risk of direct physical loss or damage from external causes including debris removal, demolition occasioned by enforcement of any applicable legal requirements and shall cover reasonable compensation for architects' and engineers' services and expenses, and other "soft costs," required as a result of such insured loss.

c. Builders' Risk insurance must provide coverage from the time any covered property falls within CONTRACTOR's control and/or responsibility and continue without interruption during construction or renovation or installation, including any time during which covered property is being transported to the construction or installation site, and while on the construction or installation site awaiting installation. The policy will provide coverage while the covered premises or any part thereof is occupied. Builders' Risk insurance shall be primary and not contributory.

d. If the CONTRACT requires testing of equipment or materials or other similar operations, at the option of CITY, CONTRACTOR will be responsible for providing property insurance for these exposures under a Boiler Machinery insurance policy.

6. **Contractor's Personal Property**

CONTRACTOR and each of its subcontractors and suppliers shall be solely responsible for any loss or damage to its or their personal property and that of their employees and workers, including, without limitation, property or materials created or provided pursuant to this CONTRACT, any subcontract or otherwise, its or their tools, equipment, clothing, fencing, forms, mobile construction equipment, scaffolding, automobiles,

trucks, trailers or semi-trailers including any machinery or apparatus attached thereto, temporary structures and uninstalled materials, whether owned, used, leased, hired or rented by CONTRACTOR or any subcontractor, consultant or supplier or employee or worker (collectively, "Personal Property"). CONTRACTOR and its subcontractors, consultants and suppliers, at its or their option and own expense, may purchase and maintain insurance for such Personal Property and any deductible or self-insured retention in relation thereto shall be its or their sole responsibility. Any such insurance shall be CONTRACTOR's and the subcontractors', suppliers' volunteers and employees' and workers' sole source of recovery in the event of loss or damage to its or their Personal Property. Any such insurance purchased and maintained by CONTRACTOR and any subcontractor, consultant or supplier shall include a waiver of subrogation as to Owner. CONTRACTOR waives all rights of recovery, whether under subrogation or otherwise, against all such parties for loss or damage covered by CONTRACTOR's property insurance. CONTRACTOR shall require the same waivers from all subcontractors and suppliers and from the insurers issuing property insurance policies relating to the Work or the Project purchased and maintained by all subcontractors and suppliers. The waivers of subrogation referred to in this subparagraph shall be effective as to any individual or entity even if such individual or entity (a) would otherwise have a duty of indemnification, contractual or otherwise, (b) did not pay the insurance premium, directly or indirectly, and (c) whether or not such individual or entity has an insurable interest in the property which is the subject of the loss or damage.

7. **Theft, Damage, or Destruction of Work**

In the event of theft, damage or destruction of the Work, CONTRACTOR will re-supply or rebuild its Work without additional compensation and will look to its own resources or insurance coverages to pay for such re-supply or rebuilding. CONTRACTOR will promptly perform, re-supply or rebuild, regardless of the pendency of any claim by CONTRACTOR against any other party, including Owner, that such party is liable for damages, theft or destruction of CONTRACTOR's Work. This subparagraph shall apply except to the extent that the cost of re-supply or rebuilding is paid by Owner's builder's risk insurance; in such event, Owner waives (to the fullest extent permitted by the builder's risk policy) all rights of subrogation against CONTRACTOR and each of its subcontractors to the extent of such payment by Owner's builder's risk insurer.

D. ADDITIONAL INSURANCE REQUIREMENTS: The policies shall include, or be endorsed to include, the following provisions:

1. Lake Havasu City, its departments, agencies, boards, commissions and its officers, officials, agents, volunteers and employees wherever additional insured status is required. Such additional insured shall be covered to the full limits of liability purchased by the CONTRACTOR, even if those limits of liability are in excess of those required by this CONTRACT.
2. The Contractor's insurance coverage shall be primary insurance with respect to all other available sources.
3. Coverage provided by the Contractor shall not be limited to the liability assumed under the indemnification provisions of this CONTRACT.

E. NOTICE OF CANCELLATION: Each insurance policy required by the insurance provisions of this CONTRACT shall not be suspended, voided, cancelled, reduced in coverage or in limits without ten (10) business days written notice to City. Such notice shall be mailed directly to Lake Havasu City, Administrative Services Department, Procurement Division, 2330 McCulloch Blvd. North, Lake Havasu City, AZ, 86403 and shall be sent by certified mail, return receipt requested.

F. ACCEPTABILITY OF INSURERS**:** Insurance is to be placed with duly licensed or approved non-admitted insurers in the state of Arizona with an "A.M. Best" rating of not less than A-VII. CITY in no way warrants that the above-required minimum insurer rating is sufficient to protect the CONTRACTOR from potential insurer insolvency.

G. VERIFICATION OF COVERAGE**:**

1. CONTRACTOR shall furnish CITY with certificates of insurance as required by this CONTRACT. The certificates for each insurance policy are to be signed by a person authorized by that insurer to bind coverage on its behalf and the Project/contract number and project description shall be noted on the certificate of insurance.
2. All certificates and endorsements are to be received and approved by CITY at least ten (10) days before work commences. Each insurance policy required by this CONTRACT must be in effect at or prior to commencement of work under this CONTRACT and remain in effect for the duration of the Project. Failure to maintain the insurance policies as required by this CONTRACT, or to provide evidence of renewal, is a material breach of contract.
3. All renewal certificates required by this CONTRACT shall be sent directly to Lake Havasu City, Administrative Services Department, Procurement Division, 2330 McCulloch Blvd. North, Lake Havasu City, AZ, 86403. The Project/contract number and project description shall be noted on the certificate of insurance. CITY reserves the right to require complete, certified copies of all insurance policies required by this CONTRACT at any time**.**

H. SUBCONTRACTORS**:** CONTRACTOR's certificate(s) shall include all subcontractors as insureds under its policies **or** CONTRACTOR shall furnish to CITY separate certificates and endorsements for each subcontractor. All coverages for subcontractors shall be subject to the minimum requirements identified above.

I. APPROVAL**:** Any modification or variation from the insurance requirements in this CONTRACT must have prior approval from the CITY's Human Resources/Risk Management Division, whose decision shall be final. Such action will not require a formal CONTRACT amendment, but may be made by administrative action.

J. EXCEPTIONS**:** In the event the CONTRACTOR or sub-contractor(s) is/are a public entity, then the Insurance Requirements shall not apply. Such public entity shall provide a Certificate of Self-Insurance.

SECTION 00500B
CONTRACTOR Claim Handling Procedure

1. Claimant is to submit in writing to the OWNER or their REPRESENTATIVE the details of the claim to include the where, when, and how of the claim, and an estimate of damage, if applicable.

2. OWNER or their REPRESENTATIVE will forward the claim directly to the CONTRACTOR for handling. The CONTRACTOR is to respond to the claimant, in writing, within 30 calendar days of receipt with copies to:

   Lake Havasu City Human Resources/Risk Management Division
   Lake Havasu City Administrative Services Department
   OWNER'S REPRESENTATIVE, if applicable

   If the CONTRACTOR denies the claim, the reasons for such denial must be included in the response to the claimant.

SECTION 00510
ARIZONA STATUTORY PERFORMANCE BOND

PURSUANT TO TITLES 28, 34, AND 41, ARIZONA REVISED STATUTES
(Penalty of this bond must be 100% of the Contract amount)

KNOW ALL MEN BY THESE PRESENTS THAT: _____ (hereinafter "Principal"), as Principal, and _____ (hereinafter "Surety"), a corporation organized and existing under the laws of the State of _____ with its principal office in the City of _____, holding a certificate of authority to transact surety business in Arizona issued by the Director of Insurance pursuant to Title 20, Chapter 2, Article 1, as Surety, are held and firmly bound unto Lake Havasu City, Arizona (hereinafter "Obligee") in the amount of **WRITTEN AMOUNT AND 00/100** (Dollars) (**$#,###,###.##-NUMERIC AMOUNT**), for the payment whereof, Principal and Surety bind themselves, and their heirs, administrators, executors, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS, the Principal has entered into a certain written contract with the Obligee, dated the ____ day of _____, _____, to furnish all of the material, supplies, tools, equipment, labor and other services necessary for the construction and completion of

Park Avenue Lift Station Renovation, PROJECT NUMBER B24-PW-107019-500397

which contract is hereby referred to and made a part hereof as fully and to the same extent as if copied at length herein.

NOW, THEREFORE, THE CONDITION OF THE OBLIGATION IS SUCH, that if the Principal faithfully performs and fulfills all of the undertakings, covenants, terms, conditions and agreements of the contract during the original term of the contract and any extension of the contract, with or without notice of the Surety, and during the life of any guarantee required under the contract, and also performs and fulfills all of the undertakings, covenants, terms, conditions and agreements of all duly authorized modifications of the contract that may hereafter be made, notice of which modifications to the Surety being hereby waived, the above obligation is void. Otherwise it remains in full force and effect.

PROVIDED, HOWEVER, that this bond is executed pursuant to the provisions of Title 34, Chapter 2, Article 2, Arizona Revised Statutes, and all liabilities on this bond shall be determined in accordance with the provisions of Title 34, Chapter 2, Article 2, Arizona Revised Statutes, to the same extent as if it were copied at length in this agreement.

The prevailing party in a suit on this bond shall recover as part of the judgment reasonable attorney fees that may be fixed by a judge of the court.

Witness our hands this ____ day of _____ , _____.

_____

PRINCIPAL SEAL

_____ BY:_____

AGENCY OF RECORD

_____ _____

AGENCY ADDRESS SURETY SEAL

BY:_____

** END OF SECTION **

SECTION 00520
ARIZONA STATUTORY PAYMENT BOND
PURSUANT TO TITLES 28, 34, AND 41, ARIZONA REVISED STATUTES
(Penalty of this bond must be 100% of the Contract amount)

KNOW ALL MEN BY THESE PRESENTS THAT: _____

(hereinafter "Principal"), as Principal, and _____

_____

(hereinafter Surety), a corporation organized and existing under the laws of the State of with its principal office in the City of _____

_____,

holding a certificate of authority to transact surety business in Arizona issued by the Director of the Department of Insurance pursuant to Title 20, Chapter 2, Article 1, as Surety, are held and firmly bound unto Lake Havasu City, Arizona (hereinafter "Obligee") in the amount of **WRITTEN AMOUNT AND 00/100 (Dollars) (($#,###,###.##-NUMERIC AMOUNT)** for the payment whereof, Principal and Surety bind themselves, and their heirs, administrators, executors, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS, the Principal has entered into a certain written contract with the Obligee, dated the _____ of _____, _____, to furnish all of the material, supplies, tools, equipment, labor and other services necessary for the construction and completion of

Park Avenue Lift Station Renovation, PROJECT NUMBER B24-PW-107019-500397

which contract is hereby referred to and made a part hereof as fully and to the same extent as if copied at length herein.

NOW, THEREFOR, THE CONDITION OF THE OBLIGATION IS SUCH, that if the Principal promptly pays all monies due to all persons supplying labor or materials to the Principal or the Principal's subcontractors in the prosecution of the work provided for in the contract, this obligation is void. Otherwise it remains in full force and effect.

PROVIDED, HOWEVER, that this bond is executed pursuant to the provisions of Title 34, Chapter 2, Article 2, Arizona Revised Statues, and all liabilities on this bond shall be determined in accordance with the provisions, conditions and limitations of Title 34, Chapter 2, Article 2, Arizona Revised Statutes, to the same extent as if it were copied at length in this agreement.

The prevailing party in a suit on this bond shall recover as part of the judgment reasonable attorney fees that may be fixed by a judge of the court.

Witness our hands this ___ day of _____, _____.

_____

PRINCIPAL SEAL

_____ BY:_____

AGENCY OF RECORD

_____ _____

AGENCY ADDRESS SURETY SEAL

BY:_____

** END OF SECTION **

SECTION 00670
NOTICE OF AWARD

TO: **DATE:**

PROJECT DESCRIPTION: Park Avenue Lift Station Renovation

The OWNER has considered the BID submitted by you for the above described WORK in response to its Advertisement for BIDS dated September 6, 2023, and Information for Bidders.

You are hereby notified that your BID has been accepted for items in the amount of $, to include: [LIST BID ITEMS AWARDED]

You are required by the Information for Bidders to execute the Contract and furnish the required CONTRACTOR'S Performance Bond, Payment Bond, and Certificates of Liability, Vehicular, and Workmen's Compensation Insurance within ten (10) calendar days from the postmark date when this notice was sent by U.S. Mail.

If you fail to execute said Contract and to furnish said BONDS within ten (10) days from the date of this Notice, said OWNER will be entitled to consider all your rights arising out of the OWNER'S acceptance of your BID as abandoned and as a forfeiture of your BID BOND. The OWNER will be entitled to such other rights as may be granted by law.

You are required to return an acknowledged copy of this NOTICE OF AWARD to the OWNER.

Dated this [DATE] day of [MONTH], 20##.

Lake Havasu City, Arizona

BY: _____

NAME: Lynette Singleton

TITLE: Procurement Official

Acceptance of Notice
(NOTE: The contractor shall return a signed copy of this notice to the owner.)

Receipt of this NOTICE OF AWARD is hereby acknowledged by:

Contractor

This the ____ day of _____, 20##.

BY: _____ TITLE: _____

** END OF SECTION **

REV 3/30/16

SECTION 00685
CERTIFICATE OF SUBSTANTIAL COMPLETION

I hereby state that the degree of completion of:

Park Avenue Lift Station Renovation
Project No. B24-PW-107019-500397

Provides the full-time use of the project, or defined portion of the project, for the purposes for which it was intended and is the commencement of the Guarantee Period.

"Substantial Completion" shall not be considered as final acceptance.

Lake Havasu City, Arizona

Date: _____

By: _____

Name: _____

Title: _____

ACCEPTANCE OF NOTICE

(NOTE: The Contractor shall return a signed copy of this Notice to the Owner)

Receipt of the above **CERTIFICATE OF SUBSTANTIAL COMPLETION** is hereby acknowledged this the _____ day of _____, _____.

By: _____

Name: _____

Title: _____

E-original: [CONTRACTOR]
E-copy: Procurement (Purchasing@lhcaz.gov)
Lake Havasu City, City Clerk (CityClerk@lhcaz.gov)

CERTIFICATE OF COMPLETION

I hereby state that all goods and services required by:

Park Avenue Lift Station Renovation
Project No. B24-PW-107019-500397

have been delivered in conformance with the Contract, and all activities required by the Contractor under the Contract were completed as of _____.
(Date)

Lake Havasu City, Arizona

By: _____

Name:_____

Title: _____

E-original: [CONTRACTOR]
E-copy: Procurement (Purchasing@lhcaz.gov)
City Clerk (CityClerk@lhcaz.gov)

SECTION 00700
GENERAL CONDITIONS

This section of the Contract Documents is pre-printed. Any modifications to the following Articles, as may be required for this Project, are made in the Special Provisions.

1.0 DEFINITIONS

Wherever in the Contract Document the following terms are used, the intent and meaning shall be interpreted as follows:

1.1 Addenda

Written or graphic instruments issued prior to the opening of Bids which modify or interpret the Contract Documents, Drawings and Specifications, by additions, deletions, clarifications or corrections.

1.2 As Approved

The words "as approved," unless otherwise qualified, shall be understood to be followed by the words "by the Owner."

1.3 As Shown, and as Indicated

The words "as shown" and "as indicated" shall be understood to be followed by the words "on the Drawings" or "in the Specifications."

1.4 Award

The acceptance, by the Owner, of the successful Bidder's proposal.

1.5 Bid

The offer or proposal of the Bidder submitted on the prescribed form setting forth the prices for the Work to be performed.

1.6 Bidder

Any individual, firm partnership or corporation, or combination thereof submitting a proposal for the Work contemplated, acting directly or through a duly authorized representative.

1.7 Bonds

Bid, Performance, and Payment Bonds and other instruments of security, furnished by the Contractor and its surety in accordance with the Contract Documents.

1.8 Calendar Day

Every day shown on the calendar, measured from midnight to the next midnight.

1.9 Change Order

A written order to the Contractor, signed by the Owner, covering changes in the Plans, Specifications, or proposal quantities and establishing the basis of payment and contract time adjustment, if any, for the Work affected by such changes.

If the Change Order increases the existing Contract Amount, the Builder's Risk Insurance limit must be increased to the adjusted Contract Amount.

1.10 Contract

The "Contract" is the written Contract covering the performance of the Work and the furnishing of labor, materials, incidental services, tools, and equipment in the construction of the Work. It includes Supplemental Contracts amending or extending the Work contemplated in the manner hereinafter described and which may be required to complete the Work in a substantial and acceptable manner to the Owner. The Contract may include Contract Change Orders.

1.11 Contract Documents

The "Contract Documents" consist of the Bidding Requirements, Contract Forms, Conditions of the Contract including General and/or Supplemental General Conditions, Special Provisions, the Technical Specifications, and the Drawings, including all Addenda and modifications thereafter incorporated into the Documents before execution and including all other requirements incorporated by specific reference thereto.

1.12 Contract Price

The total monies payable by Owner to the Contractor under the terms and conditions of the Contract Documents.

1.13 Contract Time

The number of calendar days stated in the Contract Documents for the completion of the Work.

1.14 Contractor

The individual, partnership, firm, or corporation primarily liable for the acceptable performance of the Work contracted for and the payment of all legal debts pertaining to the Work who acts directly or through lawful agents or employees to complete the Contract Work.

1.15 Days

Unless otherwise specifically stated, the term "days" will be understood to mean calendar days.

1.16 Drawings

The term "Drawings," also described as "Plans," refers to the official drawings, profiles, cross sections, elevations, details, and other working drawings, and supplementary drawings, or reproductions thereof, which show the locations, character, dimensions, and details of the Work to be performed. Drawings may either be bound in the same book as the balance of the Contract Documents or bound in separate sets, and are a part of the Contract Documents, regardless of the method of binding.

1.17 Engineer

The individual, partnership, firm, or corporation duly authorized by the Owner (sponsor) to be responsible for the Engineering of the contract Work and acting directly or through an authorized representative.

1.18 Field Order

A written order effecting a change in the Work not involving an adjustment in the Contract Price or an extension of the Contract Time, issued by the Engineer to the Contractor during construction.

1.19 Final Acceptance

Upon due notice from the Contractor of presumptive completion of the entire project, the Owner will make an inspection. If all construction provided for and contemplated by the contract is found completed to the Owner's satisfaction and all requirements of the contract have been met, that inspection shall constitute the final inspection and the Owner will make the final acceptance and issue the Certificate of Completion.

If, however, the inspection discloses any work, in whole or in part, as being unsatisfactory or that all requirements of the contract have not been met, the Owner will give the Contractor the necessary instructions for correction or completion, and the Contractor shall immediately comply with and execute the instructions. Upon correction of the work, completion of contract requirements, and notification to Owner, another inspection will be made which shall constitute the final inspection provided the work has been satisfactorily completed and all requirements of the contract met. In such event, the Owner will make the final acceptance and issue the Certificate of Completion.

1.20 Inspector

An authorized representative of the Owner assigned to make all necessary inspections and/or tests of the Work performed or being performed, or of the materials furnished or being furnished by the Contractor.

1.21 Methodology and Quality of Workmanship

The manner and sequence of construction which considered to be the acceptable standard in which to perform the Work.

1.22 Notice

The term "notice" or the requirement to notify, as used in the Contract Documents or applicable State or Federal statutes, shall signify a written communication delivered in person or by certified or registered mail to the individual, or to a member of the firm, or to an officer of the corporation for whom it is intended. Certified or registered mail shall be addressed to the last business address known to him who gives the notice.

1.23 Notice of Award

The written notice of the acceptance of the Bid from the Owner to the successful Bidder.

1.24 Notice to Proceed

Written communication issued by the Owner to the Contractor authorizing him to proceed with the Work and establishing the date of commencement of the Work.

1.25 Or Equal

The phrase "or equal" shall be understood to indicate that the "equal" product is the same or better than the product names in function, performance, reliability, quality, and general configuration. Determination of equality in reference to the project design requirements will be made by the Owner.

1.26 Owner

The term "Owner" shall be understood to be Lake Havasu City, Arizona.

1.27 Payment Bond

The approved form of security furnished by the Contractor and its surety as a guaranty that it will pay in full all bills and accounts for materials and labor used in the construction of Work.

1.28 Performance Bond

The approved form of security furnished by the Contractor and its surety as a guarantee that the Contractor will complete the Work in accordance with the terms of the Contract and guarantee the Work for a period of one (1) year after the date of Certificate of Substantial Completion.

1.29 Plans

Plans shall have the same meaning as "Drawings," see Section 1.16.

1.30 Project

The undertaking to be performed as provided in the Contract Documents, see Section 1.11.

1.31 Proposal

The offer of the Bidder for the Work when made out and submitted on the prescribed proposal form, properly signed and guaranteed.

1.32 Proposal Guarantee

The cash, or cashier's check or certified check, or bidder's bond accompanying the Proposal submitted by the Bidder, as a guarantee that the Bidder will enter into a contract with the Owner for the construction or doing of the Work, if it is awarded to it, and will provide the contract bonds and insurance required.

1.33 Shop Drawings

All drawings, diagrams, illustrations, brochures, schedules and other data which are prepared by the Contractor, a Subcontractor, manufacturer, supplier or distributor, which illustrate how specific portions of the Work shall be fabricated or installed.

1.34 Specifications

The directions, provisions and requirements pertaining to the method and manner of performing the Work or to the quantities and qualities of the materials to be furnished under the Contract, together with all other directions, provisions and requirements, plus such amendments, deletions from or additions which may be provided for by Supplemental Contract or Change Orders.

1.35 Subcontractor

A Subcontractor is a person or entity who has a direct or indirect contract with a Contractor to perform any of the Work at the site. For convenience, the term Subcontractor is referred to throughout the Contract Documents as if singular in number and masculine in gender but includes the plural and feminine gender and includes a Sub-Subcontractor or an authorized representative thereof. The term Subcontractor does not include any separate Contractor or its Subcontractors.

1.36 Substantial Completion

"Substantial Completion" shall be that degree of completion of the project or a defined portion of the project, sufficient to provide the Owner, at its discretion, the full-time use of the project or defined portion of the project for the purposes for which it was intended. "Substantial Completion" shall not be considered as final acceptance.

1.37 Supplemental General Conditions

Modifications to General Conditions required by a Federal Agency for participation in the Project and approved by the agency for participation in the Project and approved by the agency in writing prior to inclusion in the Contract Documents and such requirements that may be imposed by applicable state laws. The term also includes modifications or additions to the General Conditions required by the Owner or Engineer.

1.38 Supplier

Any person or organization who supplies materials or equipment for the Work, including that fabricated to a special design, but who does not perform labor at the site.

1.39 Surety

The corporation, partnership, or individual, other than the Contractor, executing Payment, or Performance Bonds which are furnished to the Owner by the Contractor.

1.40 Work

The word "Work" within these Contract Documents shall include all material, labor, tools, utilities, and all appliances, machinery, transportation, and appurtenances necessary to perform and complete the Contract, and such additional items not specifically indicated or described which can be reasonably inferred as belonging to the item described or indicated and as required by good practice to provide a complete and satisfactory system or structure.

1.41 Working Day

A working day shall be any day, other than a legal holiday, Saturday or Sunday, on which the normal working forces of the Contractor may proceed with regular work.

2.0 NOTICE TO PROCEED

2.1 After the Owner has issued the Notice Of Award, the Contractor shall provide the Performance Bond, the Payment Bond, the Certificate Of Insurance, the Work Schedule, the monthly cash flow, and a signed Contract within ten (10) calendar days. The Owner's attorney will review each document and, if they are found to be acceptable, the Owner will sign and

execute the Contract. Within a period of sixty (60) calendar days after executing the Contract, the Owner will issue the Notice To Proceed. Within ten (10) calendar days of the postmark date of the Notice To Proceed, the Work shall commence. The Contractor shall not commence any Work until such time that the Notice To Proceed has been issued.

3.0 ADDITIONAL INSTRUCTIONS AND DETAIL DRAWINGS

3.1 The Engineer may furnish additional instructions to the Contractor by means of Drawings or otherwise, during the progress of the Work as necessary to make clear or to define in greater detail the intent of the Specifications and Contract Drawings.

The additional drawings and instruction thus supplied will become a part of the Contract Documents. The Contractor shall carry out the Work in accordance with the additional detail drawings and instructions.

4.0 SCHEDULES, REPORTS AND RECORDS

4.1 The Contractor shall submit to the Owner payrolls, reports, estimates, records and other data where applicable as are required by the Contract Documents for the Work to be performed.

4.2 The Contractor, after the Contract award and prior to the Pre-Construction Conference, shall prepare for submittal to the Engineer for review, a detailed progress schedule. The progress schedule shall be brought up to date and submitted to the Engineer prior to each progress payment request, and at such other time intervals as the Engineer may request.

A. Progress Schedule

The schedule shall be a time-scaled critical path progress schedule showing in detail the proposed sequence of activity. The critical path analysis shall consist of a graphic network diagram and shall clearly show start and completion dates and percentage of work completed.

4.3 The Contractor shall also forward to the Engineer, prior to each progress payment request, an itemized report of the delivery status of major and critical items of purchased equipment and material, including Shop Drawings and the status of shop and field fabricated work. These progress reports shall indicate the date of the purchase order, the current percentage of completion, estimated delivery, and cause of delay, if any.

4.4 If the completion of any part of the Work or the delivery of materials is behind the approved schedule, the Contractor shall submit in writing a plan acceptable to the Engineer for bringing the Work up to schedule.

4.5 The Owner shall have the right to withhold progress payments for the Work if the Contractor fails to update and submit the progress schedule and reports as specified, and such withholding shall not constitute grounds for additional claims by the Contractor against the Owner.

4.6 The Contractor shall submit an estimated monthly cash flow, based upon the progress schedule with the bonds, schedules, and Certificate Of Insurance.

5.0 DRAWINGS AND SPECIFICATONS

5.1 The intent of the Drawings and Specifications is that the Contractor shall furnish all labor, materials, tools, equipment, utilities, and transportation necessary for the proper execution of the Work in accordance with the Contract Documents and all incidental work necessary to complete the Project in an acceptable quality and manner, ready for use, occupancy or operation by the Owner.

5.2 In case of conflict between the Drawings and Specifications, the Specifications shall govern. Figure dimensions on Drawings shall govern over scale dimensions, and detailed Drawings shall govern over general Drawings.

5.3 Any discrepancies found between the Drawings and Specifications and site conditions or any inconsistencies or ambiguities in the Drawings or Specifications shall be immediately reported verbally and within 24 hours of such a discovery, in writing to the Engineer, who shall promptly correct such inconsistencies or ambiguities in writing. Work done by the Contractor after his discovery of such discrepancies, inconsistencies or ambiguities shall be done at the Contractor's risk, and the Contractor shall assume full responsibility therefor and shall bear all costs attributable thereto, if not acceptable to the Owner.

6.0 SHOP DRAWINGS

6.1 The Contractor shall provide seven (7) copies of the Shop Drawings as specified or as may be necessary for the prosecution of the Work as required by the Contract Documents. All drawings and schedules shall be submitted sufficiently in advance to allow the Engineer not less than 20 regular working days for checking the submittal. The Engineer's approval of any Shop Drawings shall not release the Contractor from responsibility for deviations from the Contract Documents.

6.2 When submitted for the Engineer's review, Shop Drawings shall bear the Contractor's certification by means of a signed Stamp, that he has reviewed, checked and approved the Shop Drawings and that they are in conformance with the requirements of the Contract Documents. Shop Drawings, which in the opinion of the Engineer are incomplete or unchecked by the Contractor, will be returned to the Contractor for resubmission in the proper form.

If Shop Drawings or submittals are rejected by the Engineer, all costs incurred by the Engineer Or The Owner for reviewing the resubmittals shall be charged to the Contractor, and the Owner has the right to deduct such costs from any monies owed the Contractor by the Owner.

6.3 When Shop Drawings have been reviewed by the Engineer, two sets of submittals will be returned to the Contractor appropriately stamped. If major changes or corrections are necessary, the Shop Drawing may be rejected and one set will be returned to the Contractor with such

changes or corrections indicated, and the Contractor shall correct and resubmit the Shop Drawings. No changes shall be made by the Contractor to resubmitted Shop Drawings other than those changes indicated by the Engineer, unless such changes are clearly described in a letter accompanying the resubmitted Shop Drawings.

6.4 The review of such Shop Drawings and catalog cuts by the Engineer shall not relieve the Contractor from responsibility for corrections of dimensions, fabrication details, and space requirements, or for deviations from the Contract Drawings or Specifications, unless the Contractor has called attention to such deviations in writing by a letter accompanying the Shop Drawings and the Engineer approves the change or deviation in writing at the time of submission; nor shall review by the Engineer relieve the Contractor from the responsibility for errors in the Shop Drawings. When the Contractor does call such deviations to the attention of the Engineer, the Contractor shall state in his letter whether or not such deviations involve any deduction or extra cost adjustment.

6.5 Portions of the Work requiring a Shop Drawing or sample submission shall not begin until the Shop Drawing or submission has been approved by the Engineer. A copy of each approved Shop Drawing and each approved sample shall be kept in good order by the Contractor at the site and shall be available to the Engineer.

7.0 RECORD DRAWINGS

7.1 During construction, the Contractor shall keep an accurate record of the following:

A. Deviations between the Work as shown on the Plans and the Work as actually installed.

B. The specific locations of piping, valves, electric conduits, duct work, equipment, and other such work which was not located on the Plans. The Record Drawings shall show distances to these locations from known points on the Plans.

C. Equipment schedules indicating manufacturer's names and model numbers. When all revisions showing work as installed are made, the corrected set of plans shall be delivered to the Engineer before the final pay request is processed. These plans shall be clearly marked "Record Drawings."

7.2 Nothing contained in this section shall be construed as authorizing any deviation in the Work as shown on the Contract Drawings without a written Change Order or written authority to the Contractor from the Engineer.

8.0 MATERIALS, SERVICES, AND FACILITIES

8.1 It is understood that, except as otherwise specifically stated in the Contract Documents, the Contractor shall provide and pay for all materials, labor, tools, equipment, water, light, power, transportation, supervision, temporary construction of any nature, and all other services and facilities of any nature whatsoever necessary to execute, complete, and deliver the Work within

the specified time.

8.2 The Contractor shall furnish the Owner a list of materials and the source of supply of each of the materials on the list. The source of supply of each of the materials shall be approved by the Owner before the delivery of said materials is started. Only materials conforming to these Specifications and approved by the Owner shall be used in the Work. All materials proposed for use may be inspected or tested at any time during their preparation and use. After trial, if it is found that sources of supply which have been approved do not furnish a uniform product, or if the product from any source proves unacceptable at any time, the Contractor shall furnish approved material from other approved sources. No material which, after approval, has in any way become unfit for use shall be used in the Work.

8.3 The Contractor warrants to the Owner and Engineer that the materials and equipment furnished under the Contract will be new and of a quality equal to that specified or approved and, that all Work will be of good quality, free from faults and defects and in conformance with the Contract Documents. Mechanical and electrical equipment shall be the products of manufacturers of established good reputations and regularly engaged in the fabrication of such equipment. Unless otherwise noted, any equipment offered shall be current models which have been in successful regular operation under comparable conditions for a period of at least two years. This time requirement, however, does not apply to minor details nor to thoroughly demonstrated improvements in design or in material of construction. Work shall be done and completed in a thorough and workmanlike manner and if required by Engineer, the Contractor shall furnish satisfactory evidence as to the kind and quality of materials and equipment used.

8.4 All materials which the Engineer or its authorized Inspector has determined do not conform to the requirements of the Plans and Specifications will be rejected. They shall be removed immediately from the vicinity of the Work by the Contractor at his own expense, unless otherwise permitted by the Engineer. No rejected material, the defects of which have been subsequently corrected, shall be used in the Work, unless approval in writing has been given by the Engineer. Upon failure of the Contractor to comply promptly with any order of the Engineer made under the provisions in this section, the Engineer shall have authority to cause the removal and replacement of rejected material and to deduct the cost thereof from any monies due or to become due the Contractor.

8.5 If any part or portions of the Work done or material furnished under this Contract shall prove defective or non-conforming with the Drawings and Specifications, and if the imperfection in the same shall not be of sufficient magnitude or importance as to make the Work dangerous or unsuitable, or if the removal of such Work will create conditions which are dangerous or undesirable, the Engineer shall have the right and authority to retain such Work but shall make such deductions in the final payment therefor as may be just and reasonable. Such adjustment shall be effected whether or not final payment has been made.

8.6 Materials and equipment shall be so stored as to insure the preservation of their quality and fitness for the Work. Stored materials and equipment to be incorporated in the Work shall

be located so as to facilitate prompt inspection.

8.7 Manufactured articles, materials and equipment shall be applied, installed, connected, erected, used, cleaned and conditioned as directed by the manufacturer.

8.8 Materials, supplies or equipment to be incorporated into the Work shall not be purchased by the Contractor or the Subcontractor subject to a chattel mortgage or under a conditional sale contract or other Contract by which an interest is retained by the seller.

9.0 INSPECTION AND TESTING

9.1 All material and equipment used in the construction of the Project shall be subject to adequate inspection and testing in accordance with generally accepted standards, as required and defined in the Contract Documents.

9.2 The Owner shall provide all inspection and testing services not required by the Contract Documents.

9.3 The Contractor shall provide at its expense the testing and inspection services required by the Contract Documents.

9.4 If the Contract Documents, laws, ordinances, rules, regulations or orders of any public authority having jurisdiction require any Work to specifically be inspected, tested, or approved by someone other than the Contractor, the Contractor will give the Engineer timely notice of readiness, the minimum of which shall be forty-eight (48) hours. The Contractor will then furnish the Engineer the required certificates of inspection, testing or approval.

9.5 Inspections, tests or approvals by the Engineer or others shall not relieve the Contractor from its obligations to perform the Work in accordance with the requirements of the Contract Documents.

9.6 The Engineer and its representatives will at all times have access to the Work. In addition, authorized representatives and agents of any participating Federal or State agency shall be permitted to inspect all Work, materials, payrolls, records of personnel, invoices of materials, and other relevant data and records. The Contractor will provide proper facilities for such access and observation of the Work and also for any inspection, or testing thereof.

9.7 If any Work is covered contrary to the written instructions of the Engineer or prior to inspection, if must, if requested by the Engineer, be uncovered for his observation and replaced at the Contractor's expense.

9.8 If the Engineer considers it necessary or advisable that Work that has already been approved be inspected or tested by the Engineer or others, the Contractor, at the Engineer's request, will uncover, expose or otherwise make available for observation, inspection or testing as the Engineer may require, that portion of the Work in question, furnishing all necessary labor,

materials, tools, and equipment. If it is found that such Work is defective, the Contractor will bear all the expenses of such uncovering, exposure, observation, inspection and testing and of satisfactory reconstruction. If, however, such Work is not found to be defective, the Contractor will be allowed an increase in the Contract Price or an extension of the Contract Time, or both, directly attributable to such uncovering, exposure, observation, inspection, testing and reconstruction and an appropriate Change Order shall be issued.

10.0 SUBSTITUTIONS

10.1 Whenever a material, article or piece of equipment is identified on the Drawings or Specifications by reference to brand name or catalogue number, it shall be understood that this is referenced for the purpose of defining the performance or other salient requirements and that other products of equal capacities, quality and function shall be considered. The Contractor may recommend the substitution of a material, article, or piece of equipment of equal substance and function for those referred to in the Contract Documents by reference to brand name or catalogue number, and if, in the opinion of the Engineer, such material, article, or piece of equipment is of equal substance and function to that specified, the Engineer may approve its substitution and use by the Contractor. Any cost differential shall be deductible from the Contract Price and the Contract Documents shall be appropriately modified by Change Order. The Contractor warrants that if substitutes are approved, no major changes in the function or general design of the Project will result. Incidental changes or extra component parts required to accommodate the substitute will be made by the Contractor without a change in the Contract Price or Contract Time. Any substitutions not properly approved and authorized by the Engineer may be considered defective and the Engineer may require the Contractor to remove the substituted material, article or piece of equipment and the Contractor shall bear any and all costs associated with the removal of the substituted item, including all engineering, inspection, testing or surveying costs incurred by the Owner or the Engineer.

10.2 Determination of equality in reference to the project design requirements will be made by the Owner. "Equal" products shall not be purchased or installed by the Contractor without the Owner's written approval. Contractor shall have fourteen (14) days after issuance of Notice to Proceed for submission of data substantiating a request for substitution of an "or equal" item.

11.0 PATENTS

11.1 The Contractor shall pay all applicable royalties and license fees. The Contractor shall defend all suits or claims for infringement of any patent rights and indemnify and hold the Owner and Engineer harmless from loss on account thereof, except that the Owner shall be responsible for any such loss when a particular process, design, or the product of a particular manufacturer or manufacturers is specified, however if the Contractor has reason to believe that the design, process or product specified is an infringement of a patent, it shall be responsible for such loss unless it promptly gives such information to the Engineer.

12.0 SURVEYS, PERMITS, REGULATIONS

12.1 The Owner shall furnish all boundary surveys and establish all base lines for locating the principal component parts of the Work together with a suitable number of bench marks adjacent to the Work as shown in the Contract Documents. The Contractor shall satisfy itself as to the accuracy of all measurements before constructing any permanent structure and shall not take advantage of any errors which may have been made in laying out the Work. From the information provided by the Owner, unless otherwise specified in the Contract Documents, the Contractor shall develop and make all detail surveys needed for construction such as slope stakes, batter boards, stakes for pile locations and other working points, lines, elevations and cut sheets.

12.2 Such stakes and markings as the Engineer may set for either its own or the Contractor's guidance shall be scrupulously preserved by the Contractor. In the event the Contractor, or its employees, destroy or otherwise remove or obliterate such stakes or markings, an amount equal to the cost of replacing the same may be deducted from subsequent estimates due the Contractor at the discretion of the Owner.

12.3 Permits and licenses of a temporary nature necessary for the prosecution of the Work shall be secured and paid for by the Contractor unless otherwise stated in the Supplemental General Conditions. Permits, licenses and easements for permanent structures or permanent changes in existing facilities shall be secured and paid for by the Owner, unless otherwise specified. The Contractor shall give all notices and comply with all laws, ordinances, rules and regulations bearing on the conduct of the Work as drawn and specified. If the Contractor perceives that the Contract Documents are at variance therewith, he shall promptly notify the Engineer in writing, and any necessary changes shall be adjusted as provided in Section 16. Changes In The Work. If the Contractor performs and works knowing it to be contrary to such laws, ordinances, rules and regulations, and without such notice to the Engineer, he shall assume full responsibility therefore and shall bear all costs attributable thereto.

13.0 PROTECTION OF WORK, PROPERTY AND PERSONS

13.1 The Contractor shall have sole responsibility for initiating, maintaining and supervising all safety precautions and programs in connection with the Work. The Contractor shall take all necessary precautions for the safety of, and shall provide the necessary protection to prevent damage, injury or loss to, all employees on the Work and other persons who may be affected thereby, all the Work and all materials or equipment to be incorporated therein, whether in storage on or off the site, and other property at the site or adjacent thereto, including trees, shrubs, lawns, walks, pavements, roadways, structures, utilities and other items not designated for removal, relocation or replacement in the course of construction.

13.2 The Contractor shall comply with all applicable laws, ordinances, rules, regulations and orders of any public body having jurisdiction. The Contractor shall erect and maintain, as required by the conditions and progress of the Work, all necessary safeguards for safety and protection. The Contractor shall notify Owners of adjacent utilities when prosecution of the Work may affect them. The Contractor shall remedy all damage, injury or loss to any property caused, directly or indirectly, in whole or in part, by the Contractor, any Subcontractor or anyone directly or indirectly employed by any of them or anyone for whose acts any of them be liable, except damage or loss

attributable to the fault of the Contract Documents or to the acts or omissions of the Owner or the Engineer or anyone employed by either of them or anyone for whose acts either of them may be liable, and not attributable, directly or indirectly, in whole or in part, to the fault or negligence of the Contractor.

13.3 In emergencies affecting the safety of persons or the Work or property at the site or adjacent thereto, the Contractor, without special instruction or authorization from the Engineer or Owner, shall act to prevent threatened damage, injury or loss. He shall give the Engineer prompt Written Notice of any significant changes in the Work or deviations from the Contract Documents caused thereby, and a Change Order shall thereupon be negotiated and issued covering the changes and deviations involved, as provided in Section 16.0, Changes in the Work.

13.4 The Contractor shall designate a responsible member of its organization at the site whose duty shall be the prevention of accidents and the safety of all those at the site. The person shall be the Contractor's superintendent unless otherwise designated by the Contractor in writing to the Owner and the Engineer. The Engineer will not be responsible for safety precautions and programs in connection with the Work or for the Contractor's failure to properly perform its responsibilities with respect to initiating, maintaining and supervising all safety precautions and programs.

14.0 PUBLIC SAFETY

14.1 Whenever the Contractor's operations create a condition hazardous to traffic or to the public, it shall furnish at its own expense, and without cost to the Owner, such flagmen and guards as are necessary to give adequate warning to the public of any dangerous conditions to be encountered and he shall furnish, erect, and maintain such fences, barricades, lights, signs, and other devices as are necessary to prevent accidents and avoid damage or injury to the public.

14.2 Should the Contractor appear to be neglectful or negligent in furnishing warning and protective measures as above provided, the Engineer may direct attention to the existence of a hazard and the necessary warning and protective measures shall be furnished and installed by the Contractor at its own expense without cost to the Owner. Should the Engineer point out the inadequacy of warning and protective measures, such action on the part of the Engineer shall not relieve the Contractor from responsibility for public safety or abrogate his obligation to furnish and pay for these devices.

14.3 Should the Contractor fail to, be neglectful, or be negligent in furnishing or maintaining warning and protective facilities as required herein, the Owner may furnish or maintain such facilities and charge Contractor therefor by deducting the cost thereof from periodic progress payments due the Contractor as such costs are incurred by Owner.

14.4 No material or equipment shall be stored where it will interfere with the free and safe passage of public traffic, and at the end of each day's Work and at other times when construction operations are suspended for any reason, the Contractor shall remove all equipment and other obstructions from that portion of the right-of-way open for use by public traffic.

15.0 SUPERVISION BY CONTRACTOR

15.1 The Contractor shall supervise and direct the Work, using its best skill and attention. The Contractor shall be solely responsible for the means, methods, techniques, sequences and procedures of construction. The Contractor shall employ and maintain on the Work a qualified supervisor or superintendent who shall have been designated in writing by the Contractor as the Contractor's representative at the site, and who shall have been approved by the Engineer, which approval shall not be unreasonably withheld. The supervisor shall have full authority to act on behalf of the Contractor and all communications given to and by the supervisor shall be as binding as if given to and by the Contractor. The supervisor shall be present on the site at all times. The Contractor shall be responsible to the Owner for the acts and omissions of the employees, subcontractors, and the agents and employees, and other persons performing any other Work under the Contract with the Contractor.

16.0 CHANGES IN THE WORK

16.1 The Owner may at any time, as the need arises, order changes within the scope of the Work without invalidating the Contract. If such changes increase or decrease the amount due under the Contract Documents, or in the time required for performance of the Work, an equitable adjustment shall be authorized by Change Order.

16.2 The Engineer, also, may at any time, by issuing a Field Order, make changes in the details of the Work. The Contractor shall proceed with the performance of any changes in the Work so ordered by the Engineer unless the Contractor believes that such Field Order entitles him to a change in Contract Price or Time, or both, in which event he shall give the Engineer Written Notice thereof within seven (7) days after the receipt of the ordered change. Thereafter the Contractor shall document the basis for the change in Contract Price or Time within fourteen (14) days. The Contractor shall not execute such changes pending the receipt of an executed Change Order or further instruction from the Owner.

16.3 If the Contractor wishes to make a claim for an increase in the Contract sum, it shall give the Engineer written notice thereof within fourteen (14) days after the occurrence of the event giving rise to such claim. This notice shall be given by the Contractor before proceeding to execute the Work, except in an emergency endangering life or property, in which case Contractor shall proceed in accordance with the provisions of the Contract. No such claim shall be valid unless so made. If the Owner and Contractor cannot agree on the amount of adjustment in the Contract sum, it shall be determined by the Engineer. Any change in the Contract sum resulting from such claim shall be authorized in a Change Order.

16.4 The value of any Work covered by a Change Order shall be determined by one or more of the following methods in the order of precedence listed below:

A. Unit prices previously approved.
B. An agreed lump sum.

C. Cost plus percentage.

17.0 TIME FOR COMPLETION AND LIQUIDATED DAMAGES

17.1 The date of beginning and the time for completion of the Work are essential conditions of the Contract Documents and the Work embraced shall be commenced on a date specified in the Notice To Proceed.

17.2 The Contractor shall proceed with the Work at such rate of progress to insure full completion within the Contract Time. It is expressly understood and agreed, by and between the Contractor and the Owner, that the Contract Time for the completion of the Work described herein is a reasonable time, taking into consideration the average climatic and economic conditions and other factors prevailing in the locality of the Work.

17.3 The Contractor shall only work an eight (8) hour day consisting of Monday through Friday, between 6:00 a.m. to 6:00 p.m., and do not include local municipal holidays. If the Contractor desires to carry on Work more than eight (8) hours each day, or work at night or outside the regular hours, it shall give timely notice (72 hours) to the Engineer and receive the Owner's written approval to allow satisfactory arrangements to be made for inspecting the Work in progress. Should the prosecution of the Work be discontinued for any reason, the Contractor shall notify the Engineer at least 24 hours in advance of resuming operations. The Contractor shall be responsible for any extra compensation due or costs incurred as a result of Contractor's desire to carry out Work beyond an eight (8) hour day, or at night or outside regular hours, including but not limited to, any additional costs or compensation due the Engineer And Owner or its employees or agents as a result of having to be present at the site. The costs or extra compensation necessitated by the Contractor's Work beyond an eight (8) hour day, or at night or outside regular business hours may be deducted or withheld from progress payment or any other payments due to Contractor.

17.4 If for any reason a suspension of the work should occur; the Contractor, at its own expense, shall do all the Work necessary to provide a safe, smooth and unobstructed passageway through construction for use by public traffic or to provide for the proper and efficient operation of sewer, drainage and other facilities within the site of the Work, during the period of such suspension. In the event that the Contractor fails to perform the Work specified in this Subsection, the Owner will perform such Work and the cost thereof will be deducted from periodic progress payments due the Contractor.

17.5 During inclement weather and other conditions, the Contractor shall pursue only such portions of the Work as shall not be damaged thereby. No portions of the Work which satisfactory quality or efficiency will be affected by an unfavorable condition shall be constructed while these conditions remain, unless by special means or precautions, approved by the Engineer, the Contractor is able to overcome them.

17.6 Delays in delivery of equipment or material purchased by the Contractor or its Subcontractor, including Engineer-selected equipment, shall not be considered as a just cause for

delay as this is not beyond the control of the Contractor. The Contractor shall be fully responsible for the timely ordering, scheduling, expediting, delivery, and installation of all equipment and materials.

17.7 In case of failure on the part of the Contractor to complete the Work within the time affixed in the Contract, or such extension thereof as may be allowed by Engineer or Owner, the Contract shall by that fact be terminated by written notice. The Owner shall not thereafter pay or allow the Contractor any further compensation for any Work done by it under said Contract, and the Contractor and its sureties shall be liable to the Owner for all loss or damage which it may suffer by reason of his failure to complete the Contract within such time. Failure to prosecute the Work diligently shall be grounds for termination by the Owner pursuant to this paragraph.

In the event the Contract should be terminated, the Owner shall have the right to take over the Work and to proceed with the same until it is completed, either by performing said Work itself directly or by contracting it out to some other person or persons, and in such event the Owner may take possession of and utilize, in completing the Work, such materials, appliances and plant as may be on the site of the Work and necessary for its completion. Nothing herein contained shall be deemed to limit the right of the Owner in the event of any breach of Contract by the Contractor; but all rights herein given to the Owner are and shall be deemed to be additional to any other rights or remedies which the Owner shall have under any provision of law.

17.8 Should the Contractor fail to complete the Work, or any part thereof, in the time agreed upon in the Contract or within such extra time as may have been allowed for delays by extensions granted as provided in the Contract, the Contractor shall reimburse the Owner for the additional expense and damage for each calendar day that the Contract remains uncompleted after the Contract completion date. It is agreed that the amount of such additional expense and damage incurred by reason of failure to complete the Work is the per diem rate, as stipulated in Section 15, Information For Bidders, plus any costs incurred by the Engineer including, but not limited to: the Engineer's costs for additional inspection, testing or surveying as a result of the Contractor's failure to complete the Work in the time agreed upon. The said amounts are agreed upon as liquidated damages for the loss to the Owner on account of expense due to the employment of Engineers, inspectors, and other employees after the expiration of the time of completion, and on account of the value of the operation of the Works dependent thereon. It is expressly understood and agreed that this amount is not to be considered in the nature of a penalty, but as liquidated damages which have accrued against the Contractor. The Owner shall have the right to deduct such damages from any amount due, or that may become due the Contractor, or the amount of such damages shall be due and collectible from the Contractor or its Surety.

17.9 The Contractor shall not be charged with liquidated damages or any excess costs when the delay in completion of the Work is due to any of the reasons set forth below provided the Contractor has given Written Notice of the delay within three (3) days of the occurrence of the cause of the delay to the Owner or Engineer. In the event notice is not given as provided, liquidated damages may be assessed.

A. To unforeseeable causes beyond the control and without the fault or negligence of the

Contractor, including but not restricted to: acts of God, or of the public enemy, acts of the Owner, acts of another Contractor in the performance of a separate contract with the Owner, fires, floods, epidemics, quarantine restrictions, strikes, freight embargoes, and abnormal and unforeseeable weather.

18.0 CORRECTION OF WORK

18.1 The Contractor shall promptly correct all work rejected by the engineer as defective or as failing to conform to the contract documents, whether observed before or after substantial completion and whether or not fabricated, installed or completed. Contractor shall bear all costs of correcting such rejected work, including compensation for the engineer's additional services made necessary thereby. Contractor shall also bear the costs of making good all work of the Owner or separate Contractor destroyed or damaged by such correction or removal.

18.2 All removal and replacement work shall be done at the Contractor's expense. If the Contractor does not take action to remove such rejected work within ten (10) days after receipt of Written Notice, the Owner may remove such work and store the materials at the expense of the Contractor, including compensation for the engineer's additional services made necessary thereby.

19.0 SUBSURFACE CONDITIONS

19.1 The Contractor shall promptly, and before such conditions are disturbed, except in the event of an emergency, notify the Owner by Written Notice of:

A. Subsurface or latent physical conditions at the site differing materially from those indicated in the Contract Documents; or

B. Unknown physical conditions at the site, of an unusual nature, differing materially from those ordinarily encountered and generally recognized as inherent in Work of the character provided for in the Contract Documents.

19.2 The Owner shall promptly investigate the conditions, and if it finds that such conditions do so materially differ and cause an increase or decrease in the cost of, or in the time required for, performance of the Work, an equitable adjustment shall be made and the Contract Documents shall be modified by a Change Order. Any claim of the Contractor for adjustment hereunder shall not be allowed unless he has given the required Written Notice; provided that the Owner may, if he determines the facts so justify, consider and adjust any such claims asserted before the date of final payment.

20.0 SUSPENSION OF WORK, TERMINATION AND DELAY

20.1 The Owner may suspend the Work or any portion thereof for a period of not more than ninety (90) days or such further time as agreed upon by the Contractor, by Written Notice to the Contractor and the Engineer which notice shall fix the date on which Work shall be resumed. The

Contractor shall resume that Work on the date so fixed. The Contractor shall be allowed an increase in the Contract Price or an extension of the Contract Time, or both, directly attributable to any suspension.

20.2 In addition to any other reasons for termination provided in the Contract, the Contractor shall be considered in default of the Contract and such default will be considered as cause for the Owner to terminate the Contract for any of the following reasons if the Contractor:

A. Fails to begin the Work under the Contract within the time specified in the "Notice To Proceed," or

B. Fails to perform the Work or fails to provide sufficient workers, equipment or materials to assure completion of Work in accordance with the terms of the Contract, or

C. Performs the Work unsuitably or neglects or refuses to remove materials or to perform such new Work as may be rejected as unacceptable and unsuitable, or

D. Discontinues the prosecution of the Work, or

E. Fails to resume Work which has been discontinued within a reasonable time after notice to do so, or

F. Becomes insolvent or is declared bankrupt, or commits any act of bankruptcy or insolvency, or

G. Allows any final judgment to stand against him unsatisfied for a period of 10 days, or

H. Makes an assignment for the benefit of creditors, or acceptable manner, or

I. Is otherwise in breach of the Contract and has failed to remedy the breach within ten (10) days of written notice of the existence of such breach, or

J. Fails to provide safe conditions for its workers and/or the general public.

Should the Owner consider the Contractor in default of the Contract for any reason above, he shall immediately give Written Notice to the Contractor and the Contractor's surety as to the reasons for considering the Contractor in default and the Owner's intentions to terminate the Contract.

If the Contractor or Surety, within a period of 10 days after Written Notice, does not proceed in accordance therewith, then the Owner shall have, upon written notification of the facts of such delay or neglect, the power and authority without violating the Contract, to take the prosecution of the Work out of the hands of the Contractor. The Owner may appropriate or use any or all

materials and equipment that have been mobilized for use in the Work and are acceptable and may enter into an Contract for the completion of said Contract according to the terms and provisions thereof, or use such other methods as in the opinion of the Owner will be required for the completion of said Contract in an acceptable manner.

All costs and charges incurred by the Owner, together with the cost of completing the Work under Contract, will be deducted from any monies due or which may come due the Contractor. If such expense exceeds the sum which would have been payable under the Contract, then the Contractor and the Surety shall pay to the Owner the amount of such excess.

20.3 Where Contractor's services have been so terminated by Owner, the termination will not affect any rights or remedies of Owner against Contractor then existing or which may thereafter accrue. Any retention or payment of monies due Contractor by Owner will not release Contractor from liability.

20.4 Upon seven days Written Notice to Contractor and Engineer, Owner may, without cause and without prejudice to any other right or remedy of Owner, elect to terminate the Contract. In such case, Contractor shall be paid (without duplication of any items):

20.4.1 for completed and acceptable Work executed in accordance with the Contract Documents prior to the effective date of termination, including fair and reasonable sums for overhead and profit on such work;

20.4.2 for expenses sustained prior to the effective date of termination in performing services and furnishing labor, materials or equipment as required by the Contract Documents in connection with uncompleted Work, plus fair and reasonable sums for overhead on such expenses;

20.4.3 for reasonable costs incurred in settlement of terminated contracts with Subcontractors, Suppliers and others; and

20.4.4 for reasonable expenses directly attributable to termination.

Contractor shall not be paid on account of loss of anticipated profits or revenue or other economic loss arising out of or resulting from such termination.

20.5 If the Work should be stopped under an order of any court or other public authority for a period of more than ninety (90) days, through no act or fault of the Contractor or of anyone employed by him, or if the Owner should fail to pay the Contractor within 45 days after the time specified in the Payments To Contractor, Section 22.0, then the Contractor may, upon 15 days Written Notice to the Owner, stop Work until payment of the amount owing has been received.

20.6 The Owner may terminate the Contract or a portion thereof if conditions encountered during the progress of the Work make it impossible or impracticable to proceed with the Work or a local or national emergency exists.

When Contracts, or any portion thereof, are terminated before completion of all Work in the Contract, adjustments in the amount bid for the pay items will be made on the actual quantity of Work performed and accepted, or as mutually agreed for pay items of Work partially completed or not started. No claim for loss of anticipated profits will be considered.

Termination of the Contract or any portion thereof shall not relieve the Contractor of its responsibilities for the completed work nor the surety of its obligation for and concerning any just claims arising out of the Work performed.

21.0 ISSUANCE OF NOTICE OF COMPLETION AND FINAL ACCEPTANCE BY OWNER

21.1 Upon completion of the Project, a Final Inspection shall be requested by the Contractor in writing and the Owner will make an inspection within seven (7) days. If all construction provided for and contemplated by the contract is found completed to his satisfaction, that inspection shall constitute the final inspection and the Owner will make the final acceptance and issue a Certificate Of Completion to the Contractor.

If, however, the inspection discloses any Work, in whole or in part, as being unsatisfactory, the Owner will give the Contractor the necessary instructions for correction of same, and the Contractor shall immediately comply with and execute such instructions. Upon correction of the Work, another inspection will be made which shall constitute the final inspection provided the Work has been satisfactorily completed. In such event, the Owner will make the final acceptance and issue a Certificate Of Completion to the Contractor.

22.0 PAYMENTS TO CONTRACTOR

22.1 In addition to any documents required by the Engineer to be submitted to Engineer at the time a partial pay estimate is submitted, including partial lien released as specified in Section 22.9 of the General Conditions*,* the Contractor shall, at least ten (10) days before each progress payment falls due (but not more often than once a month), submit to the Engineer a partial payment estimate filled out and signed by the Contractor covering the Work performed during the period covered by the partial payment estimate and supported by such data as the Engineer may reasonably require. If payment is requested on the basis of materials and equipment not incorporated in the Work, title to such materials and equipment shall vest in the Owner, and Contractor shall supply, at the time of submission of payment estimate, supporting documents satisfactory to the Owner, to establish and protect Owner's interest in the materials and equipment, and Contractor shall maintain appropriate insurance on same until such time as actual possession by the Owner of the materials and equipment shall occur. The Engineer will, within seven (7) days after receipt of each partial payment estimate, either indicate in writing his approval of payment and present the partial payment estimate to the Owner or return the partial payment estimate to the Contractor indicating in writing his reasons for refusing to approve payment. In the latter case, the Contractor may make the necessary corrections and resubmit the partial payment estimate. The Owner will, within fourteen (14) days of presentation to him of an approved partial payment estimate, pay the Contractor a progress payment on the basis of the approved partial payment estimate. The Owner shall retain ten (10) percent of the amount

of each payment until final completion and acceptance of all Work covered by the Contract Documents. When the Contract is fifty percent completed, one-half of the amount retained shall be paid to the Contractor provided the Contractor makes a written request for the payment and the Contractor is making satisfactory progress on the Contract and there is no specific cause or claim requiring a greater amount to be retained. After the Contract is fifty per cent completed, no more than five per cent of the amount of any subsequent progress payments made under the Contract may be retained providing the Contractor is making satisfactory progress on the project, except that if at any time the Owner determines satisfactory progress is not being made, ten per cent retention shall be reinstated for all progress payments made under the Contract subsequent to the determination.

22.2 In lieu of ten percent (10%) retention provided for in paragraph 22.1, of this Article, the Owner shall, at the Contractor's option, accept as a substitute an assignment of any of the following:

A. Time certificates of deposit of banks licensed by the State of Arizona; or

B. Securities of or guaranteed by the United States of America; or

C. Securities of the State of Arizona, or any county, municipality or school district thereof; or

D. Shares of savings and loan institutions authorized to transact business in the State of Arizona.

Such assigned instruments shall have a face value in an amount equal to ten percent (10%) of the progress payment for which such instruments are tendered and shall be retained by the Owner as a guarantee for complete performance of the Contract.

In the event the Owner accepts substitute security as provided herein for the ten percent (10%) retention, the Contractor shall be entitled to all interest or income earned by such security, and all such security in lieu of retention shall be returned to the Contractor within sixty (60) days after final completion and acceptance of all material, equipment and work covered by the contract if the Contractor has furnished the Owner satisfactory receipts for all labor and material billed and waivers of liens from any and all persons holding claims against the work.

In no event shall the Owner accept a time certificate of deposit of a bank or shares of a savings and loan institution in lieu of the retention specified in paragraph 22.1 of this Article unless accompanied by a signed and acknowledged waiver of the bank or savings and loan institution of any right or power to set off against either the Owner or the Contractor in relationship to the certificates or shares assigned.

22.3 The Contractor shall promptly pay each Subcontractor, upon receipt of payment from the Owner out of the amount paid to the Contractor on account of such Subcontractors' Work, the amount to which said Subcontractor is entitled, reflecting the percentage actually retained, if any,

from payments to the Contractor on account of such Subcontractors' Work. The Contractor shall, by an appropriate Contract with each Subcontractor, require each Subcontractor to make payments to his Sub-subcontractors in similar manner.

22.4 Prior to Substantial Completion, the Owner, with the approval of the Engineer and with the concurrence of the Contractor, may use any completed or substantially completed portions of the Work. Such use shall not constitute an acceptance of such portions of the Work.

22.5 The Owner shall have the right to enter the premises for the purpose of doing Work not covered by the Contract Documents. This provision shall not be construed as relieving the Contractor of the sole responsibility for the care and protection of the Work, or the restoration of any damaged Work except such as may be caused by agents or employees of the Owner.

22.6 Upon final completion and acceptance of the Work, the Engineer shall issue a certificate attached to the final payment request that the Work has been accepted under the conditions of the Contract Documents. No retention of payments may be delayed or retained without a specific written finding by the Engineer or Owner of the reasons justifying the delay in payment. The entire balance found to be due the Contractor, including the retained percentages, except the amount necessary to pay the expenses the Owner reasonably expected to incur in order to pay or discharge the expenses determined by the Engineer or Owner in the finding justifying the retention or delay, shall be paid to the Contractor, within sixty (60) days of completion or proper filing of the Notice of Completion.

22.7 The Contractor shall indemnify and save the Owner or the Owner's agents harmless from all claims growing out of the lawful demands of Subcontractors, laborers, workmen, mechanics, materialmen, and furnishers of machinery and parts thereof, equipment, tools, and all supplies, incurred in the furtherance of the performance of the Work. The Contractor shall, at the Owner's request, furnish satisfactory evidence, in the form of lien releases or other documents deemed appropriate by the Owner, that all obligations of the nature designated above have been paid, discharged, or waived. If the Contractor fails to do so the Owner may, after having notified the Contractor, either pay unpaid bills or withhold from the Contractor's unpaid compensation a sum of money deemed reasonably sufficient to pay any and all such lawful claims until satisfactory evidence is furnished that all liabilities have been fully discharged whereupon payment to the Contractor shall be resumed, in accordance with the terms of the Contract Documents, but in no event shall the provisions of this sentence be construed to impose any obligations upon the Owner to either the Contractor, his Surety, or any third party. In paying any unpaid bills of the Contractor, any payment so made by the Owner shall be considered as a payment made under the Contract Documents by the Owner to the Contractor and the Owner shall not be liable to the Contractor for any such payments made in good faith.

22.8 If any payment to Contractor is delayed after the date due, interest shall be paid at the rate of one percent per month or fraction of a month on such unpaid balance as may be due. If the Owner fails to make payment sixty (60) days after final completion and acceptance, in addition to other remedies available to the Contractor, interest shall be paid at the rate of one per cent per month or fraction of the month on such unpaid balance as may be due, except for that amount

necessary to pay the expenses the Owner reasonably expects to incur in order to pay or discharge the expense determined by the Engineer or Owner in the finding justifying the retention or delay.

22.9 The Owner may require the Contractor to furnish partial releases or liens executed by all persons, firms and corporations who have furnished labor services or materials incorporated into the Work during the period of time for which the progress payment is due, releasing such lien rights as these persons, firms or corporations may have for that period.

23.0 ACCEPTANCE OF FINAL PAYMENT AS RELEASE

23.1 Following the Owner's acceptance of the Work, the Owner will issue a Notice of Completion to the Contractor. Sixty days after the issuing of the Notice of Completion, and upon receipt of the necessary Unconditional lien releases executed by all persons, firms and corporations who have furnished labor services or materials incorporated into the work evidencing that all liabilities have been fully discharged, the Owner will pay to the Contractor the entire sum so found to be due after deducting therefrom all previous payments and all amounts to be kept and all amounts to be retained under the provisions of the Contract. All previous prior partial estimates and payments shall be subject to correction in the final estimate and payment.

23.2 The acceptance by the Contractor of final payment shall be and shall operate as a release to the Owner of all claims and all liability to the Contractor other than claims in stated amounts as may be specifically excepted by the Contractor for all things done or furnished in connection with this Work and for every act and neglect of the Owner and others relating to or arising out of this Work. Any payment, however, final or otherwise, shall not release the Contractor or his sureties from any obligations under the Contract Documents or the Performance Bond and Payment Bonds.

24.0 INSURANCE

24.1 The Contractor shall give special attention to Section 00500-A of the Bid Documents when preparing a bid, which outline the insurance requirements of Owner and the Contractor shall consider these insurance requirements part of the Bid/Contract documents.

The Contractor shall purchase and maintain such insurance as will protect him from claims set forth below which may arise out of or result from the Contractor's execution of the Work, whether such execution be by itself or by any Subcontractor or by anyone directly or indirectly employed by any of them, or by anyone for whose acts any of them may be liable:

A. Claims under worker's compensation, disability benefit and other similar employee benefit acts;

B. Claims for damages because of bodily injury, occupational sickness or disease, or death of his employees;

C. Claims for damages because of bodily injury, sickness or disease, or death of any

person other than his employees;

D. Claims for damages insured by usual personal injury liability coverage which are sustained (1) by any person as a result of an offense directly or indirectly related to the employment of such person by the Contractor, or (2) by any other person; and

D. Claims for damages because of injury to or destruction of tangible property, including loss of use resulting therefrom.

The Contractor is responsible to respond to claims arising as a result of its work. See Section 500-B for specific procedures.

24.2 Certificates of Insurance acceptable to the Owner shall be filed with the Owner prior to commencement of the Work. These Certificates shall contain a provision that coverages afforded under the policies will not be canceled unless at least ten (10) days prior Written Notice has been given to the Owner, "Attention: Contract Administrator, 2330 McCulloch Boulevard North, Lake Havasu City, AZ, 86403".

24.3 The Contractor shall procure and maintain, at its own expense, during the Contract Time, liability insurance as specified in Section 500-A, incorporated herein.

25.0 CONTRACT SECURITY

25.1 The Contractor shall within ten (10) days after the receipt of the Notice Of Award furnish the Owner with a Performance Bond and a Payment Bond in sums equal to the amount of the Contract PRICE, conditioned upon the performance by the Contractor of all undertakings, covenants, terms, conditions and Contracts of the Contract Documents, and upon the prompt payment by the Contractor to all persons supplying labor and materials in the prosecution of the Work provided by the Contract Documents. Such Bonds shall be executed by the Contractor and a corporate bonding company licensed to transact such business in the state in which the Work is to be performed and named on the current list of "Surety Companies Acceptable on Federal Bonds" as published in the Treasury Department Circular Number 570. The expense of these Bonds shall be borne by the Contractor. If at any time a surety on any such Bond is declared a bankrupt or loses its right to do business in the state in which the Work is to be performed or is removed from the list of Surety Companies accepted on Federal Bonds, Contractor shall within ten (10) days after notice from the Owner to do so, substitute an acceptable Bond (or Bonds) in such form and sum and signed by such other surety or sureties as may be satisfactory to the Owner. The premiums on such Bond shall be paid by the Contractor. No further payments shall be deemed due nor shall be made until the new surety or sureties shall have furnished an acceptable Bond to the Owner.

26.0 ASSIGNMENTS

26.1 Neither the Contractor nor the Owner shall sell, transfer, assign or otherwise dispose of the Contract or any portion thereof, or of his right, title or interest therein, or his obligations

thereunder, without written consent of the other party. Nor shall the Contractor assign any monies due or to become due to him hereunder without the previous written consent of the Owner.

26.2 The Owner and Contractor each bind itself, its partners, successors and assigns and legal representatives to the other party hereto and to the partners, successors, assigns and legal representatives of such other party in respect to all covenants, Contracts and obligations contained in the Contract Documents.

27.0 INDEMNIFICATION

27.1 Contractor shall indemnify and hold harmless City, its officers and employees from and against any and all liabilities, damages, losses, and costs, including reasonable attorney's fees, but only to the extent caused by the negligence, recklessness, or intentional wrongful conduct of Contractor or other persons employed or used by the Contractor in the performance of this Contract. It is agreed that Contractor will be responsible for primary loss investigation, defense, and judgment costs where this indemnification is applicable.

27.2 In any and all claims against the Owner or the Engineer, or any of their agents or employees, by any employee of the Contractor, any Subcontractor, anyone directly or indirectly employed by any of them, or anyone for whose acts any of them may be liable, the indemnification obligation shall not be limited in any way by any limitation on the amount or type of damages, compensation of benefits payable by or for the Contractor or any Subcontractor under worker's compensation acts, disability benefit acts or other employee benefits acts.

27.3 The obligation of the Contractor under this paragraph shall not extend to the liability of the Engineer, his agents or employees arising out of the preparation or approval of maps, DRAWINGS, opinions, reports, surveys, Change Orders, designs or Specifications.

28.0 SEPARATE CONTRACTS

28.1 The Owner reserves the right to let other contracts in connection with this Project. The Contractor shall afford other Contractors reasonable opportunity for the introduction and storage of their materials and the execution of their Work, and shall properly connect and coordinate its Work with theirs. If the proper execution or results of any part of the Contractor's Work depends upon the Work of any other Contractor, the Contractor shall inspect and promptly report to the Engineer any defects in such Work that render it unsuitable for such proper execution and results.

28.2 The Owner may perform additional Work related to the Project by itself, or it may let other contracts containing provisions similar to these. The Contractor shall afford the other Contractors who are parties to such Contracts (or the Owner, if he is performing the additional Work himself), reasonable opportunity for the introduction and storage of materials and equipment and the execution of Work, and shall properly connect and coordinate his Work with theirs.

28.3 If the performance of additional Work by other Contractors or the Owner is not noted in the Contract Documents prior to the execution of the Contract, written notice thereof shall be given to the Contractor prior to starting any such additional Work. If the Contractor believes that the performance of such additional Work by the Owner or others involves it in additional expense or entitles him to an extension of the Contract Time, it may make a claim therefore as provided in Sections 16 and 17.

29.0 SUBCONTRACTING

29.1 The Contractor may utilize the services of specialty Subcontractors on those parts of the Work which come under normal contracting practices or are typically performed by specialty Subcontractors, provided the Contractor, simultaneously with the delivery of the executed Contract, shall furnish to the Owner and the Engineer in writing the names of the persons or entities (including those who are to furnish materials or equipment fabricated to a special design) proposed for each of the principal portions of the Work. The engineer will promptly reply to the Contractor in writing stating whether or not the Owner or the Engineer, after due investigation, has reasonable objection to any such proposed person or entity. Failure of the Owner or Engineer to promptly reply shall constitute notice of no reasonable objection. The Contractor shall not contract with any such proposed person or entity to whom the Owner or Engineer has made reasonable objection and the Contractor shall not be required to contract with anyone to whom he has a reasonable objection. If the Owner or Engineer has a reasonable objection to any proposed person or entity, the Contractor shall submit a substitute to whom the Owner or the Engineer has no reasonable objection. The Contractor shall make no substitution for any Subcontractor, person or entity previously selected if the Owner or Engineer makes reasonable objection to such substitution.

29.2 The Contractor shall not award Work to Subcontractor(s), in excess of forty-nine (49%) percent of the Contract Price, without prior written approval of the Owner.

29.3 The Contractor shall be fully responsible to the Owner for the acts and omissions of its Subcontractors, and of persons either directly or indirectly employed by them, as it is for the acts and omissions of persons directly employed by it.

29.4 The Contractor shall not employ any Subcontractors that are not properly licensed with Lake Havasu City and the State of Arizona. Changes of Subcontractors listed with the Proposal shall be made only with the approval of the Owner.

29.5 Nothing contained in these Contract Documents shall be construed as creating any contractual relationship between any Subcontractor and the Owner; the Contractor shall be as fully responsible to the Owner for the acts and omissions of Subcontractors, and of persons employed by them, as he is for the acts and omissions of persons directly employed by him.

29.6 The Contractor shall, without additional expense to the Owner, utilize the services of specialty Subcontractors on those parts of the Work which are specified or required by State or

local laws to be performed by specialty Subcontractors.

29.7 The Contractor shall be responsible for the coordination of all trades, Subcontractors, material and people engaged upon this Work. The Owner will not undertake to settle any differences between the Contractor and his Subcontractors or between Subcontractors.

29.8 The Contractor shall cause appropriate provisions to be inserted in all subcontracts relative to the Work to bind Subcontractors to the Contractor by the terms of the Contract Documents insofar as applicable to the Work of Subcontractors and to give the Contractor the same power as regards terminating any subcontract that the Owner may exercise over the Contractor under any provision of the Contract Documents.

29.9 Nothing contained in this Contract shall create any contractual relation between any Subcontractor and the Owner.

30.0 ENGINEER'S AUTHORITY

30.1 The Engineer shall act as the Owner's representative during the construction period. The Engineer shall decide questions which may arise as to quality and acceptability of materials furnished and Work performed and shall interpret the intent of the Contract Documents in a fair and unbiased manner. The Engineer will make periodic visits to the site and determine if the Work is proceeding in accordance with the Contract Documents.

30.2 The Contractor will be held strictly to the intent of the Contract Documents in regard to the quality of materials, workmanship and execution of the Work. Inspections may be made at the factory or fabrication plant of the source of material supply.

30.3 The Engineer shall not be responsible for the construction means, controls, techniques, sequences, procedures, or construction safety precautions and programs in connection with the Work and will not be responsible for the Contractor's failure to carry out the Work in accordance with the Contract Documents. The Engineer shall not be responsible or have control or charge over the acts or omissions of the Subcontractors, or any of their agents or employees, or any other person performing any of the Work.

30.4 The Engineer shall promptly make decisions relative to interpretation of the Contract Documents.

30.5 The Engineer will have the authority to reject Work which does not conform to the Contract Documents. Whenever, in its opinion, it is considered necessary or advisable for the implementation of the intent of the Contract Documents, the Engineer will have authority to require special inspection or testing of the Work in accordance with the other terms of this Contract whether or not such Work be then fabricated, installed or completed.

31.0 LAND AND RIGHTS-OF-WAY

31.1 Prior to issuance of Notice To Proceed, the Owner shall obtain all land and rights-of-way necessary for carrying out and for the completion of the Work to be performed pursuant to the Contract Documents, unless otherwise mutually agreed.

31.2 The Owner shall provide to the Contractor information which delineates and describes the lands owned and rights-of-way acquired.

31.3 The Contractor shall provide at its own expense and without liability to the Owner any additional land and access thereto that the Contractor may desire for temporary construction facilities, or for storage of materials.

32.0 GUARANTEE

32.1 Except as otherwise specified, all Work shall be guaranteed by the Contractor against defects resulting from the use of inferior materials, equipment, or workmanship for a period of one (1) year from the date the Certificate of Substantial Completion is issued by the Owner, or within such longer period of time as may be prescribed by law or by the terms of any applicable special guarantee required by the Contract Documents.

32.2 If, within any guarantee period, repairs or changes are required in connection with guaranteed Work, which, in the opinion of the Owner, is rendered necessary as the result of the use of materials, equipment, or workmanship which are inferior, defective, or not in accordance with the terms of the Contract, the Contractor shall, promptly upon receipt of notice from the Owner, and without expense, (1) place in satisfactory condition in every particular all of such guaranteed Work, correcting all defects therein; (2) make good all damage to the building, site or Work, or equipment or contents thereof, which in the opinion of the Owner, is the result of the use of materials, equipment, or workmanship which are inferior, defective, or not in accordance with the terms of the contract; and (3) make good any Work or material, or the equipment and contents of said building, site or Work disturbed in fulfilling any such guarantee. If the Contractor, after notice, fails to proceed promptly to comply with the terms of the guarantee, the Owner may have the defects corrected and the Contractor and his surety shall be liable for all expense incurred. The Performance Bond shall remain in full force and effect through the guarantee period.

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GUARANTEE

The Contractor agrees to execute, and to cause each Subcontractor to execute, a written guarantee to the Owner, in substantially the following form:

GUARANTEE FOR:

We hereby guarantee, both jointly and severally, that the improvement which we have installed for the Owner of Project, specifically described as:

Park Avenue Lift Station Renovation, PROJECT NO. B24-PW-107019-500397

has been done in accordance with the Contract Drawings and Specifications.

We agree, both jointly and severally, to repair and replace any or all Work included in said improvement, together with any other adjacent work which may be displaced or damaged by so doing, that may prove to be defective in its workmanship or material within a period of one year from date of the Certificate of Substantial Completion, ordinary wear and tear and unusual abuse or neglect accepted.

In the event of our failure to comply with the above mentioned conditions within a reasonable period of time (as determined by the Owner) after being notified in writing by the Owner, we both jointly and severally, do hereby authorize the Owner to proceed to have said defects repaired and made good at our expense, and we will honor and pay the costs and charges therefore upon demand.

Signed _____

Countersigned _____

Local Representative to be contacted for service:

Name _____

Address _____

Phone No. _____

FAX _____

The guarantee form(s) shall be completed and returned with the acknowledgement of the Certificate of Completion.

The failure of the Contractor or any Subcontractor to execute, such guarantee shall not affect the right of the Owner to rely on and enforce the guarantee and the obligations respectively assumed by the Contractor and each Subcontractor under Subparagraph 32.1 and 32.2 hereof.

33.0 ARBITRATION

33.1 Provided both parties mutually agree, all claims, disputes and other matters in question arising out of, or relating to, the Contract Documents or the breach thereof, except for claims which have been waived by the making and acceptance of final payment as provided by Section 23, may be decided by arbitration in accordance with the American Arbitration Association or any other similar body. The foregoing Contract to arbitrate shall be specifically enforceable under the prevailing arbitration law (Arizona Revised Statutes Sections 12-1501, *et seq*.) of the State of Arizona. The award rendered by the arbitrators shall be final, and judgment may be entered upon it in any court having jurisdiction thereof.

33.2 Notice of the demand for arbitration shall be filed in writing with the other party to the Contract Documents and with the American Arbitration Association and a copy shall be filed with the Engineer. The party filing for arbitration may select which arbitration service to use. Demand for arbitration shall in no event by made on any claim, dispute or other matter in question which would be barred by the applicable statute of limitations.

33.3 The Contractor shall carry on the Work and maintain the progress schedule during any arbitration proceedings, unless otherwise mutually agreed in writing.

33.4 The provisions of the Contract pertaining to arbitration are not binding upon Engineer and Engineer cannot be compelled to participate against his will in an arbitration arising out of a dispute over the Contract or Contract Documents unless Engineer so consents in writing to be a party to the arbitration.

34.0 TAXES AND CHARGES

34.1 The Contractor shall pay all State and local sales and use taxes on items, and in a manner as required by the laws and statutes of the State of Arizona and its political subdivisions. The Contractor shall withhold and pay any and all withholding taxes, whether State or Federal, and pay all Social Security charges, State Unemployment Compensation charges, industrial insurance, workers' compensation charges, and pay or cause to be withheld, as the case may be, any and all taxes, charges, or fees, or sums whatsoever, which are now or may hereafter be required to be paid or withheld under any laws.

35.0 MISCELLANEOUS CONDITIONS

35.1 In the event that either party to the Contract is required to institute arbitration or litigation to enforce its rights under the terms of the Contract, then the prevailing party in the arbitration or litigation shall be entitled to recover all costs and attorney's fees incurred.

35.2 In the event that any provision contained in the Contract is found to be contrary to the applicable law, then it shall be severed and the remaining provisions of the Contract shall remain in full force and effect.

35.3 The Contract shall be governed by the laws of the State of Arizona.

36.0 CONFLICTS WITHIN THE PLANS OR SPECIFICATIONS

36.1 In the event that a conflict is discovered between sections of the Specifications or between the Plans and the Specifications, the following list of priority shall be used to resolve the conflict:

A. Executed Change Orders
B. Addenda
C. Contract
D. Special Provisions
E. General Conditions
F. Instructions to Bidders
G. Technical Specifications
H. Plans
I. Referenced Standard Specifications or Other Documents

37.0 NONDISCRIMINATION

37.1 The Contractor, with regard to the work performed pursuant to this contract, shall not discriminate on the grounds of race, color, sex, religion, creed, age, physical or mental disability, or national origin or ancestry in any contracts with the public and in the selection and retention of employees or subcontractors, nor in the procurement of materials and leases of equipment.

38.0 INTEGRATION

38.1 This Contract represents the entire Contract between the parties hereto and supersedes any and all prior negotiations or representations, either written or oral.

38.2 Amendments or modifications to the Contract shall be in writing, signed by both parties, or by Change Orders.

38.3 The Contract Documents shall not be construed to create any contractual relationship of any kind between the Engineer and the Contractor, but the Engineer shall be entitled to performance of obligations intended for his benefit, and to the enforcement thereof.

39.0 HAZARD COMMUNICATION PROGRAM

39.1 All contractors working on City projects shall submit a copy of their hazard communication plan to the Fire Prevention Office prior to commencement of work on any project. This will ensure that other individuals on the job site are not unknowingly exposed to a hazardous substance or chemical.

The Fire Prevention Office shall be provided a list of the hazardous substances and the material safety data sheets that are applicable to the work areas of those contract employees.

All contract labor within City facilities will be treated the same as regular employees with regard to this hazard communication standard.

** END OF SECTION **

SECTION 00800
SPECIAL PROVISIONS

1.0 SCOPE

These Special Provisions supplement and modify the General Conditions, Technical Specifications, and Plans. All requirements and provisions of the General Conditions, Technical Specifications and Plans apply except where modified by these Special Provisions.

2.0 DEFINITION OF TERMS

Wherever in these documents the word "ENGINEER" appears, it shall be understood to mean Lake Havasu City Public Works Department, Engineering Division.

3.0 PRECONSTRUCTION CONFERENCE

Within ten (10) days after the contract has been awarded, but before the start of construction, the ENGINEER will schedule a conference to be held at the site of the project for the purpose of discussing such matters as project supervision, onsite inspections, progress schedules and reports, payrolls, payments to Contractors, equal employment opportunity, contract change orders, insurance, safety, and any other items pertinent to the project. The Contractor shall arrange to have all supervisory personnel connected with the project on hand to meet with the representatives of the Owner and the Engineer.

4.0 DRAWINGS OF RECORD

Two sets of the Contract Documents are to be kept at the job site, maintained in good condition, and marked daily by the Contractor as the work proceeds. The Contract Documents shall be kept available for inspection by the OWNER at all times, and shall be kept up to date.

5.0 SURVEYS

The CONTRACTOR shall layout the WORK, in accordance with the drawings, shall establish all necessary lines, etc., required to complete the work in accordance with the Contract Documents. The CONTRACTOR shall employ an experienced and competent Arizona Registered Land Surveyor (R.L.S.) satisfactory to the OWNER to layout the WORK and to verify lines and elevations as the WORK progresses.

6.0 WEATHER CONDITIONS

In the event of temporary suspension of work, or during inclement weather, or whenever the OWNER shall direct, the Contractor will and will cause his Subcontractors to protect carefully his and their work and materials against damage or injury from the weather. If, in the opinion of the OWNER, any work or materials shall have been damaged or injured by reason of failure on the part of the Contractor or any of his subcontractors to so protect his work, such materials shall be removed and replaced at the expense of the Contractor.

7.0 SUBMITTALS

Prior to construction and as soon as possible, the Contractor shall supply all submittals required by the Technical Specifications or as requested by the Owner.

8.0 INSPECTION OF THE WORK

The Owner intends to provide a full-time resident inspector for the project. The resident inspector will be available for a forty (40) hour period during the week from Monday through Friday during the period of the Contract. In the event the Contractor elects to work outside the forty (40) hour week that occurs between Monday through Friday, such as Saturday, Sunday or legal holidays, in accordance with Article 17.0 of the General Conditions the Contractor will be responsible for all inspection, engineering, and testing costs incurred during that period. For any inspection work performed on Saturday, Sunday, or local municipal holidays the minimum chargeable time shall be four (4) hours. The Owner reserves the right to deduct these additional inspection, engineering, and testing costs directly from the Contractor's payments.

9.0 WATER AND POWER

A. WATER

Water is available from the Water Department at no cost to the Contractor. The Contractor shall make application and obtain a hydrant meter from the Water Department for the purpose of metering the use of water on the project. The Contractor shall adhere to all conditions stated in the Meter Application, including payment of a deposit for the meter, return of the meter to the Water Department each month during the project for reading, and notification to the Water Department prior to any change in the location of the hydrant meter. The maximum water to be drawn off a hydrant at any time is 200 gpm (water drawn from 4" hydrant whenever available). Water shall only be drawn off hydrants approved by the Lake Havasu City Water Superintendent or his authorized representative.

B. POWER

All power for lighting, operation of Contractor's plant or equipment or for any other use as may be required for proper completion of the work to be performed under the provisions of these contract documents, shall be provided by the Contractor at his sole cost and expense.

10.0 BURNING OF VEGETATION

No burning of vegetation will be allowed.

11.0 MATERIALS TESTING

A. CONSTRUCTION TESTING

All quality control testing must be provided by CONTRACTOR. The material and workmanship provided during construction will be tested on a regular basis by the CONTRACTOR. It shall be the responsibility of the CONTRACTOR, at no additional cost, to provide material samples for testing at the **OWNER's** request.

The CONTRACTOR shall be responsible for charges resulting from failed tests, costs for retesting shall be based upon hourly and/or individual test rates. In the event any portion of the project is rejected because of substandard work, all materials testing, engineering, and inspection costs associated with corrective measures shall be chargeable to the CONTRACTOR at the current respective rates.

B. PRELIMINARY MATERIALS TESTING

All preliminary materials testing and mix design testing required by the specifications to ensure materials and mix designs are suitable for project use will be the responsibility of the CONTRACTOR at no additional cost to the OWNER.

12.0 CLEANUP AND POLLUTION CONTROL

A. GENERAL

The CONTRACTOR shall be responsible for the removal of all debris, litter and waste from the job site(s) and/or equipment maintenance area and the restoration of any and all areas affected, directly or indirectly by the construction, transportation of equipment or materials and/or by the acts of neglect or omission by his employees.

All debris, litter, etc., shall be disposed of in accordance with prevailing ordinance or law. Open burning of trash, debris, etc., will not be permitted.

Such clean-up operations shall be on a daily basis. All pavement, concrete, brush, rocks, excess materials, etc. accumulated or removed during the course of construction must be disposed of in those areas designated by the Engineer or his authorized representative, including but not limited to the Lake Havasu City Landfill. All costs for disposal, including gate or tipping fees, etc. are the responsibility of the Contractor. This material must be disposed of within ten (10) days of time of removal. If the areas in question are not cleaned up to the satisfaction of the ENGINEER, progress payments will be withheld until clean-up is completed and approved by the ENGINEER, or, in the case of private projects, other legal action will be taken.

B. TEMPORARY FACILITIES

The CONTRACTOR shall provide temporary mailboxes and traffic control signs where necessary until completion of backfilling and clean-up.

C. SOLID WASTES

All solid wastes shall be removed and disposed of in accordance with prevailing ordinance or law. Clean-up shall be completed on a daily basis. All costs for disposal shall be the responsibility of the Contractor, and shall be considered incidental to the costs of the various bid items.

All spilled paving material shall be removed and disposed of prior to final acceptance and payment.

D. MAINTENANCE AREAS

Maintenance areas shall be kept clean during construction and shall be free of litter at all times. All empty containers, debris, waste, etc., shall be removed and disposed of prior to final acceptance. Upon inspection by the ENGINEER, the CONTRACTOR may be required to dress the surface of the ground, dependent upon the extent of spillage of petroleum products on the surface. If so directed, such dressing shall consist of scarifying the surface to a depth of six (6) inches and moving and compacting the soil in such a way as to blend the spill areas into clean soil and restore the surface by partial compaction.

E. POLLUTION

The CONTRACTOR shall be held responsible for acts leading to pollution of

water, air or land by any means.

Open burning of trash, debris, etc., will not be permitted anywhere in the City limits.

The discharge of any pollutants upon the surface of the ground, or into any stream, ravine, wash or body of water which may result in pollution of the public water supply, or of groundwater contributory thereto, will not be permitted.

Violation of these conditions will be cause for the termination of work, and possible legal action.

F. REMOVAL AND REPLACEMENT OF SIGNS, MAILBOXES, ETC.

It is the responsibility of the CONTRACTOR to remove all poles, etc. which are located within the construction area and replace at the time of backfilling and clean-up in the locations determined by the Street Superintendent. In the case of landscaping or other private items located in the construction area, the CONTRACTOR shall hand-deliver a written notice to all residences in that area stating his intentions to perform construction activities and shall do so at least five (5) working days prior to work commencing. If, at the time of construction these items are still in the construction area, the CONTRACTOR is to remove and dispose of them properly. All signs and mailboxes shall be permanently installed within forty-eight (48) hours of completion of construction activities.

G. NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES)GENERAL PERMIT

At the time of the preconstruction conference, the contractor shall submit, for the Engineer's approval, a program which includes all the measures which the contractor proposes to take for the construction of permanent erosion control work specified in the contract and all the temporary control measures to prevent erosion and pollution of streams, lakes and reservoirs.

Permanent erosion control work and pollution prevention measures shall be performed at the earliest practicable time consistent with good construction practices. Temporary work and measures are not meant to be performed in lieu of permanent work specified in the contract.

Construction of drainage facilities as well as the performance of other contract work which will contribute to the control of erosion and sedimentation shall be carried out in conjunction with earthwork operations

or as soon thereafter as possible.

Except for that approved in writing by the Engineer, the contractor shall perform no clearing and grubbing or earthwork until the contractor's program has been approved.

If in the opinion of the Engineer, clearing and grubbing, excavation, or other construction operations are likely to create an erosion problem because of the exposure of erodible earth material, the Engineer may limit the surface area to be disturbed until satisfactory control measures have been accomplished. Unless otherwise permitted by the Engineer, the contractor shall not expose an area of erodible earth material greater than 217,800 square feet at any one location.

The Engineer may order the contractor to provide immediate measures to control erosion and prevent pollution. Such measures may involve the construction of temporary berms, dikes, dams, sediment basins and slope drains; the use of temporary mulches, mats and seeds and the use of other devices, methods, items, etc., as necessary.

At any time the contractor proposes to change his/her schedule of operations, the contractor shall review and update his/her erosion and pollution control program and submit it to the Engineer for approval.

The contractor shall not be entitled to additional compensation or an extension of contract time for any delays to the work because of the contractor's failure to submit an acceptable erosion and pollution control program.

Erosion control and pollution prevention work specified in the contract which is to be accomplished under any of the various contract items will be paid for by the bid item. Any additional work required by the Owner will be paid for by the Force Account set up for this work.

The cost of any erosion control and pollution prevention work which may be proposed by the contractor in his/her program, in addition to that specified in the contract, will be considered as included in the prices bid for contract items.

13.0 DUST CONTROL

It shall be the Contractor's responsibility to provide adequate water for dust control. It is imperative that the air quality standards are maintained. In addition, dust could be quite hazardous in the everyday operations. It shall be the

Contractor's responsibility to ensure that all regulations for air quality and safety are met.

14.0 SUPERVISORY PERSONNEL

It is the intent of these Specifications to provide a completed project which will in every way reflect the work of competent journeyman mechanics in the various trades represented. The Contractor shall ensure that each portion of the work is supervised by a qualified person, well versed in the operation of the various tools required for the trade, the method in which the work is to be done, and a knowledge of the general requirements of the construction work. All work is to be done in accordance with the latest methods devised for such work to ensure the highest quality product.

15.0 SAFETY REQUIREMENTS

The Contractor shall comply with all pertinent provisions of the Department of Labor "Safety and Health Regulations for Construction" (29 CFR Part 1518, 36 CFR 7340), with additions or modifications thereto, in effect during construction of this project.

THE FOLLOWING MEASURES OR PROVISIONS ARE TO BE ADHERED TO AT ALL TIMES DURING THE CONSTRUCTION OF THIS PROJECT:

A. All heavy construction machinery to include trenching machines, bulldozers, backhoes, etc., must be equipped with a roll bar meeting the requirements of the above regulation.

B. Safety helmets will be worn by all personnel working at the site. In addition, all spectators and inspectors will be required to wear safety helmets in construction zone.

C. Steel toe safety shoes or boots will be worn by all personnel working at the site.

16.0 PRESERVATION OF BENCH MARKS AND MONUMENTS

The Contractor shall exercise caution to ensure that permanent bench marks, monuments, established property corners, survey lines, and points are not damaged or disturbed by this work. If any survey monuments, property corners, survey lines or points are damaged or disturbed, the Contractor's representative shall immediately notify the inspector. All centerline survey monumentation located in pavement removal areas shall be replaced by an Arizona Registered Land Surveyor (R.L.S.) after completion of the pavement removal and replacement

operations. All costs incurred to re-establish such points shall be borne by the Contractor.

17.0 DISPOSAL OF EXCESS MATERIAL

Excess soil and unsuitable materials shall be removed from the site by the Contractor at his own expense and disposed of in accordance with the Contract Documents unless otherwise permitted herein. In the event the Contractor chooses to utilize local private lots to dispose of excess material, the Contractor must provide the Engineer with written permission from the lot owner prior to utilizing the lot. Placing material suitable for fill on vacant lots will require a Grading Permit in advance of placing the material.

18.0 REFERENCE STANDARD SPECIFICATIONS

Where standard specifications or testing methods have been referred to, such as ASTM or AASHTO, the intent is to refer to the latest applicable issue or revision of such specifications or testing methods. The following abbreviations are used in these specifications.

AWWA	American Waterworks Association
AASHTO	American Association of State Highway and Transportation Officials
ACI	American Concrete Institute
AI	Asphalt Institute
AISI	American Iron and Steel Institute
ANSI	American National Standards Institute (formerly the USA Standards Institute)
ASTM	American Society for Testing and Materials
NSF	National Sanitation Foundation
S.P.W.C.	Standard Specifications for Public Works Construction. (Wherever written herein shall mean "Maricopa Association of Governments, Arizona Specification for Public Works Construction".) The "Sample Forms" and "Part 100 – General Conditions" of these Standard Specifications for Public Works Construction are excluded from the documents for this

project.

19.0 CODES, ORDINANCES AND LOCAL SPECIFICATIONS

All work under this project shall be performed in strict accordance with these specifications and the Standard Specifications for Public Works Construction (SPWC). Where any conflict occurs between these plans and specifications and the local codes and ordinances in effect at the time, such codes and ordinances shall take precedence over these plans and specifications only if these plans and specifications are inferior as to materials and workmanship called for by such codes and ordinances.

20.0 INTERFERING STRUCTURES AND UTILITIES

The Contractor shall notify Blue Stake (1-800-782-5348) at least three (3) working days prior to any excavations.

The Contractor shall exercise all possible caution to prevent damage to existing structures and utilities, whether above ground or underground. The Contractor shall notify all utility offices concerned at least seventy-two (72) hours in advance of construction operations in which a utility's facilities may be involved.

Any structure or utility damage caused by the work shall be repaired or replaced in a condition equal to or better than the condition prior to the damage. Such repair or replacement shall be accomplished at the Contractor's expense without additional compensation from the Owner.

If interfering structures or installations such as vaults, manholes, valves, utility poles, guy wires, or anchors are encountered, the Contractor shall notify the Engineer and contact the appropriate utility or structure owner at least seven (7) days in advance of construction to arrange for protection or relocation of the structure.

The Contractor shall remove, protect and/or replace all existing structures, utilities or other improvements and similar items within the proposed improvements at his own expense without additional compensation from the Owner unless specifically provided for as a pay item of work by the Specifications or as otherwise provided for on the Plans. Replacement shall be in a manner and in a condition at least equivalent to, or better than, the original condition.

If the Contractor encounters existing facilities which will prevent the construction of any facility and which are not properly shown on the Plans, he shall notify the Owner before continuing with the construction in order that the Owner may make

such field revisions as necessary to avoid conflict with the existing structure. The cost of waiting or "down" time during such field revision shall be borne by the Contractor without additional cost to the Owner. If the Contractor fails to notify the Owner when an existing structure is encountered, but proceeds with the construction despite this interference, he does so at his own risk. In particular, when the location of the new construction will prohibit the restoration of existing structures to their original condition; the Contractor shall notify the Engineer and contact the utility or structure owner so a field relocation may be made if possible to avoid the conflict.

In the event of interruption to any utility service as a result of accidental breakage or as a result of being exposed or unsupported, the Contractor shall promptly notify the proper authority. He shall cooperate with the said authority in restoration of service as promptly as possible and shall bear all costs of repair. In no case shall interruption of any utility service be allowed to exist outside working hours unless prior approval of the Owner is received.

Neither the Owner nor its officers or agents shall be responsible for damages to the Contractor as a result of the locations of the water and sewer lines or utilities being other than those shown on the Plans or for the existence of water, sewer lines or utilities not shown on the Plans.

21.0 AIR QUALITY - OPERATING PERMITS

The Contractor may be required to obtain registration certificates and/or operating permits for sources of air pollution.

Information concerning these certificates and permits may be obtained from:

The Office of Air Quality
Arizona Department of Environmental Quality
P.O. Box 600
Phoenix, AZ 85001-0600
(602) 207-2300

22.0 ADJUST UTILITIES TO FINISHED GRADE

The Contractor shall be responsible for locating all manhole rims, valve boxes, meter boxes, utility vaults, etc., and setting them to finished grade. The Contractor shall adjust sewer and water facilities to finished grade in accordance with the specifications within seven (7) days after street surfacing has been completed on each street. All valves and/or manholes will be made visible and accessible for emergency use within 24 hours. It shall be the responsibility of the Contractor to coordinate with the various private utility companies so that they can

adjust their facilities to finished grade at an appropriate time. Adjust all facilities in accordance with these specifications and the MAG Standard Details, as modified by Lake Havasu City.

23.0 SAFETY, HEALTH AND SANITATION PROVISIONS

The Contractor shall provide and maintain in a neat, sanitary condition such accommodations for the use of his employees as may be necessary to comply with the requirements and regulations of the Arizona State Department of Health.

The Contractor shall provide all safeguards, safety devices and protective equipment and take any other needed actions, on his own responsibility or as the Owner may determine, reasonably necessary to protect the life and health of employees on the job, the safety of the public and to protect property in connection with the performance of the work covered by the contract.

Precaution shall be exercised by the Contractor at all times for the protection of persons (including employees) and property. The Contractor shall comply with the provisions of all applicable laws, pertaining to such protection including all Federal and State occupational safety and health acts, and standards and regulations promulgated thereunder.

24.0 PUBLIC SAFETY AND TRAFFIC CONTROL

Every attempt shall be made to provide public safety during the construction of the project. Traffic control shall be performed in accordance with Section 2650, Traffic Control, of the Technical Specifications.

During all construction operations, the Contractor shall construct and maintain such facilities as may be required to provide access for all property owners to their property. No person shall be cut off from access to his residence or place of business for a period exceeding two (2) hours, unless the Contractor has made a special arrangement with the affected persons. It shall be the Contractor's responsibility to notify all adjacent property owners of the construction activity and the schedule of such activities.

The CONTRACTOR shall submit for approval a traffic control and barricade plan within ten (10) days of receipt of Notification of Award of Contract. There shall be no deviations from the approved barricade plan unless a revised barricade plan is submitted and approved. The CONTRACTOR shall issue a news release once a week for duration of the project. The release will be published in Sunday's newspaper and shall indicate the area in which the CONTRACTOR will be performing work for that week.

Businesses must be notified forty-eight (48) hours prior to any restrictions on normal parking areas used by their employees or patrons.

The CONTRACTOR shall contact, cooperate with, and give notice to each resident, homeowner, business or school that will be affected by any part of the construction process, particularly concerning temporary interruptions to vehicular access.

Written notice of the approximate schedule and explanation of work shall be given to each resident, homeowner, business or school at least five (5) days prior to commencement of work in the area. Verbal door-to-door communication shall be made at least twenty-four (24) hours prior to construction to remind all affected parties of the construction to take place.

The OWNER shall receive a copy of all notifications to residents. In the event of complaints by residents, the OWNER may require the CONTRACTOR to provide documentation (i.e. check list) showing the date & time of the verbal door-to-door communication.

In addition, the CONTRACTOR is responsible to answer and resolve any conflicts that may arise between a homeowner or business owner and himself during the construction process.

The CONTRACTOR shall provide and station competent flaggers whose sole purpose shall be to direct the movement of public traffic through or around the work. Proper advanced warning signs shall be in place when flaggers are working and removed when work requiring flaggers is completed. Flaggers must be used to assist trucks for safe ingress and egress whenever truck movements may interfere with safe passage through the work zone.

All traffic control devices that are not in use or will not be used for a period greater than 72 hours or that are determined by the Engineer to be unnecessary, confusing, or causing an unsafe condition, shall be removed by the CONTRACTOR from the public right-of-way immediately upon notification by the Engineer.

Every attempt shall be made to provide public safety during the construction of the project. Traffic control shall be performed in accordance with Section 2650, Traffic Control, of the Technical Specifications. No person shall be cut off from access to his residence or place of business for a period exceeding six (6) hours, unless the Contractor has made a special arrangement with the affected persons. In addition, no work will be scheduled which will interrupt regular trash pickup to either residential or commercial properties. It will be the CONTRACTOR'S responsibility to coordinate his activities with the local trash haulers.

No streets, avenues, boulevards or cul-de-sacs will be closed to traffic unless prior

arrangements have been made and approval has been obtained from the ENGINEER.

25.0 TEMPORARY FACILITIES ON SITE

A. General

Except as otherwise provided, the Owner shall bear no costs of temporary facilities and their removal.

B. Temporary Utility Services

The Contractor shall provide temporary electric power as necessary for the execution of the Work, including that required by all Subcontractors. He shall make the necessary arrangements with Owner, shall bear all costs for these temporary services and shall furnish and install all necessary transformers, metering facilities and distribution centers from branch circuits as he may require.

The Contractor shall provide lighting and outlets in temporary structures throughout the project as may be required for safety, proper performance and inspection of the Work. If operations are performed during hours of darkness, or if natural lighting is deemed insufficient by Owner, the Contractor shall provide adequate floodlights, clusters and spot illumination. The use of permanently installed lighting fixtures, lamps and tubes for work will not be permitted except by special permission of Owner. The Contractor shall make arrangements with Subcontractors for electrical services and lighting as may be necessary in the performance of their work.

Temporary water service lines, if required, shall be installed and removed by the Contractor, who shall pay all charges for making the connections, running the temporary lines, removing the temporary lines at the completion of the Work and disconnecting the services. All relocations required to clear the work of others shall be performed by the Contractor when requested by the Owner.

C. Temporary Structures

Prior to starting Work, the Contractor shall, as directed by Owner, provide and maintain suitable temporary office facilities for the duration of the Project as required for the Contractor's project administration; and all necessary sheds and facilities for the proper storage of tools, materials and equipment employed in the performance of the Work.

D. Toilet Facilities

The Contractor shall provide and maintain temporary toilet facilities for the duration of operations, which shall be maintained in a clean and sanitary condition acceptable to Owner and in full compliance with applicable regulations of any public authority.

E. Telephones

The Contractor shall provide, maintain and pay for telephone services for the duration of the Work as required for the Contractor's operation.

F. Fence and Barricades

The Contractor shall provide such protective fences and barricades as he may deem necessary for public safety and to protect his storage areas and the Work in place. The location and appearance of all fences shall be subject to the approval of the Owner.

G. Contractor Parking

The Contractor shall not park his equipment, nor allow his personnel to park, in any area except those specifically designated by the Owner.

H. Temporary Living Quarters

Temporary living quarters shall not be allowed on the job site or on publicly owned properties. In addition, all Lake Havasu City Zoning Codes for the area in question shall be strictly adhered to.

I. Removal of Temporary Construction

The Contractor shall remove temporary office facilities, toilets, storage sheds and other temporary construction from the site as soon as, in Owner's opinion, the progress of Work permits. He shall recondition and restore those portions of the site occupied by the same to a condition equal to or better than it was prior to construction.

26.0 ACCESS TO WASHES

A. Unless otherwise mentioned herein, the Contractor must obtain written permission from the Owner prior to gaining access or utilizing washes or City parcels for any purpose. Request for access to washes and City parcels will be reviewed on a case by case basis. The Contractor shall have access

to washes and City parcels via public streets and/or private easements only. For the purposes of this paragraph, "private easement" means an Contract by and between the Contractor and a property owner, in writing, authorizing the Contractor to travel across the property owner's real property in order to have ingress or egress to washes, parcels or any portion thereof. Such Contracts, if any, shall be filed with the Office of the City Engineer before the Contractor may exercise the rights thereunder granted. Access to any wash, parcels, or portion thereof by any means not in compliance with the terms of this paragraph shall be deemed a trespass and a breach of the terms of the Contract.

B. Violations of the provisions of subparagraph (a.) hereof, shall entitle the City to deduct the sum of One Thousand Dollars ($1,000.00) from the monies due to Contractor as and for liquidated damages for each such violation. For the purposes of this paragraph, each entry by a vehicle upon land for which Contractor has not received permission to enter shall be deemed a separate violation of subparagraph (a.) hereof.

27.0 COOPERATION AND COOPERATION WITH UTILITY COMPANIES AND OTHER TRADES

A. Coordination/Interruption

The Contractor is responsible to coordinate work with all utility companies and other trades, on or affecting the job, for an efficient and effective execution of the complete project. The Contractor shall carefully examine all work that may conflict, and plan removal and/or installation details in advance of the construction to avoid any such conflict. Failure on the contractor's part to coordinate with any and all utilities, public or private, shall preclude the City's consideration for additional time or cost.

B. Permission Required

Utility mains and utility service to buildings shall not be cut off or otherwise interrupted without the Contractor obtaining permission from the Owner in each and every instance.

C. Scheduling of Interruptions

Where utilities serve facilities or buildings in use, interruptions in service shall be scheduled during the hours when the facility is not in operation. Any overtime costs occasioned thereby shall be regarded as incidental to, and included within, the Contract Sum.

D. General Requirements

Prior to interrupting any utility service, the Contractor shall ascertain that he has the proper materials, together with adequate workmen and equipment, to complete the Work with a minimum of delay.

E. Project Electrical Service

The Contractor is responsible to coordinate with Unisource, Electric Division, to determine the extent of work to be performed by Unisource and by the Contractor to provide electric service for the finished product. The Contractor is also responsible to contact Unisource to determine the hardware required by Unisource to provide service to the final product. Unisource does not provide service to delta connections.

LAKE HAVASU CITY

Project Technical Specifications
Bid Documents

Volume II

Park Avenue Lift
Station Renovation

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SPECIFICATIONS

DIVISION I
GENERAL REQUIREMENTS

SECTION 01040

ORDER OF CONSTRUCTION

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Order of construction activities to allow the OWNER normal operation of the existing facilities located on the Project site.

B. Related Sections include, but are not necessarily limited to:

1. Division 1.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

A. Milestone Dates - The construction duration to reach substantial completion shall not exceed 300 calendar days.

1. CONTRACTOR shall include sufficient and complete overhead costs in base Bid for a 300 calendar day construction duration to reach substantial completion at each site as listed above. No change orders or claims for extended overhead will be considered unless the actual duration to reach substantial completion exceeds 300 calendar days and OWNER was responsible for extending the timeline:

a. No credit or refund will be given to CONTRACTOR if the work is substantially completed sooner than 300 calendar days.

B. Tie-ins shall be coordinated with the OWNER and shall be scheduled as to minimize the disruption of services:

1. Thirty calendar days before start of tie-ins between new and existing facilities and shutdown of facilities, CONTRACTOR shall provide a written proposed maintenance of plant operation (MOPO) for tie-in activities and shutdowns for review by the OWNER.
2. CONTRACTOR, with input from OWNER, can identify the timeframe and duration of facility shutdowns.
3. At no time shall CONTRACTOR or his employees modify operation of the existing facilities or start construction modifications without approval of the OWNER.
4. CONTRACTOR shall plan his work to allow OWNER access to existing facilities to perform maintenance and repair work.
5. Operation of existing valves shall only be performed by OWNER’s personnel.

C. Order of Construction - The Contractor shall follow a phased approach for constructing the booster pump station as follows:

1. Construct force main
2. Install bypass pumping system. Piping and header piping with valves and associated electrical panels, VFD and wiring.
3. After installation of new Lift Station components, demolish existing electrical panels. Complete testing and transfer existing electrical service to new panels (to be coordinated with Owner).
4. Complete all work associated with the roof modifications including civil/site work and installation of hatches.
5. Any damage to existing property/equipment must be replaced to original working conditions.

END OF SECTION

SECTION 01060

SPECIAL CONDITIONS

PART 1 - GENERAL

1.01 SITE MAINTENANCE AND TEMPORARY FACILITIES

A. Maintain in good repair temporary structures, fences, barricades and related items.

B. Keep site clean of debris. Store and stockpile materials in an orderly manner and protect against damage.

1.02 TESTING (NOT REQUIRED)

1.03 PROJECT MEETINGS

A. The OWNER/ENGINEER shall conduct a preconstruction conference and progress meetings involving:
   1. CONTRACTOR's Project Manager.
   2. CONTRACTOR's Project Superintendent.
   3. OWNER's designated Representative(s).
   4. CONTRACTOR's Subcontractors as appropriate to the work in progress.

B. Progress meetings will be held bi-weekly at a location designated by OWNER.

C. The CONTRACTOR shall have available at each meeting up-to-date red line as-built drawings.

1.04 SPECIAL CONSIDERATIONS

A. CONTRACTOR shall be responsible for negotiations of any waivers or alternate arrangements required to enable transportation of materials to the site.

1.05 CONSTRUCTION SCHEDULE AND WORK HOURS

A. The CONTRACTOR shall prepare a construction schedule:
   1. The CONTRACTOR shall submit a complete computer software generated critical path method schedule (CPM) to the OWNER at the pre-construction meeting (Primavera or approved equal). This schedule shall include a complete critical path schedule to cover the CONTRACTOR's anticipated time schedule.
   2. The schedule shall include a detailed network diagram acceptable to the OWNER with the following features:
      a. The schedule shall be time-scaled in calendar days.
      b. The schedule shall show the order and interdependence of activities and the sequence of work as reflected in the schedule report as described below. The critical activities shall be prominently distinguished.

c. The schedule shall include, in addition to all construction activities, such tasks as mobilization and demobilization, submittal and approval of samples of materials and shop drawings, procurement of significant materials and equipment, fabrication of special items, installation, startup, commissioning, site work, cleanup, and interfacing with other projects/contractors/utility companies, etc.
d. The schedule diagram shall be organized and described as to conform to the schedule of values.
e. The diagram shall be accompanied by a schedule report of the network with a tabulation of the following data for each activity:
    1) preceding and following event numbers
    2) activity description
    3) activity duration
    4) earliest start date
    5) earliest finish date
    6) latest start date
    7) latest finish date
    8) total float time
    9) responsibility for activity (for example, CONTRACTOR, subcontractor, supplier, etc.)

3. The CONTRACTOR shall provide updated schedules and reports every month commencing from notice to proceed in conformation with the following:
    a. The OWNER or ENGINEER shall determine if the detailed network diagram and/or report requires revision in whole or in part, and shall so inform the CONTRACTOR of noncompliance with Contract schedule within 5 calendar days.
    b. The report shall show the activities or portion of activities completed during the one month period and the portion completed on the project to date; actual start and finish dates shall be shown plus future activities for the next four week period.
    c. The report shall state the percentage of revenue actually earned as of the report date.
    d. The report shall be accompanied by a narrative description of progress, problem areas, and current and anticipated delaying factors and their anticipated effect, and any correction actions proposed or taken. This report shall identify departures from earlier schedules or changes in logical sequence or logical ties.
    e. The report shall include a summary of all activities scheduled to begin in the next four week period that are critical path, those activities whose float had changed and those activities with less than the ten day float. The activities shall be sequenced by critical path activities, by least total float and by greatest float respectively.
    f. The CONTRACTOR shall use computer generated critical path scheduling software.
4. At each progress meeting the CONTRACTOR shall provide a two week look ahead schedule.

5. Acceptance of the CONTRACTOR's schedule by the OWNER is not to be construed as relieving the CONTRACTOR of its obligation to complete the Contract work within the Contract time.

B. The CONTRACTOR shall plan construction activities between normal work hours (6:00 a.m. to 6:00 p.m.) Monday through Friday excluding National holidays:
   1. Work hours outside these hours including Saturday may be permissible provided a construction schedule has been prepared, submitted to, and found acceptable to the OWNER. Work hours on Saturday shall be between 7:00 am to 6:00 pm.
   2. The schedule shall identify the Work to be performed, including the location and duration of planned activities.
   3. Submittals shall be made a minimum of seven days prior to the planned work to allow sufficient time for the OWNER and to review the request and schedule any necessary inspections.
   4. The CONTRACTOR shall be responsible for payment for all overtime and off-hours inspection for ENGINEER and testing that occur outside the normal and expected working hours indicated above.

1.06 SITE SECURITY

A. CONTRACTOR shall store small equipment and tools in secure, locked storage containers at the end of the work day.

B. CONTRACTOR assumes all risk associated with leaving construction materials, tools, vehicles, and equipment on site. OWNER is not liable for any damages or theft.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01072
PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.01 SUMMARY

A. Prepare and maintain record documents for the project to accurately reflect the construction work as built. The record documents must be submitted at completion of the construction work as a condition of final acceptance of the Work by the OWNER.

1.02 MAINTENANCE OF RECORD DOCUMENTS

A. The CONTRACTOR shall maintain one copy each of the following record documents:
   1. Contract Drawings.
   2. Specifications.
   3. Design addenda.
   4. Reviewed shop drawings.
   5. Contract Change Orders and field orders.
   6. Supplemental drawings and written material provided by the ENGINEER to clarify the Contract Documents.
   7. Other contract modifications.
   8. Approved samples and/or sample results.

1.03 MARKING DEVICES

A. Mark all changes with red pencil or pen.

1.04 RECORDING

A. The CONTRACTOR shall keep the record documents current with construction in progress. Completed construction work shall not be permanently concealed until required information has been recorded.

B. The CONTRACTOR shall neatly stamp, in red, each record document “PROJECT RECORD”, and legibly mark the Contract Drawings to record actual construction deviations as follows:
   1. Horizontal and vertical location of underground utilities and appurtenances referenced to permanent surface improvements.
   2. Field changes of dimension and detail.
   3. Changes made by design addenda, change order or field order.
   4. Details not on original Contract Drawings.

C. The red line as-builts shall also include buried conduit in yard.

1.05 SUBMITTAL

A. Red line record drawings shall be available for review by the OWNER whenever an application for a monthly progress payment is made. The partial record drawings shall be up-to-date through the end of the progress payment application period.

B. At completion of construction, and prior to the final inspection and final acceptance of the project by the OWNER, the CONTRACTOR shall deliver the project record documents to the ENGINEER bound into rolls of convenient size for ease of handling and properly labeled.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01110

SUMMARY OF WORK

PART 1 - GENERAL

1.1 Summary

This Section summarizes the **Scope of Work** and **DESCRIPTION** of the Project as covered in detail in the complete Contract Documents.

1.2 Project Description

A. Description of Project: The project involves the rehabilitation of the Project as follows:
This project consists of the renovation of the Park Avenue Lift Station, associated site and electrical system improvements, and construction of 600 feet of 8-inch force main. Specific elements include site work, concrete foundations, new lift station pumps and piping, wet well coating, replacement and addition of certain valves and piping, temporary bypass system, new force main, full electrical system rehabilitation including pump panels, main service upgrade, lighting, main switchgear, SCADA/ RTU, standby diesel generator, associated conduits and wiring, new metal shade canopy, along with related civil/site upgrades as necessary.

B. Work Covered by Contract Documents:
CONTRACTOR shall provide all materials, labor and services needed to complete the project as shown in the contract documents (drawings and specifications).

1.3 Contractor's Use of Premises

A. Limited Use

1. Limit use of the premises for storage and execution of the Work to allow for Owner occupancy. Confine operations to areas within Contract limits indicated. Portions of the Site outside the Contract limits shall not be disturbed.
2. Coordinate with other separate contractors and Owner to avoid interference of operations.
3. Conduct operations so as to ensure the least inconvenience to Owner and the general public.

1.4 Owner's Use of Premises

A. Partial Owner Occupancy: The Owner reserves the right to occupy and to use the area outside of the Contract limits.

1.5 Work Sequence

A. General: (See Section 1040).

PART 2 – MATERIALS –

PART 3 – EXECUTION –

END OF SECTION

SECTION 01200

MOBILIZATION/DEMOBILIZATION

PART 1 - GENERAL

1.1 Description

A. Description of Work

The work to be performed in accordance with this section includes the movement of personnel, equipment, supplies, and incidentals to the project site; for the establishment of offices, buildings and other facilities necessary for work on the project; for premiums on bonds and insurance for the project and for all other work and operations which must be performed or costs incurred before beginning work on the various contract items.

Demobilization at the end of the job includes removal of tools, materials, equipment and facilities used by the CONTRACTOR during construction of the project. Also included is final cleanup to leave the site with a neat, clean appearance.

PART 2 - MATERIALS

2.1 General

Materials shall consist of equipment, buildings, and tools necessary to move to the project site to perform work. Material for bid items shall not be included in Mobilization.

PART 3 - EXECUTION

3.1 General

Setting up of offices, and the use of private property for storage or work area shall be executed in a legal manner in accordance with local and state codes and ordinances.

Use of private property will require a signed agreement with the property owner, and shall be submitted to Engineer for approval prior to use. Sign off from property owner regarding restored property conditions will be required prior to project closeout.

PART 4 - MEASUREMENT AND PAYMENT

See Section 01210

See Section 00310 Bid Schedule for Bid Items.

SECTION 01210
MEASUREMENT AND PAYMENT

PART 1 - GENERAL

1.1 Description

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

All materials required for construction shall be furnished by the Contractor unless specifically stated. Items not specifically measured and paid for shall be considered as subsidiary items required to complete the installation in accordance with the intent of the contract documents. The Contractor shall include in the unit price bid items all costs associated with subsidiary items not being measured for payment.

1.2 Authority

Measurement methods delineated in the individual specification sections complement the criteria of this section. In the event of conflict, the requirements of the individual specification section govern.

Take all measurements and compute quantities. The Engineer will verify measurements and quantities.

1.3 Unit Quantities

Quantities indicated in the Bid Form are for bidding and contract purposes only. Quantities and measurements supplied or placed in the Work and verified by the Engineer shall determine payment.

If the actual Work requires more or fewer quantities than indicated, provide the required quantities at the unit prices contracted.

PART 2 – UNITS AND METHODS OF MEASUREMENT

2.1 General

All items that are included in the bid for measurement and payment are included herein. All other items of work shall be considered subsidiary to construction and will not be measured for payment.

2.2 Units and Methods of Measurement

2.2.1 Mobilization, Bonds, and Insurance

The Contract Lump Sum Price for this item shall constitute full compensation for furnishing all materials, labor, equipment and tools for all required bonds, insurance, mobilization of staff and equipment, and any other costs associated with complying with the contract administrative requirements and commencing work at the project site. This item also includes all work and materials necessary to complete the work as described in the plans and specifications. **Payment for this item shall be a lump sum and shall not be requested until at least thirty days from the notice to proceed has elapsed.**

Payment for this item shall be made in accordance with Table A.

TABLE A

Payment for Mobilization on First Partial Payment	Not to exceed 2.5% of the Lump Sum Base Bid
Subsequent payments for Mobilization	Not to exceed 2.5% of the Lump Sum Base Bid
Payment For Mobilization on Final Partial Payment	Any remaining Mobilization in excess of 5% of the Lump Sum Base Bid

2.2.2 Construction Staking

The Contract Lump Sum Price for this item shall constitute full compensation for furnishing all materials, labor, equipment and tools for the construction staking of all effluent piping, vadose wells, concrete pads, electrical conduits and all other related items. This item also includes all work and materials necessary to complete the work as described in the Plans and Specifications. Payment of this item shall be lump sum.

**END OF SECTION **

SECTION 01300

FORCE ACCOUNT

PART 1 - GENERAL

1.1 Description of Work

The work to be performed in accordance with this section includes additional work that is outside the general scope of the proposed project. The work to be performed shall be specifically requested in writing by the OWNER or the ENGINEER. As the project is completed, it is anticipated that the OWNER may request additional work to be performed that currently is not a part of this Contract and it is the intent that the requested work shall be performed in accordance with this section.

PART 2 - MATERIALS

2.1 General

Any materials utilized under this Section shall conform specifically with the appropriate Materials Section of these Specifications unless the OWNER specifically requests in writing a deviation from the Specifications. If the materials are not covered by an appropriate Specification of this document, then the OWNER will provide a written specification for the materials requested.

PART 3 - EXECUTION

3.1 Workmanship

Furnish all materials, equipment and labor required to complete the work. All workmanship shall meet or exceed the appropriate Specifications included in this document or any supplemental Specifications that may be provided. Perform work in accordance with the contract Plans or in accordance with any supplemental plans that may be provided by the OWNER.

PART 4 - MEASUREMENT AND PAYMENT

4.1 Measurement

The method of measurement shall be in accordance with the appropriate specification or as included in specific written instructions from the OWNER or the ENGINEER.

4.2 Payment

Payment for work performed under this section shall be made for those items specifically requested in writing by the OWNER. The value of any work performed in this Section shall be determined by one or more of the following methods in the order of precedence listed below.

A. Unit prices previously approved.

B. An agreed upon price.

The amount specified for Force Account in the Bid Documents is an estimate that is provided so each potential bidder has an equal opportunity in the bidding. The amount does not in any way represent what work may be requested or the quantity or value of the work. The CONTRACTOR shall only be compensated for the actual work requested and performed.

See Section 00310 Bid Schedule for Bid Items.

SECTION 01320
PROJECT MEETINGS, SCHEDULES,
AND REPORTS

PART 1 - GENERAL

1.1 Summary

This Section includes the following administrative and procedural requirements:

A. Project Meetings

1. Preconstruction conference.
2. Progress/Coordination meetings.

B. Schedules and Reports

1. Initial Project schedules.
2. Weekly Construction progress schedule.
3. Procurement schedule.
4. Construction progress reports.
5. Schedule of values.
6. Special reports.
7. Quality Control Testing Plan and Reports.
8. Health and Safety Plan.

C. Related Work Specified Elsewhere

Submittals.....Section 01330

1.2 Project Meetings

A. Preconstruction Conference

1. Engineer will conduct a meeting as described in Section 800, Special Provisions, Paragraph 4.0, to review items stated in the following agenda and to establish a working understanding between the parties as to their relationships during performance of the Work.

2. Preconstruction conference shall be attended by the following.

    a. Contractor and his superintendent
    b. Engineer/Owner
    c. Utilities
    d. City Departments
    e. Representatives of principal Subcontractors and Suppliers.

3. Meeting Agenda

    a. Construction schedules.
    b. Critical Work sequencing plan/Baseline schedule with milestones
    c. Designation of responsible personnel
    d. Project coordination.
    e. Procedures and Processing of:
        (1) Field decisions.
        (2) Substitutions.
        (3) Submittals.
        (4) Change Orders.
        (5) Applications for Payment.
    f. Procedures for testing.
    g. Procedures for maintaining record documents.
    h. Use of Premises:
        (1) Office, work, and storage areas.
        (2) Owner's requirements.
    i. Construction facilities, controls, and construction aids.
    j. Temporary utilities.
    k. Safety and first-aid.
    l. Security.

4. Location of Meeting: To Be Determined.

5. Reporting:

    a. Within 5 working days after the meeting, Engineer will prepare and distribute minutes of the meeting to Owner and Contractor.
    b. Contractor shall provide copies to Subcontractors and major Suppliers.

B. Coordination Schedules

1. Engineer will conduct a meeting at least 10 days before submission of the first Application for Payment to finalize the initial coordination schedules requested under ARTICLE 1.3 this Section.
2. The meeting shall be attended by:
   a. Contractor and his superintendent.
   b Representatives of principal Subcontractors and Suppliers. Engineer

C. Progress Meetings

1. Engineer will schedule and conduct a weekly meeting, and as necessary, as determined by the Engineer. Representatives of the Owner, Engineer, and Contractor shall be present at each meeting. With Engineer's concurrence, Contractor may request attendance by representatives of Subcontractors, Suppliers, or other entities concerned with the Project or involved with planning, coordination, or performance of future activities. All participants in the meeting shall be familiar with the Project and authorized to conclude matters relating to the Work.
2. Contractor and each Subcontractor represented shall be prepared to discuss the current construction progress report and any anticipated future changes to the schedule. Each Subcontractor shall comment on the schedules of Contractor and other Subcontractors and advise if their current progress or anticipated activities are compatible with the proposed Work.
3. Contractor shall be responsible for addressing any issues with subcontractors, and provide directions as are necessary to resolve the situation and promote construction progress.
4. Meeting Agenda:
   a. Review of construction progress since previous meeting.
   b. Field observations, interface requirements, conflicts.
   c. Problems which impede construction schedule.
   d. Off-site fabrication.
   e. Delivery schedules.
   f. Submittal schedules and status.
   g. Site use and responsibilities.
   h. Temporary facilities and services.

i.
j. Hours of Work.
k. Hazards/Safety.
l. Housekeeping.
m. Quality and Work standards.
n. Change Orders.
o. Documentation of information for payment requests.
p. Corrective measures and procedures to regain construction schedule if necessary.
q. Revisions to construction schedule.
r. Review of proposed activities for succeeding Work period.
s. Review proposed Contract modifications for:
(1) Effect onconstruction schedule and on completion date.
(2) Effect on other contracts of the Project.
t. Other business.

5. Location of Meetings: Meeting shall be held at the office of the Owner, unless otherwise approved.

6. Reporting:

a. Within 5 working days after each meeting, Engineer will prepare and distribute minutes of the meeting to Contractor. Contractor shall distribute copies to principal subcontractors and Suppliers.

1.3 Schedules and Reports

A. Initial Coordination Schedules

1. Within 10 days after the Effective Date of the Agreement, Contractor shall submit to Engineer for review and acceptance:
a. A preliminary procurement schedule of Equipment and Materials.
b. A preliminary schedule of values for partial pay purposes.
c. A preliminary schedule of Submittals, as stated in Section 01330.
d. Preliminary cash requirement prediction.

B. Baseline Construction Schedule

1. Within 20 days after issuance of Notice of Award of the Contract, Contractor shall submit to Engineer for review and acceptance a detailed baseline construction schedule employing the critical path scheduling method.
   a. The schedule shall show the Work in a horizontal bar chart, and indicate the start date, duration, and end date for each activity.
   b. The Contractor shall submit to the Engineer, 1 electronic copy in approved format for review. Sheet size shall be a minimum 11 x 17-inches.
   c. o single activity shall be more than 15 days in duration.
   d. The Contractor shall include all work by Subcontractors in the baseline construction schedule.
   e. The schedule shall be resourced base and include work breakdown structures.
   f. Within each activity, indicate estimated completion percentage in 10% increments.
2. After the construction schedule is approved, the schedule shall serve as the Contractor's Baseline Schedule for all Work on the project. Activity ID's shall not be changed without the Engineer's written permission from this point forward. New activity ID's will be allowed, but only for new work outside the original project baseline schedule activities.
3. If required by Engineer, the Contractor shall provide sub schedules to define in more detail, critical portions of the baseline schedule, including inspections and tests.
4. The Contractor shall coordinate the baseline construction progress schedule with the schedule of values, Submittal schedule, procurement schedule, progress reports, and payment requests.
5. The Contractor shall revise the construction baseline schedule after each meeting, event, or activity where revisions have been recognized and accepted in accordance with the GENERAL CONDITIONS.

6. The Contractor shall update and submit one (1) electronic copy in approved format of the revised schedule to the Engineer at least once each month to show actual progress compared to the originally accepted baseline construction schedule and any proposed changes in the schedule of remaining Work. The revised schedule shall be updated and submitted to the Engineer prior to each payment request. Engineer's approval for payment will not be recommended to be paid by the Owner until the monthly revised schedule is accepted by the Engineer. Include the schedule with construction progress report (See Section 1320.1.3.D).

C. Procurement Schedule

1. After submittal of preliminary procurement schedule as stated above under "Initial Coordination Schedules", submit a detailed schedule for procurement of Equipment and Materials to be furnished by Contractor, Subcontractors, manufacturers, and Suppliers. Do not include minor items which are known to be regularly stocked by local suppliers or readily available upon short notice. Submit to Engineer for review with the construction progress schedule.
2. Engineer will review and comment on the schedule for procurement. Contractor shall make all required revisions as specified, prior to acceptance of schedule.
3. Procurement schedule shall coincide with the construction progress schedule and the Submittal schedule, and shall indicate the date each item will be needed at the Site and the time required for delivery after order is placed.
4. Update the accepted schedule for procurement at least once each month to show the status of orders placed, Submittals, and delivery. Submit with the construction progress report.
5. If requested by Engineer, submit copies of purchase orders placed by Contractor or Subcontractors.

D. Construction Progress Reports

1. Submit a report on actual construction progress on a monthly basis. More frequent reports may be required should the Work fall behind the accepted schedule.
   a. Submit a weekly report to coordinate with, and supplement the monthly construction progress report, and which details Work scheduled for the following one-week interval, including:
      (1) Work activities which will occur.
      (2) Number and size of crews.
      (3) Construction equipment on Site.
      (4) Major items of Equipment and Material to be

installed.

(5) CONTRACTOR quality control testing update.
(6) Health and safety update.

b. Format shall be on 11 x 17- inch paper, submitted to Engineer in seven (7) copies.

2. Construction progress reports shall consist of the revised construction progress schedule and a narrative report which shall include but not be limited to the following:
   a. Comparison of actual progress to planned progress shown on originally accepted schedule.
   b. Summary of activities completed since the previous construction progress report.
   c. Identification of problem areas and proposed corrective actions.
   d. A description of current and anticipated delaying factors, if any.
   e. Impact of possible delaying factors.

3. Submit a construction progress report to Engineer with each application for partial payment. Work reported complete but not readily apparent to Engineer must be substantiated with supporting data when requested by Engineer.

4. If a schedule update reveals that, through no fault of Owner, the Work is likely to be completed later than the Contract completion date, Contractor shall:
   a. Establish a plan for making up lost time.
      (1) Increase number of workers, or
      (2) Increase amount or kinds of tools, or
      (3) Work overtime or additional shifts, or
      (4) A combination of the above actions.
   b. Submit plan to Engineer before implementing the plan.
   c. Take actions as accepted to get the Work back on schedule at no additional cost to Owner.

E. Schedule of Values

1. Submit as set forth in GENERAL CONDITIONS, based on the preliminary schedule of values.
2. Coordinate preparation of schedule of values with preparation and content of construction progress schedule.
3. Content
   a. Schedule shall list the installed value of the component parts of the Work in sufficient detail to serve as a basis for computing values for progress payments during construction.
   b. Follow the construction progress schedule breakdown of Work activities as format for listing component items and assigning values.
   c. For each major line item, list subvalues of major products or operations under the item.
      (1) Each item shall include a directly proportional amount of the Contractor's overhead and profit.
      (2) For items on which progress payments will be requested for stored materials received, but not installed, break down the value into:
         (a) The cost of the materials delivered and unloaded, including taxes paid, unless taxes are exempted. Contractor shall provide a paid in full invoice.
         (b) The total installed value.
   d. The sum of all values listed in the schedule shall equal the total Contract Price.

F. Special Reports

1. When an event of an unusual and significant nature occurs at the site, prepare and submit a special report. List the chain of events, persons participating, response by Contractor's personnel, an evaluation of the results or effects, and similar pertinent information. Advise the Owner in advance when such events are known or predictable.
2. Submit original report to Engineer.

G. Quality Control Testing Plan and Reports

1. A Quality Control Testing Plan shall be developed by the CONTRACTOR and submitted to the ENGINEER no later than the Preconstruction Conference. The Plan will include the following items:

   a. Qualifications of the proposed laboratory including laboratory accreditations and certifications for technicians proposed for the work.

   b. Test Frequency Table (one table for each specification section requiring CONTRACTOR quality control) establishing the proposed number of tests. The Table shall include columns for:

      (1) Material Tested
      (2) Sampling and Testing Points
      (3) Test Method
      (4) Minimum Sampling Frequency
      (5) Estimated Quantity of Materials
      (6) Number of Tests Required
      (7) The Table shall also include columns for number of tests complete and % of tests complete. These last two columns are for use in periodic reporting of QC testing to the ENGINEER.

2. The CONTRACTOR shall submit reports of Quality Control Testing to the ENGINEER at each Coordination Meeting. The report shall include all Quality Control test reports for testing completed during the prior week, and shall include updated Test Summary Tables. The Tables shall include updated values for cummulative number of tests completed and % of required number of tests completed. One Table shall be submitted for each specification item requiring CONTRACTOR quality control testing, and it shall be updated through the end of the prior week.

PART 2 - PRODUCTS - Not Applicable.

PART 3 - EXECUTION - Not Applicable.

PART 4 - MEASUREMENT AND PAYMENT - Not Applicable.

** END OF SECTION 01320 **

SECTION 01325

CONSTRUCTION PHOTOGRAPHS

PART 1 - GENERAL

1.1 Summary

This Section specifies administrative and procedural requirements for construction photographs.

1.2 Submittals

A. Submit CD's as specified in Section 01330, Submittals and in PART 3 - this Section.

B. Photographer shall submit a digital sample set of the type and quality required during construction, for review and acceptance by Engineer.

1.3 Quality Assurance

Contractor shall provide adequate photography such that he can document conditions. Inadequate documentation not being able to prove responsibility for damages will hence cause the contractor to be responsible.

PART 2 - PRODUCTS

2.1 Photographic Requirements

Specified in PART 3, this Section.

PART 3 - EXECUTION

3.1 Project Site Photographs

A. The CONTRACTOR shall be responsible for photographing the entire project site to show the existing and general condition of the site prior to construction. Each photograph must be time stamped with the date of the photograph. In addition, the CONTRACTOR shall take photographs before, during, and after each of the following phases of construction:

1. Site clearing
2. Demolitions
3. Excavations
4. Installation
5. Final completion

B. Photographs shall be taken of the following areas and at the following times at a minimum.

    1. Existing Site conditions before Site work is started. Number of views shall be adequate to cover the Site.
    2. Finished Project after completion of Work. Number of views shall be adequate to show the finished Work. It is particularly important to provide a view of the restoration of each property upon completion of construction.
    3. If Project is not completed during the Contract Time or authorized extensions, photographs shall continue to be taken at no increase in Contract Price.

C. The principal reason for obtaining photographs is to document the existing condition of items not scheduled for replacement or items to be removed and replaced in kind such as landscaping, privacy walls, wash locations, etc., as may be necessary for the completion of the WORK. The photographs may, in some degree, preclude the possibility of post construction litigation between CONTRACTOR, adjacent property owners, and the OWNER.

D. Digital Images

    1. Submit one (1) complete set of digital image electronic files for each area of work prior to starting work.

        a. Provide images in JPEG format, with minimum sensor size of 5.0 mega pixels.
        b. Submit images that have same aspect ratio as the sensor, uncropped.
        c. The photos of each residence and areas adjacent shall be labeled electronically on each photograph by address.
        d. Any media submitted shall be labeled with Project name, area and street. Station and/or address shall be included as applicable.
        e. Identify electronic media with date digital photographs were taken.

E. Deliver to Engineer/Owner

1 PROPERTY PHOTOGRAPHS FOR WORK ON PRIVATE PROPERTY

a. Photographs shall be taken at each residential property in sufficient detail to record the existing condition of the property and all existing improvements including trees, shrubs decorative rock and other ornamental or functional improvements. The photographs must be approved by the Engineer and Owner prior to any construction activities on the property. When taking property photos, the street name needs to be properly defined.

2 Additional Photographs

a. From time to time Engineer/Owner may issue requests for additional photographs, in addition to periodic photographs specified
b. Engineer will give the contractor notice, where feasible.
    i. In emergency situations, the contractor shall take additional photographs within 24 hours of Engineer's request.
c. Circumstances that could require additional photographs include, but are not limited to:
d. Substantial Completion of major phase or component of Work.
    i. Owner's request for special publicity photographs.
    ii. Special events planned at Project Site.
    iii. Immediate follow-up when on-site events result in construction damage or losses
    iv. Special events planned at Project Site.
    v. Photographs to be taken at fabrication locations away from Project Site.
    vi. Extra record photographs at time of final acceptance

4 MEASUREMENT AND PAYMENT - Not Applicable.

** END OF SECTION 01325 **

SECTION 01330

SUBMITTALS

PART 1 - GENERAL

1.1 Summary

A. This Section includes definitions, descriptions, transmittal, and review of Submittals.

B. Related Work Specified Elsewhere:

Project Meetings, Schedules, and Reports	Section 01320
Construction Photographs	Section 01325
Equipment and Materials	Section 01600
Substitutions	Section 01631
Contract Closeout	Section 01780

1.2 General Information

A. Definitions

1. Shop Drawings, product data, and Samples are technical Submittals prepared by Contractor, Subcontractor, manufacturer, or Supplier and submitted by Contractor to Engineer as a basis for approval of the use of Equipment and Materials proposed for incorporation in the Work or needed to describe installation, operation, maintenance, or technical properties.

a. Shop Drawings include custom-prepared data of all types including drawings, diagrams, performance curves, material schedules, templates, instructions, and similar information not in standard printed form applicable to other projects.

b. Product data includes standard printed information on materials, products, and systems; not custom- prepared for this Project. Designation of selection for the specific item must highlight the proposed choice.

c. Samples include both fabricated and not fabricated physical examples of materials, products, and Work; both as complete units and as smaller portions of units of Work; either for limited visual inspection or (where indicated) for more detailed testing and analysis. Mock-ups are a special form of Samples, which are too large to be handled in the specified manner for transmittal of Sample Submittals.

2. Informational Submittals are those technical reports, administrative Submittals, certificates, and guarantees not defined as Shop Drawings, product data, or Samples.

a. Technical reports include laboratory reports, tests, technical procedures, technical records, and Contractor's design analysis.
b. Administrative Submittals are those non-technical Submittals required by the Contract Documents or deemed necessary for administrative records. These Submittals include maintenance agreements, Bonds, Project photographs, physical work records, statements of applicability, and copies of industry standards, Project record data, security/protection/safety data, and similar type Submittals.
c. Certificates and guarantees are those Submittals on Equipment and Materials where a written certificate or guarantee from the manufacturer or Supplier is called for in the Specifications.

3. Refer to ARTICLES 1.3 and 1.4 of this Part for detailed lists of documents and specific requirements.

B. Quality Requirements

1. Submittals such as Shop Drawings and product data shall be of suitable quality for legibility and reproduction purposes. Every line, character, and letter shall be clearly legible. Drawings such as reproducible shall be useable for further reproduction to yield legible hard copy.

2. Documents submitted to Engineer that do not conform to specified requirements shall be subject to rejection by Engineer, and upon request by Engineer, Contractor shall resubmit conforming documents. If conforming Submittals cannot be obtained, such documents shall be retraced, redrawn, or photographically restored as may be necessary to meet such requirements. Contractor's (or his Subcontractor's) failure to initially satisfy the legibility quality requirements will not relieve Contractor (or his Subcontractors) from meeting the required schedule for Submittals.

C. Language and Dimensions

1. All words and dimensional units shall be in the English language.
2. Metric dimensional unit equivalents may be stated in addition to the English units. However, English units of measurement shall prevail.

D. Submittal Completeness

1. Submittals shall be complete with respect to dimensions, design criteria, materials of construction, and other information specified to enable Engineer to review the information effectively.
2. Where standard drawings are furnished which cover a number of variations of the general class of Equipment, each drawing must be annotated to indicate exactly which parts of the drawing apply to the Equipment being furnished. Use hatch marks to indicate variations that do not apply to the Submittal. The use of "highlighting markers" will not be an acceptable means of annotating Submittals. Annotation shall also include proper identification of the Submittal permanently attached to the drawing.
3. Reproductions or copies of Contract Drawings or portions thereof will not be accepted as complete fabrication or erection drawings.

1.3 Submittals

Contract Drawings for erection drawings to indicate information on erection or to identify detail drawing references. Whenever the Drawings are revised to show this additional Contractor information, Engineer's title block shall be replaced with a Contractor's title block, and Engineer's professional seal shall be removed from the drawing. The Contractor shall revise these erection drawings for subsequent Engineer revisions to the Contract Drawings.

A. Items shall include, but not be limited to, the following:

1. Manufacturer's specifications.
2. Catalogs, or parts thereof, of manufactured Equipment.
3. Shop fabrication and erection drawings.
4. Instruction books and operating manuals.
5. Material lists or schedules.
6. Performance tests on Equipment by manufacturers.
7. Concrete mix design information.
8. All drawings, catalogs or parts thereof, manufacturer's specifications and data, samples, instructions, and other information specified or necessary:
    a. For Engineer to determine that the Equipment and Materials conform to the design concept and comply with the intent of the Contract Documents.
9. Equipment List.
10. Hourly rate for equipment and labor.

B. Schedule of Submittals

1. Schedule all submittals required prior to fabrication, manufacture, or installation, for submission within 14 calendar days of the Notice to Proceed. Prepare for Engineer's concurrence, a schedule for submission of all Submittals specified or necessary for Engineer's approval of the use of Equipment and Materials proposed for incorporation in the Work or needed for proper installation, operation, or maintenance. Submit the schedule with the procurement schedule and construction progress schedule. Schedule submission of all Submittals to permit review, fabrication, and delivery in time so as to not cause a delay in the Work of Contractor or his Subcontractors or any other contractors as described herein.

2. In establishing schedule for Submittals, allow 20 calendar days in Engineer's office for reviewing original Submittals and 5 calendar days in Engineer's office for reviewing resubmittals.
3. The schedule shall indicate the anticipated dates of original submission for each item and Engineer's approval thereof, and shall be based upon at least one resubmission of each item.
4. Schedule Submittals pertaining to storage, installation, and operation at the Site for Engineer's approval prior to delivery of the Equipment and Materials.
5. Submittals shall be resubmitted until the Engineer determines the submittals are acceptable. Any delay in the submittal acceptance, due to the submission of unacceptable submittals, does not warrant any extension of contract times.
6. Contractor shall provide submittals for the following items no later than 30 days after Notice to Proceed:
   A. Pumps and motors
   B. Valves 20" and larger
   C. Emergency Generator
   D. Precast Electrical Building
   E. Electrical Switchgear
   F. Work Plan for Existing Pump Station Shutdown and Connections

C. Transmittal of Submittals

1. All Submittals for Equipment and Materials furnished by Contractor, Subcontractors, manufacturers, and Suppliers shall be submitted to Engineer by Contractor.
2. After checking and verifying all field measurements, transmit all Submittals to Engineer for approval as follows:

   a. Mark each Submittal by Project name and number, Contract title and number, and the applicable Specification Section and Article number. Include in the letter of transmittal the Drawing number and title, sheet number (if applicable), revision number, and electronic filename (if applicable). Unidentifiable Submittals will be returned for proper identification.

b. Check and include Contractor's approval for Submittals of Subcontractors, Suppliers, and manufacturers prior to transmitting them to Engineer. Contractor's approval shall constitute a representation to Owner and Engineer that Contractor has either, determined and verified all quantities, dimensions, field construction criteria, materials, catalog numbers, and similar data, or Contractor assumes full responsibility for doing so, and that Contractor has coordinated each Submittal with the requirements of the Work and the Contract Documents.

c. At the time of each submission, call to the attention of Engineer in the letter of transmittal any deviations from the requirements of the Contract Documents.

d. Make all modifications noted or indicated by Engineer and return revised Submittals until approved. Direct specific attention in writing, or on revised Submittals, to changes other than the modifications called for by Engineer on previous Submittals. After Submittals have been approved, submit copies thereof for final distribution. Previously approved Submittals transmitted for final distribution will not be further reviewed and are not to be revised. If errors are discovered during manufacture or fabrication, correct the Submittal and resubmit for review.

e. Following completion of the Work, and prior to final payment, furnish record documents and approved Samples and Shop Drawings necessary to indicate "as constructed" conditions, including field modifications, in the number of copies specified. Furnish additional copies for insertion in Equipment instruction books and operating manuals as required. All such copies shall be clearly marked "PROJECT RECORD."

f. Keep a copy or sample of each Submittal in good order at the project site.

3. Information to Manufacturer's District Office: Contractor shall arrange for manufacturers and Suppliers of Equipment and Materials to furnish copies of all agreements, drawings, specifications, operating instructions, correspondence, and other matters associated with this Contract to the manufacturer's district office servicing the Owner. Insofar as practicable, all business matters relative to Equipment and Materials included in this Contract shall be conducted through such local district offices.

D. Engineer's Review

1. Engineer will review and take appropriate action on Submittals in accordance with the accepted schedule of Submittals. Engineer's review and approval will be only to determine if the items of Equipment and Materials covered by the Submittals will, after installation or incorporation into the Work, conform to information given in the Contract Documents and be compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents.Engineer's review and approval will not extend to design data reflected in Submittals, which is peculiarly within the special expertise of Contractor or Contractor's Subcontractors or Suppliers. Review and approval of a component item as such will not indicate approval of the assembly in which the item functions.

2. Engineer's review and approval of Shop Drawings, product data, or Samples will not relieve Contractor of responsibility for any deviation from requirements of the Contract Documents unless Contractor has in writing called Engineer's attention to such deviation at the time of submission, and Engineer has given written approval of the specific deviation. Approval by Engineer shall not relieve Contractor from responsibility for errors or omissions in Submittals.

E. Submittal Action Stamp

1. Engineer's review action stamp, appropriately completed, will appear on all Submittals of Contractor when returned by Engineer. Review status designations listed on Engineer's action stamp are defined as follows:

A - APPROVED: Signifies Equipment or Material represented by the Submittal, conforms to the design concept and complies with the intent of the Contract Documents and is

approved for incorporation in the Work. Contractor is to proceed with fabrication or procurement of the items and with related Work. Copies of the Submittal are to be transmitted by Engineer for final distribution.

B - APPROVED AS NOTED (RESUBMIT): Signifies Equipment and Material represented by the Submittal conforms to the design concept and complies with the intent of the Contract Documents and is approved for incorporation in the Work in accordance with Engineer's notations. Contractor is to proceed with fabrication or procurement of the items and with related Work in accordance with Engineer's notations and is to submit a revised Submittal responsive to notations marked on the returned Submittal or written in the letter of transmittal.

C - RETURNED FOR REVISION (RESUBMIT): Signifies Equipment and Material represented by the Submittal appears to conform to the design concept and comply with the intent of the Contract Documents, but information is either insufficient in detail or contains discrepancies which prevent Engineer from completing his review. Contractor is to resubmit revised information responsive to Engineer's annotations on the returned Submittal or written in the letter of transmittal. Fabrication or procurement of items represented by the Submittal and related Work is not to proceed until the Submittal is approved.

D - NOT APPROVED (SUBMIT ANEW): Signifies Equipment and Material represented by the Submittal does not conform to the design concept or comply with the intent of the Contract Documents and is disapproved for use in the Work. Contractor is to provide Submittals responsive to the Contract Documents.

E - PRELIMINARY: Signifies Submittals of such preliminary nature that a determination of conformance with the design concept or compliance with the intent of the Contract Documents must be deferred until additional information is furnished. Contractor is to submit such additional information to permit layout and related activities to proceed.

F - REFERENCE ONLY, NO APPROVAL IS REQUIRED: Signifies Submittals which are for supplementary information only; pamphlets, general information sheets, catalog cuts, standard sheets, bulletins and similar data, all of which are useful to Engineer or Owner in design, operation, or maintenance, but which by their nature do not constitute a basis for determining that items represented thereby conform with the design concept or comply with the intent of the Contract Documents. Engineer reviews such Submittals for general content but not for basic details.

G - FOR DISTRIBUTION: (PREVIOUSLY APPROVED): Signifies Submittals which have been previously approved and are being distributed to Contractor, Owner, Resident Project Representative, and others for coordination and construction purposes.

F. Instruction Books and Operating Manuals

1. Equipment instruction books and operating manuals prepared by the manufacturer shall include the following:

   a. Index and tabs.
   b. Instructions for installation, start-up, operation, inspection, maintenance, parts lists and recommended spare parts, and data sheets showing model numbers.
   c. Applicable drawings.
   d. Warranties and guarantees.
   e. Address of nearest manufacturer-authorized service facility.
   f. All additional data specified.

2. Information listed above shall be bound into hard-back binders of three-ring type. Sheet size shall be 8-1/2 x 11. Binder color shall be white. Capacity shall be a minimum of 1-1/2-inches, but sufficient to contain and use sheets with ease.

   a. Provide with following accessories:
      (1) Label holder.
      (2) Business card holder.
      (3) Sheet lifters.
      (4) Horizontal pockets.

b. The following information shall be imprinted, inserted or affixed by label on the binder front cover:
   (1) Equipment name.
   (2) Manufacturer's name.
   (3) Project name.
   (4) Contract name and number.

c. The following information shall be imprinted, inserted, or affixed by label on the binder spine:
   (1) Equipment name.
   (2) Manufacturer's name.
   (3) Volume number (if applicable).

G. Samples

1. Office Samples shall be of sufficient size and quantity to clearly illustrate the following:
   a. Functional characteristics of the product, with integrally related parts and attachment devices.
   b. Full range of color, texture, and pattern.

2. Field Samples and Mock-ups:
   a. Contractor shall erect field Samples and mock-ups at the Project Site and at a location acceptable to Engineer.
   b. Size or area shall be as specified in the respective Specification Section.
   c. Fabricate each Sample and mock-up complete and finished.
   d. Remove mock-ups at conclusion of Work or when acceptable to the Engineer if not a permanent part of construction.

1.4 Information Submittals

A. Informational Submittals are comprised of technical reports, administrative Submittals, and guarantees, which relate to the Work, but do not require Engineer approval prior to proceeding with the Work. Informational Submittals include:

1. Welder qualification tests.
2. Welding procedure qualification tests.
3. X-ray and radiographic reports.
4. Hydrostatic testing of pipes.
5. Field test reports.
6. Concrete cylinder test reports.
7. ASME pressure vessel test reports.
8. Certification on Materials:
    a. Steel mill tests.
    b. Brick and concrete masonry unit lab tests.
9. Soil test reports.
10. Piping stress analysis.
11. Warranties and guarantees.

B. Transmittal of Informational Submittals

1. All informational Submittals furnished by Subcontractors, manufacturers, and Suppliers shall be submitted to Engineer by Contractor unless otherwise specified.
    a. Identify each informational Submittal by Project name and number, Contract title and number, and the Specification Section and Article number marked thereon or in the letter of transmittal. Unidentifiable Submittals will be returned for proper identification.
    b. At the time of each submission, call to the attention of Engineer in the letter of transmittal any deviations from the requirements of the Contract Documents.

2. Format Requirements:
    a. Technical reports and administrative Submittals except as otherwise specified shall be submitted in a .pdf format
    b. Responsibilities of Contractor, Owner, and Engineer regarding tests and inspections of Equipment and Materials and completed Work are set forth elsewhere in these Contract Documents.
    c. The party specified responsible for testing or inspection shall in each case, unless otherwise specified, arrange for the testing laboratory or reporting agency to distribute test reports in .pdf format.

C. Engineer's Review

1. Engineer will review informational Submittals for indications of Work or Material deficiencies.
2. Engineer will respond to Contractor on those informational Submittals, which indicate Work or Material deficiency.

PART 2 - PRODUCTS - Not Applicable. PART 3 -

EXECUTION – Not Applicable.

PART 4 - MEASUREMENT AND PAYMENT - Not Applicable

** END OF SECTION 01330 **

SECTION 01331

REFERENCE FORMS

PART 1 - GENERAL

1.01 DESCRIPTION

A. This Section contains the required forms for CONTRACTOR's use in documenting testing Work and other Work required under this Contract. This Section supplements but does not supercede specific testing requirements found elsewhere in the Contract Documents.

B. The forms listed below are included in this Section are referenced from other Sections in the Contract Documents. Forms will include, but will not necessarily be limited to the following:

	Title
1.	Request for Change Order Proposal
2.	Change order Proposal
3.	Request for Information
4.	Contractor's Daily Construction Report
5.	Field Order
6.	Work Change Directive
7.	Shop Drawing Transmittal Form

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

REQUEST FOR CHANGE ORDER PROPOSAL

Date: _____

Contractor:_____

Project Name:

Request for Change Order Proposal No. _____

NOTICE TO CONTRACTOR: Please submit a Change Order Proposal for the proposed modifications to the Contract Documents as described below. If acceptable, a Change Order will be issued to authorize the work. THIS IS NOT A CHANGE ORDER FOR AUTHORIZATION TO PROCEED WITH THE WORK AS DESCRIBED!

SCOPE OF WORK:

_____

OWNER

CHANGE ORDER PROPOSAL

Date:_____

Contractor: _____

Project Name:

Project No.

Change Order Proposal No.:

Dear Sir:
Certain items of extra work have been found necessary which are not covered by the Contract for the above referenced Project. Therefore, we submit the following amounts as the basis of compensation for such extra work:

JUSTIFICATION:

The Contract Time will be (increased)(decreased)_____calendar days.

The Contract Amount will be (increased)(decreased) $_____dollars.

By:_____

Title:_____

Contractor:_____

REQUEST FOR INFORMATION

Project Name:

Contractor_____ RFI#_____
Requested By_____ Directed to _____
Subject_____ Date Received _____
Spec. Section_____ Date Transmitted _____
Drawing References_____ Date Reply Received _____
Date Reply Needed_____ Date Reply Transmitted _____

INFORMATION NEEDED:

Date:_____ Signature: _____

REPLY:

Date:_____ Signature:_____

CONTRACTOR'S DAILY CONSTRUCTION REPORT

Project Name:

Contractor's Name_____Report No._____Date: _____

CONTRACTORS WORK FORCE:	SUBCONTRACTORS WORK FORCE:	EQUIPMENT ON SITE:
Administrative		In Use / Not in Use
Supervisors	Mechanical	Cranes
Carpenters	Electrical	Loaders
Iron Workers	Instrumentation	Dozers
Operators	Sitework	Scrapers
Finishers	Masonry	Compactors
Welders	Roofing	Compressors
Electricians	Rebar	Welders
Laborers	Foundation	Graders
_____	Painting	Trucks
_____	_____	Backhoe
_____	_____	___
	_____	

Work Performed:

Material and Equipment Delivered:

Remarks:

_____
(Authorized Signature)

FIELD ORDER

Date:_____

Contractor:_____

Project Name:

Field Order No.: _____

By:_____ By_____
Owner's Authorized Signature Contractor's Receipt Acknowledged

Date:_____ Date:_____

WORK CHANGE DIRECTIVE

No. _____

PROJECT:

DATE OF ISSUANCE_____ EFFECTIVE DATE _____

OWNER:

CONTRACTOR:

You are directed to proceed promptly with the following change(s):

Description:

Purpose of Work Change Directive:

Attachments: (List documents supporting change)

If a claim is made that the above change(s) have affected Contract Price or Contract Times, any claim for a Change Order based thereon will involve one or more of the following methods of determining the effect of the change(s).

Method of determining change in Contract Price:

□ Unit Prices

□ Lump Sum

□ Other_____

Estimated increase (decrease) in Contract Price: $_____
If the change involves an increase, the estimated amount is not to be exceeded without further authorization.

Method of determining change in Contract Times:

□ Contractor's records

□ OWNER's records

□ Other _____

Estimated increase (decrease) in Contract Times: Substantial Completion:____days
Ready for final payment:____days
If the change involves an increase, the estimated time is not to be exceeded without further authorization.

AUTHORIZED:

_____
OWNER

By: _____

NCS

Shop Drawing Transmittal

Project Name:		Transmittal No.:
Project Location:		Date Received:
To:	From:	Montrose Job No.:
		Reviewed By:
		Date Reviewed:
Attn:	Attn:	Spec. Section:
Date Transmitted:	Previous Transmittal Date:	1st. Sub.☐ ReSub.☐

No. Copies	Description	Manufacturer	Drawing or Data No.	Action Taken*

Submitter's Remarks:

* The action Designated Above is in Accordance with the Following Legend:

A - No Exceptions Taken
B - Furnish as Noted
C - Revise and Submitt
1. Not enough information for review.
2. No reproducibles submitted.
3. Copies illegible
4. Not enough copies submitted.
5. Wrong sequence number.
6. Wrong resubmittal suffix.
7. Wrong specification section.
8. Wrong form used.
9. See comments.

D - Rejected
E - Engineer’s review not required.
1. Submittal not required.
2. Supplemental information. Submittal retained for informational purposes only.
3. Information reviewed and approved on prior submittal.
4. See comments.

Reviewer's Comments:

Returned by (NCS) : Date:

Distribution:	Supplier (if applicable)	____ Copies	OWNER:	____ Copies
	Sub Consultant 1:	____ Copies	MONTROSE:	____ Copies
		____	Sub Consultant 2:	____ Copies

SECTION 01350

SPECIAL PROCEDURES

PART 1 - GENERAL

1.01 CONCEALED EXISTING FACILITIES

A. Verify locations of utilities and facilities which may exist by consulting with OWNER, utility companies, and Blue Stake before you dig:
   1. Abide by easement and right-of-way restrictions.

B. Notify owners of facilities when the Work will be in progress. Make arrangements for potential emergency repairs in accordance with requirements of owners of facilities including individual or residential facilities.

C. Assume responsibility for repair of facilities damaged by performance of the Work.

D. Expose sanitary and storm sewers, water, gas, electric, telephone utility lines, and other underground facilities indicated to permit survey of location and elevation prior to commencement of Work in affected area.

E. Expose in ample time to permit relocation of interfering utilities with minimum delaying effect on contract time.

F. Work required for raising, lowering, or relocating utilities in right of way not indicated will be performed by affected utility owners or as part of the Work at option of affected owners of utilities and OWNER.

1.02 PROTECTION OF THE WORK AND PROPERTY

A. CONTRACTOR shall assume responsibility for taking all precautions, providing all programs, and taking all actions necessary to protect the Work and all public and private property and facilities from damage as specified in the General Conditions and herein.

B. In order to prevent damage, injury or loss, CONTRACTOR'S actions shall include, but not be limited to the following:
   1. Store apparatus, materials, supplies, and equipment in an orderly, safe manner that will not unduly interfere with the progress of the Work or the Work of any other contractor or utility service company.
   2. Provide suitable storage facilities for all materials which are subject to injury by exposure to weather, theft, breakage, or otherwise.
   3. Place upon the Work or any part thereof only such loads as are consistent with the safety of that portion of the Work.

4. Clean up frequently all refuse, rubbish, scrap materials, and debris caused by CONTRACTOR's operations, to the end that at all times the site of the Work shall present a safe, orderly and workmanlike appearance.
5. Provide barricades and guard rails around openings, for scaffolding, for temporary stairs and ramps, around excavations, elevated walkways and other hazardous areas.

C. CONTRACTOR shall not, except after written consent from proper parties, enter or occupy privately owned land with personnel, tools, materials or equipment, except on easements provided herein.

D. CONTRACTOR shall assume full responsibility for the preservation of all public and private property or facility on or adjacent to the site. If any direct or indirect damage is done by or on account of any act, omission, neglect or misconduct in the execution of the Work by the CONTRACTOR, it shall be restored by the CONTRACTOR, at his expense, to a condition equal to that existing before the damage was done.

E. Underground Structures:
1. Underground structures are defined to include, but are not limited to, all sewer, water, gas, and other piping, and manholes, chambers, electrical conduits, tunnels and other existing subsurface work located within or adjacent to the limits of the Work.
2. All underground structures known to ENGINEER, except water, gas, sewer, electric, and telephone service connections, are shown on Drawings. This information is shown for the assistance of CONTRACTOR, in accordance with the best information available, but is not guaranteed to be correct or complete.
3. CONTRACTOR shall explore ahead of trenching and excavation Work and shall uncover all obstructing underground structures sufficiently to determine their location, to prevent damage to them and to prevent interruption to the services which such structures provide. If CONTRACTOR damages an underground structure, restore it to original condition at his expense.
4. Necessary changes in the location of the Work may be made by the OWNER to avoid unanticipated underground structures.
5. If permanent relocation of an underground structure or other subsurface facility is required and is not otherwise provided for in the Contract Documents, OWNER will direct CONTRACTOR, in writing, to perform the Work, which shall be paid for under the provisions of the General Terms and Conditions.

F. Surface Structures: Surface structures are defined as all existing buildings, structures and other facilities above the ground surface. Included with such structures are their foundations or any extension below the surface. Surface structures include, but are not limited to, buildings, tanks, walls, roads, open

drainage, piping, poles, wires, posts, signs, markers, curbs, walks and all other facilities that are visible above the ground surface.

G. Protection of Underground and Surface Structures:

1. CONTRACTOR shall sustain in their places and protect from direct or indirect injury all underground and surface structures located within or adjacent to the limits of the Work. Such sustaining and supporting shall be done carefully and as required by the party owning or controlling such structure. Before proceeding with the work of sustaining and supporting such structure, CONTRACTOR shall satisfy the OWNER that the methods and procedures to be used have been approved by the party owning same.
2. CONTRACTOR shall assume all risks attending the presence or proximity of all underground and surface structures within or adjacent to the limits of the Work. CONTRACTOR shall be responsible for all damage and expense for direct or indirect injury caused by his Work to any structure. CONTRACTOR shall repair immediately all damage caused by his work, to the satisfaction of the OWNER of the damaged structure.

H. All other existing surface facilities, including but not limited to guard rails, posts, guard cables, signs, poles, markers, and curbs, which are temporarily removed to facilitate installation of the Work, shall be replaced and restored to their original condition at CONTRACTOR's expense.

1.03 DAILY WORK REPORTS

A. CONTRACTOR shall provide to OWNER and ENGINEER one copy of his daily field report indicating work completed, number and classification of personnel on site, number and types of construction equipment on site and weather conditions. The field reports shall be in pdf format and shall be submitted on Monday for the prior week.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01420

DEFINITIONS AND STANDARDS

PART 1 - GENERAL

1.1 SUMMARY

A. Definitions

1. Basic contract definitions used in the Contract Documents are defined in the GENERAL CONDITIONS. Definitions and explanations are not necessarily either complete or exclusive, but are general for the Work.
2. General Requirements are the provisions or requirements of DIVISION 1 Sections, and which apply to the entire Work of the Contract.

B. Related Information Specified Elsewhere: Specification standards and associations applicable to the Work are specified in each Section.

1.2 Specification Format and Content Explanations

A. Specification Format: The Specifications are organized into Divisions and Sections based on the Construction Specifications Institute's (CSI) Section Format and MasterFormat numbering system. Some portions may not fully comply and no particular significance will be attached to such compliance or noncompliance.

1. Divisions and Sections: For convenience, a basic unit of Specification text is a "Section," each unit of which is numbered and named. These are organized with related Sections, into "Divisions," which are recognized as the present industry consensus on uniform organization and sequencing of Specifications. The Section title is not intended to limit meaning or content of Section, nor to be fully descriptive of requirements specified therein, nor to be an integral part of text.
2. Section Numbering: Used for identification and to facilitate cross-references in Contract Documents. Sectionsare placed in numeric sequence; however, numbering sequence is not complete, and listing of Sections in Table of Contents at beginning of the Project Manual must be consulted to determine numbers and names of Specification Sections in these Contract Documents.

3. Page Numbering: Numbered independently for each Section. Section number is shown with page number at bottom of each page, to facilitate location of text.
4. Parts: Each Section of Specifications generally has been subdivided into three basic "parts" for uniformity and convenience (PART 1 - GENERAL, PART 2 - PRODUCTS, and PART 3 - EXECUTION). These "Parts" do not limit the meaning of text within. Some Sections may not contain all three "Parts" when not applicable, or may contain more than three "Parts" to add clarity to organization of Section.
5. Underscoring of Titles: Used strictly to assist reader of Specification in scanning text for key words in content. No emphasis on or relative importance is intended except where underscoring may be used in body of text to emphasize a duty, critical requirement, or similar situation.
6. Project Identification: Project file number and identification are recorded at bottom of each page of Specifications to minimize possible misuse of Specifications, or confusion with other Project Specifications.

B. Specification Content

1. These Specifications apply certain conventions in the use of language and the intended meaning of certain terms, words, and phrases when used in particular situations or circumstances. These conventions are explained as follows:
    a. Imperative and Streamlined Language: These Specifications are written in imperative and abbreviated form. This imperative language of the technical Sections is directed at the Contractor, unless specifically noted otherwise. Incomplete sentences shall be completed by inserting "shall," "the Contractor shall," and "shall be," and similar mandatory phrases by inference in the same manner as they are applied to notes on the Drawings. The words "shall be" shall be supplied by inference where a colon (:) is used within sentences or phrases. Except as worded to the contrary, fulfill (perform) all indicated requirements whether stated imperatively or otherwise.

b. Specifying Methods: The techniques or methods of specifying requirements varies throughout text, and may include "prescriptive," "compliance with standards," "performance," "proprietary," or a combination of these. The method used for specifying one unit of Work has no bearing on requirements for another unit of Work.

c. Overlapping and Conflicting Requirements: Where compliance with two or more industry standards or sets of requirements is specified, and overlapping of those different standards or requirements establishes different or conflicting minimums or levels of quality, notify Engineer for a decision as specified in GENERAL CONDITIONS.

d. Abbreviations: Throughout the Contract Documents are abbreviations implying words and meanings which shall be appropriately interpreted. Specific abbreviations have been established, principally for lengthy technical terminology and in conjunction with coordination of Specification requirements with notations on Drawings and in schedules. These are normally defined at first instance of use. Organizational and association names and titles of general standards are also abbreviated.

C. Assignment of Specialists: In certain instances, Specification text requires that specific Work be assigned to specialists in the operations to be performed. These specialists shall be engaged for performance of those units of Work, and assignments are requirements over which Contractor has no choice or option. These assignments shall not be confused with, and are not intended to interfere with, enforcement of building codes and similar regulations governing the Work, local trade and union jurisdictions, and similar conventions. Nevertheless, final responsibility for fulfillment of Contract requirements remains with Contractor.

D. Trades: Except as otherwise specified or indicated, the use of titles such as "carpentry" in Specification text, implies neither that the Work must be performed by an accredited or unionized tradesperson of corresponding generic name (such as "carpenter"), nor that specified requirements apply exclusively to work by tradespersons of that corresponding generic name.

1.3 Drawing Symbols

A. Except as otherwise indicated, graphic symbols used on Drawings are those symbols recognized in the construction industry for purposes indicated. Refer instances of uncertainty to Engineer for clarification.

1.4 Industry Standards

A. Applicability of Standards: Except where the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents. Such standards are made a part of the Contract Documents by reference and are stated in each Section.

1. Referenced standards, referenced directly in Contract Documents or by governing regulations, have precedence over nonreferenced standards which are recognized in industry for applicability to the Work.
2. Where compliance with an industry standard is required, standard in effect shall be as stated in GENERAL CONDITIONS.

3. Where an applicable code or standard has been revised and reissued after the date of the Contract Documents and before performance of Work affected, the Engineer will decide whether to issue a Change Order to proceed with the updated standard.

4. In every instance the quantity or quality level shown or specified shall be the minimum to be provided or performed. The actual installation may comply exactly, within specified tolerances, with the minimum quantity or quality specified, or it may exceed that minimum within reasonable limits. In complying with these requirements, indicated numeric values are minimum or maximum values, as noted, or appropriate for the context of the requirements. Refer instances of uncertainty to the Engineer for a decision before proceeding.

5. Each entity engaged in construction on the Project is required to be familiar with industry standards applicable to that entity's construction activity. Copies of applicable standards are not bound with the Contract Documents.

a. Where copies of standards are needed for performance of a required construction activity, Contractor shall obtain copies directly from the publication source.

B. Abbreviations and Names: Trade association names and titles of general standards are frequently abbreviated. Where such acronyms or abbreviations are used in the Specifications or other Contract Documents, they mean the recognized name of the trade association, standards generating organization, authority having jurisdiction, or other entity applicable to the context of the text provision.

PART 2 - PRODUCTS - Not Applicable.

PART 3 - EXECUTION - Not Applicable.

PART 4 - MEASUREMENT AND PAYMENT - Not Applicable.

** END OF SECTION 01420 **

SECTION 01423

REFERENCE STANDARDS

PART 1 - GENERAL

1.01 DESCRIPTION

A. When a reference standard is specified, comply with requirements and recommendations stated in that standard, except when they are modified by the Contract Documents, or when applicable laws, ordinances, rules, regulations or codes establish stricter standards. The latest provisions of applicable standards shall apply to the Work, unless otherwise specified. Reference standards include, but are not necessarily limited to, the following:

1. American Association of State Highway and Transportation Officials (AASHTO).
2. American Concrete Institute (ACI).
3. American Gear Manufacturers Association (AGMA).
4. American Institute of Steel Construction (AISC).
5. American Iron and Steel Institute (AISI).
6. American National Standards Institute (ANSI).
7. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE).
8. American Society of Mechanical Engineers (ASME).
9. American Society for Testing and Materials (ASTM).
10. American Water Works Association (AWWA).
11. American Welding Society (AWS).
12. Concrete Reinforcing Steel Institute (CRSI)
13. Factory Mutual (FM).
14. Institute of Electrical and Electronics Engineers (IEEE).
15. National Electrical Manufacturer's Association (NEMA).
16. Occupational Safety and Health Administration (OSHA).
17. National Fire Protection Association (NFPA).
18. Underwriters' Laboratories, Inc. (UL).
19. All other applicable standards listed in the Specifications and the standards of utility service companies, where applicable.
20. NSF International (NSF).
21. State Division of Industrial Safety (DIS)
22. Institute of Makers of Explosives (IOMOE)
23. Enclosures for Industrial Controls and Systems (ICS)
24. (ISA) See 13329-3
25. National Association of Corrosion Engineers (NACE)

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01530

TEMPORARY BARRIERS AND CONTROLS

PART 1 - GENERAL

1.1 Summary

A. This Section includes General Requirements for:

1. Safety and protection of Work.
2. Safety and protection of existing property.
3. Barriers.
4. Environmental controls.
5. Traffic control and use of roadways.

B. Related Work Specified Elsewhere

Temporary Utilities and Facilities ..... Section 01560
Traffic Control..... Section 02560

PART 2 - PRODUCTS – Not Applicable PART 3 -

EXECUTION

3.1 Safety and Protection of Work and Property

A. General

1. Provide for the safety and protection of the Work as set forth in GENERAL CONDITIONS. Provide protection at all times against rain, wind, storms, frost, freezing, condensation, or heat, so as to maintain all Work, Equipment, and Materials free from damage. At the end of each day, all new Work likely to be damaged shall be appropriately protected.
2. Notify Engineer immediately, at any time operations are stopped, due to conditions which make it impossible to continue operations safely, or to obtain proper results.
3. Construct and maintain all necessary temporary drainage and do all pumping necessary to keep excavations, floors, pits, trenches, manholes, and ducts free of water.

4. Protect floors from damage by proper covering and care when handling heavy equipment, painting, or handling mortar or other such materials. Use proper cribbing and shoring to prevent overloading of floors while moving heavy equipment. Provide metal pans under machines and clean such pans daily, keeping oil off floors. Restore floors to former condition where damaged or stained.
5. Concrete floors less than 28 days old shall not be loaded without written permission from Engineer.
6. Restrict access to roofs except as required by the Work. Where access is required, provide protection with plywood, boards, or other suitable materials.
7. Any equipment or materials left in the Right-of-Way overnight shall be properly barricaded, including a minimum of two lighted barricades.

B. Property Other than Owner's

1. Provide for the safety and protection of property as set forth in the GENERAL CONDITIONS. Report immediately to the owners thereof and promptly repair damage to existing facilities resulting from construction operations.
2. Names and telephone numbers of representatives of agencies and utilities having jurisdiction over streets and utilities in the Work area can be obtained from Engineer for the agencies listed below. Concerned agencies or utilities shall be contacted a minimum of 24 hours prior to performing Work, closing streets and other traffic areas, or excavating near underground utilities or pole lines.

    a. Water.
    b. Gas.
    c. Sanitary sewers.
    d. Storm drains.
    e. Pipeline companies.
    f. Telephone.
    g. Electric.
    h. Municipal streets.
    i. State highways.
    j. City engineer.
    k. Fire.
    l. Police.

3. Operation of valves or other appurtenances on existing utilities, when required, shall be by or under the direct supervision of the owning utility, unless otherwise directed by Engineer
4. Where fences are to be breached on private property, the owners thereof shall be contacted and arrangements made to ensure proper protection of any animals or other property thus exposed.
5. The applicable requirements specified for protection of the Work shall also apply to the protection of existing property of others.
6. Before acceptance of the Work by Engineer, restore all property affected by Contractor's operations to the original or better condition.

3.2 Barriers

A. General

1. Furnish, install, and maintain suitable barriers as required to prevent public entry, protect the public, and to protect the Work, existing facilities, trees, and plants from construction operations. Remove when no longer needed or at completion of Work.
2. Materials shall meet all MUTCD standards, new or used, suitable for the intended purpose, but shall not violate requirements of applicable codes and standards or regulatory agencies.
3. Barriers shall be of a neat and reasonable uniform appearance, structurally adequate for the required purposes.
4. Maintain barriers in good repair and clean condition for adequate visibility. Relocate barriers as required by progress of Work.
5. Repair any damage caused by installation and restore area to original or better condition. Clean the work area.

B. Tree and Plant Protection

1. Preserve and protect existing trees and plants.
2. Provide temporary barriers around each, or around each group of trees and plants. Construct to a height of 6 feet around trees, and to a height to adequately protect plants.
3. Employ qualified tree surgeon to remove and to treat cuts.

4. Protect root zones of trees and plants as follows:

   a. Do not allow vehicular traffic or parking.

   b. Do not store materials or products.

   c. Prevent dumping of refuse or chemically injurious materials or liquids.

   d. Prevent piddling or continuous running water.

5. Carefully supervise excavating, grading and filling, and subsequent construction operations to prevent damage.

6. Remove and replace similar size & type (or agreed upon by tree owner), or suitably repair, trees and plants which are damaged or destroyed due to construction operations, and which were designated to remain.

3.3 Environmental Conditions

A. Dust Control

1. Provide proactive positive methods and apply dust control materials to minimize the raising of dust from construction operations; and to prevent airborne dust from dispersing into the atmosphere throughout the duration of the project day and night. ADEQ "Air Quality Permit Requirements" & AZNPDES (Arizona National Pollution Discharge Elimination System). shall be adhered to. Fines may result if out of compliance with permit requirements.

2. Clean interior spaces prior to the start of finish painting and continue cleaning on an as-needed basis until painting is finished.

3. Schedule operations so that dust and other contaminants resulting from cleaning process will not fall on wet or newly-coated surfaces.

B. Water and Erosion Control

1. Provide methods to control surface water to prevent damage to the Project, the Site, or adjoining properties.

2. Plan and execute construction and earthwork by methods to control surface drainage from cuts and fills, and from borrow pit and waste disposal areas, to prevent erosion and sedimentation.

    a. Hold the areas of bare soil exposed at one time to a minimum.
    b. Provide temporary control measures such as berms, dikes, and drains.

3. Control fill, grading, and ditching to direct surface drainage away from excavations, pits, tunnels, and other construction areas; and to direct drainage to proper runoff.
4. Provide, operate, and maintain hydraulic equipment of adequate capacity to control surface and groundwater.
5. Dispose of drainage water in a manner to prevent flooding, erosion, or other damage to any portion of the Site or to adjoining areas.
6. Provide temporary drainage where the roofing or similar waterproof deck construction is completed prior to the connection and operation of the permanent drainage piping system.

C. Debris Control and Clean-Up

1. Keep the premises free at all times from accumulations of debris, waste materials, and rubbish caused by construction operations and employees. Responsibilities shall include:

    a. Adequate trash receptacles about the Site, emptied promptly when filled.
    b. Periodic cleanup to avoid hazards or interference with operations at the Site and to maintain the Site in a reasonably neat condition.
    c. The keeping of construction materials such as forms and scaffolding neatly stacked.
    d. Immediate cleanup to protect the Work by removing splattered concrete, asphalt, oil, paint, corrosive liquids, and cleaning solutions from walls, floors, and metal surfaces before surfaces are marred.

2. Prohibit overloading of trucks to prevent spillages on access and haul routes. Provide periodic inspection of traffic areas to enforce requirements.

3. Final cleanup is specified in Section 01780 - CONTRACT CLOSEOUT.

D. Pollution Control

1. Provide methods, means, and facilities required to prevent contamination of soil, water, or atmosphere by the discharge of hazardous or toxic substances from construction operations.
2. Provide equipment and personnel, perform emergency measures required to contain any spillages, and remove contaminated soils or liquids. Excavate and dispose of any contaminated earth off-Site in approved locations, and replace with suitable compacted fill and topsoil.
3. Take special measures to prevent harmful substances from entering public waters, sanitary, or storm sewers.

3.4 Traffic Control and Use of Roadways

A. Traffic Control:

Refer to Section 2650

B. Maintenance of Roadways

1. Repair roads, walkways, and other traffic areas damaged by operations. Keep traffic areas as free as possible of excavated materials and maintain in a manner to eliminate dust, mud, and hazardous conditions.
2. All operations and repairs shall meet the approval of owners or agencies having jurisdiction.
3. The CONTRACTOR will provide dust control, be required to grade, smooth-out, fill holes, and generally maintain the streets where the pavement has been removed. This maintenance will be done daily, if necessary, to allow local traffic to travel through the area on an acceptable surface.

PART 4 - MEASUREMENT AND PAYMENT - Not Applicable.

** END OF SECTION 01530 **

SECTION 01570

ENVIRONMENTAL PROTECTION
AND SPECIAL CONTROLS

PART 1 - GENERAL

1.01 SUMMARY

A. The CONTRACTOR shall perform all work in such manner as to minimize the polluting of air, water, or land, and shall, within reasonable limits, control noise and the storage of solid waste materials.

1.02 QUALITY ASSURANCE

A. Employ and utilize environmental protection methods, and obtain all necessary permits required at the site for air quality, solid waste, storm water pollution, and hazardous wastes. CONTRACTOR shall comply with all state, county, and Federal regulations.

1.03 SUBMITTALS

A. See Section 01340.
B. See Section 3.01.C.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.01 ERECTION AND INSTALLATION

A. Land Protection:
   1. Manage and control all work or storage areas, access routes and embankments to prevent sediment from entering nearby water or land adjacent to site of work.
   2. Restore all disturbed areas including haul areas and establish permanent type of locally adaptable vegetative cover.
   3. Unless earthwork is immediately paved or surfaced, protect all side slopes and backslopes immediately upon completion of final grading.
   4. Plan and execute earthwork in a manner to minimize duration of exposure of unprotected soils.

B. Erosion Protection:
   1. Utilize methods necessary to effectively prevent erosion and control of sediment and include the following:
      a. Retardation: Mechanically retard rate of runoff by construction of diversion ditches, terraces, and berms. Divert run off to protect damage courses.
      b. Borrow constraints: Do not borrow soils from areas where environmental controls are not possible.
      c. Protect side and backslopes as soon as rough grading is complete by accelerated growth of permanent vegetation, temporary vegetation, mulching or netting. Where slopes are too steep for stabilization, use hydroseeding, mulching anchored in placed, cover anchored in placed, cover by anchored netting, sodding, or combination to prevent erosion. Remove temporary protection prior to final grading.
   2. Comply with requirements of NPDES storm water regulations for construction sites.

C. Control of Responsibilities:
   1. Collect and dispose of solid waste on a daily basis.
   2. Provide disposal of degradable debris to an approved solid waste disposal site.
   3. Provide disposal of nondegradable debris to an approved solid waste disposal site or in an alternate manner approved by OWNER and regulatory agencies.
   4. Store chemical wastes in watertight containers and remove from project site and dispose of to sites approved by regulatory agencies. Assure maximum disposal frequency of 1 month.
   5. Control dust at all times, including nonworking hours, weekends and holidays. Sprinkle site or treat with dust suppressors as necessary to control dust. Utilize methods and practices of construction to eliminate dust in full observance of regulatory agencies.
   6. Minimize noise by fitting equipment with appropriate mufflers. The use of explosives or blasting operations are not approved.
   7. On completion of work, leave area in a clean condition representative of current conditions. Assure all signs of temporary construction and activities incidental to construction of required permanent work in place are obliterated.

D. Historical Protection:
   1. If during the course of construction evidence of deposits of historical or archaeological interests are found, cease work affecting find and notify the OWNER. Do not disturb deposits until written notice from OWNER is given to proceed. Lost time or changes in construction to avoid the find shall be compensated for based upon partial suspension of work.

END OF SECTION

SECTION 01560

TEMPORARY UTILITIES AND FACILITIES

PART 1 - GENERAL

1.1 Summary

A. This Section includes contractor requirements of a temporary nature not normally incorporated into final Work. It includes the following:

1. Utility services.
2. Construction and support facilities.
3. Construction aids.
4. Safety and health.
5. Fire protection.

B. Related Work Specified Elsewhere

Temporary Barriers and Controls ..... Section 01530
Field Offices and Sheds ..... Section 01520

1.2 Quality Assurance

A. Reference Standards and Specifications

1. American National Standards Association (ANSI)

   A10 Series - Safety Requirements for Construction and Demolition.
2. National Electrical Contractors Association (NECA)
3. Electrical Design Library - Temporary Electrical Facilities.
4. National Fire Protection Association (NFPA)

   10 - Portable Fire Extinguishers.

   70 - National Electrical Code.

   241 - Safeguarding Construction, Alterations, and Demolition Operations.

B. National Electrical Manufacturers Association (NEMA).

C. Underwriters Laboratories (UL).

D. Regulations: Comply with industry standards and applicable laws and regulations of authorities having jurisdiction, including but not limited to:

1. Building Code requirements.
2. Health and safety regulations.
3. Utility company regulations.
4. Environmental Protection Regulations.

E. Standards

1. Comply with NFPA 10 and 241, and ANSI A10 Series standards “Temporary Electrical Facilities."
2. Comply with NEMA, NECA, and UL standards and regulations for temporary electric service. Install service in compliance with NFPA 70.

F. Inspections

Contractor shall obtain required certifications and permits. Arrange for authorities having jurisdiction to inspect and test each temporary utility before use.

1.3 Submittals

Temporary Utilities

Submit reports of tests, inspections, meter readings, and similar procedures performed on temporary utilities.

1.4 Project Conditions

Conditions of Use: Keep temporary services and facilities clean and neat in appearance. Operate in a safe and efficient manner. Take necessary fire prevention measures. Do not allow hazardous, dangerous, unsanitary conditions, or public nuisances to develop or persist on the Site.

PART 2 - PRODUCTS

2.1 Materials and Equipment

A. Provide new materials and equipment. Provide materials and equipment suitable for the use intended, of capacity for required usage, and meeting applicable codes and standards. Comply with requirements of DIVISIONS 2 through 16.

PART 3 - EXECUTION

3.1 Temporary Utilities

Furnish, install, and maintain temporary utilities required for adequate construction, safety, and security. Modify, relocate, and extend systems as Work progresses. Repair damage caused by installation or use of temporary facilities. Remove on completion of Work or until service or facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

3.2 Temporary Sanitary Facilities

Contractor-Furnished Facilities

1. Furnish, install, and maintain temporary sanitary facilities for use through construction period. Remove on completion of Work.
2. Provide for all construction workers under this Contract and representatives at the Site.
3. Toilet facilities shall be of the chemical, aerated recirculation, or combustion type, properly vented, and fully enclosed with a glass-fiber-reinforced polyester shell or similar nonabsorbent material.
4. Drinking Water Fixtures: Provide containerized tap dispenser type drinking water units.
5. Supply and maintain toilet tissue, paper towels, paper cups and similar disposable materials as appropriate for each facility. Provide appropriate covered waste containers for used material.
6. Supply garbage containers for misc. construction trash and debris, with cover.

3.3 Temporary Safety and Health

General: Contractor shall be responsible for development of safety and health programs for personnel at Project Site as specified in the GENERAL CONDITIONS.

3.4 Installation and Removal

A. Relocation: Relocate construction aids as required by progress of construction, storage limitations, or Work requirements and to accommodate requirements of Owner and other contractors at the Site.

B. Removal: Remove temporary materials, equipment, and services when construction needs can be met and allowed by use of permanent construction, or at completion of the Project.

C. Repair: Clean and repair damage caused by installation or by use of temporary facilities.

PART 4 - MEASUREMENT AND PAYMENT - Not Applicable.

** END OF SECTION 01560 **

SECTION 01580
PROJECT IDENTIFICATION AND SIGNS

PART 1 - GENERAL

1.1 Summary

A. This Section includes basic requirements for temporary Project identification and informational signs required during construction.
B. Related Work Specified Elsewhere

Submittals..... Section 01330

1.2 Quality Assurance

A. Design sign and structure to withstand wind and environmental conditions of locality. Provide with finish adequate to withstand weathering, fading, chipping, and peeling for duration of construction.

1.3 Submittals

A. Submit as specified in Section 01330.
B. Includes, but not limited to, the following

1. Shop Drawings and product data as applicable.
2. Show content, layout, lettering, colors, structure, and foundation.

PART 2 - PRODUCTS

2.1 Identification Signs

A. Project Identification

1. Construct to design, size, and material indicated.
2. Construct structure and framing of wood, structurally adequate to resist design requirements of locality.
3. Construct sign surface of minimum 3/4-inch thickness exterior grade plywood with medium density overlay. Panels shall be of size to minimize joints. Overall size shall be 4’ x 8’.
4. Rough hardware shall be galvanized or aluminum.

5. Coating: Paint as specified of colors selected by Engineer.
6. Information Content:

    a. Project title, logo, and name of Owner as shown on Contract Documents.
    b. Names and titles of authorities.
    c. Name and title of Engineer.
    d. Name of prime Contractor and major Subcontractors.
    e. Responsible Individual Phone Number

B. Contractor Identification: If not part of Project identification sign, provide and install Contractor's standard sign.

2.2 INFORMATIONAL SIGNS

A. Construction

1. This includes signs for traffic, construction workers, and general public in regards to directions, warnings, hazards, locations of areas, facilities, equipment, and others of a similar nature.
2. Provide signs of design, size, color, and lettering as required by regulatory agencies. Signs shall be painted metal, wood, plastic, or fiberglass and of materials suitable for the conditions in which they are placed, such as weathering and fading.
3. Construct structure and framing of wood or metal, structurally adequate to resist design requirements of area of Project. If within ROW signs should be designed with quick releases or break points.

PART 3 - EXECUTION

3.1 Installation

A. Project and Contractor Identification Sign

1. CONTRACTOR shall obtain OWNER’s approval for the location of the CONTRACTOR’s identification sign. The sign shall be installed in an appropriate location so as not to obstruct traffic, pedestrians, or construction operations.
2. Erect on framing or foundation, and rigidly brace.
3. Maintain sign in good repair, in a clean and neat condition.
4. Remove upon completion of Project.

B. Informational Signs

1. Install at appropriate locations and in sufficient quantities to assure visibility. Relocate as required by progress of work, or Engineer's request.

2. Maintain signs in good repair, in a neat, clean, readable condition.

3. Remove all signs, framing, supports, and foundations upon completion of Project.

PART 4 - MEASUREMENT AND PAYMENT - Not Applicable.

** END OF SECTION 01580 **

SECTION 01600

EQUIPMENT AND MATERIALS

PART 1 - GENERAL

1.1 Summary

A. This Section includes administrative and procedural requirements governing Contractor's selection of products for use in the Project.

B. Related Work Specified Elsewhere

1. For the applicability of industry standards to products specified: DIVISIONS 2 through 16.
2. For submittal of Contractor's construction progress schedule and the Submittal schedule: Section 01320 and Section 01330.
3. For handling requests for substitutions made after award of the Contract: Section 01631.

1.2 Definitions

A. Definitions used in this Article are not intended to change the meaning of other terms used in these Contract Documents, such as "specialties," "systems," "structures," "finishes," "accessories," and similar terms. Such terms are self-explanatory and have well- recognized meanings in the construction industry.

1. "Products" are items purchased for incorporation in the Work, whether purchased for the Project or taken from previously purchased stock. The term "product" includes the terms "Material," "Equipment," "system," and terms of similar intent.
   a. "Named Products" are items identified by the manufacturer's product name, including make or model number or other designation, shown or listed in the manufacturer's published product literature, that is current as of the date of the Contract Documents.
   b. "Foreign Products," as distinguished from "domestic products," are items substantially manufactured (50% or more of value) outside the United States and its possessions. Products produced or supplied by entities substantially owned (more than 50%) by persons who are not citizens of, nor living within, the United States and its possessions are also considered to be foreign products.

2. "Materials" are products substantially shaped, cut, worked, mixed, finished, refined or otherwise fabricated, processed, or installed to form a part of the Work.

3. "Equipment" is a product with operational or non-operational parts, whether motorized, or manually operated, that may require service connections, such as wiring or piping.

1.3 Submittals

A. Submittal of preliminary procurement schedule is specified in Section 01320 - PROJECT MEETINGS, SCHEDULES, AND REPORTS.

B. Submittals for products are specified in Section 01330 and in applicable Sections of DIVISIONS 2 through 16.

1.4 Quality Assurance

A. Source Limitations: To the fullest extent possible, provide products of the same kind from a single source.

B. Nameplates: Along with required labels and operating data, manufacturer or producer's nameplates, imprints, or trademarks may be placed on surfaces exposed to view.

1. Labels: Locate required product labels and stamps on concealed surfaces or, where required for observation after installation, on accessible surfaces that are not conspicuous.
2. Equipment Nameplates: Provide a permanent nameplate on each item of service-connected or power-operated Equipment. Locate on an easily accessible surface that is inconspicuous in occupied spaces. The nameplate shall contain the following information and other essential operating data:
    a. Name of product and manufacturer including address (and telephone number).
    b. Model and serial number.
    c. Capacity.
    d. Speed.
    e. Ratings.

1.5 Transportation and Shipment

A. Shipment Preparation

1. Contractor shall require manufacturers and Suppliers to prepare products for shipment in a manner to facilitate unloading and handling, and to protect against damage, deterioration, or unnecessary exposure to the elements in transit and storage. Provisions for protection shall include the following:

a. Crates or other suitable packaging materials.
b. Covers and other means to prevent corrosion, moisture damage, mechanical injury, and accumulation of dirt in motors, electrical equipment, and machinery.
c. Suitable rust-preventive compound on exposed machined surfaces and unpainted iron and steel.
d. Grease packing or oil lubrication in all bearings and similar items.

B. Marking: Each product item shall be tagged or marked as identified in the delivery schedule or on Submittals. Complete packing lists and bills of material shall be included with each shipment. Each piece of every item need not be marked separately, provided that all pieces of each item are packed or bundled together and the packages or bundles are properly tagged or marked.

1.6 Product Delivery, Storage and Handling

A. Deliver, store, and handle products according to the manufacturer's recommendations, using means and methods that will prevent damage, deterioration, and loss, including theft.

1. Schedule delivery to minimize long-term storage at the Site and to prevent overcrowding of construction spaces. Allow ample time to avoid delay of the Work.
2. Coordinate delivery with installation time to assure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
3. Deliver products in an undamaged condition in the manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
4. Inspect products upon delivery to ensure compliance with the Contract Documents and to ensure that products are undamaged and properly protected. Inspect shipment to assure:

a. Product complies with requirements of Contract Documents and reviewed Submittals.
b. Quantities are correct.
c. Containers and packages are intact and labels are legible.
d. Products are properly protected and undamaged.

5. Store products at the Site in a manner that will facilitate inspection and measurement of quantity or counting of units. Mark deliveries of component parts of Equipment to identify the Equipment, to permit easy accumulation of parts, and to facilitate inspection and measurement of quantity or counting of units.
6. Store heavy materials in a manner that will not endanger the supporting construction.
7. Store products subject to damage by the elements above ground, under cover in a weather tight enclosure, and with ventilation adequate to prevent condensation. Maintain temperature and humidity within range required by manufacturer's instructions.
8. Protect motors, electrical Equipment, plumbing fixtures, and machinery of all kinds against corrosion, moisture deteriorations, mechanical injury, and accumulation of dirt or other foreign matter.
9. Protect exposed machined surfaces and unpainted iron and steel as necessary with suitable rust-preventive compounds.
10. Protect bearings and similar items with grease packing or oil lubrication.
11. Handle and store steel plate, sheet metal, and similar items in a manner to prevent deformation.
12. For storage of pipe and other products on easements and rights-of-way in residential and commercial areas, do not exceed the minimum required by scheduled laying operations, and conform to all requirements of public authorities. Store or place pipe along roads, set back from shoulder or curb, and at an angle tending to deflect vehicles if struck. Place or block pipe to preclude its accidental movement.

B. Handling

1. Provide equipment and personnel necessary to unload and handle products, by methods to prevent damage or soiling to products, or packaging.
2. Handle by methods to prevent bending or overstressing. Where lifting points are designated, lift components only at those points.
3. Provide additional protection to surrounding surfaces as necessary to prevent damage.

C. Maintenance of Storage

1. Inspect stored products on a scheduled basis as approved by engineer.
2. Verify that storage facilities comply with manufacturer's product storage requirements, including environmental conditions continually maintained.
3. Verify that surfaces of products exposed to elements are not adversely affected; that any weathering of finishes is acceptable under requirements of Contract Documents.
4. For mechanical and electrical Equipment in long-term storage, provide manufacturer's service instructions to accompany each item, with notice of enclosed instructions on exterior of package. Service Equipment on a regularly scheduled basis.

D. Protection After Installation: Provide substantial coverings as necessary to protect installed products from damage from subsequent construction operations.

PART 2 - PRODUCTS

2.1 Product Selection

A. General Product Requirements: Provide products that comply with the Contract Documents, that are undamaged and, unless otherwise specified or indicated, new at the time of installation.

1. Provide products complete with accessories, trim, finish, safety guards, and other devices and details needed for a complete installation and the intended use and effect.
2. Where available, provide standard products of types that have been produced and used successfully in similar situations on other projects.
3. Continued Availability: Where, because of the nature of its application, Owner is likely to need replacement parts or additional amounts of a product at a later date, either for maintenance and repair, or replacement, provide standard products for which the manufacturer has published assurances that the products and its parts are likely to be available to Owner at a later date.
4. Conform to applicable Specifications, codes, standards, and regulatory agencies.
5. Comply with size, make, type, and quality specified, or as specifically approved in writing by Engineer.

6. Manufactured and Fabricated Products:
    a. Design, fabricate, and assemble in accordance with the best engineering and shop practices.
    b. Manufacture like parts of duplicate units to standard sizes and gages, to be interchangeable.
    c. Equipment and Materials shall be suitable for service conditions intended.
    d. Equipment capacities, sizes, and dimensions indicated or specified shall be adhered to unless variations are specifically approved in writing by Engineer.
    e. Provide labels and nameplates where required by regulatory agencies or to state identification and essential operating data.
7. Do not use products for any purpose other than that for which designed.
8. To the fullest extent possible, provide products of the same kind from a single source.

PART 3 - EXECUTION

3.1 Installation of Products

A. Comply with manufacturer's instructions and recommendations for installation of products in the applications indicated. Anchor each product securely in place except as required for proper movement and performance, and accurately located and aligned with other Work.

1. Obtain and distribute copies of manufacturer's printed instructions and recommendations if not a part of submittals, containers, or packaging to parties involved in the installation, including a copy to Engineer (and Resident Project Representative).
2. Maintain one complete set of instructions at the Site during installation and until completion.
3. Handle, install, connect, clean, condition, and adjust products in accordance with such instructions and in conformance with specified requirements. Should job conditions or specified requirements conflict with manufacturer's instructions, consult with Engineer for further instructions.

B. Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of completion.

PART 4 - MEASUREMENT AND PAYMENT - Not Applicable

** END OF SECTION 01600 **

SECTION 01610

REGULATORY REQUIREMENTS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Description of applicable codes, ordinances, and regulations.

1.02 CODES AND ORDINANCES

A. Applicable Codes: Compliance with all laws, ordinances, and regulations of authorities having jurisdiction is an integral requirement of the Contract Documents, whether each code is mentioned or not in the Contract documents.

B. Compliance: Comply with all applicable codes, ordinances and regulations in effect at the time of bid opening, including but not necessarily limited to the following:
1. 2015 International Building Code with Local amendments.
2. 2014 National Electrical Code with Local amendments.
3. 2015 International Plumbing Code with Local amendments.
4. 2015 International Fire Code with Local amendments and supplemental rules and regulations.
5. National Fire Protection Association Standards.
6. Utility Company requirements.
7. State and Federal Safety and Health Laws.
8. National Electrical Safety Code (NESC).
9. Amendments to Codes.
10. Clean Water Act compliance for storm water and potable water discharges.
11. NSF International Standards 60 and 61.

C. Detailed Requirements: Be familiar with and verify detailed requirements of applicable codes to verify that items and their installation provided under Work of this Contract meet or exceed legal requirements.
1. Discrepancies: If discrepancies occur between the Contract Documents, local codes, local utility requirements, etc., most stringent requirements shall apply.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01612
SEISMIC DESIGN CRITERIA

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Seismic design criteria for the following:
   1. Anchorage of mechanical and electrical equipment.
   2. Seismic design and anchorage of tanks and vessels, unless indicated otherwise in tank and vessel specifications.
   3. Other structures or items as specified or indicated on the Drawings.

1.02 REFERENCES

A. International Building Code, 2015.

B. American Society of Civil Engineers Standard 7 - Minimum Design Loads for Buildings and Other Structures, to the extent referenced by the 2015 International Building Code

1.03 SYSTEM DESCRIPTION

A. Design requirements: Design in accordance with the requirements of the International Building Code:
   1. International Building Code Site Classification of "D" and Risk Category III shall be utilized for design, along with following:

Table 1 – 2015 International Building Code Seismic Design Criteria

Seismic Design Factors	**Value**
Site Class	D
Site Coefficient, F_a	1.6
Site Coefficient, F_v	2.4
Mapped Spectral Response Acceleration at 0.2-second Period, S_s	0.164 g
Mapped Spectral Response Acceleration at 1.0-second Period, S_1	0.055 g
Spectral Response Acceleration at 0.2-second Period Adjusted for Site Class. S_{MS}	0.262 g
Spectral Response Acceleration at 1.0-second Period Adjusted for Site Class. S_{M1}	0.132 g
Design Spectral Response Acceleration at 0.2-second Period, S_{DS}	0174 g
Design Spectral Response Acceleration at 1.0-second Period, S_{D1}	0.088 g

2. Seismic Importance factor For Anchorage of Mechanical and Electrical Equipment: 1.25.
3. Seismic Importance Factor For The Design Of Tanks And The Anchorage Of Tanks: 1.25.
4. Do not use friction to resist sliding due to seismic forces.
5. Use anchor bolts, bolts, studs for anchors for resisting seismic forces. Anchor bolts used to resist seismic forces shall have a standard hex bolt head. Do not use anchor bolts fabricated from rod stock with an L or J shape:
   a. Do not use concrete anchors, flush shells, chemical anchors, powder actuated fasteners, or other types of anchors unless indicated on the Drawings or accepted by the ENGINEER.
   b. Seismic forces must be resisted by direct bearing on the fasteners used to resist seismic forces. Do not use connections which use friction to resist seismic forces.

1.04 SUBMITTALS

A. Shop Drawings and Calculations: Provide seismic calculations and required details with the applicable equipment shop drawing.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01631
SUBSTITUTIONS

PART 1 - GENERAL

1.1 Submittals

A. Substitution Request Submittal: Engineer will consider written requests for substitution if received within 14 calendar days of Notice to Proceed. Requests received more than 14 calendar days after Notice to Proceed may be considered or rejected solely at the discretion of the Owner.

1. Submit 3 copies of each request for substitution for consideration. Submit requests in the form and according to procedures required for Change Order proposals. Requests for substitution shall not be submitted in the form of a Request for Information (RFI).
2. Identify the Equipment or Material, the fabrication, or installation method to be replaced in each request. Include related Specification Section/Article and Drawing numbers.

3. Provide complete documentation showing compliance with the requirements for substitutions, and the following information, as appropriate:

a. Statement indicating why specified product or method of construction cannot be provided.
b. Coordination information, including a list of changes or modifications needed to other parts of the Work and to construction performed by Owner and separate contractors, that will be necessary to accommodate the proposed substitution.
c. A detailed comparison of significant qualities of the proposed substitution with those of the Work specified. Significant qualities may include elements such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
d. Product data, including drawings and descriptions of products and fabrication and installation procedures.
e. Samples, where applicable or requested.
f. Identification of available sales, maintenance, repair, and replacement services.

g. A statement indicating the effect of the substitution on Contractor's construction progress schedule compared to the schedule without approval of the substitution. Indicate the effect of the proposed substitution on the overall Contract Times. If specified product cannot be provided within the Contract Times, provide letter from manufacturer, on manufacturer's letterhead, stating lack of availability or delay in delivery.

h. An itemized estimate of costs that will result directly or indirectly from approval of the substitution, including:
   (1) A proposal of the net change, if any, in the Contract Price.
   (2) Costs of redesign required by the proposed change.
   (3) Costs of resulting claims as determined in coordination with other contractors having work on the Project affected by the substitution.

i. Statement indicating whether or not incorporation or use of the substitute is subject to payment of any license fee or royalty.

j. Contractor's certification that the proposed substitution conforms to requirements in the Contract Documents, will perform adequately the functions and achieve the results called for by the general design, is similar in substance to that specified, and is suitable for same use as that indicated and specified.

k. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of the failure of the substitution to perform adequately.

4. Engineer's Action: If necessary, Engineer will request additional information or documentation for evaluation within one week of receipt of a request for substitution. Engineer will notify Contractor of acceptance or rejection of the substitution within 14 calendar days of receipt of the request, or one week of receipt of additional information or documentation, whichever is later. Acceptance, if granted, will be in the form of a Change Order.

PART 2 - PRODUCTS

2.1 Substitutions

A. Conditions: Engineer will receive and consider Contractor's request for substitution when one or more of the following conditions are satisfied, as determined by Engineer. If the following conditions are not satisfied, Engineer will return the requests without action except to record noncompliance with these requirements.

1. Extensive revisions to the Contract Documents are not required.
2. Proposed substitution is in keeping with the general intent of the Contract Documents and will produce indicated results.
3. Substitution request is timely, fully documented, and properly submitted.
4. The specified product or method of construction cannot be provided within the Contract Times. Engineer will not consider the request if the product or method cannot be provided as a result of failure to pursue the Work promptly or coordinate activities properly.
5. The requested substitution offers Owner a substantial advantage, in cost, time, energy conservation, or other considerations, after deducting additional responsibilities Owner must assume. Owner's additional responsibilities may include compensation to Engineer for redesign and evaluation services, increased cost of other construction by Owner, and similar considerations.
6. The specified product or method of construction cannot receive necessary approval by a governing authority, and the requested substitution can be approved.
7. The specified product or method of construction cannot be provided in a manner that is compatible with other materials

   and where Contractor certifies that the substitution will overcome the incompatibility.
8. The specified product or method of construction cannot be coordinated with other materials and where Contractor certifies that the proposed substitution can be coordinated.
9. The specified product or method of construction cannot provide a warranty required by the Contract Documents and where Contractor certifies that the proposed substitution provides the required warranty.

B. Engineer’s review and acceptance of Submittals shall not relieve Contractor from responsibility for any variation from the requirements of the Contract Documents. Engineer’s acceptance of Submittals not complying with the Contract Documents does not constitute an acceptable or valid request for substitution, nor does it constitute approval of a substitution. Acceptance by Engineer shall not relieve Contractor from responsibility for errors or omissions in the Submittals.

PART 3 - EXECUTION - Not Applicable.

PART 4 - MEASUREMENT AND PAYMENT - Not Applicable.

** END OF SECTION 01631 **

SECTION 01650
DEMONSTRATION OF SYSTEMS / COMMISSIONING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Pre-operational, Startup, and Commissioning.

B. Related Sections include but are not necessarily limited to:
   1. Division 1 - General Requirements.

1.02 DEFINITIONS

A. Pre-operational Period: The period of time after the initial installation/construction.

B. Startup Period: A period of time (anticipated one week) immediately following the completion of the pre-operational period during which the CONTRACTOR initiates flow through the facility, starts up process equipment, calibrates and adjusts systems, completes OWNER training, and confirms the equipment is working as a system. During this period, the CONTRACTOR, manufacturer's agents, and OWNER's equipment pre-purchase suppliers verify installation requirements.

1.03 SUBMITTALS

A. General:
   1. Approved Operation and Maintenance manuals prior to start of startup.
   2. Written request for OWNER and ENGINEER to witness each system start-up. Request to be received by OWNER minimum two weeks before scheduled training of OWNER's personnel on that system.
   3. Equipment installation and start-up certifications.
   4. Letter verifying completion of all pre-operational testing and start-up activities including receipt of all specified items from manufacturers/suppliers as final item prior to initiation of commissioning.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.01 EXECUTION

A. General:

1. Demonstration of systems and commissioning of the facilities constructed under this Contract shall be performed in three phases, as indicated in Article 1.02.

B. Pre-operational Period:

1. CONTRACTOR requirements:

a. Properly connect, align, calibrate, and adjust all system components. Check out procedures include but are not limited to:

1) Ring out all power, control and monitoring circuits prior to connection.
2) Voltage check of all circuits.
3) Phase sequence check.
4) Connecting piping system cleanliness check.
5) Alignment check of all connected machinery.
6) Pressure and vacuum testing of all closed systems.
7) Check of lubrication.
8) Calibration of all safety equipment.
9) Manual rotation/movement of moving parts to assure freedom of movement.
10) "Bump starting" of electrical motors to verify proper rotation.
11) Check of valving orientation and position status for manual operating mode.
12) Clean water testing of tankage for integrity.
13) Verify proper instrumentation and control signal generation, transmission, reception and response.
14) Check that all tagging/identification systems are in place.
15) Achieve successful bateriological test for piping, equipment, and tanks.

b. OWNER shall witness CONTRACTOR operation of each system prior to training to verify functional integrity.

c. Provide all labor, supervision, utilities, equipment, vehicles, and required items necessary to perform work during this period.
d. Provide certificate signed by equipment manufacturer's representative and CONTRACTOR that equipment was correctly installed and is ready for operation (as shown in Exhibit A-1650).

C. Startup Period:
1. CONTRACTOR Requirements:
a. Startup pumping equipment and support systems.
b. Calibrate and adjust system.
c. Provide training of OWNER personnel on all equipment during the startup period:
1) OWNER personnel training on individual systems will not be considered as meeting the Contract requirements unless:
a) All pretraining deliverables are received and approved.
b) During training, all system malfunctions are addressed.
c) All provisions of field/classroom training specifications are met.
2) Training not in compliance with the above will be performed again in its entirety by the manufacturer at no additional cost to OWNER.
3) Training shall not be conducted until water is running through the wells and the treatment plant, and the equipment is operational.
d. Maintain the facilities.

END OF SECTION

SECTION 01780
CONTRACT CLOSEOUT

PART 1 - GENERAL

1.1 Summary

A. This Section includes administrative and procedural requirements for Contract closeout including, but not limited to, the following:

1. Inspection procedures.
2. Project record document submittal.
3. Instruction book and operating manual submittal.
4. Submittal of warranties.
5. Final cleaning.

B. Closeout requirements for specific construction activities are included in the appropriate Sections of the Specifications.

C. Related Work Specified Elsewhere

1. Prerequisites to Contract Completion and Final Acceptance: GENERAL CONDITIONS.
2. Submittals: SECTION 01330.

1.2 Contract Completion

A. Preliminary Procedures: Before requesting inspection for Notice of Completion, complete the following. List exceptions in the request.

1. In the Application for Payment that coincides with, or first follows, the date Final Acceptance is claimed, show 100% completion for the portion of the Work.
    a. Include supporting documentation for completion as indicated in these Contract Documents and astatement showing an accounting of changes to the Contract Price.
    b. If 100% completion cannot be shown, include a list of incomplete items, the value of incomplete Work, and reasons the Work is not complete.
2. Advise Owner of pending insurance changeover requirements.
3. Submit specific warranties, workmanship Bonds, maintenance agreements, final certifications, and similar documents.
4. Obtain and submit releases enabling Owner unrestricted use of the

Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.

5. Submit record drawings, instruction books and operating manuals, final project photographs, damage or settlement surveys, property surveys, and similar final record information.
6. Deliver tools, spare parts, extra stock, and similar items.
7. Make final changeover of permanent locks and transmit keys to Owner. Advise Owner's personnel of changeover in security provisions.
8. Complete start-up testing of systems and instruction of Owner's operation and maintenance personnel. Discontinue and remove temporary facilities from the Site, along with mockups, construction tools, and similar elements.
9. Submit consent of Certificate of Completion from Contractor.

B. Inspection Procedures: On receipt of a request for inspection, Engineer will either proceed with inspection or advise Contractor of unfilled requirements. Owner will prepare the Notice of Completion following inspection or advise Contractor of construction that must be completed or corrected before the notice will be issued.

1. Engineer will repeat inspection when requested and assured by Contractor that the work is complete.
2. Results of the completed inspection will form the basis of requirements for Final Acceptance.

1.3 Final Acceptance

A. Preliminary Procedures: Before requesting final inspection for Notice of Completion of Final Acceptance and final payment, complete the following. List exceptions in the request.

1. Submit the final payment request with releases and supporting documentation not previously submitted and accepted. Include insurance certificates for products and completed operations where required.
2. Submit an updated final statement, accounting for final additional changes to the Contract Price.
3. Submit a certified copy of Engineer's final inspection list of items to be completed or corrected, endorsed and dated by Engineer. The certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance and shall be endorsed and dated by Engineer.

4. Submit final meter readings for utilities, a measured record of stored fuel, and similar data as of the Date of Contract Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work.

5. Submit consent of surety to final payment.

6. Submit evidence of final, continuing insurance coverage complying with insurance requirements.

7. Submit a final liquidated damages settlement statement.

B. Reinspection Procedure: Engineer will re-inspect the Work upon receipt of notice that the Work, including inspection list items from earlier inspections, has been completed, except for items whose completion is delayed under circumstances acceptable to Engineer.

1. Upon completion of re-inspection, Owner will prepare a Notice of Completion of Final Acceptance. If the Work is incomplete, Engineer will advise Contractor of Work that is incomplete or of obligations that have not been fulfilled but are required for Final Acceptance.
2. If necessary, re-inspection will be repeated.

1.4 Record Document Submittals

A. General: Do not use record documents for construction purposes. Protect record documents from deterioration and loss in a secure, fire-resistant location. Provide access to record documents for Engineer's reference during normal working hours.

B. Record Drawings: Maintain a clean, undamaged set of blue or black line white-prints of Contract Drawings and Shop Drawings. Mark the set to show the actual installation. This will require an “as constructed” elevation of the manhole top and invert elevations of all pipes entering and leaving the manhole.

1. Record information concurrently with construction progress.
2. Mark record sets with red erasable pencil. Use other colors to distinguish between variations in separate categories of the Work. Mark each document "PROJECT RECORD" in neat, large, printed letters.
3. Mark new information that is important to Owner but was not shown on Contract Drawings or Shop Drawings.

4. Note related Change Order numbers where applicable.
5. Organize record drawing sheets into manageable sets. Bind sets with durable-paper cover sheets; print suitable titles, dates, and other identification on the cover of each set.
6. Upon completion of the Work, submit record drawings to Engineer for Owner's records.
7. Include the following:

    a. Depths of various elements of foundation in relation to finish first floor datum.

    b. Horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.

    c. Location of internal utilities and appurtenances concealed in the construction, referenced to visible and accessible features of construction.

    d. Where Submittals are used for mark-up, record a cross-reference at corresponding location on Drawings.

    e. Field changes of dimension and detail.

    f. Changes made by Change Order or other Modifications.

    g. Details not on original Contract Drawings.

    h. As constructed information shall include a GPS coordinate of the sanitary manhole including the invert elevation of the pipes entering and leaving the manhole. The GPS level of accuracy shall be to centimeters. A registered land surveyor of the state of Arizona shall conduct the survey. This information shall be recorded on the record information set submitted to the Engineer. The information shall also be provided in an electronic format compatible with AUTOCAD release 2004.

    i. Provide a record location of all service laterals where they connect to the main sewer. The separation distance between the service lateral at the crossing of a water line shall be recorded by the Contractor on his record documents.

C. Record Specifications: Maintain one complete copy of the Project Manual including Addenda. Include with the Project Manual one copy of other written construction documents, such as Change Orders and Modifications issued in printed form during construction.

1. Mark these documents to show substantial variations in actual Work performed in comparison with the text of the Specifications and modifications.

2. Give particular attention to substitutions and selection of options and information on concealed construction that cannot otherwise be readily discerned later by direct observation.
3. Note related record drawing information and product data.
4. Upon completion of the Work, submit record Specifications to Engineer for Owner's records.
5. Include the following:

    a. Manufacturer, trade name, catalog number, and Supplier of each product and item of Equipment actually installed, particularly optional and substitute items.
    b. Changes made by Addendum, Change Order, or other Modifications.
    c. Related Submittals.

D. Record Product Data: Maintain one copy of each product data Submittal. Note related Change Orders and markup of record drawings and specifications.

1. Mark these documents to show significant variations in actual Work performed in comparison with information submitted. Include variations in products delivered to the Site and from the manufacturer's installation instructions and recommendations.
2. Give particular attention to concealed products and portions of the Work that cannot otherwise be readily discerned later by direct observation.
3. Upon completion of markup, submit complete set of record product data to Engineer for Owner's records.

E. Miscellaneous Record Submittals: Refer to other Specification Sections for requirements of miscellaneous record keeping and Submittals in connection with actual performance of the Work. Immediately prior to the date or dates of Substantial Completion, complete miscellaneous records and place in good order. Identify miscellaneous records properly and bind or file, ready for continued use and reference. Submit to Engineer for Owner's records.

F. Warranties and Bonds: Specified in GENERAL CONDITIONS, Section 01330.

PART 2 - PRODUCTS - Not Applicable.

PART 3 - EXECUTION

3.1 Closeout Procedures

A. Operation and Maintenance Instructions: Arrange for each installer of Equipment that requires regular maintenance to meet with Owner's personnel at Project Site to provide instruction in proper operation and maintenance. Provide instruction by manufacturer's representatives if installers are not experienced in operation and maintenance procedures. Include a detailed review of the following items:

1. Instruction books and operating manuals.
2. Record documents.
3. Tools.
4. Lubricants.
5. Fuels.
6. Identification systems.
7. Control sequences.
8. Hazards, hazardous chemicals data sheets.
9. Cleaning.
10. Warranties and bonds.
11. Maintenance agreements and similar continuing commitments.

B. As part of instruction for operating Equipment, demonstrate the following procedures:

1. Start-up.
2. Shutdown.
3. Emergency operations.
4. Noise and vibration adjustments.
5. Safety procedures.
6. Economy and efficiency adjustments.
7. Effective energy utilization.

3.2 Final Restoration

A. General: The GENERAL CONDITIONS requires general cleaning during construction.

1. Remove temporary structures, tools, equipment, supplies, and surplus materials.
2. Remove temporary protection devices and facilities, which were installed, to protect previously completed Work.

3. Restore the entire construction area to pre-construction condition.

B. Removal of Protection: Remove temporary protection and facilities installed for protection of the Work during construction.

C. Compliance: Comply with regulations of authorities having jurisdiction and safety standards for cleaning. Do not burn waste materials. Do not bury debris or excess materials on the Owner's property. Do not discharge volatile, harmful, or dangerous materials into drainage systems. Remove waste materials from the Site and dispose of lawfully.

PART 4 - MEASUREMENT AND PAYMENT - Not Applicable.

** END OF SECTION 01780 **

DIVISION II
SITE WORK

SECTION 02072
DEMOLITION, CUTTING AND PATCHING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. All demolition, cutting and patching.

B. Related Sections include but are not necessarily limited to:
   1. Division 1 - General Requirements.

1.02 QUALITY ASSURANCE

A. Use only firms or individual trades qualified to perform work required under this Section.

1.03 SUBMITTALS

A. Not Used.

1.04 DELIVERY, STORAGE, AND HANDLING

A. General:
   1. Salvage items, designated for OWNER's salvage, as a unit. Clean, list, and tag for storage. Protect from damage and store on site where designated by OWNER. Salvage each item with auxiliary or associated equipment required for operation.

1.05 PROJECT/SITE CONDITIONS

A. Perform preliminary investigations as required to ascertain extent of work. Conditions which would be apparent by such investigation will not be allowed as cause for claims for extra costs.

1.06 SEQUENCING AND SCHEDULING

A. Coordinate and reschedule work as required to preclude interference with other operations.

1.07 PERMITS

A. Obtain and pay for all permits required by all authorities having jurisdiction and notify all involved utility companies.

B.

C. Obtain approval of authorities having jurisdiction for any work which affects access to or exit from such areas. Obtain approval of authorities for any temporary construction which affects such areas.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Non shrink grout:
      a. Master flow 713 by Master Builders.
      b. Approved equal.
   2. Epoxy bonding adhesive:
      a. Euco No. 452 MV by Euclid Chemical Co.
      b. Sikadur 32 Hi-Mod by Sika Corporation.
      c. Or approved equal.

2.02 MATERIALS

A. Non shrink Grout:
   1. Nonmetallic, noncorrosive and non-staining.
   2. Premixed with only water to be added in accordance with manufacturer's instructions at jobsite.
   3. Grout to produce a positive but controlled expansion. Mass expansion not to be created by gas liberation or by other means.
   4. Minimum compressive strength at 28 days to be 6500 psi.
   5. Coat exposed edges of grout with a cure/seal compound recommended by grout manufacturer.

B. Epoxy Bonding Adhesive:
   1. Two component, moisture insensitive adhesive manufactured for the purpose of bonding fresh concrete to hardened concrete.

PART 3 - EXECUTION

3.01 PREPARATION

A. Provide substantial barricades and safety lights as required.

B. Provide temporary weather protection as necessary.

3.02 INSTALLATION

A. Cutting and Removal:
   1. Remove existing work indicated to be removed, or as necessary for installation of new work.
   2. Neatly cut and remove materials and prepare all openings to receive new work.
   3. Remove masonry or concrete in small sections.

B. Modification of Existing Concrete:
   1. Where indicated, remove existing concrete and finish remaining surfaces as specified in Section 03356:
      a. Protect remaining concrete from damage.
      b. Make openings by sawing through the existing concrete.
      c. Concrete may be broken out after initial saw cuts in the event concrete thickness prevents cutting through.
      d. Where sawing is not possible, make openings by drilling holes around perimeter of opening and then chipping out the concrete:
         1) Holes shall be sufficient in number to prevent damage to remaining concrete.
   2. Oversize required openings in existing concrete 1 IN on all sides and build back to required opening size by means of non-shrink grout epoxy bonded to the existing concrete.
   3. Where oversized openings cannot be made, remove the concrete to the required opening size and cut back exposed reinforcing 1 IN from face of concrete and fill resulting holes with non-shrink grout.

C. Matching and Patching:
   1. Methods and materials:
      a. Similar in appearance, and equal in quality to adjacent areas for areas or surfaces being repaired.
      b. Subject to review of ENGINEER.

Salvaged Items:
   2. Thoroughly dry and clean all metal surfaces.
   3. Prime all bare metal in accordance with Section 09800.
   4. Dispose of items or materials not designated for OWNER's salvage or reuse. Promptly remove from site.
   5. Do not store or sell CONTRACTOR salvaged items or materials on site.

D. Clean up:
   1. Transport debris and legally dispose of off-site.

END OF SECTION

SECTION 02100

CLEARING AND GRUBBING

PART 1 - GENERAL

1.1 Description

A. Description of Work

The work to be performed in accordance with this section includes clearing, grubbing, and disposal of materials, for all ground surfaces within the limits designated on the plans. The work shall include the furnishing of all labor, tools, equipment, materials and the performing of all operations required to provide a complete item in accordance with the project plans and these specifications.

Clearing and grubbing includes the removal of all brush, undergrowth, heavy growth of grass or weeds, debris, rubbish of any nature, obstructions or material which is unsuitable for the foundation of fills, pavements, or other required structures and the disposal of all spoil materials resulting from clearing and grubbing in an approved landfill.

B. Related Work Specified Elsewhere

Removal of Existing Improvements .....Section 02110
Earthwork .....Section 02200

1.2 Protection of Property

Protect existing improvements, adjacent property, utilities, trees, plants, or any other existing items which are not specifically intended to be removed.

1.3 Submittals

A. Disposal Area

Describe the location of the disposal area and provide written approval for the use of the area for disposing of waste from the operation. Work performed at the disposal area shall meet all local codes and ordinances.

PART 2 - MATERIALS (NOT APPLICABLE) PART 3

- EXECUTION

3.1 Limits of Work

Clearing and grubbing operations are to remain within the limits of construction and/or the right-of-way as shown on the plans. Clear and grub only in areas that are affected by excavation or other earthwork operations.

3.2 Construction Methods

Remove all stumps, roots, buried logs, brush, grass, and other unsuitable materials. Grub roots and other projections over 1-1/2 inches in diameter to a depth of at least 18 inches below the finished subgrade or slope elevation.

Backfill all holes remaining after the grubbing operation in accordance with Section 02200, Earthwork.

3.3 Disposal

Dispose of all debris at an approved landfill.

3.4 Burning

No burning shall be permitted.

3.5 Existing Vegetation to Remain

Save all trees and shrubs which will not interfere with excavation or embankment or cause disintegration of the improvements. Coordinate removal of vegetation with the OWNER. Protect trees, shrubbery, vines, plants, grasses and other vegetation growing outside of the limits of construction.

PART 4 - MEASUREMENT AND PAYMENT

4.1 Measurement

No measurement will be made for this item.

4.2 Payment

No payment will be made for Clearing and Grubbing. Clearing and grubbing shall be considered incidental to other items.

**END OF SECTION*

SECTION 02110

REMOVAL OF EXISTING
IMPROVEMENTS

PART 1 - GENERAL

1.1 Summary

A. Description of Work

The work to be performed in accordance with this section includes the removal and disposal of various existing improvements, such as pavements, structures, pipes, curbs and gutters, and other items necessary for the accomplishment of the improvement. The work shall include the furnishing of all labor, tools, equipment, materials and the performing of all operations required to provide a complete item in accordance with the project plans and these specifications.

B. Related Work Specified Elsewhere

Clearing and Grubbing ..... Section 02100

1.2 Protection of Property

Protect existing improvements, adjacent property, utilities, trees, plants, or any other existing items which are not specifically intended to be removed.

1.3 Disposal

All materials shall be disposed of at an approved landfill, unless otherwise approved by the Owner.

1.4 Submittals

A. Landfill

Provide a copy of the permit to use the landfill.

B. Disposal Area

For sites other than the landfill, describe the location of the disposal area and provide written approval for the use of the area for disposing of waste from the operation. Work performed at the disposal area shall meet all local codes and ordinances.

PART 2 -MATERIALS

2.1 General

Materials required for relocation work shall be as specified herein or as otherwise indicated.

PART 3 - EXECUTION

3.1 Limits of the Work

Confine removal of existing improvements to within the area of construction. Pavement removal shall be limited to an area that is no more than the one week ahead of the projected work. At no time shall the Contractor have asphalt removed from any street longer than 60 days.

3.2 Construction Methods

A. Removal of Existing Portland Cement Concrete Sidewalks, Curb and Gutter and Pavements.

1. Saw cut concrete to neat, vertical, true lines in such a manner that the adjoining surface will not be damaged. The full depth of the existing concrete shall be saw cut.

B. Removal of Existing Asphalt Concrete Pavement

1. Saw cut asphalt concrete to neat, vertical, true lines in such a manner that the adjoining surface will not be damaged. The full depth of the existing asphalt shall be saw cut.
2. Existing asphalt concrete not used in fill areas shall be removed from the site and disposed in an approved landfill or used in a recycling operation.

Miscellaneous Removals

Perform all miscellaneous removals as required by the Owner or where indicated on the plans. The miscellaneous removals shall include but not be limited to the following tasks:

C. Relocate existing fences and gates.
D. Remove planter boxes, block walls, concrete walls and footings.
E. Remove existing irrigation systems and replace or plug.
F. Removal and relocation of signs and mailboxes. All City owned signs shall be removed from the areas of construction and delivered to the City as directed. All privately owned signs located within the areas of construction shall be removed and delivered to the property Owner or placed on the adjacent property as directed.

   All mailboxes located within the areas of construction shall be removed and temporarily reset on the adjacent property for use. When grading and construction is adequately completed, the mailboxes shall be permanently reset at the back of the curb and restored to a better than or equal condition than existing.

3.3 Backfill and Densification

Backfill all holes remaining after removal of existing improvements.

PART 4 - MEASUREMENT AND PAYMENT

4.1 Measurement

No Measurement shall be made for this item.

4.2 Payment

A. Removal of Existing Improvements
   If no item is listed in the bid tab or the measurement and payment section, this item is to be considered incidental.

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B. Removal of Existing Improvements
   Payment will be made at the contract lump sum price. This price shall be full compensation for furnishing all materials, labor, equipment, tools and appurtenances necessary to complete the work.

C. Miscellaneous Removals

All other removals shall be considered incidental to other items. No payment will be made for miscellaneous removals.

See Section 00310 Bid Schedule for Bid Items.

** END OF SECTION 02110 **

SECTION 02200
EARTHWORKS

PART 1 - GENERAL

1.1 Description

A. Description of Work

The work to be performed in accordance with this section includes excavation, fill, borrow, spoil and compaction for roadways, structures, channels and embankments. The work shall include the furnishing of all labor, tools, equipment, materials and the performing of all operations required to provide a complete item in accordance with the project plans and these specifications.

B. Related Work Specified Elsewhere

Clearing and Grubbing .....Section 2100
Removal of Existing Improvements .....Section 2110
Trench Excavation and Backfill .....Section 2300
Subgrade Preparation.....Section 2600

1.2 Quality Assurance

A. Reference Test Standards and Specifications

ASTM D698, Test Methods for Moisture Density of Soils and Soil-Aggregate Mixtures Using 5.5 lb. Rammer and 12-inch Drop.

ASTM D1556, Density of Soil in Place by the Sand-Cone Method.

ASTM D6938-08a, Density of Soil and Soil-Aggregate in Place by Nuclear Methods.

ASTM D6938-08a, Moisture Content of Soil and Soil-Aggregate in Place by Nuclear Methods.

Rock Correction Procedure for Maximum Density Determination, ARIZ 227.

B. Frequency of Testing

1. Maximum Dry Density and Optimum Moisture Content, ASTM D698.

a. One test for each different class or type of material shall be provided by the CONTRACTOR prior to any earthwork operations.

b. CONTRACTOR shall provide additional test when previous test is suspect, due to subtle changes in the material, as determined by the OWNER.

2. Density of Soil In-Place by the Sand Cone or by Nuclear Methods, ASTM D1556 or D6938-08a.

a. OWNER will perform a minimum of one test per lift per 5,000 square yards per each type of material.

b. OWNER will perform additional tests as required to ensure proper compaction.

C. Testing Tolerances

1. Relative Percent Compaction

Not less than as specified on plans or in these specifications.

2. In-Place Moisture Content

As required to achieve minimum relative compaction.

3. Soft or Yielding Surfaces

Regardless of the percent compaction obtained by test, areas which are soft and yield under the load of construction equipment are to be removed and replaced at no additional cost.

Submittals

D. Materials Test Reports

Report on maximum dry density and optimum moisture content of soils proposed for use in the work prior to beginning of construction.

E. Disposal Area

Provide the location of the disposal area(s) and provide written approval for the use of the area(s) for disposing of excess soils from the operation. Work performed at the disposal areas shall meet all local codes and ordinances.

PART 2 - MATERIALS

2.1 Soil and Soil Aggregate Materials

A. Unsuitable materials not to be incorporated in the work.

1. Organic matter such as peat, mulch, organic silt or sod.
2. Soils containing expansive clays.
3. Material containing excessive moisture.
4. Poorly graded coarse material.
5. Material with particle sizes in excess of 12 inches.
6. Material which will not achieve density and/or bearing requirements.
7. Asphalt concrete or Portland cement concrete that does not conform to 3.5 Engineered Fill under Section 2200, Earthwork.

2.2 Earthwork Balance

No attempt has been made to estimate cut and fill earthwork quantities. The CONTRACTOR is solely responsible for the estimation of the earthwork quantities required to construct the project as indicated on the plans and described herein.

PART 3 - EXECUTION

3.1 Preliminary Investigation of the Work

Verify that all preliminary work including clearing, grubbing and staking has been performed in accordance with these specifications prior to earthwork operations.

3.2 Blasting

No blasting will be permitted unless approved by the OWNER. All permits shall be obtained by the CONTRACTOR at his own expense.

3.3 Spoil Disposal Area

Disposal of surplus excavated material shall be in an approved spoil area, outside of the project right-of-way. Make all arrangements necessary for disposal of material at an off-site location. The disposal of surplus materials in the designated area shall meet all local codes and ordinances.

3.4 Excavation

A. Unsuitable Material

Overexcavate existing unsuitable material below the lower limit of excavation to a depth that will provide adequate bearing, as determined by the OWNER. Remove unsuitable material from the site and dispose of the material at approved spoil area. Replace the overexcavated material with suitable material in accordance with Subsection 3.5 Engineered Fill.

B. Slides and Slipouts

Excavate and grade material outside the finished work which is unstable, or which has slipped out, to the slope and elevation determined by the OWNER. Dispose of excess material at approved spoil disposal area.

C. Slopes

Finish excavation slopes to the lines and grades shown on the plans. Remove all debris and loose materials. Round all grade breaks and slope transitions. Finish elevations on slopes shall not deviate from the plan elevation by more than ".25 feet. Variations from the plan grade and cross section shall be compensating so that the average grade and cross section are obtained.

D. Foundation Excavation

1. Cast in Place Concrete on Rock

Remove sufficient depth of rock surface to expose sound rock. Cut rock to approximate horizontal and vertical steps to provide minimum dimensions. Grout seams and faults in rock surfaces as directed by the OWNER.

2. Cast in Place Concrete on In-Situ Soil

Excavate to the lines shown such that the surface on which the concrete is to rest is undisturbed native material with no loose materials or debris. Replace overexcavation with concrete as specified for the structure.

E. Roadway Excavation

Remove the existing pavement and excavate the existing base course and subgrade materials to the new subgrade elevation. Excavate to the cross section as shown on the plan. Prepare the existing soil at the new subgrade elevation in accordance with Section 2600, Subgrade Preparation.

F. Shoring and Sheeting

Provide such bracing, sheeting or shoring necessary to perform and protect the excavation as required for safety. Shore, sheet and brace excavations as set forth in the rules, orders and regulations of the United States Department of Labor Occupational Health and Safety Administration (OSHA). Provide detailed plan and calculations as prepared by a registered professional engineer for excavations 20 feet in depth or greater or when shoring, sheeting or bracing deviates from OSHA standards. Place and remove shoring, sheeting and bracing so as not to damage adjacent improvements, utilities or utility being placed. Costs for shoring, sheeting and bracing to be incidental to the other items.

3.5 Engineered Fill

A. Subgrade Preparation

Prior to fill placement, plow or scarify the surface to a minimum depth of 6 inches. Moisture condition and compact surface to 95 percent of the maximum density in accordance with Section 2600, Subgrade Preparation.

B. Moisture Conditioning

Condition the soil by aerating or wetting to obtain the moisture content required to achieve the relative percent compaction. Mix the soil such that the moisture content is uniform throughout the lift.

C. Fill Placement

1. Lift Thickness

The uncompacted lift thickness shall not exceed eight (8) inches. When material contains more than 25 percent of rock larger than six (6) inches, the uncompacted lift thickness shall not exceed the maximum particle size dimension.

2. Rock Fill

Rock, broken portland cement concrete and crushed asphalt concrete is permitted in fill areas when conforming to the following:

a. Place earth or other fine material around the interstices of the pieces to form a dense fill layer. Nesting is not permitted.

b. Do not place pieces larger than 4 inches closer than 12 inches from any structure.

c. Do not place pieces larger than 2-1/2 inches closer than 12 inches from the finish subgrade.

d. Existing asphalt concrete conforming to these requirements for rock fill may be used as fill material only in areas to receive pavement.

3. Benching

When fill is to be placed and compacted on slopes steeper than 5:1 or where new fill is to be compacted against existing fill or where embankment is built 1/2 width at a time, the slopes of original and old or new fills shall be benched as the fill is placed. A new bench shall be started wherever the vertical cut of the next lower bench intersects the existing ground. Material thus cut out shall be recompacted along with the new embankment material by the CONTRACTOR at no additional cost. The vertical bench cut shall not exceed three (3) feet.

D. Compaction

1. Compaction Methods

Water consolidation will not be permitted.

2. Percent Relative Compaction

Compact fill and backfill as indicated on the plan. When not indicated on the plan, compact as specified herein.

a. 95% of maximum dry density

1. Areas to receive fill
2. Areas to receive structures, including pavement, upper two feet of fill
3. Structural backfill

b. 90% of maximum dry density

1. All other areas

PART 4 - MEASUREMENT AND PAYMENT

4.1 Measurement

A. No measurement will be made for the item, Earthwork.

B. Overexcavation

Overexcavation shall be measured by the cubic yard. The quantity will be computed by the average end area method. The end area is that bound by the original ground line established by field cross sections and the final theoretical pay line established by cross sections shown on the plans subject to verification by the OWNER. After completion of all operations and prior to the placing of base or subbase material, the final embankment shall be verified by the OWNER by means of field cross sections taken randomly at intervals not exceeding 500 linear feet.

Final field cross sections shall be employed if the following changes have been made:

1. Plan width of embankments or excavations are changed by more than plus or minus 1.0 foot; or
2. Plan elevations of embankments or excavations are changed by more than plus or minus 0.5 foot.

4.2 Payment

A. Earthwork

Payment for earthwork will be made at the contract lump sum price. The lump sum payment shall be full compensation for excavation of existing materials to the new subgrade elevation, subgrade preparation, fill placement, waste, borrow, hauling, and testing required to complete the item. The item shall be full compensation for all materials; for all preparation, hauling, and placing of these materials; and for all labor, equipment, tools, and incidentals necessary to complete the item.

B. Overexcavation

Payment for overexcavation will be made at the contract cubic yard price. The payment shall be full compensation for excavating the existing material to the depth and section required, hauling and wasting the overexcavated material and backfilling with suitable material. This item shall be full compensation for all work including furnishing all materials; for all preparation, hauling, and placing of these materials; and for all labor, equipment, tools, and incidentals necessary to complete the item.

The quantity of this item listed in the bid schedule represents no actual estimate, is nominal only, and may be greatly increased or decreased or reduced to zero. The increase or reduction of this quantity as compared with that set forth in the bid schedule shall not constitute a basis for claim by the CONTRACTOR for extra payment or damages.

See Section 00310 Bid Schedule for Bid Items.

SECTION 02300
TRENCH EXCAVATION AND BACKFILL

PART 1 - GENERAL

1.1 Description

A. Description of Work

The work to be performed in accordance with this section includes the excavation, trenching, backfilling, and surface repair for all pipelines, pipe culverts, box culverts, accessories and lines connected thereto, complete including sheeting and shoring, dewatering, grading and cleanup.

Excavation for appurtenant structures such as manholes, inlets, transition structures, junction structures, vaults, valve boxes, catch basins, etc. shall be included in this section.

The work shall include the furnishing of all labor, tools, equipment, materials and performing all operations to provide a complete item in accordance with the project plans and these specifications.

B. Related Work Specified Elsewhere

Earthwork ..... Section 02200
Ductile Iron Pipe ..... Section 02648
Cement-Mortar Lined and Coated Steel Pipe and Fittings ..... Section 02651
General Piping Systems and Appurtenances ..... Section 15000
Valves and Appurtenances ..... Section 15020

C. Definitions

1. Trench

   An excavation in which the depth is greater than the width of the bottom of the excavation.

2. Foundation

   Material on which bedding is to be directly placed.

3. Bedding

   Granular material on which pipe or structure is to be directly placed. The bedding extends from 6 inches below the pipe to 12 inches above the top of the pipe.

4. Select Backfill

Material placed from top of the bedding to finished subgrade.

1.2 Quality Assurance

A. Reference Test Standards and Specifications

ASTM C94, Standard Specification for Ready Mix Concrete.

ASTM C117, Standard Test Method for Materials Finer than No. 200 Sieve in Mineral Aggregates by Washing.

ASTM C131, Standard Test Method for Resistance to Degradation of Small Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.

ASTM C136, Standard Method for Sieve Analysis of Fine and Coarse Aggregate.

ASTM D1556, Standard Test Method for Density and Unit Weight of Soil in Place by Sand-Cone Method.

ASTM D698, Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3).

ASTM D6938, Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).

ASTM D4215, Standard Specification for Cold Mixed, Cold Laid Bituminous Paving Mixture.

ASTM D4318, Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

Rock Correction Procedure for Maximum Density Determination, ARIZ 227.

Moisture – Density Relationship Using Typical Moisture – Density Curves (One Point Proctor) Method A, ARIZ 232

B. Frequency of Testing

1. Maximum Dry Density and Optimum Moisture Content, ASTM D698.
   a. One test for each different class or type of material shall be provided by the CONTRACTOR.

   b. CONTRACTOR shall provide additional test when previous test is suspect, as determined by the ENGINEER.
   c. The ENGINEER at the discretion of the OWNER may perform quality assurance testing for compaction, gradation and plasticity index of bedding sand and select backfill. If any test results show non-compliance with the project specifications, the non-complying materials shall be removed and replaced or reworked by the CONTRACTOR. The CONTRACTOR shall perform additional tests at his cost to verify an acceptable condition prior to acceptance by the ENGINEER.

2. Density of Soil In-Place by Sand Cone or by Nuclear Methods

   a. CONTRACTOR shall perform a minimum of one test per lift per 500 linear feet of trench for each type of material.

   b. CONTRACTOR shall perform additional tests as required to ensure proper compaction.

3. Sieve Analysis of Aggregate, ASTM C136

   a. CONTRACTOR shall perform one test per 1,000 cy per material type of Bedding Sand Material incorporated into the WORK.

   b. CONTRACTOR shall perform one test per 1,000 cy per material type of Select Backfill Material incorporated into the WORK.

4. Plasticity Index of Soils, ASTM D4318

   a. CONTRACTOR shall perform one test per 1,000 cy per material type of Bedding Sand material incorporated into the WORK.

b. CONTRACTOR shall perform one test per 1,000 cy per material type of Select Backfill material incorporated into the WORK.

5. Moisture – Density Relationship Using Typical Moisture – Density Curves (One Point Proctor) Method A, ARIZ 232

a. CONTRACTOR shall perform this test any time the fill material appears to have changed or as directed by the ENGINEER or DESIGNEE to verify the appropriate proctor is being utilized.

C. Testing Tolerances

1. Percent Relative Compaction
Not less than as specified on plans or in these specifications.
2. In-Place Moisture Content
As required to achieve specified percent relative compaction.
3. Soft or Yielding Surfaces

Regardless of percent relative compaction obtained by test, areas which are soft and yield under the load of construction equipment are to be removed and replaced at no additional cost.

1.3 Submittals

A. Materials Test Reports

1. Report on maximum dry density and optimum moisture content prior to beginning of construction.

2. Report on bedding and backfill materials compliance tests as required. Compaction test reports shall be submitted to the ENGINEER within two (2) business days of completion of each test.

B. Spoil Disposal Area

Provide location and written approval for area to dispose of spoil from operation, as approved by ENGINEER.

C. Shoring Plan

Provide plans, details, and calculations by a professional ENGINEER registered in the State of Arizona if shoring or sheeting is required. See Section 02254

D. Dewatering Plan

Provide plans, details and calculations by a professional Engineer registered in the State of Arizona if dewatering is required.

1.4 Job Conditions

A. Dewatering

It is the CONTRACTOR'S responsibility to dewater if groundwater is encountered.

B. Protection of Existing Utilities

Maintain all utilities both underground and overhead in continuous service throughout the contract period. Liability for damages to, or interruption of services caused by the construction shall be borne by the CONTRACTOR.

PART 2 - MATERIALS

2.1 Soil and Soil Aggregate Materials

A. Unsuitable materials not to be incorporated in the work include:

1. Organic matter such as peat, mulch, organic silt or sod.
2. Soils containing expansive clays.
3. Material containing excessive moisture.
4. Poorly graded coarse material.
5. Particle size in excess of 6-inches.
6. Material which will not achieve density and/or bearing requirements.
7. Material containing asphalt concrete or Portland cement concrete.

B. Bedding

Bedding for all water, sewer, storm drain lines, and manholes specified in Sections 2500, 2551, 2550, 2560, and 2570 shall be bedded in bedding sand. Culverts, specified in Section 2520, shall be bedded on aggregate base course per subsection 2.1.E unless otherwise specified.

1. Bedding Sand

Bedding sand shall consist of non-plastic sandy material conforming to the following requirements:

Sand Equivalent (SE), 30 Minimum PH
6.5 – 8.5
Resistivity 2,000 – 50,000 ohm-cm
Sulfate (optional) 1500 PPM or less

SIEVE SIZES	PERCENTAGE BY WEIGHT
3/8"	100
No. 4	90-100
No. 50	10-40
No. 100	3-20
No. 200	0-15

C. Granular Backfill

Native excavated or approved import granular material, free draining and free of unsuitable materials defined herein. Granular backfill shall be non-plastic, well graded and meet the following requirements:

Sieve Size	Percent by Weight Passing
4 inches	100
No. 4	30-75
No. 8	20-60
No. 30	10-40
No. 200	0-12

D. Aggregate Base Course

Crushed aggregate or processed natural material, clean, hard, sound, and free of any detrimental quantity of soft, friable, elongated, or laminated pieces, organic matter or other deleterious substances. Properties of which shall meet the following requirement:

a. Grading, ASTM C136 and ASTM C117.

Sieve Size	Percent by Weight
1 1/2"	100
No. 4	30-70
No. 8	20-60
No. 30	10-40
No. 200	0-12

b. Percentage of Wear, ASTM C131, maximum percentage of wear of 40 after 500 revolutions.

c. Plasticity Index and Liquid Limit, ASTM D4318, maximum plasticity index of 5, maximum liquid limit of 25 percent.

2.2 Portland Cement Concrete

ASTM C94 and Specification Section 3300.

2.3 Asphalt Cement Concrete

As required in Specification Section 2630.

2.4 Cold Mix, Cold Laid Bituminous Paving Mixture

ASTM D4215.

2.5 Buried Warning and Identification Tape

Polyethylene plastic and metallic core or metallic-faced, acid- and alkali-resistant, polyethylene plastic warning tape manufactured specifically for locating, warning, and identification of buried utility lines. Provide tape on rolls, 3-inch minimum width, color coded as stated below for the intended utility with warning and identification imprinted in bold black letters continuously over the entire tape length. Warning and identification to read, "CAUTION, BURIED (intended service) LINE BELOW" or similar wording. Color and printing is to be permanent, unaffected by moisture or soil.

WARNING TAPE COLOR CODES	
RED	ELECTRIC
YELLOW	GAS, OIL, DANGEROUS MATERIALS
ORANGE	TELEPHONE AND OTHER COMMUNICATIONS
BLUE	WATER
GREEN	SEWER
WHITE	STEAM, AIR
PURPLE	REUSE

A. Warning Tape for Metallic Piping

Acid and alkali-resistant polyethylene plastic tape conforming to the width, color, and printing requirements indicated above. Minimum thickness of the tape shall be 0.003 inch. Tape shall have a minimum strength of 1500 psi lengthwise and 1250 psi crosswise with a maximum 350 percent elongation.

B. Detectable Warning Tape for Non-Metallic Piping

Polyethylene plastic tape to the width, color, and printing requirements indicated above. Minimum thickness of the tape shall be 0.004 inch. Tape shall have a minimum strength of 1500 psi lengthwise and 1250 psi crosswise.

PART 3 - EXECUTION

A. Preliminary Investigation of the Work

Verify that all of the preliminary work including construction staking has been performed in accordance with the plans and specifications prior to trenching and backfill operations.

B. Trenching in Fill Areas

Grade fill areas to within 1 foot of the finish grade prior to trenching and placement of the pipeline.

C. Excavation

1. General

Perform all excavations of every description and of whatever substances encountered to the depths indicated on the plans and including excavation ordered by the ENGINEER of compacted fill for the purpose of performing tests. Use open cut excavation methods unless otherwise indicated on the plans or approved by the ENGINEER.

2. Trench Widths

Trenches shall be excavated per LHC Standard Detail 200A

Maintain trench walls as vertical as possible except as required by safety standards and as required for sheeting and shoring.

If the maximum trench width is exceeded at the top of the pipe, the CONTRACTOR shall provide necessary additional load bearing capacity by means approved by the ENGINEER at no additional cost to the OWNER .

3. Over excavation

a. Unauthorized
Fill and compact unauthorized excavation beyond the specified grade line, at the CONTRACTOR'S expense, with bedding material, compact to 95 percent of the maximum density. No payment will be made for unauthorized over excavation.

b. Rock
Over excavate rock encountered in the trench to provide a minimum of six inches of bedding below the pipe and the minimum width at the springline.

c. Unsuitable Material
Over excavate unsuitable material to the depth necessary to provide the required support as determined by the ENGINEER. Backfill the over excavation with bedding material and compact to at least 95 percent of the maximum density.

4. Excavation for Manholes, Valves, Inlets, Catch Basins and Other Accessories

Provided the excavated surfaces are firm and unyielding, the CONTRACTOR may elect to cast concrete for the structure directly against excavated surfaces. Over excavate to provide bedding where shown on the plans.

5. Pavement and Concrete Cutting and Removal

Sawcut, remove and dispose of existing pavements and concrete per Specification Section 2110.

6. Grading and Stockpiling

a. Grading

Grade in the vicinity of the trench to prevent surface water from flowing into the trench. Remove any water accumulated in the trench by pumping or by other approved methods. Stockpile excavated material in an orderly manner a sufficient distance back from the edges of the trench to avoid overloading and to prevent slides or cave-ins.

b. Topsoil

Excavate topsoil and stockpile separately. Replace topsoil upon completion of backfill and grade to the elevations indicated on the plans.

7. Shoring and Sheeting

Shore, sheet and brace excavations as set forth in the rules, orders and regulations of the United States Department of Labor Occupational Health and Safety Administration (OSHA), and as specified in section 02254 of these specifications. Provide detailed plan and calculations as prepared by a registered professional ENGINEER for excavations 20 feet in depth or greater or when shoring, sheeting or bracing deviates from OSHA standards. Place and remove shoring, sheeting and bracing so as not to damage adjacent improvements, utilities or utility being placed. Costs for shoring, sheeting, and bracing is considered incidental.

8. Open Trench

a. Maximum Length

The maximum length of open trench within developed, dedicated right of way is not to exceed 500 feet per trench and pipeline crew, provided that all proper barricades and safety procedures have been addressed. The trench is considered to be open until backfill is completed to adjacent finish grade elevation.

b. **Street Crossing**

Complete backfill of trench across streets at the end of each work day. Use temporary patch material (cold mix asphalt concrete) or steel plates as required.

c. Temporary Provisions

Furnish and install trench bracing and steel plating required to provide safe and convenient vehicular and pedestrian passage across trenches where required. Maintain access to and from emergency facilities at all times.

D. Foundation, Bedding, Backfilling and Compaction

1. Foundation

Excavate trench bottom to the depth and width as shown. Remove all loose, disturbed material from the bottom of the trench such that the bedding shall rest on firm, undisturbed soil.

2. Bedding

Moisture condition and place bedding material to required thickness. Compact bedding material to the specified density.

3. Fine Grading

Accurately grade the bottom of the trench to provide uniform bearing and support for each section of pipe at every point along its entire length, except where it is necessary to excavate for joints.

4. Moisture Conditioning

Moisture condition all bedding and backfill materials by aerating or wetting to obtain the moisture content required to achieve specified percent relative compaction. Completely mix the material until the moisture content is uniform throughout the lift.

5. Lift Thickness

a. The following table applies when using mechanical compaction:

LIFT DESCRIPTION	MAXIMUM LOOSE LIFT THICKNESS, INCHES
Bedding	8-Inches in all cases
Backfill	
Aggregate Base Course	

Lift thickness may be increased if CONTRACTOR can prove, through a series of density tests, to be approved by the Engineer, that minimum density is achieved throughout the lift thickness.

6. Compaction

a. Compaction Methods\

Construction shall be accomplished by mechanical methods. Rubber tire wheel rolling will not be allowed.

b. Pipe Haunch

When using mechanical methods, hand compact initial backfill in pipe haunch with a pipe haunch compactor (J-bar) or mechanical vibrator sized to fit the narrow width between the pipe and the trench. Give special attention to provide proper compactive effort in the pipe haunch zone.

c. Compaction Densities

Thoroughly compact trench bedding and backfill to not less than the percent relative compaction as presented in the following table, unless more stringent requirements are called for on the plans.

PERCENT RELATIVE COMPACTION MINIMUM DENSITY REQUIRED				
Backfill Type	Location	From Subgrade Surface To 2' Below Surface	From 2' Below Surface To 1' Above Top of Pipe	From 1' Above Top of Pipe To Bottom of Trench
I	Under any existing or proposed pavement, curb, gutter, sidewalk, or such construction included in the contract or when any part of the trench excavation is within 2' of the above.	95%	95%	95%
II	On any utility easement, street, road or alley right-of-way outside of (I).	95%	95%	95%
III	Around any structures or exposed utilities.	95% in all cases		
IV	Outside of right-of-way and not below any curb, gutter sidewalk or other structures.	90% in all cases		

E. Buried Warning and Identification Tape

Place warning and identification tape to the depth indicated on the plan. Center tape over pipeline.

F. Backfill for Manholes, Valves, Inlets, Catch Basins and Other Accessories

Backfill appurtenances and structures including bedding, backfill, lift thicknesses and compaction as indicated.

G. Pavement Replacement and Surface Restoration

1. Grading

Perform all grading adjacent to backfilled trenches and structures necessary to leave the area in a neat and satisfactory condition as approved by the Engineer.

2. Surface Restoration

Restore all streets, alleys, driveways, sidewalks, curbs or other surfaces which were broken or damaged by the installation of the new work, to a condition as good as or better than originally encountered in accordance with these specifications, accepted standards and as acceptable to the ENGINEER.

a. Landscape

Replace landscape rock, sod, shrubs, trees, grass, sprinkler systems as required to a condition as good as or better than originally encountered in accordance with these specifications, accepted standards and as acceptable to the Engineer.

b. Temporary Pavement

Place cold mix, cold laid bituminous paving mixture in accordance with ASTM D4215 immediately following backfilling and compaction of trenches through existing pavement. Maintain pavement in safe and smooth condition until final pavement can be placed.

c. Pavement Replacement

Replace permanent asphalt cement, concrete pavement per the requirements of Specification Section 2630, Asphalt Concrete Pavement.

d. Clean Up

Remove all excess soil, concrete, etc. from the premises. Leave job site in a neat and clean condition.

PART 4 - MEASUREMENT AND PAYMENT

A. Measurement

1. Trench Excavation and Backfill

No measurement will be made for trench excavation and backfill.

2. Over excavation

Over excavation of unsuitable material will be measured by the average end area method per Section 2200, Earthwork.

3. Surface Repair

Measure surface repair along the centerline of utility over which it occurs from junction center to center.

B. Payment

1. Trench Excavation and Backfill

No payment will be made for trench excavation and backfill. All trench excavation and backfill work including but not limited to excavation, material testing, disposal, backfill grading is incidental to the pipelines and appurtenant bid items.

2. Over excavation

Payment for over excavation will be made per Specification Section 2200, Earthwork.

END OF SECTION 02300

SECTION 02321

EXCAVATION, FILLING, AND BACKFILLING FOR STRUCTURES

PART 1 - GENERAL

1.1 Summary

A. This Section includes all necessary excavation, filling, and backfilling for structures and all related Work, including duct banks and manholes.

B. Related Work Specified Elsewhere

Trench Excavation and Backfill… .....Section 02300
Concrete… .....DIVISION 3

1.2 Quality Assurance

A. Reference Standards and Specifications

1. American Society for Testing and Materials (ASTM)

ASTM D1557 - Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort.

ASTM D4253 - Test Method for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table.

ASTM D4254 - Test Method for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density.

2. Occupational Safety and Health Administration (OSHA)

Part 1926 - Safety and Health Regulations for Construction.

1.3 Submittals

A. Submit as specified in Section 01330.

B. Where selecting an option for excavation, trenching, and shoring in compliance with local, state, or federal safety regulations such as "OSHA Part 1926" or successor regulations, which require design bya registered professional engineer, submit (for information only and not for Engineer approval) the following:

1. Copies of design calculations and notes for sloping, benching, support systems, shield systems, and other protective systems prepared by or under the supervision of a professional engineer legally authorized to practice in the jurisdiction where the Project is located.
2. Documents provided with evidence of registered professional engineer's seal, signature, and date in accordance with appropriate state licensing requirements.

PART 2 - MATERIALS

2.1 Fill and Backfill Material

A. Earth Backfill:

Use suitable material as specified in SECTION 02300, PART 2 for granular backfill.

B. Granular Fill:

Native excavated or approved import granular material, free draining and free of unsuitable materials defined herein. Granular backfill shall be non-plastic, well graded and meet the following gradation:

Sieve Size	Percent by Weight Passing
¾ inches	100
No. 4	40 - 85
No. 8	30 - 75
No. 40	10 - 50
No. 100	5 - 20
No. 200	3 - 12

2.2 Concrete

A. Includes all concrete used to restore bottom of excavation to proper elevation, and in concrete seal coats.

B. Concrete shall be as specified in DIVISION 3.

PART 3 - EXECUTION

3.1 Excavation

A. Perform as specified in Section 02300 and as follows:

1. Excavate area adequate to permit efficient erection and removal of forms.
2. Trim to neat lines where details call for concrete to be deposited against earth.
3. Excavate by hand in areas where space and access will not permit use of machines.
4. Notify Engineer immediately when excavation has reached the depth indicated. Do not proceed further until approved.
5. Restore bottom of excavation to proper elevation with compacted fill in areas over excavated, as approved.

6. Top with 75-mm (3-inch) concrete seal coat if required to provide satisfactory subgrade for structural base slabs:

   a. Seal coat shall conform to applicable requirements of DIVISION 3.

7. Use sides of trenches to form sides of duct banks where possible and where sides of trench are vertical, stable, and excavated to the proper line.

B. Sheeting and Shoring:

1. Sheeting and Shoring shall be provided when soil conditions indicate the need for sheeting and shoring.
2. Damages
   a. Repair all damage resulting from Contractor's excavation and remove and replace all undermined pavements with Owner-approved equal, either concrete or asphalt, at Contractor's expense and in accordance with Section 02630.
   b. Filling and Backfilling

C. Granular Fill:

1. Place on prepared subgrade where indicated, prior to placing concrete in slabs on grade.
2. Lifts shall not exceed 150 mm (6 inches) in loose-layer thickness.
3. Compact to 95% relative density as referenced to ASTM D4253 and D4254.

D. Earth Backfill:

1. Backfill only after concrete has attained 70% design strength.
2. Backfill adjacent to structures only after, in the opinion of Engineer, a sufficient portion of the structure has been built to resist the imposed load.
3. Remove all debris from excavation prior to placement of material.
4. The slope bounding the excavation, if steeper than 6 horizontal: 1 vertical, shall be stepped or serrated prior to placing the backfill material.
5. Perform backfilling simultaneously on all sides of structures.
6. Place backfill in level layers not exceeding 100 to 200 mm (4 to 8 inches) in loose-layer thickness.

7. Exercise extreme care in the use of heavy equipment in areas adjacent to structures.

8. Compact to 95% of maximum dry density within the moisture content range from 2% below optimum to 2% above optimum. Optimum moisture and maximum dry density shall be determined by ASTM D1557. Accomplish without inundation or flooding.

3.2 Field Quality Assurance

A. Compaction:

1. Contractor shall, through services of an independent laboratory, test all filling and backfilling for structures to determine conformance with density relationships specified.

2. Method of test shall be as specified in SECTION 02300, PART 3.

3. The frequency of tests shall be in compliance with jurisdictional requirements.

PART 4 - MEASUREMENT AND PAYMENT – Not Applicable

END OF SECTION

SECTION 02532
UTILITY STRUCTURES

PART 1 – GENERAL

1.1 Summary

A. Description of the Work

The work shall include the furnishing of all labor, tools, equipment, materials and performing all required operations to provide a complete item in accordance with the project plans and these specifications.

B. This Section includes the following structures and related appurtenances:

Precast concrete manholes
Pump Station wet well and valve vault. Accessory vault.
Concrete anchor and thrust blocks.

C. Related Work Specified Elsewhere:

Trench Excavation and Backfill ..... Section 02300

Sewer Line Construction ..... Section 02560

Concrete ..... Section 03300

1.2 Quality Assurance

A. Applicable Test Standards and Specifications

1. American Society for Testing and Materials (ASTM)

ASTM A48 - Gray Iron Castings

ASTM C76 - Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe

ASTM C270 - Mortar for Unit Masonry

ASTM C443 - Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets

ASTM C478 - Precast Reinforced Concrete Manhole Sections
ASTM C1107 –Packaged Dry, Hydraulic-Cement Grout, Nonshrink

2. Federal Specification (FS)

FS FF-H-106 - General Hardware, Builder's, Locks and Door Trim
FS SS-S-00210 - Sealing Compound, Preformed Plastic, for Expansion Joints and Pipe Joints

3. American Association of State Highway Transportation Officials (ASSHTO)

AASHTO H20 – Axial Loading

4. American Concrete Institute (ACI)

ACI 350 – Code Requirements for Environmental Engineering Concrete Structures and Commentary

B. Leakage Test

Test all manholes installed under this contract using the vacuum method described below. Provide all equipment necessary to perform the test. Coordinate test schedule with the Owner. Test will not be accepted unless witnessed by the Owner.

1. Plug all pipes entering the manhole, taking care to securely brace the plug from being drawn into the manhole.

2. Place the test head inside of the top of the cone section and inflate seal in accordance with the manufacturer’s recommendations.

3. Draw a vacuum of 10 inches of mercury and shut off the vacuum pump. With the valves closed, measure the time for the vacuum to drop to 9 inches. The manhole shall pass if the time for the vacuum to drop is greater than 60 seconds for 48” diameter manhole, 75 seconds for 60" diameter manhole and 90 seconds for 72" diameter manholes. In lieu of vacuum testing, a water tightness test may be performed by filling the manhole with water. The manhole shall pass if the drop in water level does not exceed 0.001% of the manhole volume in one hour.

4. If the manhole fails the initial test, make necessary repairs with a non-shrink grout while the vacuum is still being drawn. Retest until a satisfactory test is obtained.

1.3 Submittals

A. Certificates of Compliance and Descriptions required for Frames and Covers.

B. Provide submittal for precast reinforced manholes per Section 01330, Submittals. The minimum information required for each manhole includes:

1. Top Elevation.

2. Base Elevation.

3. All pipe inverts entering and leaving the manhole.

4. All angles between lines leaving and entering the manhole.

1.4 Product Delivery, Storage And Handling

Take all necessary precautions in handling, storage and placement of manhole components and appurtenances. Replace defective materials.

PART 2 – PRODUCTS

2.1 Precast Manholes

A. Precast concrete manholes shall conform to ASTM C478 with ASTM C443 two-fin serrated flat gasket to concrete joint or with FS SS-S- 00210 preformed plastic concrete joint.

B. Precast manholes shall be 48-inchs in diameter unless otherwise indicated.

C. Provide precast concrete manhole bases for all concrete precast manholes.

D. Manhole cone section shall conform to ASTM C478, 24 inch minimum inside diameter of similar quality as manhole riser sections.

E. Manhole penetrations for pipes entering the manhole shall be provided with A-lock gaskets or approved equal and shall be included in the precast base section.

F. Manhole Frames And Covers

G. Shall conform to ASTM A48, Class 30B.

H. The word "sewer" shall be cast into the top of the lid and the lid shall contain the City's Logo.

I. The cover and frame shall be a locking, nonventilated type for all locations in nonpaved areas, and nonlocking, nonventilated type in paved areas.

J. Provide a concrete collar around the frame. (Minimum 1' wide and 8" thick)

K. Provide one ("T" Handle Type) for 24-inch manhole frame and cover for locking units required for non-paved installations.

L. Acceptable Manufacturers:

1. Neenah Foundry Company Model R-1772 Cast Iron Manhole Frame & Cover with special lid containing the City Logo.
2. Model REXUS D 400 or PAMREX as manufactured by SAINT GOBAIN. (This manufacturer can provide a Ductile Iron Locking Lid as specified to be installed in easements.)
3. East Jordan Iron Works – Product no. 00102214 Catalog No. 1022Z3 with special lid containing the Logo.
4. Engineer approved equal.

M. Machine-bearing surfaces to provide even seating.

2.2 Non Shrink Grout

ASTM C1107, prepackaged.

2.3 Preformed Joint Material For Precast Concrete Manholes

Plastic or mastic as recommended by the barrel section manufacturer. Resistant to sewer environment to provide water tight seal between concrete sections. Preformed joint material shall be Ram-Nek, Kent Seal, or equal.

PART 3 - EXECUTION

3.1 Excavation, Backfill And Compaction

A. Manholes

Prepare subgrade and bedding in accordance with Section 02300, Trench Excavation and Backfill. Provide bedding to depth and density indicated. Place and compact bedding and backfill with the same material and to the same density indicated for the adjacent trench.

1. Extensions
   Place each extension plumb. Join sections with a full bed of preformed joint material. Cut off excess joint material to provide space for at least 1/4 inch depth of grout. Grout smooth the interior and exterior of the joint after the mastic has set.
2. Final Adjustment to Grade
   Adjust frame and cover to required elevation with manhole extensions. Do not exceed maximum dimensions of 18 inches between the top of the frame and the top of the cone. Use preformed joint material to provide water tight seal between extension sections. Grout smooth the interior surface of sections and extensions.
3. Frame and Cover
   Place frame and cover level to the elevation indicated or required to match surface conditions on full bed of mortar. Construct concrete collar as indicated.
4. Connections for precast concrete manholes
   Grout around pipes with nonmetallic non-shrink grout. Install all piping using a flexible-rubber, entrance-hole gasket joint of pattern approved by the Engineer. Place pipe stub in manhole wall with bell or coupling outside manhole wall to provide flexible joints as indicated. Make provisions for future connections where indicated. Include plug or stopper capableof withstanding 4.3 psi of internal or external pressure without leakage for future connections.
5. Manhole Installation: All manholes shall be installed in accordance with manufacturers instructions. A representative of the manufacturer must be present for the installation of all manholes until the manufacturer is satisfied that the Contractor is proficient in the installation of the manhole.
6. Invert Channels: Form invert channel with 4,000 psi Type II Portland cement concrete. Make changes in direction of flow with smooth curves of as large a radius as size of manhole permits. Make changes in size and grade smoothly and uniformly. Slope floor of manhole adjacent to channels as indicated. Finish channel bottom smoothly without roughness, irregularity, or pockets.

B. Accessory Vault

1. Design: Construct to conform to Drawings of reinforced concrete pipe conforming to ASTM C76, Class II
2. Installation:
   a. Install vaults where indicated.
   b. Extend from centerline of pipe to ground surface.
   c. Notch lower section 2 inches greater than pipe OD and include fiberglass batt to prevent transmission of loads to pipe barrel.
3. Manhole Frame and Cover:
   a. Pattern as shown on drawings. Set frame level and to grade in mortar.

C. Air Valve Vault

1. Design:
   a. Precast and masonry construction as indicated.
   b. Precast concrete footings.
   c. Riser of ASTM C76, Class II pipe.
   d. Top slab shall be precast as indicated.
2. Manhole Frame and Cover:
   a. Pattern as shown on attached detail.
   b. Set frame level and to grade in mortar.

D. CONCRETE ANCHOR AND THRUST BLOCKS

1. Install at tees, elbows, bends, and dead ends where indicated.
2. Place against undisturbed earth or rock.
3. Of design indicated or specified.

PART 4 – MEASUREMENT AND PAYMENT

4.1 Measurement And Payment

A. Measurement and payment for manholes shall be as specified in Section 01210 – Measurement and Payment.

** END OF SECTION 02532

SECTION 2600

SUBGRADE PREPARATION

PART 1 - GENERAL

1.1 Description

A. Description of the Work

The work to be performed in accordance with this section includes the preparation of native or excavated soils prior to the placement of subbase, base course, pavement, curb, gutter, driveways, sidewalks or other structures.

The work shall include the furnishing of all labor, tools, equipment, materials and performing all required operations to provide a complete item in accordance with the project plans and these specifications.

B. Related Work Specified Elsewhere

Clearing and Grubbing.....Section 2100
Earthwork.....Section 2200
Trench Excavation and Backfill.....Section 2300

1.2 Quality Assurance

A. Reference Test Standards and Specifications

ASTM D1556, Density of Soil in Place by the Sand-Cone Method.

ASTM 1557, Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort.

ASTM D6938-08a, Density of Soil and Soil-Aggregate in Place by Nuclear Methods.

ASTM D6938-08a, Moisture Content of Soil and Soil-Aggregate in Place by Nuclear Methods.

Rock Correction Procedure for Maximum Density Determination, ARIZ 227.

B. Frequency of Testing

1. Maximum Dry Density and Optimum Moisture Content, ASTM D1557.

a. One test for each different class or type of material shall be provided by the prior to beginning construction.

b. CONTRACTOR shall provide additional test when previous test is suspect, due to subtle changes in the material, as determined by the OWNER.

2. Density of In-Place Soil by the Sand Cone or by Nuclear Methods, ASTM D1556 or D6938-08a

a. CONTRACTOR will perform a minimum of one test per lift per 2,000 square yard per type of material.

b. CONTRACTOR will perform additional test as required to ensure proper compaction.

C. Testing Tolerances

1. Percent Relative Compaction

Not less than as specified on plans or in these specifications.

2. In-Place Moisture Content

As required to achieve minimum relative compaction.

3. Soft or Yielding Surfaces

Regardless of the percent compaction obtained by test, areas which are soft and yield under the load of construction equipment are to be removed and replaced at no additional cost.

1.3 Submittals

A. Materials Test Report

1. Report on maximum dry density and optimum moisture content prior to beginning of construction.

1.4 Job Conditions

A. Soils Report

This section does not apply to this project.

PART 2 - MATERIALS

2.1 General

A. Unsuitable materials not to be incorporated in the work.

1. Organic matter such as peat, mulch, organic silt or sod

2. Soil containing expansive clays

3. Material containing excessive moisture

4. Poorly graded coarse material

5. Material with particle sizes in excess of 6 inches

6. Material which will not achieve density and/or bearing requirements

2.2 Earthwork Balance

No attempt has been made to estimate cut and fill earthwork quantities. The CONTRACTOR is solely responsible for an estimation of quantities of earthwork materials to construct the project as shown.

PART 3 - EXECUTION

3.1 Preliminary Investigation of the Work

The CONTRACTOR is to satisfy himself that all preliminary work including clearing, grubbing and staking has been performed in accordance with these specifications prior to subgrade preparation.

3.2 Subgrade Preparation

A. Scarification

Scarify and loosen to a minimum depth of 6 inches. Remove any particles larger than 6 inches.

B. Moisture Conditioning

Condition the soil by aerating or wetting to the moisture content required to obtain the minimum compaction requirements. Mix the soil such that the moisture content is uniform throughout the lift. No payment will be made for conditioning of the soil, wetting, or drying.

C. Compaction

Construct subgrade cut and fill areas to achieve a uniform soil structure. Compact the subgrade to the percent relative compaction indicated on the plans. When not shown on the plan, compact as indicated herein.

Major streets, other streets and traffic ways	95%
Curbs, gutters and sidewalks	95%
Area to receive Engineered fill	95%

D. Subgrade Tolerances

Below pavement, sidewalk, curb and gutter	+1/4 inch
Below base course	+3/4 inch

Variations from the plan grade and cross section shall be compensating so that the average grade and cross section are obtained.

PART 4 - MEASUREMENT AND PAYMENT

4.1 Measurement

No measurement will be made for this item.

4.2 Payment

No payment will be made for subgrade preparation. This item shall be considered incidental to Section 2630, Asphalt Concrete Pavement.

SECTION 02610

AGGREGATE BASE COURSE

PART 1 - GENERAL

1.1 Description

A. Description of Work

The work to be performed in accordance with this section includes furnishing and placing an aggregate base course to plan grades and cross sections.

This work shall include the furnishing of all labor, tools, equipment, materials and performing all operations required to provide a complete item in accordance with the project plans and specifications.

B. Related Work Specified Elsewhere

Earthwork.....Section 2200
Subgrade Preparation .....Section 2600

C. Definitions

1. Crushed Rock

Crushed rock shall consist of the product obtained by crushing rock, stone, or gravel so that at least 50 percent by weight of aggregate is retained on the No. 4 sieve for 3/4 inch or larger maximum sizes, and 50 percent is retained on the No. 8 for maximum sizes less than 3/4 inch. All crushed rock particles shall have at least one rough, angular surface produced by crushing.

2. Gravel

Material designated herein as gravel shall be composed entirely of particles that are either fully or partially rounded and water- worn. The quality and gradation requirements shall be as specified herein.

3. Sand

Sand shall consist of fine granular material produced by the crushing of rock or gravel or naturally produced by disintegration of rock and shall be sufficiently free of organic material, mica, loam, clay, and other deleterious substances to be thoroughly suitable for the purpose for which it is intended.

1.2 Quality Assurance

A. Reference Test Standards and Specifications

ASTM C117, Test Method for Material Finer Than 75-um (No. 200) Sieve in Mineral Aggregates by Washing.

ASTM C131, Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.

ASTM C136, Method for Sieve Analysis of Fine and Coarse Aggregates

ASTM D1556, Density of Soil in Place by the Sand-Cone Method.

ASTM D1557, Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort.

ASTM D6938-08a, Density of Soil and Soil-Aggregate in Place by Nuclear Methods.

ASTM D6938-08a, Moisture Content of Soil and Soil-Aggregate in Place by Nuclear Methods.

ASTM D4318, Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

Rock Correction Procedure for Maximum Density Determination, ARIZ 227.

B. Frequency of Testing

1. Maximum Dry Density and Optimum Moisture Content, ASTM D1557.

   a. One test for each different class to type of material shall be provided by the CONTRACTOR prior to placing aggregate base.
   b. CONTRACTOR shall provide additional test when previous test is suspect, due to subtle changes in the material, as determined by the OWNER.

2. Density of Soil In-Place by the Sand Cone or by Nuclear Methods, ASTM D1556 or D6938-08a.

   a. CONTRACTOR will perform a minimum of one test per lift per 2,000 square yards per type of material.
   b. CONTRACTOR will perform additional test as required to ensure proper compaction.

3. Method for Sieve Analysis of Fine and Coarse Aggregates, ASTM C136.

   a. OWNER may perform sampling of Aggregate Base in place to check conformance with gradation requirements.

C. Testing Tolerances

1. Percent Relative Compaction

   Not less than as specified on plans or in these specifications.

2. In-Place Moisture Content

   As required to achieve minimum relative compaction.

3. Soft or Yielding Surfaces

   Regardless of the percent compaction obtained by test, areas which are soft or yield under the load of construction equipment are to be removed and replaced at no additional cost.

1.3 Submittals

A. Materials Test Report

Report on maximum dry density and optimum moisture content, as well as gradation prior to beginning of construction.

1.4 Job Conditions

A. Soils Report

This section does not apply to this project.

PART 2 - MATERIALS

2.1 Aggregate Base

Crushed aggregate or processed natural mineral shall be clean, hard, sound and free of any detrimental quantity of soft, friable elongated or laminated pieces, organic matter or other deleterious substances. Aggregate base shall meet the following requirements:

A. Grading

ASTM C136 and ASTM C117

Sieve Size	Percent by Weight Passing
1-1/8"	100
No. 4	38-65
No. 8	25-60
No. 30	10-40
No. 200	3-12

B. Percentage of Wear

ASTM C131, maximum percentage of wear of 40 after 500 revolutions.

C. **Plasticity Index and Liquid Limit**

ASTM D4318, maximum plasticity index of 5, maximum liquid limit of 25 percent.

D. Fractured Faces

1. Maximum aggregate size of 3/4 inch or greater, at least 50 percent of aggregate retained on the No. 4 sieve, at least one fractured face.
2. Maximum aggregate size less than 3/4 inch, at least 50 percent of aggregate retained on the No.8 sieve, at least one fractured face.

PART 3 - EXECUTION

3.1 Preliminary Investigation of the Work

Verify that all of the preliminary work including clearing, grubbing, subgrade preparation and staking has been performed in accordance with the plans and specifications prior to placing aggregate base.

3.2 Base Course Placement and Compaction

A. Moisture Conditioning

Condition the base by aerating or wetting to the moisture content required to obtain the minimum percent compaction. Mix the soil such that the moisture content is uniform throughout the lift. Take care so as not to damage the subgrade below.

B. Lift Thickness

Place and compact base course lifts, 6 inches or less, in a single lift. For lifts in excess of 6 inches thick, place and compact in successive equal layers not to exceed a maximum of 6 inches.

C. Compaction

Construct base course to achieve a uniform soil structure. Compact the base course to a relative density of not less than 100 percent.

D. Base Course Tolerances

Place and compact the base course to the grade and cross sections indicated. The base course shall not vary from plan grade and cross sections by more than 1/4 inch.

E. Deficiencies

Remove and replace deficiencies prior to placement of the pavement. Deficiencies in the base course, covered by paving will be removed and replaced at no additional to the OWNER.

PART 4 - MEASUREMENT AND PAYMENT

4.1 Measurement

The quantity of aggregate base course to be paid for will be determined by measurement of the number of square yards of each thickness placed and accepted by the OWNER as complying with the drawings and specifications. The quantity shall be based on plan dimensions.

4.2 Payment

Payment will be made at the contract unit price per square yard for each thickness of aggregate base course. This price shall be full compensation for furnishing all materials, for preparing and placing these materials, and for all the labor, equipment, tools and incidentals necessary to complete the item.

See Section 00310 Bid Schedule for Bid Items.

DIVISION III
CONCRETE

SECTION 03100

CONCRETE WORK

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Concrete formwork.

B. Related Sections:
1. Section 03600 - Grout.

1.02 REFERENCES

A. American Concrete Institute (ACI):
1. 117 - Specification for Tolerances for Concrete Construction and Materials and Commentary.

1.03 SYSTEM DESCRIPTION

A. Design Requirements:
1. Design concrete forms, falsework, and shoring in accordance with local, state, and federal regulations.
2. Design forms and ties to withstand concrete pressures without bulging, spreading, or lifting of forms.

B. Performance Requirements:
1. Construct forms so that finished concrete conforms to shapes, lines, grades, and dimensions indicated on the Drawings.
2. It is intended that surface of concrete after stripping presents smooth, hard, and dense finish that requires minimum amount of finishing.
3. Provide a more, sufficient number of forms so that the work may be performed rapidly and present uniform appearance in form patterns and finish.
4. Use forms that are clean and free from dirt, debris, concrete, and similar type items. Coat with acceptable form release oil if required, prior to use or reuse.

1.04 QUALITY ASSURANCE

A. Qualifications of Formwork Manufacturers: Use only forming systems manufactured by manufacturers having a minimum of 5 years' experience, except as otherwise specified.

B. Regulatory Requirements: Install work of this Section in accordance with local, state, and federal regulations.

1.05 PROJECT CONDITIONS

A. Requirements Due to Weather Condition:
1. Removal of Formwork: Do not remove forms from concrete which has been placed when outside ambient air temperature is below 50 degrees Fahrenheit until concrete has attained specified strength as determined by test cylinders stored in field under equivalent conditions as concrete structure.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Form Ties:
1. General:
a. Provide form ties for forming system selected that are manufactured by recognized manufacturer of concrete forming equipment.
b. Do not use wire ties or wood spreaders of any form.
c. Provide ties of type that accurately tie, lock, and spread forms.
d. Provide form ties of such design that when forms are removed, they locate no metal or other material within 1-1/2 inches of the surface of the concrete.
e. Do not allow holes in forms for ties to allow leakage during placement of concrete.
2. Cone-Snap or Flat Bar Form Ties:
a. Cone-snap ties shall form a cone shaped depression in the concrete with a minimum diameter of 1 inch at the surface of the concrete and 1-1/2 inches deep.
b. Provide neoprene water seal washer which is located near the center of the concrete.
3. Taper Ties:
a. Neoprene Plugs for Taper Tie Holes: Size so that after they are driven, plugs are located, in center third of wall thickness.
b. Dry pack Mortar for Filling Taper Tie Holes:
1) Consist of mix of one part of Portland Cement to one part of plaster sand.
2) The amount of water to be added to cement-sand mix is to be such that mortar can be driven into holes and be properly compacted.
3) Admixtures or additives: Are not to be used in dry pack mortar.

B. Built-Up Plywood Forms:
   1. Built-up plywood forms may be substituted for prefabricated forming system following minimum requirements:
      a. Size and Material:
         1) Full size 4 by 8 feet plywood sheets, except where smaller pieces are able, to cover the entire area.
         2) Sheet Construction: 5-ply plywood sheets, 3/4-inch nominal, made with 100 percent waterproof adhesive, and having finish surface that is coated or overlaid with surface which is impervious to water and alkaline calcium and sodium hydroxide of cement.

      b. Wales: Minimum 2 by 4-inch lumber.
      c. Studding and Wales: Contain no loose knots and be free of warps, cups, and bows.

C. Steel or Steel Framed Forms:
   1. Steel Forms: Provide forms that are:
      a. Rigidly constructed and capable of being braced for minimum deflection of finish surface.
      b. Capable of providing finish surfaces that are flat without bows, cups, or dents.
   2. Steel Framed Plywood Forms:
      a. Provide forms that are rigidly constructed and capable of being braced.
      b. Plywood Paneling: 5-ply, 5/8-inch nominal or 3/4-inch nominal, made with 100 percent waterproof adhesive, and having finish surface that is coated or overlaid with surface which is impervious to water and alkaline calcium and sodium hydroxide of cement.

D. Incidentals:
   1. External Angles:
      a. Where not otherwise indicated on the Drawings, provided with 3/4-inch bevel, formed by utilizing true dimensioned wood or solid plastic chamfer strip on walkways, slabs, walls, beams, columns, and openings.
      b. Provide 1/4-inch bevel formed by utilizing true dimensioned wood or solid plastic chamfer strip on walkways, walls, and slabs at expansion, contraction, and construction joints.
   2. Keyways: Steel, plastic, or lumber treated with form coating, applied according to label directions.
   3. Inserts: Dovetail Anchors or Ties.
   4. Pipe Sleeves: Refer to Drawings for type, location, and sizes. All sleeves shall be made of cast iron, unless noted otherwise.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verification of Conditions:
1. Do not place any concrete until all forms have been thoroughly checked for alignment, level, strength, and to assure accurate location of all mechanical and electrical inserts or other embedded items.

3.02 INSTALLATION

A. Forms and Accessories:
1. Vertical Forms:
a. Remain in place for a minimum of 24 hours after concrete is placed.
b. If, after 24 hours, concrete has sufficient strength and hardness to resist surface or other damage, forms may be removed.

2. Other Forms Supporting Concrete and Shoring: Remain in place as follows:
a. Sides of Footings: 24 hours minimum.
b. Vertical Sides of Beams, Girders, And Similar Members: 48 hours minimum.
c. Slabs, Beams, and Girders: Until concrete strength reaches specified strength or until shoring is installed.
d. Shoring for Slabs, Beams, and Girders: Shore until concrete strength reaches specified strength.
e. Wall Bracing: Until concrete strength of beams and slabs laterally supporting wall reaches specified strength.

B. Form Ties:
1. Cone-Snap Rod and Bar Ties: Tie forms together at not more than 2-foot centers vertically and horizontally. After forms are removed from wall, fill tie holes as follows:
a. Remove form ties from surfaces.
b. Roughen cone shaped tie holes by heavy sandblasting before repair.
c. Dry pack cone shaped tie holes with dry pack mortar as specified in Section 03600.

2. Taper Ties:
a. Neoprene Plug in Taper Tie Holes: After forms and taper ties are removed from wall, plug tie holes with neoprene plug as follows:
1) Heavy sandblast and then clean tie holes.
2) After cleaning, drive neoprene plugs into each of taper tie holes with steel rod. The final location of neoprene plug shall be in center third of wall thickness. Bond neoprene plug to concrete with epoxy.
3) Locate steel rod in cylindrical recess, made in plug, during driving:

a) At no time are plugs to be driven on flat area outside cylindrical recess.

b. Dry Pack of Taper Tie Holes: After installing plugs in tie holes:

1) Coat tie hole surface with epoxy bonding agent and fill with dry pack mortar as specified in Section 03600.

a) Dry pack Mortar: Place in holes in layers with thickness no exceeding tie hole diameter and heavily compact each layer.

b) Dry pack the outside of the hole no sooner than 7 days after the inside of the hole has been dry packed.

c) Wall surfaces in area of dry packed tie holes: On the water side of water containing structures and the outside of below grade walls:

i. Cover with a minimum of 10 mils of epoxy gel.

ii. Provide epoxy gel coating on wall surfaces that extend a minimum of 2 inches past dry pack mortar filled tie holes.

iii. Provide finish surfaces that are free from sand streaks or other voids.

3. For water retaining structures, use taper ties. No other type of tie will be allowed.

C. Built-Up Plywood Forms:

1. Studding:
   a. Spaced at 16 inches or 24 inches in the center.
   b. Closer spacing may be required depending upon strength requirements of the forms, in order to prevent any bulging surfaces on faces of finished concrete work.
   c. Install studs perpendicular to grain of exterior plies of plywood sheets.
2. Wales: Form wales of double lumber material minimum size as specified in this Section.
3. Number of Form Reuses: Depends upon durability of surface coating of overlay used, and ability to maintain forms in condition such that they are, capable of producing flat, smooth, hard, dense finish on concrete when stripped.

D. Steel or Steel Framed Forms:

1. Steel Forms:
   a. Adequately brace forms for minimum deflection of finish surface.
2. Steel Framed Plywood Forms:
   a. Rigidly construct and brace with joints fitting closely and smoothly.
   b. Number of Form Reuses: Depends upon durability of surface coating or overlay used.
3. Built-Up Plywood Forms: As specified in this Section may be used in conjunction with steel forms or steel framed plywood forms for special forming conditions such as corbels and forming around items which will project through forms.

E. Bracing and Alignment of Forms:
   1. Line and Grade: Limit deviations to tolerances which will permit proper installation of structural embedded items or mechanical and electrical equipment and piping.
   2. Formwork:
      a. Securely brace, support, tie down, or otherwise hold in place to prevent any movement.
      b. Make adequate provisions for uplift pressure, lateral pressure on forms, and defection of forms.
   3. When Second Lift is Placed on Hardened Concrete: Take special precautions in formwork at top of old lift and bottom of new lift to prevent:
      a. Spreading and vertical or horizontal displacement of forms.
      b. Grout "bleeding" on finish concrete surfaces.
   4. Pipe Stubs, Anchor Bolts, and Other Embedded Items: Set in forms where required.
   5. Cracks, Openings, or Offsets At Joints in Formwork: Close those that are 1/16 inch or larger by tightening forms of by filling with acceptable crack filler.

F. Incidentals:
   1. Keyways: Construct keyways as indicated on the Drawings.
   2. Reentrant Angles: May be left square.
   3. Level Strips: Install level strips at top of wall concrete placements to maintain true line at horizontal construction joints.
   4. Inserts:
      a. Encase pipes, anchor bolts, steps, reglets, castings, and other inserts, as indicated on the Drawings or as required, in concrete.
      b. Use dovetail anchors or ties in conjunction with slots or inserts for various materials as specified under other sections of these Specifications and as may be necessary for required work.

G. Pipe and Conduit:
   1. Install pipe and conduit in structures as indicated on the Drawings, and seal with suitable materials.

H. Tolerances:
   1. Finish concrete shall conform to shapes, lines, grades, and dimensions indicated on the Drawings.
   2. The maximum deviation from true line and grade shall not exceed tolerances listed below at time of acceptance of project.
   3. General: Comply with ACI 117, paragraphs 2.0 through 2.2 and paragraphs 4.0 through 4.5, except as modified in following:
      a. Slabs:
         1) Slope: Uniformly sloped to drain when slope is indicated on the Drawings.

2) Slabs Indicated to be Level: Have maximum deviation of 1/8 inch in 10 feet without any apparent changes in grade.

b. Inserts: Set inserts to tolerances required for proper installation and operation of equipment or systems to which insert pertains.

c. Maximum Tolerances: As follows:

Item	Inches
Sleeves and Inserts	Plus 1/8 Minus 1/8
Projected Ends of Anchor Bolts	Plus 1/4 Minus 0.0
Anchor Bolt Setting	Plus 1/16 Minus 1/16

END OF SECTION

SECTION 03200

CONCRETE REINFORCEMENT

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Concrete reinforcement.

B. Related Sections:
   1. Section 03100 - Concrete Formwork.

1.02 REFERENCES

A. American Concrete Institute (ACI):
   1. SP-66- ACI Detailing Manual.
   2. 315 - Details and Detailing of Concrete Reinforcement.
   3. 318 - Building Code Requirements for Structural Concrete and Commentary.

B. American Society for Testing and Materials (ASTM):
   1. A 143 - Standard Practice for Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement.
   2. A 185 - Standard Specification for Steel Welded Wire Reinforcement, Plain for Concrete.
   3. A 615 - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
   4. A 767 - Standard Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement.
   5. E 8 - Standard Test Methods for Tension Testing of Metallic Materials.
   6. A 706 - Standard Specification for Deformed and Plain Low-Alloy Steel Bars for Concrete Reinforcement.

C. American Welding Society (AWS):
   1. D1.4 - Structural Welding Code - Reinforcing Steel.

1.03 SYSTEM DESCRIPTION

A. The Drawings contain general notes concerning amount of reinforcement and placing, details for reinforcement at wall corners and intersections, and details of extra reinforcement around openings in concrete.

1.04 SUBMITTALS

A. Shop Drawings:
   1. Shop Drawings on Reinforcing Steel:
      a. Submit to the ENGINEER reinforcing steel detail drawings in accordance with Contract Documents.
      b. Changes to Reinforcing Steel Contract Drawing Requirements:
         1) Indicate in a separate letter submitted with shop drawings any changes of requirements indicated on the drawings for reinforcing steel.
         2) Such changes will not be acceptable unless the ENGINEER has accepted such changes in writing.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Packing And Shipping:
   1. Deliver bars bundled and tagged with identifying tags.

B. Acceptance At Site:
   1. Reinforcing Bars: Deliver reinforcing bars accompanied by manufacturer's guarantee of grade.

C. Storage:
   1. All rebar shall be stored on dunnage.

1.06 SEQUENCING AND SCHEDULING

A. Bar Supports: Do not place concrete until samples and attached data of bar supports has been accepted by the ENGINEER.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Reinforcement:
   1. General: Provide reinforcing steel that is a new material, of quality specified, free from excessive rust or scale or any defects affecting its usefulness.

B. Reinforcing Bars:
   1. Reinforcing Bars to be Embedded in Concrete or Masonry: Grade 60 deformed bars conforming to ASTM A 615 except as specified in the next subparagraph.
   2. Reinforcement resisting earthquake-induced flexural and axial forces in concrete frame members and in concrete wall boundary members shall

comply with low alloy ASTM A 706. ASTM A 615 Grade 60 reinforcement may be used in these members if the following requirements are met:

a. The actual yield strength based on mill tests does not exceed the specified yield strength by more than 18,000 pounds per square inch (retest shall not exceed this value by more than an additional 3,000 pounds per square inch).
b. The ratio of the actual ultimate tensile stress to the actual tensile yield strength is not less than 1.25.

3. Hot-Dip Galvanized Reinforcing Bars:
   a. When reinforcing bars are indicated on the Drawings to be hot dip galvanized, perform such galvanizing in accordance with ASTM A 767 and ATM A 143.
   b. Galvanizing: Galvanize bars in conformance with Class 1 coating and perform galvanizing after fabrication and shearing.
4. Thread Bars:
   a. Provide thread bars having continuous rolled-in patter of thread-like deformations along entire length.
   b. Provide hex nuts and couplers for the thread bars that develop 125 percent of yield strength of bar.
   c. Thread Bars:
      1) Conform to ASTM A 615 Grade 60.
   d. Do not substitute cut threads on regular reinforcing bars for thread bars.

C. Bar Supports:
1. Reinforcement Support Chairs:
   a. Hot-dip galvanized steel. Provide hot-dip galvanized steel with plastic tips at surfaces which will be exposed to view. Use unless otherwise indicated on the Drawings.
   b. Stainless Steel was indicated on the Drawings.
   c. Provide concrete adobe blocks to support rebar associated with building foundation slabs.
   d. Other suitable material approved by ENGINEER.

D. Tie Wires: Annealed Steel.

2.02 FABRICATION

A. Shop Assembly:
1. Cut and bend bars in accordance with provisions of ACI 315 and ACI 318.
2. Bend bars cold.
3. Provide bars free from defects and kinks and from bends not indicated on the Drawings.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verification of Conditions:
   1. Reinforcing Bars:
      a. Verify that bars are new stock free from rust scale, loose mill scale, excessive rust, dirt, oil, and other coatings which adversely affect bonding capacity when placed in the work.

3.02 PREPARATION

A. Surface Preparation:
   1. Reinforcing Bars: Thin coating of red rust resulting from short exposure will not be considered objectionable. Thoroughly clean any bars having rust scale, lose mill scale, or thick rust coat.
   2. Cleaning of Reinforcement Materials: Remove concrete of other deleterious coatings from dowels and other projecting bars by wire brushing or sandblasting before bars are embedded in subsequent concrete placement.

3.03 INSTALLATION

A. Reinforcing Bars:
   1. No field bending of bars will be allowed on bars larger than #4.
   2. Welding:
      a. Weld reinforcing bars were indicated on the Drawings or acceptable to the ENGINEER.
      b. Perform welding in accordance with AWS D1.4.

B. Placing Reinforcing Bars:
   1. Accurately place bars and adequately secure them in position.
   2. Overlap bars at splices as specified or indicated on the Drawings.
   3. Unless specifically otherwise indicated on the Drawings, install bars at lap splices in contact with each other and fasten bars together with tie wire.
   4. If lap splice length for bars in concrete is not specified or indicated on the Drawings, bars shall be lap spliced in accordance with ACI 318.
   5. Bar Supports:
      a. Provide a sufficient number to prevent sagging and to support loads during construction, but in no case less than quantities and at locations as indicated in ACI 315.
      b. Support reinforcing for concrete places on ground by standard manufactured chairs, with steel plates for resting on ground.
      c. Do not use brick, broken concrete masonry units, spalls, rocks, or similar material for supporting reinforcing steel.
   6. If not indicated on the Drawings, provide protective concrete cover in accordance with ACI 318.

C. Tying of Bar Reinforcement:
   1. Fasten bars securely in place with wire ties.
   2. Tie bars sufficiently often to prevent shifting.
   3. There shall be at least 3 ties in each bar length (do not apply to dowel lap splices or to bars shorter than 4 feet, unless necessary for rigidity).
   4. Tie slab bars at every intersection around periphery of slab.
   5. Tie wall bar and slab bar intersections other than around periphery at not less than every fourth intersection, but at not greater than following maximum spacing:

Bar Size	Slab Bars Spacing (Inches)	Wall Bars Spacing (Inches)
Bars Number 5 and Smaller	60	48
Bars Number 6 through Number 9	96	60
Bars Number 10 and Number 11	120	96

   6. After tying wire ties, bend ends of wire ties in towards the center of the concrete section. Wire ties shall conform to the cover requirements of the reinforcing bars.

D. Lap Splices of Reinforcing Bars:
   1. Where bars are to be lapped spliced at joints in concrete, ensure bars project from concrete first placed, minimum length equal to lap splice length indicated on the Drawings.
   2. Where lap splice length is not indicated on the Drawings, then provide lap splice length as specified in ACI 318 and this Division.

E. Welded Wire Fabric Reinforcement:
   1. Install necessary wiring, spacing chairs, or supports to keep welded wire fabric in place while concrete is being placed.
   2. Bend fabric as indicated on the Drawings or required to fit work.
   3. Unroll or otherwise straighten fabric to make a perfectly flat sheet before placing it in the Work.
   4. Lap splice welded wire fabric as indicated on the Drawings.
   5. If lap splice length is not shown on the Drawings, splice fabric in accordance with ACI 318.

END OF SECTION

SECTION 03300

CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes: Cast-in-place concrete.

B. Related Sections:
1. Section 03100 - Concrete Formwork.
2. Section 03200 - Concrete Reinforcement.

1.02 REFERENCES

A. American Concrete Institute (ACI):
1. 318 - Building Code Requirements for Structural Concrete and Commentary.
2. Manuals of Concrete Practice.
3. Recommended Practices.

B. American Society for Testing and Materials (ASTM):
1. C 31 - Standard Test Practice for Making and Curing Concrete Test Specimens in the Field.
2. C 33 - Standard Specification for Concrete Aggregates.
3. C 39 - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
4. C 40 - Standard Test Method for Organic Impurities in Fine Aggregates for Concrete.
5. C 42 - Standard Test Method of Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
6. C 88 - Standard Test Method of Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate.
7. C 94 - Standard Specification for Ready-Mixed Concrete.
8. C 114 - Standard Test Methods for Chemical Analysis of Hydraulic Cement.
9. C 117 - Standard Test Method for Materials Finer Than 75-μm (No. 200) Sieve in Mineral Aggregates by Washing.
10. C 123 - Standard Test Method for Lightweight Particles in Aggregate.
11. C 131 - Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
12. C 136 - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.

13. C 142 - Standard Test Method for Clay Lumps and Friable Particles in Aggregates.
14. C 143 - Standard Test Method for Slump of Hydraulic Cement Concrete.
15. C 150 - Standard Specification for Portland Cement.
16. C 157 - Standard Test Method for Length Change of Hardened Hydraulic-Cement Mortar and Concrete.
17. C 172 - Standard Practice for Sampling Freshly Mixed Concrete.
18. C 173 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method.
19. C 203 - Standard Test Methods for Breaking Load and Flexural Properties of Block-Type Thermal Insulation.
20. C 227 - Standard Test Method for Potential Alkali Reactivity of Cement-Aggregate Combinations (Mortar-Bar Method).
21. C 260 - Standard Specification for Air-Entraining Admixtures for Concrete.
22. C 1260 - Standard Test Method for Potential Alkali-Silica Reactivity of Aggregates (Mortar Bar Method).
23. C 295 - Standard Guide for Petrographic Examination of Aggregates for Concrete.
24. C 309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
25. C 311 - Standard Test Methods for Sampling and Testing Fly Ash or Natural Pozzolans for Use in Portland-Cement Concrete.
26. C 469 - Standard Test Method for Static Modulus of Elasticity and Poisson's Ratio of Concrete in Compression.
27. C 494 - Standard Specification for Chemical Admixtures for Concrete.
28. C 595 - Standard Specification for Blended Hydraulic Cements.
29. C 618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.
30. D 75 - Standard Practices for Sampling Aggregates.

1.03 DEFINITIONS

A. Alkali: Is defined to mean sum of sodium oxide and potassium oxide calculated as sodium oxide.

B. Hairline Crack: Crack with a crack width of less than 4 thousandths of an inch.

1.04 SYSTEM DESCRIPTION

A. Performance Requirements:
   1. General:
      a. Except as otherwise specified, provide concrete composed of Portland Cement, fine aggregate, coarse aggregate, and water so proportioned and mixed as to produce plastic, workable mixture in accordance with requirements as specified in this Section and suitable to specific conditions of placement.

b. Proportion materials in manner such as to secure lowest water-cement ratio which is consistent with good workability, plastic, cohesive mixture, and one which is within specified slump range.
c. Proportion fine and coarse aggregate in manner such as not to produce harshness in placing nor honeycombing in structures.

2. Watertightness of Concrete Work: It is intent of this Section to secure for every part of the Work, concrete and grout of homogeneous structure, which when hardened will have required strength, watertightness, and durability.
   a. It is recognized that some surface hairline cracks and crazing will develop in the concrete surfaces.
   b. Construction, contraction, and expansion joints have been positioned in structures as indicated on the Drawings, and curing methods specified, for purpose of reducing number and size of these expected cracks, due to normal expansion and contraction expected from specified concrete mixes.
   c. Class A and Class B Concrete: Watertight. Repair cracks which develop in walls or slabs and repair cracks which show any signs of leakage until all leakage is stopped.
   d. Pressure injects visible cracks, other than hairline cracks and crazing, in following areas with epoxy injection system:
      1) Floors and walls of water bearing structures.
      2) Walls and slabs which are exposed to weather or may be washed down and are not specified to receive separate waterproof membrane.
      3) Epoxy used for Injection: Provide epoxy materials that are new and use them within shelf-life limitations set forth by manufacturer. Water-insensitive 2-part type low viscosity epoxy adhesive material containing 100 percent solids and meeting or exceeding the following characteristics when tested in accordance with standards specified Manufacturer:
         a) Master Builders, Inc., Concessive Standard LVI.
         b) Sika Chemical Corp.'s, Sikadur 35, Hi-Mod LV.
   e. Walls or Slabs, as Specified Above, That Leak or Sweat Because of porosity or Cracks too Small for Successful Pressure Grouting: Seal on water or weather side by coatings of surface sealant system, as specified in this Section.
   f. Grouting and Sealing: Continue as specified above until structure is watertight and remains watertight for not less than one year after final acceptance or date of final repair, whichever occurs later in time.

3. Workmanship and Methods: Provide concrete work, including detailing of reinforcing, conforming with best standard practices and as set forth in ACI 318, Manuals, and Recommended Practices.

1.05 SUBMITTALS

A. Product Data: Submit data completely describing products.

B. Information on Heating Equipment to be used for Cold Weather Concreting: Submit information on type of equipment to be used for heating materials and/or new concrete in process of curing during excessively cold weather.

C. For Conditions that Promote Rapid Drying of Freshly Placed Concrete Such as Low Humidity, High Temperature, and Wind: Submit corrective measures proposed for use prior to placing concrete.

D. Copies of Tests of Concrete Aggregates: Submit certified copies in triplicate of commercial laboratory tests of all sample's concrete aggregates.
   1. On tests of concrete aggregates, indicate as minimum all specified tests.

E. Concrete Mixes: Prior to placement of concrete, submit full details, including mix design calculations for concrete mixes proposed for use for each class of concrete.
   1. Include information on correction of batching for varying moisture contents of fine aggregate.
   2. Submit source quality test records with mix design submittal.

F. If there is Change in Aggregate Source, or Aggregate Quality from Same Source: Submit new set of design mixes covering each class of concrete.

G. Batch Test Data (from supplier):
   1. Submit data for each test cylinder.
   2. Submit data that identifies mix and slump for each test cylinder.

H. Repair of defective concrete: Submit mix design for grout.

I. Acceptance of Method of Concrete Repair: Do not make any repairs until the ENGINEER has accepted method of preparing surfaces and proposed method of repair.

J. Quality Control Submittals:
   1. Certificates of Compliance:
      a. Cement: Submit certified copy of mill tests, including alkali content, representative of each shipment of cement for verification of compliance with specified requirements.
      b. Pozzolan:
         1) Submit certificates by Pozzolan supplier.
         2) Submit certificates that identify source of Pozzolan and certify compliance with requirements of ASTM C 618.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Packing and Shipping:
   1. Deliver, store, and handle concrete materials in a manner to prevent damage and inclusion of foreign substances.
   2. Deliver and store packaged materials in original containers until ready for use.
   3. Deliver aggregate to mixing site and handle in such manner that variations in moisture content will not interfere with steady production of concrete of specified degree of uniformity and slump.

B. Acceptance at Site: Reject material containers or materials showing evidence of water or other damage.

1.07 PROJECT CONDITIONS

A. Environmental Requirements:
   1. Hot Weather Conditions:
      a. When Ambient Air Temperature is Above 90 Degrees Fahrenheit: Prior to placing concrete, cool forms and reinforcing steel by water cooling to below 90 degrees Fahrenheit.
      b. Temperature of Concrete Mix at Time of Placement: Keep temperature below 90 degrees Fahrenheit by methods which do not impair quality of concrete.
   2. Cold Weather Conditions:
      a. Concrete Placed Below Ambient Air Temperature of 45 degrees Fahrenheit and falling or below 40 degrees Fahrenheit: Make provision for heating water.
      b. If Material Have Been Exposed to Freezing Temperatures to Degree That Any Material is Below 35 degrees Fahrenheit: Heat such materials.
      c. Heating Water, Cement, or Aggregate Materials:
         1) Do not heat in excess of 160 degrees Fahrenheit.
      d. Protection of Concrete in Forms:
         1) Protect by means of covering with tarpaulins, or other acceptable covering.
         2) Provide means for circulating warm moist air around forms in manner to maintain temperature of 50 degrees Fahrenheit for at least 5 days.
   3. For Conditions That Promote Rapid Drying of Freshly Placed Concrete Such As Low Humidity, High Temperature, and Wind: Take corrective measures to minimize rapid water loss from concrete:
      a. Furnish and use a sufficient number, of maximum and minimum self-recording thermometers to adequately measure temperature around concrete.

1.08 SEQUENCING AND SCHEDULING

A. Schedule placing of concrete in such manner as to complete any single placing operation to construction, contraction, or expansion joint.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Aggregate:
   1. General:
      a. Provide concrete aggregates that are sound, uniformly graded, and free of deleterious material in excess of allowable amounts specified.
      b. Grade aggregate in accordance with ASTM D 75 and C 136.
      c. Provide unit weight of fine and coarse aggregate which produces in place concrete with weight of not less than 140 pounds per cubic foot.

B. Fine Aggregate:
   1. Provide fine aggregate for concrete or mortar consisting of clean, natural sand or of sand prepared from crushed stone or crushed gravel.
   2. Do not provide aggregate having deleterious substances in excess of following percentages by weight of contaminating substances. In no case shall total exceed percent listed.

Item	Test Method	Percent
Removed by decantation (dirt, silt, etc.)	ASTM C 117	3
Shale or Chert	ASTM C 295	1
Clay Lumps	ASTM C 142	1

   3. Except as otherwise specified, grade fine aggregate from coarse to fine in accordance with requirements of ASTM C 33.

C. Coarse Aggregate:
   1. General: Provide coarse aggregate consisting of gravel or crushed stone made up of clean, hard, durable particles free from calcareous coatings, organic matter, or other foreign substances.
   2. Weight: Not exceeding 15 percent, for thin or elongated pieces having length greater than 5 times average thickness.
   3. Deleterious Substances: Not in excess of following percentages by weight, and in no case having total of all deleterious substances exceeding 2 percent.

Item	Test Method	Percent
Shale or chert	ASTM C 295	1
Coal and Lignite	ASTM C 123	1/4
Clay lumps and friable particles	ASTM C 142	1/4
Materials finer than Number 200 sieve	ASTM C 117	½*
* Except when material finer than Number 200 sieve consists of crusher dust, maximum amount shall be 1 percent.		

4. Grading:
   a. Aggregate: As specified in ASTM C 33, Size Number 57, except as otherwise specified or authorized in writing by the ENGINEER.
   b. Aggregate for Class CE Concrete for Encasement of Electrical Conduits:
      1) Graded as specified in ASTM C 33, Size Number 8.
      2) Provide concrete utilizing this aggregate equal to Class C concrete in all other respects and is designated as Class CE.

D. Portland Cement:
1. General: Conform to specifications and tests for ASTM C 150, Types II or III, Low Alkali, except as specified otherwise.
2. Low Alkali Portland: Have total alkali containing not more than 0.60 percent.
3. Exposed Concrete in Any Individual Structure: Use only one brand of Portland cement.
4. Cement For Finishes: Provide cement from same source and of same type as concrete to be finished.

E. Portland-Pozzolan Cement:
1. General: Conform to requirements of ASTM C 595, Type IP (MS).
2. Portland Cement Clinker Used In Manufacture of Portland-Pozzolan Cement: Type II low alkali as specified in Paragraph 2.01D.
3. Pozzolan Content of Portland-Pozzolan Cement: Not exceed 15 percent by weight.
4. Exposed Concrete in Any Individual Structure: Use only one brand of Portland-Pozzolan Cement.

F. Admixtures:
1. General:
   a. Do not use admixtures of any type, except as specified, unless written authorization has been obtained from the ENGINEER.

b. Compatible with concrete and other admixtures.
c. Do not use admixtures containing chlorides calculated as chloride ion in excess of 5% by weight.
d. Use in accordance with manufacturer's recommendations accordance with manufacture's recommendations and add each admixture to concrete mix separately.
e. A single manufacturer shall provide all concrete admixtures.

2. Air Entraining Admixture:
   a. Provide all concrete with 5 percent, plus or minus 1 percent, entrained air of evenly dispersed air bubbles at time of placement.
   b. Conform to ASTM C 260.
3. Fly Ash Pozzolan Admixture:
   a. Pozzolan:
      1) Adding a mixture shall conform to requirements of ASTM C618, Class F in concrete made with Type II Portland Cement.
      2) Pozzolan may replace Portland Cement at ratio of 1.0-pound fly ash for each pound of Portland Cement replaced.
      3) Maximum of 20 percent by weight of minimum quantities of Portland Cement listed in Table A under paragraph 2.03E may be replaced with Pozzolan.
      4) Do not use Pozzolan as an admixture in concrete made with Portland-Pozzolan cement.
   b. Loss on Ignition for Pozzolan: Not exceed four percent.
4. Water Reducing Admixture:
   a. May be used at the CONTRACTOR's option in all areas.
   b. Conform to ASTM C 494, Type A or Type D.
   c. Not contain air entraining agents.
   d. Liquid form before adding to the concrete mix.
   e. No decrease in cement is permitted as result of use of water reducing admixture.
5. Superplasticizers: Are not to be used without acceptance by ENGINEER.

G. Water:
1. Water for Concrete, Washing Aggregate, and Curing Concrete: Clean and free from oil and deleterious amounts alkali, acid, organic matter, or other substances.
2. Chlorides and Sulfate Ions:
   a. Water for Conventional Reinforced Concrete: Use water not containing more than 1,000 milligrams per liter of chlorides calculated as chloride ion, nor more than 1,000 milligrams per liter of sulfates calculated as sulfate ion.

H. Nonslip Abrasive:
1. Type: Aluminum oxide abrasive of size 8/16, having structure of hard aggregate, homogenous, non-glazing, rustproof, and unaffected by freezing, moisture, or cleaning compounds.

2. Manufacturers: One of the following or equal:
   a. Exolon Company, Tonawanda, New York.
   b. Abrasive Materials, Incorporated, Hillsdale, Michigan.

I. Concrete Sealer:
1. Manufacturers: One of the following or equal:
   a. Hillyard Chemical Company, St. Joseph, Missouri, SEAL 341.
   b. A. C. Horn, Inc., Horn Clear Seal EM-180.

J. Conduit Encasement Coloring Agent:
1. Color: Red color concrete used for encasement of electrical ducts, conduits, and similar type items.
2. Manufacturers: One of the following or equal.
   a. Frank D. Davis Company, Red Oxide Number 1117.
   b. I. Reiss Company, Inc., equivalent product.

K. Keyway Material: Steel, plastic, or lumber.

L. Sprayed Membrane Curing Compound: Clear type with fugitive dye conforming to ASTM C 309, Type 1D, unless noted otherwise. After curing, and if subsequent coatings or toppings are specified, the curing compound shall be removed per manufacturer's recommendations.

M. Surface Sealant System: Manufacturers: One of the following or equal:
1. Radcon Laboratories, Inc., Las Vegas, Nevada, Formula Number 7.
2. IPA Systems, Philadelphia, Pennsylvania, Duripal.

2.02 EQUIPMENT

A. Mixing Concrete:
1. Mixers may be of stationary plant, paver, or truck mixer type.
2. Provide adequate equipment and facilities for accurate measurement and control of materials and for readily changing proportions of material.
3. Mixing Equipment:
   a. Capable of combining aggregates, cement, and water within specified time into thoroughly mixed and uniform mass and of discharging mixture without segregation.
   b. Maintain concrete mixing plant and equipment in good working order and operated at loads, speeds, and timing recommended by manufacturer or as specified.
   c. Proportion cement and aggregate by weight.

B. Machine Mixing:
1. Batch plant shall be capable of controlling delivery of all material to mixer within 1 percent by weight of individual material.

2. If bulk cement is used, weigh it on separate visible scale which will accurately register scale load at any stage of weighing operation from zero to full capacity.
3. Prevent cement from coming into contact with aggregate or with water until materials are in mixer ready for complete mixing with all mixing water.
4. Procedure of mixing cement with sand or with sand and coarse aggregate for delivery to project site, for final mixing and addition of mixing water will not be permitted.
5. Retempering of concrete will not be permitted.
6. Discharge entire batch before recharging.
7. Volume of Mixed Material Per Batch: Not exceed manufacturer's rated capacity of mixer.
8. Mixers:
    a. Perform mixing in batch mixers of acceptable type.
    b. Equip each mixer with device for accurately measuring and indicating quantity of water entering concrete, and operating mechanism such that leakage will not occur when valves are closed.
    c. Equip each mixer with device for automatically measuring, indicating, and controlling time required for mixing.
        1) Interlock device to prevent discharge of concrete from mixer before expiration of mixing period.

C. Transit-Mixed Concrete:
1. Mix and deliver in accordance with ASTM C 94.
2. Total Elapsed Time between Addition of Water at Batch Plant and Discharging Completed Mix: Not to exceed 90 minutes of elapsed time. At project site shall not exceed 30 minutes.
3. Under conditions contributing to quick setting, total elapsed time permitted may be reduced by the ENGINEER.
4. Equip each truck mixer with device interlocked so as to prevent discharge of concrete from drum before required number of turns and furnish such device that is capable of counting number of revolutions of drum.
5. Continuously revolve drum after it is once started until it has completely discharged its batch:
    a. Do not admit water until drum has started revolving.
    b. Right is reserved to increase required minimum number of revolutions or to decrease designated maximum number of revolutions allowed, if necessary, to obtain satisfactory mixing. The Contractor will not be entitled to additional compensation because of such increase or decrease.

D. Other Types of Mixers:
1. In case of other types of mixers, mixing shall be as follows:
    a. Mix concrete until there is uniform distribution of materials, and discharge mixer completely before recharging.

b. Neither speed nor volume loading of mixer shall exceed manufacturer's recommendations.
c. Continue mixing for minimum of 1-1/2 minutes after all materials are in drum, and for batches larger than one cubic yard increase minimum time 15 seconds for each additional cubic yard or fraction thereof.

2.03 MIXES

A. Measurements of Materials:
1. Measure materials by weighing, except as otherwise specified or where other methods are specifically authorized in writing by the ENGINEER.
2. Furnish apparatus for weighing aggregates and cement that is suitably designed and constructed for this purpose.
3. Accuracy of Weighing Devices: Furnish devices that have capability of providing successive quantities of individual material that can be measured to within one percent of desired amount of that material.
4. Measuring or Weighing Devices: Subject to review by the OWNER and bear valid seal of the Sealer of Weights and Measures having jurisdiction.
5. Weighing Cement:
a. Weigh cement separately.
b. Cement in Unbroken Standard Packages (Sacks): Need not be weighed.
c. Bulk Cement and Fractional Packages: Weigh such cement.
6. Mixing Water: Measured by volume or by weight.

B. Concrete Proportions and Consistency:
1. Concrete Consistency and Composition:
a. Provide concrete that can be worked readily into corners and angles of forms and around reinforcement without excessive vibration and without permitting materials to segregate or free water to collect on surface.
b. Prevent unnecessary or haphazard changes in consistency of concrete.
2. Ratio of Coarse Aggregate to Fine Aggregate: Not less than 1.0 nor more than 2.0 for all concrete Classes, with exception of Class CE.
3. Aggregate:
a. Obtain aggregate from source, which has capability of providing uniform quality, moisture content, and grading during any single day's operation.
4. Concrete Mix Water to Cement Ratio, Minimum Cement Content, and Slump Range: Conform to values specified in Table A in this Section unless otherwise specified.
5. Concrete Batch Weights: Control and adjust to secure maximum yield and at all times maintain proportions of concrete mix within specified limits.
6. Mixture Modification: If required, by the OWNER, modify mixture within limits set forth in this Section.

C. Concrete Mixes:
   1. Proportioning of Concrete Mix: Proportion mixes with required average compressive strength (f' CR) as defined in Subparagraph 2.04A.
   2. Mixes:
      a. Adjusting of Water: After acceptance, do not change mixes without acceptance by ENGINEER, always, except when adjust batching of water to compensate for free moisture content of fine aggregate.
      b. Total Water Content of Each Concrete Class: Not exceed those specified in Table A in this Section.
      c. Checking Moisture Content of Fine Aggregate: Furnish satisfactory means at batching plant for checking moisture content of fine aggregate.
   3. Change in Mixes:
      a. Undertake new trial batch and test program as specified in this Section.
      b. Each New Trial Batch and Test Program: Cost of such trail batches and test program shall be borne by CONTRACTOR.

D. Hand Mixed Concrete:
   1. Perform hand mixing of concrete only when requested by the CONTRACTOR in writing and accepted by the OWNER.
   2. Prepare hand mixed concrete on watertight, level platform in batches not to exceed 1/3 cubic yard each.
   3. Aggregate:
      a. First spread required amount of coarse aggregate on platform in an even and uniform layer, and then over such aggregate spread proper proportion of fine aggregate.
      b. Combined Depth of Both Such Layers: Not be greater than one foot.
   4. Cement:
      a. First evenly spread required quantity of cement over fine aggregate.
      b. Then turn entire batch with shovels at least twice before adding water.
   5. Water:
      a. Then uniformly sprinkle or spray proper amount of water over batched materials.
      b. Then turn with shovels not less than three times before being removing from platform.

E. Classes of Concrete (See Table A on Next Page for Details):
   1. Unless specified or otherwise indicated on the Drawings: Use Class A concrete.
   2. Provide concrete consisting of six classes, referred herein as Classes A, AAA, B, C, D and CE specified in this Section and use where specified or indicated on the Drawings.
   3. Weight of Concrete Classes: Provide classes of concrete having minimum weight of 140 pounds per cubic foot.
   4. Class B Concrete: Class B concrete may be substituted for Class A concrete, if high-early strength concrete is desired by the CONTRACTOR, only in

those areas specifically accepted by ENGINEER and which do not require sulfate resistant concrete.

5. Class C Concrete: Class C concrete may be used for fill for unauthorized excavation, for thrust blocks and ground anchors for piping, for bedding of pipe, and where indicated on the Drawings.
6. Class D Concrete: Use Class D for precast concrete items.
7. Class CE Concrete: Use Class CE for electrical conduit encasements.
8. Pumped Concrete: Provide pumped concrete that complies with all requirements of this Section.
9. Do not place concrete with slump outside limits indicated in Table A.
10. Classes:
    a. Classes A, C, D, and CE Concrete: Make with Type II low alkali cement.

TABLE A - CONCRETE

Class	Specified Compressive Strength F'c at 28 Days (Pounds per Square Inch)	Maximum Net Water to Cement Ratio	Minimum Cement per Cubic Yard of Concrete by Weight (Pounds)	Slump Range (Inches)
A	4,000	0.53	564	2 to 4*
AAA	3,000	0.57	470	2 to 4*
B (Type III cement)	4,000	0.53	564	2 to 4*
C	2,500	0.71	423	3 to 6
D	4,500	0.45	658	2 to 4
CE	2,500	0.71	423	3 to 6

    b. Class B Concrete: Make with Type III low alkali cement.
    c. Admixtures: Provide admixtures as specified in this Section.

* NOTE: Slump for slabs, decks, walks, and beams shall be not more than 3-1/2 inches.

2.04 SOURCE QUALITY CONTROL

A. Tests:
    1. Concrete Mixes:
        a. After acceptance of concrete mixes, have trial batches of the accepted proposed concrete mix designs prepared by testing laboratory acceptable to the ENGINEER.
        b. Prepare trial batches by using specified cement and aggregates proposed to be used for the Work.
        c. Trial Batches: Provide batches of sufficient quantity to determine slump, workability, consistency and finishing characteristics, and to provide sufficient test cylinders.

d. Test Cylinders: Provide cylinders having six-inch diameter by 12-inch length and that are prepared in accordance with ASTM C 31 for tests specified in this Section.
e. Determine slump in accordance with ASTM C 143.
f. Test Cylinders:
    1) Test 4 cylinders for compressive strength in accordance with ASTM C 39:
        a) Test 1 cylinder at 7 days and 2 at 28 days.
        b) Establish ratio between 7 day and 28-day strength for mix. Seven-day strength may be taken as satisfactory indication of 28 day strength provided effects on concrete of temperature and humidity between 7 day and 28 day are taken into account.
    2) Average Compressive Strength of 2 Test Cylinders Tested at 28 Days: Equal to or greater than required average compressive strength F'CR on which concrete mix design is based.

2. Pozzolan:
    a. Sampling and Testing:
        1) Sample and test Pozzolan in accordance with ASTM C 311.
        2) In Computing Water-Cement Ratio and Cement Content Per Cubic Yard of Concrete: Consider cement weight to be weight of Portland cement plus 100 percent of weight of fly ash.

3. Aggregate:
    a. Testing of concrete aggregate is at CONTRACTOR's expense.
    b. Sieves:
        1) Use sieves with square openings for testing grading of aggregates.
        2) Sieve Analysis: If sieve analyses indicate significant change in materials, the ENGINEER may require that new mix design be submitted and accepted before further placing of concrete.
    c. Sample aggregate in accordance with ASTM D 75 and C 136.
    d. Fine Aggregate:
        1) Provide fine aggregate not containing strong alkali nor organic matter which gives color darker than standard color when tested in accordance with ASTM C 40.
        2) Provide aggregate having soundness complying with requirements of ASTM C 33 when tested in accordance with ASTM C 88.
        3) Provide aggregate complying with reactivity requirements of ASTM C 33 when tested in accordance with ASTM C 1260.
    e. Coarse Aggregate:
        1) Soundness when tested in accordance with ASTM C 88: Have loss not greater than 10 percent when tested with sodium sulfate.
        2) Abrasion Loss: Not exceed 45 percent after 500 revolutions when tested in accordance with ASTM C 131.
        3) Reactivity: Not exceed limits specified in Appendix of ASTM C 33 when tested in accordance with ASTM C 227.

f. Portland Cement:
   1) Determination Alkali Content: Determine by method set forth in ASTM C 114.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Conduit Encasement Concrete: Mix into each cubic yard of concrete 10 pounds of coloring agent.

B. Joints and Bonding:
   1. As far as practicable construct concrete work as monolith.
   2. Locations of contraction, construction, expansion, and other joints are indicated on the Drawings or as specified in this Section.
   3. Construction Joints:
      a. Where construction joints are not indicated on the Drawings, provide slabs and walls with construction joints at intervals not greater than 30 feet.
      b. In order to preserve strength and watertightness of structures, make no other joints, except as authorized by the ENGINEER.
      c. At construction joints, thoroughly clean concrete of laitance, grease, oil, mud, dirt, curing compound, mortar droppings, or other objectionable matter by means of sandblasting, and wash surfaces just prior to succeeding concrete placement.
      d. At Horizontal Joints: Immediately prior to resuming concrete placing operations, thoroughly spread bed of grout not less than ½ inch in thickness nor more than 1 inch in thickness over horizontal joint surfaces.
   4. Keyways in Joints:
      a. Provide keyways in joints as indicated on the Drawings.
      b. Treat lumber keyway material with form release coating, applied in accordance with manufacturer's instructions.
   5. Take special care to ensure that concrete is well consolidated around and against water stops and that water stops are secured in proper position.
   6. Cleaning of Construction Joints:
      a. Wash construction joints free of sawdust, chips, and other debris after forms and built and immediately before concrete or grout placement.
      b. Should formwork confine sawdust, chips, or other loose matter in such manner that it is impossible to remove them by flushing with water, use vacuum cleaner for their removal, after which flush cleaned surfaces with water.
      c. Provide cleanout hole at base of each wall and column for inspection and cleaning.

7. Expansion, Contraction, and Construction Joints:
   a. Constructed where and as indicated on the Drawings.
   b. Expansion Joint Material, Synthetic Rubber Sealing Compound, and Other Similar Materials: As specified in Section 07900.
8. Repair of Concrete: Where it is necessary to repair concrete by bonding mortar or new concrete to concrete which has reached its initial set, first coat surface of set concrete with epoxy bonding agent as specified in Section 03301.

C. Conveying and Placing Concrete:
1. Convey concrete from mixer to place of final deposit by methods which prevent separation or loss of materials.
2. Use equipment for chuting, pumping, and conveying concrete of such size and design as to ensure practically continuous flow of concrete at delivery end without separation of materials.
3. Design and use chutes and devices for conveying and depositing concrete that direct concrete vertically downward when discharged from chute or conveying device.
4. Keep equipment for conveying concrete thoroughly clean by washing and scraping upon completion of any day's placement.

D. Delivery of Concrete:
1. Delivery time of concrete from batch to site of placement shall not exceed 90 minutes at 90° F. The ENGINEER has the right to reject the load if it fails to meet this criteria.

E. Placing Concrete:
1. Do not place concrete without prior authorization of the ENGINEER.
2. Do not place concrete until:
   a. Reinforcement is securely and properly fastened in its correct position and loose form ties at construction joints have been retightened.
   b. Dowels, bucks, sleeves, hangers, pipes, conduits, bolts, and any other fixtures required to be embedded in concrete have been placed and adequately anchored.
   c. Forms have been cleaned and oiled prior to placement around rebar to prevent form oil from pelting on rebar.
3. Placement of concrete in which initial set has occurred, or of retempered concrete, will not be permitted.
4. Do not place concrete during rainstorms or high velocity winds.
5. Protect concrete placed immediately before rain to prevent water from having contact with such concrete or winds causing excessive drying.
6. Always keep sufficient protective covering on hand, for protection of concrete.
7. After acceptance, adhere to proposed sequence of placing concrete, except when specific changes are requested by the CONTRACTOR and accepted by the ENGINEER.

8. Notify the ENGINEER in writing of readiness, not just intention, to place concrete in any portion of the work:
    a. Provide this notification in such time in advance of operations as the ENGINEER deems necessary to make final inspection of preparations at location of proposed concrete placing.
    b. Place forms, steel, screeds, anchors, ties, and inserts in place before notification of readiness is given to the ENGINEER.
    c. Depositing Concrete:
        1) Deposit concrete at or near its final position to avoid segregation caused by rehandling or flowing.
        2) Do not deposit concrete in large quantities in one place and work along forms with vibrator or by other methods.
        3) Do not drop concrete freely into place from height greater than 4 feet.
        4) Use tremies for placing concrete on slopes, at bottom of slope.
        5) Commence placement of concrete on slopes, at bottom of slope.
9. Place concrete in approximately horizontal layers not to exceed 24 inches in depth and bring up evenly in all parts of forms.
10. Continue concrete placement without avoidable interruption, in continuous operation, until end of placement is reached. The ENGINEER reserves the right to reject the placement if a cold joint is determined to affect the structural integrity.
11. If more than 20 minutes lapse prior to placement of new concrete over concrete previously places, reduce depth of layers being placed at one time, and/or increase placing operation to previously placed concrete within 20 minutes.
12. If concrete is to be placed over previously placed concrete and more than 20 minutes have elapsed, then spread layer of grout not less than ½ inch in thickness nor more than 1 inch in thickness over surface before placing additional concrete.
13. Placement of Concrete for Slabs, Beams, or Walkways:
    a. If cast monolithically with walls or columns, do not commence until concrete in walls or columns has been allowed to set and shrink.
    b. Allow set time of not less than one hour for shrinkage.

F. Consolidating Concrete:
1. Place concrete with aid of acceptable mechanical vibrators.
2. Thoroughly consolidate concrete around reinforcement, pipes, or other shapes built into the work.
3. Provide sufficiently intense vibration to cause concrete to flow and settle readily into place and to visibly affect concrete over radius of at least 18 inches.
4. Vibrators:
    a. Always keep sufficient vibrators on hand, to vibrate concrete as placed.
    b. In addition to vibrators in actual use while concrete is being placed, have on hand minimum 1 spare vibrator in serviceable condition.

c. Do not place concrete until it has been ascertained that all vibrating equipment, including spares, are in serviceable condition.

5. Take special care to place concrete solidly against forms to leave no voids.
6. Take every precaution to make concrete solid, compact, and smooth, and if for any way defective, repair such concrete in manner acceptable to the ENGINEER.

G. Footings and Slabs on Grade:
1. Do not place concrete on ground or compacted fill until subgrade is in moist condition acceptable to the ENGINEER.
2. If necessary, sprinkle subgrade with water not less than 6 nor more than 20 hours in advance of placing concrete.
3. If it becomes dry prior to actual placing of concrete, sprinkle again, without forming pools of water.
4. Do not place concrete if subgrade is muddy or soft.

H. Curing Concrete - General:
1. Cure concrete by methods specified in this Section.
2. Cure concrete minimum of 7 days.
3. Cure concrete that is to be painted or coated with water or plastic membrane.
4. Do not use curing compound on any concrete surface that is to receive paint or upon which any material is to be bonded.
5. Water cure or plastic membrane cure concrete slabs which are specified to be sealed by concrete sealer.
6. Cure other concrete by water curing or sprayed curing membrane at the CONTRACTOR's option.

I. Water Curing:
1. Keep surfaces of concrete being water cured constantly and visibly moist day and night for period of not less than 7 days.
2. Each day forms remain in place may count as 1 day of water curing.
3. No further curing credit will be allowed for forms in place after contact has once been broken between concrete surface and forms.
4. Do not loosen form ties during period when concrete is being cured by leaving forms in place.
5. Flood top of walls with water at least 3 times per day and always keep concrete surfaces moist, for a 7-day curing period.

J. Sprayed Membrane Curing:
1. Apply curing compound to concrete surface after repairing and patching, and within 1 hour after forms are removed.
2. If more than one-hour elapses after removal forms, do not use membrane curing compound, but apply water curing for full curing period.
3. If surface requires repairing or painting, water cure such concrete surfaces.
4. Curing Compound:
   a. Do not remove curing compound from concrete in less than 7 days.

b. Curing compound may be removed only upon written required by the CONTRACTOR and acceptance by the ENGINEER, stating what measures are to be performed to adequately cure structures.
c. Take care to apply curing compound in area of construction joints to see that curing compound is placed within construction joint silhouette.
d. Remove curing compound placed within construction joint silhouette by heavy sandblasting prior to placing any new concrete:
    1) CONTRACTOR's Option: Instead of using curing compound for curing of construction joints such joints may be water cured.
e. Apply curing compound by mechanical, power operated sprayer and mechanical agitator that will uniformly mix all pigment and compound.
f. Apply compound in at least 2 coats.
g. Apply each coat in direction 90 degrees to preceding coat.
h. Apply compound in sufficient quantity so that concrete has uniform appearance, and that natural color is effectively and completely concealed at time of spraying.
i. Continue to coat and recoat surfaces until specified coverage is achieved and until coating film remains on concrete surfaces.
j. Thickness And Coverage of Compound: Provide compound having film thickness that can be scraped from surfaces at all points after drying for at least 24 hours.
k. The CONTRACTOR is cautioned that the method of applying curing compound specified herein may require more compound than normally suggested by manufacturer of compound and also more than is customary in the trade.
l. Apply amounts specified herein, regardless of manufacturer's recommendations or customary practice, if curing compound is used in place of water curing.
m. If the CONTRACTOR desires to use curing compound other than specified compound, coat sample areas of concrete wall with proposed compound also similar adjacent area with specified compound in specified manner for comparison:
    1) If proposed sample is not equal or better, in opinion of the ENGINEER, in all features, proposed substitution will not be allowed.
n. Prior to final acceptance of the work, remove, by sandblasting or other acceptable method, any curing compound on surfaces exposed to view, so that only natural color of finished concrete is visible uniformly over entire surface.

K. Plastic Membrane Curing:
1. Polyethylene film may be used to cure slabs. Seal joint and edges with small sand berm.
2. Install plastic membrane as soon as concrete is finished and can be walked on without damage. Keep concrete moist under plastic membrane.

3.02 CONCRETE FINISHING

A. Provide smooth troweled finish for all process basins and containment structures.

B. Edges of Joints:
   1. Provide joints having edges as indicated on the Drawings.
   2. Protect wall and slab surfaces at edges against concrete spatter and thoroughly clean upon completion of each placement.

3.03 FIELD QUALITY CONTROL

A. Testing of Concrete:
   1. During progress of construction, the CONTRACTOR shall have tests made to determine whether the concrete, as being produced, complies with requirements specified.
   2. Tests will be performed in accordance with ASTM C 31, ASTM C 39, and ASTM C 172.
   3. The testing laboratory will make and deliver test cylinders to the laboratory and testing expense will be borne by the CONTRACTOR.
   4. Required Number Cylinders:
      a. Not less than four-cylinder specimens, 6-inch diameter by 12 inch long, will be tested for each 150 cubic yards of each class of concrete with minimum of four specimens for each class of concrete placed and not less than four specimens for each half day's placement.
      b. One cylinder will be broken at 7 days and 2 at 28 days.
   5. The CONTRACTOR shall:
      a. Test slump of concrete using slump cone in accordance with requirements of ASTM C 143.
      b. Furnish test equipment.
      c. Do not use concrete that does not meet specification requirements regarding slump but remove such concrete from project site.
      d. Test slump at the beginning of each placement, as often as necessary to keep slump within the specified range, and when requested to so by the ENGINEER.
      e. Make provisions for and furnish concrete for test specimens and provide manual assistance to the testing laboratory in preparing said specimens.
      f. Assume responsibility for care of and providing of curing conditions for test specimens in accordance with ASTM C 31.

B. Air Entraining Admixture:
      a. Test percent of entrained air in concrete at beginning of each placement, as often as necessary to keep entrained air within specified ranges, and when requested to do so by the ENGINEER.
      b. Provide test equipment.
      c. Do not use concrete that does not meet Specification requirements as to air entrainment and shall remove such concrete from project site.

d. Test air entrainment in concrete in accordance with ASTM C 173.

C. Enforcement of Strength Requirement:
1. Concrete is expected to reach higher compressive strength than that which is indicated in Table A as specified compressive strength F'c.
2. Strength Level of Concrete: Will be considered acceptable if following conditions are satisfied.
a. Averages of all sets of 3 consecutive strength test results is greater or equal to specified compressive strength F'c.
b. No individual strength test (average of 2 cylinders) falls below specified compressive strength F'c by more than 500 pounds per square inch.
c. Whenever one, or both, of 2 conditions stated above is not satisfied, provide additional curing of affected portion followed by cores taken in accordance with ASTM C 42 and ACI 318 and comply with following requirements:
1) If additional curing does not bring the average of 3 cores taken in affected area to at least specified compressive strength F'c, designate such concrete in affected areas defective.
2) The ENGINEER may require the CONTRACTOR to strengthen defective concrete by means of additional concrete, additional reinforcing steel, or replacement of defective concrete, all the CONTRACTOR's expense.

3.04 ADJUSTING

A. Repair of Defective Concrete:
1. Remove and replace or repair defective work.
2. Correct defective work as specified in this Article.
3. Do not patch, repair, or cover defective work without inspection by the ENGINEER.
4. Provide repairs having strength equal or greater than specified concrete for area involved:
a. Chip out and key imperfections in the work and make them ready for repair.
5. Dry-Pack Method:
a. Dry Pack Method: Use for holes having depth nearly equal to or greater than least surface dimension of hole, for cone-bolt, and narrow slots cut for repair.
b. Smooth Holes: Clean and roughen by heavy sandblasting before repair.
6. Mortar Method of Replacement: Use for following:
a. Holes too wide to dry pack and too shallow for concrete replacement.
b. Comparatively shallow depressions, large or small, which extend no deeper than reinforcement nearest surface.
7. Concrete Replacement:

a. Use: When holes extend entirely through concrete section or when holes are more than 1 square foot in area and extend halfway or more through the section.
b. Method of Repair For Surfaces of Set Concrete to be Repaired: First coat with epoxy bonding agent.

8. Acceptable Method of Concrete Repair:
   a. Make no repair until the ENGINEER has accepted method of preparing surfaces and proposed method of repair.

END OF SECTION

DIVISION V
METALS

SECTION 05052
ANCHOR BOLTS, TOGGLE BOLTS
AND CONCRETE INSERTS

PART 1 - GENERAL

1.01 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown on the Drawings, specified, and required to furnish and install anchor bolts, toggle bolts and concrete inserts.

B. This Section includes all anchor bolts, toggles and inserts required for the Work, but not specified under other Sections.

C. The types of Work using the anchor bolts, toggles and inserts include, but are not limited to the following:

1. Hangers and brackets.
2. Equipment.
3. Piping.
4. Electrical and Plumbing Work.
5. Metal and plastic fabrications.
6. Structural members and accessories.

D. Related Sections: CONTRACTOR shall coordinate the requirements of the Work in this Section along with the requirements of the Sections listed below which includes, but is not necessarily limited to, Work that is directly related to this Section.

1.02 QUALITY ASSURANCE

A. Reference Standards: Comply with the applicable provisions and recommendations of the following, except as otherwise shown and specified.

1. ASTM A36M-14 - Standard Specification for Carbon Structural Steel.
2. ASTM A123M-17 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
3. ASTM A153M-16a - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
4. ASTM A307-14e1 - Standard Specification for Carbon Steel Bolts, Studs and Threaded Rod 60,000 psi Tensile Strength.

5. ASTM A484M-18a - Standard Specification for General Requirements for Stainless Bars, Billets and Forgings.
6. ASTM A536-84(2019)e1 - Standard Specification for Ductile Iron Castings.
7. ASTM B633-19 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel.
8. ASTM F593-17 - Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
9. Federal Specification FF-S-325 - Shield Expansion; Nail Expansion; and Nail, Drive Screw (Devices, Anchoring, Masonry).
10. Federal Specifications WW-H-171E - Hangars and Support, Pipe.
11. ICBO, International Conference of Building Officials.
12. International Building Code.

B. Inserts shall be ICBO, UL or FM approved.

C. Toggle Bolts: Federal Specification FF-B-588C - Type I, Class A, Style 1.

1.03 SUBMITTALS

A. Shop Drawings: Submit for approval the following:

1. Copies of manufacturer's specifications, load tables, dimension diagrams and installation instructions for the devices.
2. Copies of ICBO, UL or FM Reports certifying load carrying capacities and installation requirements for the anchorage devices.

PART 2 - PRODUCTS

2.01 DESIGN CRITERIA

A. When the size, length or load carrying capacity of an anchor bolt, toggle bolt, or concrete insert is not shown on the Drawings, provide the following:

1. For anchor bolts (cast-in-place), provide the size, length and capacity required to carry the design load based on the values and requirements given in the International Building Code.
2. For concrete anchors (epoxy adhesive types), stud type expansion anchors, and concrete inserts, provide the size, length, type, and capacity required to carry the design load based on the values and requirements given in the ICBO Evaluation Report, or similar certifications by UL or FM, for the anchor to be used. Alternately the capacity may be based on independent testing lab capacities for tension and shear strength using a minimum safety factor of four. Consideration of reduced capacity due to spacing and edge distance shall be made.

B. Determine design loads as follows:

1. For equipment anchors, use the design load recommended by the equipment manufacturer.
2. For pipe hangers and supports, use the total weight of pipe, fittings, and water contained in pipe, plus the full weight of valves and accessories located between the hanger or support in question.
3. Allowances for vibration shall be included.
4. Concrete anchors shall develop ultimate shear and pull-out loads of not less than the following values in 4,000 psi concrete:

Bolt Diameter (Inches)	Min. Shear (Pounds)	Min. Pull-Out Load (Pounds)
½	5,000	7,600
5/8	8,000	12,000
3/4	11,500	17,000
7/8	15,700	20,400
1	20,500	28,400

2.02 APPLICATION

A. In masonry, only anchor bolts shall be used.

B. Anchor Bolts (cast-in-place):
1. Shall be used where indicated and may be used where concrete anchors are indicated.
2. Where an anchor bolt is indicated, only a cast-in-place anchor bolt shall be used, unless another anchor type is accepted by the ENGINEER.
3. Provide anchor bolts as shown on the Drawings or as required to secure structural steel to concrete or masonry.

C. Epoxy Adhesive Anchors:

1. Use where subject to vibration or where buried or submerged.
2. Use for pipe supports.
3. Use in concrete.
4. Shall not be used for pipe hangers.

D. Concrete Inserts:

1. Use only where indicated on the Drawings.
2. Use for pipe hangers and supports for the pipe size and loading recommended by the insert manufacturer.

E. Toggle Bolts:

1. Use for fastening brackets and other elements onto masonry units.

F. Stud Type Expansion Anchors:

1. Use only when indicated on the Drawings.

2.03 MATERIALS

A. Anchor Bolts:

1. Provide carbon steel bolts complying with ASTM A 307 - headed or non-headed type where indicated.
2. In buried or submerged locations, provide stainless steel bolts complete with washers complying with ASTM F 593 - AISI Type 316 and with Nitronic 60 stainless steel nuts and locknuts.
3. For equipment, provide anchor bolts, which meet the equipment manufacturer's recommendations for size, material, and strength.
4. Provide anchor bolts as shown on the Drawings or as required to secure structural steel to concrete or masonry.
5. Locate and accurately set the anchor bolts using templates or other devices as required.
6. Protect threads and shank from damage during installation of equipment and structural steel.
7. Comply with manufacturer’s required embedment length and necessary anchor bolt projection.

B. Epoxy Adhesive Anchors:

1. Provide stainless steel adhesive anchors complying with ASTM F 593 - AISI Type 316 with Nitronic 60 stainless steel nuts and locknuts.
2. In buried or submerged locations, provide stainless steel adhesive anchors complying with ASTM F 593 - AISI Type 316 with Nitronic 60 stainless steel nuts and locknuts.
3. Anchors shall be of the size required for the concrete strength specified.

4. Adhesive anchors shall consist of threaded rods or bolts anchored with an adhesive system into hardened concrete or grout-filled masonry. The adhesive system shall use a two-component adhesive mix and shall be injected with a static mixing nozzle following manufacturer's instructions. The embedment depth of the rod/bolt shall provide a minimum allowable bond strength that is equal to the allowable tensile capacity of the rod/bolt, unless noted otherwise on the Drawings.
5. Product and Manufacturer: Provide one of the following:
   a. RE 500 Epoxy Injection Adhesive Anchor System, as manufactured by Hilti.
   b. Or equal.

C. Concrete Inserts:

1. For piping, grating and floor plate, provide malleable iron inserts. Comply with Federal Specification WW-H-171E (Type 18). Provide those recommended by the manufacturer for the required loading.
2. The finish shall be black.
3. Product and Manufacturer: Provide inserts by one of the following:
   a. Figure 282, as manufactured by ITT Grinnell.
   b. No. 380, as manufactured by Hohmann and Barnard, Incorporated.
   c. Or equal.

D. Toggle Bolts:

1. Provide spring-wing toggle bolts, with two-piece wings.
2. Provide carbon steel bolts with zinc coating in accordance with Federal Specification FF-S-325.
3. Product and Manufacturer: Provide toggle bolts by one of the following:
   a. The Rawlplug Company, Incorporated.
   b. Haydon Bolts, Incorporated.
   c. Or equal.

E. Stud Type Expansion Anchors:
1. Product and manufacturer
   a. Kwik-Bolt 3.
   b. Or equal.

F. Powder activated fasteners and other types of bolts and fasteners not specified herein shall not be used.

PART 3 - EXECUTION

3.01 INSPECTION

A. CONTRACTOR shall examine areas and conditions under which anchor bolts, toggle bolts and concrete insert Work is to be installed.

3.02 INSTALLATION

A. Assure that embedded items are protected from damage and are not filled in with concrete.

B. Use concrete inserts for pipe hangers and supports for the pipe size and loading recommended by the insert manufacturer.

C. Use toggle bolts for fastening brackets and other elements onto masonry units.

D. For the epoxy adhesive anchors and adhesive material, CONTRACTOR shall comply with the manufacturer's installation instructions on the hole diameter and depth required to fully develop the tensile strength of the adhesive anchor or reinforcing bar. The contractor shall properly clean out the hole utilizing a wire brush and compressed air to remove all loose material from the hole, prior to installing adhesive capsules or material.

3.03 CLEANING

A. After embedded concrete is placed, remove protection and clean bolts and inserts.

END OF SECTION

SECTION 05500
METAL FABRICATIONS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. The following shop fabricated steel and aluminum items, including:

1. Cage Ladders
2. Bollards.
3. Gates.
4. Sheet Metal Fabrications.
5. Miscellaneous Steel and Aluminum Shapes.
6. Metal Strut Framing Components.
7. Stud Anchors, Chemical Anchors, Expansion Anchors, and Miscellaneous Fasteners.

1.02 RELATED REQUIREMENTS

A. Section 03300 - Cast-in-Place Concrete: Placement of metal fabrications in concrete.

B. Section 07411 – Preformed Metal Roof Panels: Gutters and downspouts

C. Section 09900 - Painting and Coating: Paint finish.

1.03 REFERENCE STANDARDS

A. ASTM A36/A36M-14 - Standard Specification for Carbon Structural Steel.

B. ASTM A53/A53M-18 - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.

C. ASTM A108-18 - Standard Specification for Steel Bars, Carbon, Cold Finished.

D. ASTM A123/A123M-17 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

E. ASTM A153/A153M-18 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

F. ASTM A276/A276M-17 - Standard Specification for Stainless Steel bars and Shapes.

G. ASTM A283/A283M-18 - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates.

H. ASTM A307-14e1 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60,000 PSI Tensile Strength.

I. ASTM A500/A500M-18 - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.

J. ASTM A575-96(2018) Standard Specification for Steel Bars, Carbon, Merchant Quality, M-Grades.

K. ASTM A576-17 Standard Specification for Steel Bars, Carbon, Hot-Wrought, Special Quality.

L. ASTM A635/A635M-15 - Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Hot-Rolled, Alloy, Carbon, Structural, High-Strength Low-Alloy, and High-Strength Low-Alloy with Improved Formability, General Requirements for.

M. ASTM A653/A653M-18 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvanized) by the Hot-Dip Process.

N. ASTM A666-15 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.

O. ASTM A1011/A1011M-18a - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength.

P. ASTM B117-18 - Standard Practice for Operating Salt Spray (Fog) Apparatus.

Q. ASTM B209-14 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.

R. ASTM B209M-14 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate [Metric].

S. ASTM B210/B210M-19 - Standard Specification for Aluminum and Aluminum-Alloy Drawn Seamless Tubes.

T. ASTM B211/B211M-19 - Standard Specification for Aluminum and Aluminum-Alloy Rolled or Cold Finished Bar, Rod, and Wire.

U. ASTM B221-14 - Standard Specification for Aluminum and Aluminum-Alloy

Extruded Bars, Rods, Wire, Profiles, and Tubes.

1. ASTM B221M-13 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes [Metric].

V. ASTM C1107/C1107M-17 - Standard Specification for Packaged, Dry, Hydraulic-Cement Grout (Non-shrink).

W. ASTM E488/E488M-18 - Standard Test Methods for Strength of Anchors in Concrete Elements.

X. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination; American Welding Society; 2012.

Y. AWS D1.1/D1.1M - Structural Welding Code - Steel; American Welding Society; 2015.

Z. AWS D1.2/D1.2M - Structural Welding Code - Aluminum; American Welding Society; 2007, and Errata 2004.

AA. SSPC-Paint 15 - Steel Joist Shop Primer; Society for Protective Coatings; 1999 (Ed. 2004).

BB. SSPC-Paint 20 - Zinc-Rich Primers (Type I, "Inorganic," and Type II, "Organic"); Society for Protective Coatings; 2002 (Ed. 2004).

CC. SSPC-SP 2 - Hand Tool Cleaning; Society for Protective Coatings; 2018.

1.04 SUBMITTALS

A. See Section 01300 for submittal procedures.

B. Product Data: Provide data for the following.

C. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, elevations, and details where applicable.

1. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.
2. Gates: Indicate materials, dimensions, connections, and screen wall locations.

D. Welders' Certificates: Submit certification for welders employed on the project, verifying AWS qualification within the previous 12 months.

PART 2 - PRODUCTS

2.01 MATERIALS – STEEL

A. Steel Sections: ASTM A36/A36M.

B. Steel Tubing: ASTM A500, Grade B cold-formed structural tubing.

C. Bars: ASTM A 36/A 36M.

D. Plates: ASTM A283.

E. Pipe: ASTM A 53, Standard Weight, black finish.

F. Stud Anchors: ASTM A 108, Grade 1015.

1. Product and Manufacturer: S3L, TRW Nelson Stud Welding Division; www.nelsonstudwelding.com or approved equal.

G. Bolts, Nuts, and Washers: ASTM A307.

H. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.

I. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.

J. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, Type I - Inorganic, complying with VOC limitations of authorities having jurisdiction.

2.02 SHEET MATERIALS

A. Galvanized Steel Sheet: ASTM A 653/A 653M, with G90/Z275 zinc coating; gage as indicated.

1. If gage is not indicated provide 16 gage sheets.

B. Stainless Steel Sheet: ASTM A 666 Type 304, soft temper, 0.015 inch thick; smooth No. 4 finish.

2.03 MATERIALS – ALUMINUM

A. Aluminum Plates, Shapes and Bars: ASTM B 308.

B. Extruded Aluminum: ASTM B221 (ASTM B221M), 6063 alloy, T5 temper.

C. Sheet Aluminum: ASTM B209 (ASTM B209M), 5052 alloy, H32 or H22 temper.

D. Aluminum-Alloy Drawn Seamless Tubes: ASTM B210 (ASTM B210M), 6063 alloy, T6 temper.

E. Aluminum-Alloy Bars: ASTM B211 (ASTM B211M), 6061 alloy, T6 temper.

F. Bolts, Nuts, and Washers: Stainless steel.

G. Welding Materials: AWS D1.2/D1.2M; type required for materials being welded.

2.04 ANCHORS

A. Anchors with capability to sustain, without failure, load imposed within factors of safety indicated, as determined by testing per ASTM E 488, conducted by a qualified independent testing agency; designed for use in concrete and masonry.

1. Expansion Anchors: Stud type zinc plated carbon steel expansion anchor with a single piece wedge.

a. Location: Provide only at locations specifically indicated to receive expansion anchors.

2. Threaded Inserts: Internally threaded, flush mounted, expansion type zinc-plated carbon steel.
3. Chemical Anchors: Two-component injectable adhesive type.

2.05 METAL STRUT FRAMING MATERIALS

A. Metal Strut Framing System: Structural support system with capability to sustain, without failure, imposed loads; consisting of channels, angles, tubes, and accessories as recommended by manufacturer for application indicated.

1. Channels: Cold formed from structural grade steel conforming to ASTM A570, GR 33 or ASTM A 653, GR 33.
2. Fittings: Fabricated from steel conforming to ASTM A 36, ASTM A 575, ASTM A576, or ASTM A 635.
3. Accessories: Manufacturer's standard nuts, bolts, washers, clamps, hangers, plates, fittings, brackets, threaded rod, inserts, splices, and other fabrications as recommended by manufacturer.

B. Finish components in accordance with one of the following:

1. Rust-inhibiting acrylic enamel paint, thoroughly baked; conforming to ASTM B 117.
2. Zinc-coated by the hot-dipped process prior to roll-forming, G90 conforming to ASTM A 653.
3. Zinc coated after all manufacturing, conforming to ASTM A 123 or ASTM A 153.

C. Product and Manufacturer: Unistrut Metal Framing, Unistrut Corporation, Division of Tyco International LTD: www.unistrut.com or approved equal.

2.06 GROUT AND ANCHORING CEMENT

A. Nonshrink, Nonmetallic Grout: Premixed, factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.

2.07 FABRICATION

A. Fit and shop assemble items in largest practical sections, for delivery to site.

B. Fabricate items with joints tightly fitted and secured.

C. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.

D. Exposed Mechanical Fastenings: Flush countersunk screws or bolts; unobtrusively located; consistent with design of component, except where specifically noted otherwise.

E. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

2.08 FABRICATED ITEMS

A. Cage Ladders: Aluminum, in compliance with ANSI A14.3, with extruded heavy-duty tubular side rails, safety cage, ladder platform, cleats, mounting brackets and attachments; Mill finish

1. Product and Manufacturer: 531 Heavy Duty Tubular Rail Access Ladder, O'Keeffe's, Inc.; www.okeeffes.com or approved equal.
2. Ladder Bottom Support: Manufacturer's standard support bracket designed to anchor bottom of ladder to wall.

a. Product and Manufacturer: Alternate Bottom Bracket, O'Keeffe's, Inc.; www.okeeffes.com or approved equal.

3. Ladder Safety Post: Factory assembled telescoping post, designed for mounting to fixed ladder, complete with brackets, hardware, and fasteners.
   a. Factory Finish: Mill finish aluminum.
   b. Product and Manufacturer: Model LU-4, The Bilco Company: www.bilco.com or approved equal.

B. Gates: Steel tubing assembly as detailed; prime paint finish; welded construction with butt joints; drill and tap units to receive hardware, anchors, and similar items.

1. Leaves: Steel tube frame as detailed.
2. 2. Infill Panels: 3/4 inch center to center, woven carbon steel, 10 gage wire mesh, welded to infill channels.
   a. Infill Channels: 1-1/4 x 1-1/4 x 1/8 inch steel channels as detailed, welded to steel tube frame.
3. Jambs: Structural steel tubes of sizes indicated; fill steel tubes with concrete in field and strike flush with top of tube.

   a. Stud Anchors: Provide at quarter points of steel tubes in contact with concrete foundation, spaced vertically 24 inches on center; locate studs in staggered arrangement with 12 inch vertical spacing from adjacent quarter point.

4. Gate Hinges: Two pieces, nominal 4 inch high assembly, tooled from 1-1/2 inch diameter solid steel bars; with flat edge for welded connection to gate frame and steel tube (jamb).

   a. Male (top) piece: Non-removable, 1 inch diameter x 1 inch long solid steel pin, tooled from 1-1/2 inch diameter x 1-1/2 inch long solid steel bar; provide flat edge on side of pin head for welding to gate frame.
   b. Female (bottom) piece: Non-removable, 1-1/2 inch long solid steel bar with tooled 1-1/16 inch diameter x 1-1/8 inch deep hole to receive pin of male piece; provide flat edge alongside of bar for welding to steel tube (jamb).
   c. Position hinges on jambs to allow gate leaves to open 90 degrees, minimum.

5. Gate Hasp: Two pieces, non-removable, welded to gate frames.

   a. Hasp: 1/4 inch thick x 2 inch high steel plate with tooled opening to receive staple; welded to gate frame.
   b. Staple: 3/16 inch diameter, U-shaped steel rod, aligned with tooled opening on hasp; configured to provide an opening to receive a 1/2 inch diameter padlock when gate is closed; welded to gate frame.

6. Cane Bolts: Non-removable, 1/2 inch diameter L-shaped steel rod, with 6-1/2 inch long handle; fabricated to slide through two pipe guides; and to rest on a keeper stud during closing and opening operations; provide one cane bolt for each gate leaf.

   a. Pipe guides: For each cane bolt provide two, 6 inch long x 5/8 inch inside diameter steel pipes welded to gate frame; locate approximately 24 inches on center vertically.
   b. Keeper studs: For each cane bolt provide one, 1/2 inch diameter x 1 inch long keeper stud welded to gate frame approximately 6 inches above upper pipe guide; locate to allow leg of cane bolt to rest on keeper stud during closing and opening of gate leaves.
   c. Sleeves: Galvanized steel pipe sleeves whose inside diameter is sized for close fit with cane bolts, anchored into concrete

C. Bollards: Steel pipe, with stud anchors, concrete filled, flush concrete cap, as detailed.

1. Diameter: 6-inch.

D. Gutters and Downspouts: Refer to Section 07411.

2.09 FINISHES – STEEL

A. Prime paint all steel items.

1. Exceptions: Galvanized items indicated.
2. Exceptions: Do not prime surfaces in direct contact with concrete, where field welding is required, and items to be covered with sprayed fireproofing.

B. Prepare surfaces to be primed in accordance with SSPC-SP2.

C. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.

D. Prime Painting: One coat.

1. Provide shop primer compatible with specified field-applied topcoats.

E. Galvanizing of Structural Steel Members: Galvanize after fabrication to ASTM A123/A123M requirements. Provide minimum 2.0 oz/sq ft galvanized coating.

F. Galvanizing of Non-structural Items: Galvanize after fabrication to ASTM A123/A123M requirements.

G. Stainless Steel Bars and Shapes: ASTM A 276, Type 304 finish.

H. Stainless Steel Plate: ASTM A 276, Type 304 finish.

I. Stainless Steel Sheet: ASTM A 666 Type 304, soft temper, 0.015 inch thick; smooth No.4 finish.

J. Finish Painting: Refer to Section 09 9000.

2.10 FABRICATION TOLERANCES

A. Squareness: 1/8 inch maximum difference in diagonal measurements.

B. Maximum Offset Between Faces: 1/16 inch.

C. Maximum Misalignment of Adjacent Members: 1/16 inch.

D. Maximum Bow: 1/8 inch in 48 inches.

E. Maximum Deviation from Plane: 1/16 inch in 48 inches.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that field conditions are acceptable and are ready to receive work.

3.02 PREPARATION

A. Clean and strip primed steel items to bare metal where site welding is required.

B. Supply setting templates to the appropriate entities for steel items required to be cast into concrete or embedded in masonry.

3.03 INSTALLATION

A. Install items plumb and level, accurately fitted, free from distortion or defects.

B. Provide for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.

C. Field weld components indicated on shop drawings.

D. Perform field welding in accordance with AWS D1.1/D1.1M.

E. Obtain approval prior to site cutting or making adjustments not scheduled.

F. After erection, prime welds, abrasions, and surfaces not shop primed.

G. Ladders: Install in accordance with manufacturer's recommendations.

H. Ladder Safety Posts: Install in accordance with manufacturer's recommendations.

I. Metal Strut Framing Components: Install in accordance with manufacturer's recommendations.

J. Anchors: Provide anchorage devices and fasteners where necessary for securing metal fabrications; including, but not limited to: chemical anchors, expansion anchors, threaded inserts, toggle bolts, through-bolts, dowels, threaded rod, lag-bolts, and anchor bolts, and other connections as required to provide for loads; Install in accordance with manufacturer's instructions.

K. Gate Hinges: Apply white lithium grease to hinge pins prior to assembly; after hinges have been welded in place; remove excess grease prior to field painting.

3.04 TOLERANCES

A. Maximum Variation from Plumb: 1/4 inch per story, non-cumulative.

B. Maximum Offset from True Alignment: 1/4 inch.

C. Maximum Out-of-Position: 1/4 inch.

END OF SECTION

SECTION 05501
MISCELLANEOUS METALS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Miscellaneous metal fabrications including:

1. Miscellaneous aluminum.
2. Miscellaneous cast iron.
3. Miscellaneous stainless steel.
4. Miscellaneous structural steel.
5. Associated accessories to the above items.

B. Related Sections:

1. Section 05052 - Anchor Bolts, Toggle Bolts, and Concrete Inserts.
2. Section 09800 - Special Coatings.
3. Section 09900 - Painting.

C. See Drawings.

1.02 REFERENCES

A. Aluminum Association (AA) - Specification M32-C22-A41 - Aluminum Finishes.

B. ANSI A12.1 - Safety Requirements for Floor and Wall Openings, Railings, and Toeboards.

C. American Society for Testing and Materials (ASTM):

1. ASTM A36/ A36M-14 - Standard Specification for Carbon Structural Steel.
2. ASTM A48/A48M-03(2016) - Standard Specification for Grey Iron Castings.
3. ASTM A53/A53M-18 - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
4. ASTM A123/A123M-17 - Standard Specification for Zinc (Hot-Dip Galvanized) Coating on Iron and Steel Products.
5. ASTM A240/A240M-18 - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
6. ASTM A269/A269M-15a - Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
7. ASTM A276/A276M-17 - Standard Specification for Stainless Steel Bars and Shapes.

8. ASTM A307-14e1 - Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60,000 PSI Tensile Strength.
9. ASTM A489-18e1 - Standard Specification for Carbon Steel Lifting Eyes.
10. ASTM A500/A500M-18 - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
11. ASTM A501/A501M-14 - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.
12. ASTM A554-16 - Standard Specification for Welded Stainless Steel Mechanical Tubing.
13. ASTM A635/A635M-15 - Standard Specification for Steel, Sheet and Strip, Heavy Thickness Coils, Hot-Rolled, Alloy, Carbon, Structural, High-Strength Low-Alloy, and High Strength Low Alloy with Improved Formability, General Requirements for.
14. ASTM A653/A653M-18 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-iron Alloy-coated (Galvanized) by the Hot-Dip Process.
15. ASTM B209-14 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
16. ASTM B221-14 - Standard Specification for Aluminum and Aluminum Alloy Extruded Bars, Rods, Wire, Profiles and Tubes.
17. ASTM F3125/F3125M-18 - Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength.

D. AWS D 1.1 - Structural Welding Code.

E. OSHA Part 1910.23 - Guarding Floor and Wall Openings and Holes.

F. International Building Code (IBC).

1.03 SUBMITTALS

A. Shop Drawings: Submit fabrication drawings for approval.

PART 2 - PRODUCTS

2.01 GENERAL

A. Materials: Unless otherwise specified or indicated on the Drawings, structural and miscellaneous metals shall conform to the standards of the American Society for Testing and Materials, including the following:

Item	ASTM Standard No.	Class, Grade Type or Alloy No.
Cast Iron		
Cast Iron	A 48	Class 40B
Steel		
Galvanized sheet iron or steel	A 653	Coating G90
Black steel, sheet or strip	A 569	–
Coil (plate)	A 635	–
Structural plate, bars, rolled shapes,	A 36	–
Standard bolts, nuts, and washers	A 307	–
High strength bolts, nuts and hardened flat washers	F3125	–
Eyebolts	A 489	Type 1
Tubing, cold-formed	A 500	–
Tubing, hot-formed	A 501	–
Steel pipe	A 53	Grade B
Stainless Steel		
Plate, sheet and strip	A 240	Type 304 or 316*
Bars and shapes	A 276	Type 304 or 316*
Aluminum		
Sheet aluminum-flashing	B 209	Alloy 5005-H14, 0.032 inches minimum thickness
Sheet aluminum-structural	B 209	Alloy 6061-T6
Structural aluminum	B 308 B 209	Alloy 6061-T6
Extruded aluminum	B 221	Alloy 6063-T42
* Use Type 304L or Type 316L if material will be welded.		

B. Stainless steels are designated by type or series defined by ASTM.

C. Where stainless steel is welded, use low-carbon stainless steel.

2.02 MISCELLANEOUS ALUMINUM

A. General: Fabricate aluminum products, not covered separately herein, in accordance with the best practices of the trade and field assemble by riveting or bolting. Do not weld or flame cut.

2.03 MISCELLANEOUS CAST IRON

A. General:

1. Tough, gray iron, free from cracks, holes, swells, and cold shuts.
2. Quality such that hammer blow will produce indentation on rectangular edge of casting without flaking metal.
3. Before leaving the foundry, clean castings and apply 16 mil dry film thickness coating of coal-tar epoxy, unless otherwise specified in or indicated on the Drawings.

2.04 MISCELLANEOUS STAINLESS STEEL

A. Provide miscellaneous stainless steel items not specified herein as indicated on the Drawings or specified elsewhere. Fabricate and install in accordance with the best practices of the trade.

2.05 MISCELLANEOUS STRUCTURAL STEEL

A. Provide miscellaneous steel items not specified herein as indicted on the Drawings or specified elsewhere. Fabricate and install in accordance with the best practices of the trade.

B. Fastenings and Fasteners: As recommended or furnished by railing manufacturer for use with this system.

PART 3 - 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, dot not begin this Work until such conditions have been corrected.

3.02 INSTALLATION, GENERAL

A. Install products as indicated on the Drawings, and in accordance with shop drawings and manufacturer's printed instructions, as applicable except where specified otherwise.

3.03 LADDERS

A. Secure to supporting surface with bent plate clips providing minimum 8 inches between supporting surface and center of rungs.

B. Where exit from ladder is forward over top rung, extend side rails 3 feet 6 inches minimum above landing, and return the rails with a radius bend to the landing.

C. Where exit from ladder is to side, extend ladder 5 feet 6 inches minimum above landing and rigidly secure at top.

D. Erect rail straight, level, plumb, and true to position indicated on the Drawings. Correct deviations from true line or grade which is visible to the eye.

E. Ladders to be fabricated of aluminum, unless noted otherwise.

3.04 RAILING

A. During construction, keep exterior surfaces of railing covered with 0.4 millimeters, minimum, heat shrink polyethylene film.

B. Do not remove protective film before railing have been accepted by OWNER nor before other Work in proximity of handrails and guardrails has been completed.

C. Discontinue railing at lighting fixtures.

D. Provide 1/8 inch diameter weep hole at base of each post.

E. Where protection is applied for prevention of dissimilar materials electrolysis, make application such that none of the protective material is visible in the completed assembly.

F. Space posts as indicated on the Drawings.

G. Anchor post into concrete by grouting posts into core drilled holes in concrete, into stainless steel sleeves cast in concrete; or bracket mount to face of concrete surfaces; as specified and indicated on the Drawings.

H. Space rails as indicated on the Drawings.

I. Make adequate provision for expansion and contraction of kickplates and rails. Make provisions for removable sections where indicated on the Drawings.

J. Make lower rails a single, unspliced length between posts, or continuous.

K. Make top rails continuous whenever possible, and attach single, unspliced length to 3 posts minimum.

L. Draw up fasteners tight with hand wrench or screw driver.

M. Space attachment brackets as indicated on shop drawings or in manufacturer's installation instructions.

N. Completed installation shall have railing rigid and free of play at joints and attachments.

O. Protect railing finish from scratches, gouges, dents, stains, and other damage.

P. Replace damaged or disfigured railing with new.

Q. Shortly before final acceptance of the Work, and after removal of protective polyethylene film, clean railing with mild detergent or with soap water.

R. After cleaning, thoroughly rinse railing and wipe with soft cloth.

S. Erect railing straight, level, plumb, and true to the positions as indicated on the Drawings. Correct deviations from true line of grade which are visible to the eye.

3.05 MISCELLANEOUS ALUMINUM

A. Coat aluminum angles cast into concrete with bituminous materials.

END OF SECTION

DIVISION IX
PROTECTIVE COATINGS

SECTION 09900

PROTECTIVE COATINGS

PART 1 - GENERAL

1.1 Summary

A. This Section includes coating of exterior and interior surfaces throughout the Project and which are listed in PART 2 with systems specified in PART 2.

B. Coating systems include surface preparation, prime coat (first coat), finish coats (second and third coats), inspection, cleaning, and touch-up of surfaces and equipment. Shop preparation, prime coat, and finish coats to be shop-applied, may be specified elsewhere or referenced to this Section so that a complete system is specified and coordinated.

1. Where surface preparation and first (prime) coat are specified in other Sections to be shop-applied, such as for structural steel, or equipment, only the touch-up and finish coats are a part of field painting. Surface preparation is the required degree of preparation prior to application of first (prime) coat regardless if done in shop or field.

2. If materials are provided without shop primer then surface preparation, first, second, and third coats are a part of field painting.

3. Concealed surfaces are generally not required to have finish-coats unless otherwise specified, but prime coat should be applied and touched up prior to concealment.

4. Where Equipment and Materials are provided with shop-applied finished coating system, only touch-up is a part of field painting.

5. Refer to applicable Sections to determine whether surface preparation and first coat, or complete coating system, is to be shop-applied.

C. Related Work Specified Elsewhere

1. Shop Painting and Coatings: All applicable Divisions.

2. Factory Prefinished Items: All applicable Divisions.

D. Colors

1. Color of finish coatings shall match accepted color Samples.

2. When second and finish coats of a system are of same type, tint or use an alternate color on second coat to enable visual coverage inspection of the third coat. When first and second coats only are specified and are of same or different types, tint or use an alternate color on first coat to enable visual coverage inspection of the second coat.

3. Contract Price shall include the following approximate number of finish coat colors to form a basis for bidding:

   a. Epoxy: Eight colors, with 50% deep tone colors.

   b. Ceramic: Two colors, with 50% deep tone colors.

1.2 Quality Assurance

A. Reference Standards and Specifications

1. American National Standards Institute (ANSI)

   ANSI A 13.1 - Scheme for the Identification of Piping Systems.

   ANSI Z 53.1 - Safety Color Code for Marking Physical Hazards.

2. American Society for Testing and Materials (ASTM)

   ASTM D4258 - Surface Cleaning Concrete for Coating.

   ASTM D4261 - Surface Cleaning Concrete Unit Masonry for Coating.

3. Society for Protective Coatings (SSPC) Surface Preparation Specifications

   SP1 - Solvent Cleaning: Removes oil, grease, soil, drawing and cutting compounds, and other soluble contaminants.

   SP2 - Hand Tool Cleaning: Remove loose material. Not intended to remove adherent mill scale, rust, and paint.

   SP3 - Power Tool Cleaning: Removes loose material. Not intended to remove all scale or rust.

   SP5 - White Metal Blast Cleaning: Removes all scale, rust, foreign matter. Leaves surface gray-white uniform metallic color.

SP6 - Commercial Blast Cleaning: Two-thirds of each square inch free of all visible residues; remainder only light discoloration.

SP10 - Near-White Metal Blast Cleaning.

SP11 - Power Tool Cleaning to Bare Metal.

4. American Waterworks Association (AWWA)

Standard for Painting and Repainting Steel Tanks, Stand-Pipes, Reservoirs, and Elevated Tanks for Water Storage, D-102.

5. American Concrete Institute (ACI)

ACI 515.1R Guide to the Use of Waterproofing, Damp-proofing, Protective and Decorative Barrier Systems for Concrete

B. Include on label of container:

1. Manufacturer's name, product name, and number.

2. Type of paint and generic name.

3. Color name and number.

4. Storage and temperature limits.

5. Mixing and application instructions, including requirements for precautions which must be taken.

6. Drying, recoat, or curing time.

C. Prepainting Conference

1. Before Project field painting starts, representatives for the Owner, Contractor, coating applicator, and coating manufacturer’s technical representative shall meet with Engineer.

2. Agenda for the meeting will include details of surface preparations and coating systems to ensure understanding and agreement by all parties for compliance.

D. Warranty

1. The coating manufacturers and applicators shall warrant their products and applications respectively against defects for a period of five (5) years under normal use. The warranty shall be in printed form.

E. In the event a problem occurs with coating system, surface preparation, or application, coating applicator and coating manufacturer's technical representative shall promptly investigate the problem and submit results to Engineer.

F. Stated VOC shall be unthinned maximum VOC certified by manufacturer.

G. A coating report shall be completed daily by Contractor at each phase of the coating system starting with surface preparation. These shall be submitted on the form attached at the end of this Section.

1.3 Submittals

A. Submit as specified in Section 1330.

B. Includes, but not limited to, the following:

1. Schedule of products and paint systems to be used. Schedule shall include the following information:

a. Surfaces for system to be applied.

b. Surface preparation method and degree of cleanliness.

c. Product manufacturer, name, and number.

d. Method of application.

e. Dry-film mil thickness per coat of coating to be applied.

2. Color charts for selection and acceptance.

3. Technical and material safety data sheets.

4. Certification by coating manufacturer(s) that all coatings are suitable for service intended as stated on each coating system sheet. If manufacturer has an equivalent product as that specified, but it is not suitable for the intended purpose, he shall submit the recommended

product for approval at no increase in cost, and state reasons for substitution.

5. Contractor shall certify in writing to the Engineer that applicators have previously applied all the systems in this Specification and have the ability and equipment to prepare the surfaces and apply the coatings correctly.

1.4 Delivery, Storage, and Handling

A. Delivery of Materials

1. Deliver in original unbroken sealed containers with labels and information legible and intact. Containers shall also have correct labels with required information.

2. Allow sufficient time for testing if required.

3. Open and mix on the premises and in the presence of the Engineer. Any rejected material shall be at once removed from the premises. Colors shall be as selected by Engineer.

B. Storage of Materials

1. Store only acceptable materials on Project site in enclosed structures to protect them from weather and excessive heat and cold. Store in accordance with County and State Safety Codes.

2. Provide separate area and suitable containers for storage of coatings and related coating equipment.

3. Dispose of used or leftover containers, thinners, rags, brushes, and rollers in accordance with applicable regulations.

1.5 Regulatory Requirements

A. In addition to requirements specified elsewhere for environmental protection, provide coating materials that conform to the restrictions of the local and regional jurisdiction. Notify Engineer of any coating specified herein that fails to conform to the requirements for the location of the project or location of application.

B. Lead Content: Use only coatings that are totally lead free except for zinc-rich primers which shall not have a lead content over 0.06% by weight of nonvolatile content.

C. Chromate Content: Do not use coatings containing zinc-chromate or strontium chromate.

D. Asbestos Content: Materials shall not contain asbestos.

E. Mercury Content: Materials shall not contain mercury or mercury compounds.

1.6 Project Conditions

A. This Project is in a location in which drifting coatings, if spray-applied, could contaminate adjacent surfaces or vehicles nearby. All containment precautions and application methods shall be taken into consideration and implemented to prevent the above from occurring.

1.7 Inspection Service

A. Owner will engage in the services of an independent NACE certified coating inspection service, Level III certification.

B. Inspection service will provide full-time inspection of all field surface preparation and coating applications to ensure full compliance with the requirements of this Specification. The presence of the inspection service shall not relieve Contractor for compliance with Specifications or authorized changes.

C. Inspection service will document all work, including nonconformance, using forms acceptable to Owner and Engineer. All documentation and reports will be prepared and signed by the Inspection service representative, and submitted to Engineer on a daily basis. At the completion of all coating applications, Inspection service representative will also submit a conformance report certifying that all Work relative to coatings complies with the Specifications or authorized change.

D. Inspection service will be responsible for field verification and recommendations of the following field coating operations:

1. Surface preparation methods, equipment.

2. Substrate conditions, moisture content of concrete, substrate profiles, and surface temperatures.

3. Temperature, humidity, and wind conditions at times of coating applications.

4. Specified or approved coating verification.

5. Application equipment.

6. Coating wet and dry film thickness.

7. Proper coating curing.

8. Coating system failure, causes, and remedy.

E. Inspection service representative will discuss with Engineer, Owner, and Contractor all recommended Specification deviations, changes in products, or application methods.

PART 2 - MATERIALS

2.1 Acceptable Manufacturers

A. Acceptable manufacturers are as follows:

1. Sauereisen

2. Carboline

3. Raven Lining Systems

4. Ameron Protective Coatings Systems Group, Ameron Corp.

5. Devoe Coating Company, Division of ICI.

6. Futura Coatings, Inc.

7. The Glidden Company.

8. International Protective Coatings.

9. Keeler & Long, Inc.

10. Kop-Coat, Inc., Division of Carboline.

11. Pittsburgh Paints, PPG Industries Inc.

12. Santile, Division of Carboline Company, Inc.

13. Tnemec Company, Inc.

14. Polyken

2.2 General

A. Materials furnished for each coating system must be compatible to the substrate.

B. When unprimed surfaces are to be coated, entire coating system shall be by the same coating manufacturer to assure compatibility of coatings.

C. When shop-painted surfaces are to be coated, ascertain whether finish materials will be compatible with shop coating. Inform Engineer/ Architect of any unsuitable substrate or coating conditions.

D. Coating system shall be as specified below or to the manufacturer's standard, whichever is more stringent.

2.3 Areas of Application

A. Submerged Concrete Surfaces, exposed to H_2S vapor:

1. Surface Preparation and coating system: In accordance with manufacturer's recommendations.

2. Applied to all concrete surfaces including floors, walls, baffles and ceilings.

3. Product and Manufacturer (see drawings):

a. Sauereisen 210

b. Raven 405

c. Plasite 5371

d. Tnemec

B. Ferrous Metals including all Structural Steel, Miscellaneous Ferrous Metals, and all Ferrous Piping; Interior Non-submerged:

1. Surface Preparation: SSPC-SP6 Commercial Blast Cleaning as specified in Paragraph 3.1.

2. Interior non-submerged applies to areas that are housed within a building and/or within a non-process, enclosed structure.

3. Product and Manufacturer: Provide one of the following:

a. Protecto 401

1) 40-45 D Mils

2) Total in accordance with manufatures instructions

b. Or approved equal

C. Ferrous Metals, Including all Ferrous Piping; Exterior Non-submerged:

1. Surface Preparation: SSPC-SP6 Commercial Blast Cleaning as specified in Paragraph 3.1.

2. Exterior non-submerged applies to areas that are not housed within a building or structure, and that are not located within process and / or water carrying structures or tanks.

3. Product and Manufacturer: Provided one of the following:

a. Tnemec:

1) Primer: 66 H.B. Epoxoline – tow coats, 2-3 dry mils per coat.

2) Intermediate: 69 H.B. Epoxoline II – one coat, 4-5 dry mils.

3) Finish: 75 Endura-Shield – tow coats, 1.5-2 dry mils per coat

b. Or approved equal.

D. Galvanized Metal and Non-Ferrous Metal; Interior Non-Submerged:

1. Surface Preparation: SSPC-SP1 Solvent Cleaning, as specified in Paragraph 3.1.

2. Interior non-submerged applies to areas that are housed within a building and/or within a non-process, enclosed structure.

3. Product and Manufacturer: Provide one of the following:

a. Tnemec:

1) Primer: 66 H.B. Epoxoline – one coat, 3-4 dry mils

2) Finish: 69 H.B. Epoxoline II – one coat, 4-5 dry mils.

b. Or approved equal.

E. All Aluminum in Contact with Dissimilar Materials:

1. Surface Preparation: Remove all foreign matter.

2. Product and Manufacturer: Provide one of the following:

a. Tnemec:

1) 66 H.B. Epoxoline – two coats, 2.0 – 3.0 dry mils per coat

b. Or approved equal.

F. PVC Piping, CPVC Piping, Fiberglass, Fiberglass Insulation Covering; Exterior:

1. Surface Preparation: Sand as specified by the coating manufacturer.

2. Exterior applies to areas that are not housed within a building and/or within an enclosed structure.

3. Product and Manufacturer: provide one of the following

a. Tnemec:

1) Primer/Intermediate: 66 H.B. Epoxoline – one coat each, 2.0 – 3.0

2) Finish: 75 Endura-Shield – one coat, 3.0 dry mils

b. Or approved equal.

G. PVC Piping, CPVC Piping, Fiberglass, Fiberglass Insulation Covering; Interior Non-Submerged:

1. Surface Preparation: Sand as specified by the coating manufacturer.

2. Product and Manufacturer: Provide one of the following:

a. Tnemec:

1) Primer/Intermediate/Finish: 66 H.B. Epoxoline – one coat each, 2.0 – 3.0 dry mils per coat.

b. Or approved equal.

H. Steel and Galvanized Steel Pipe; Buried Exterior:

1. Surface Preparation: SSPC-SP10, Near-White Blast, as specified in Paragraph 3.1.

2. Product and Manufacturer: Provide one of the following:

a. Tnemec:

1) Primer: 66-1211 Epoxoline – two coats, 3-4 dry mils per coat.

2) Field Primer or Field Touchup: Surface preparation as specified.

3) Finish: 46-413 Tneme-Tar – two coats, 10.0 dry mils per coat.

b. Or approved equal.

I. Submerged or Intermittently Submerged Ferrous Metals; Interior and Exterior:

1. Definition: Submerged shall apply to all metals below the maximum water surface elevation in open top structure unless otherwise noted or otherwise shown; and to all metals within liquid or residual solids carrying structures that are covered, including all metals on the underside of the covers unless otherwise noted or otherwise shown; and to all metals within an enclosed process structure. This shall apply to all metals whether intermittently or continuously submerged.

2. Surface Preparation: SSPC-SP 10 Near-White Blast Cleaning as specified in Paragraph 3.1.

a. Tnemec:

1) Primer: 69-1211 Epoxoline II – tow coats, 3-4 dry milsper coat.

2) Intermediate: 69 H.B. Epoxoline II – tow coats, 5 dry mils per coat.

3) Finish: 69 H.B. Epoxoline II – two coats, 5 dry mils per coat.

b. Or approved equal.

J. Special Requirements for Aluminum:

1. Aluminum surfaces bearing in or embedded in concrete and fayin surfaces of bolted aluminum joints ,except anchor bolts, shall be given two coats of 66 H.B. Epoxoline Primer, or approved equal. The primer shall be allowed to dry between coats and before concrete is poured against it.

2. Where aluminum metals are placed in contact with or fastened to ferrous or stainless steel metals, the contact surfaces of each shall receive the protective coating specified for that metal and a gasket shall be placed between the two contact surfaces. The gasket material shall be non-conductive commercial grade neoprene, 60 durometer, 0.03-inch in thickness unless otherwise specified. Bolts shall be isolated using one piece non-conductive sleeves and washers as manufactured by PSI Products, Inc., Burbank, California: Parker Seal Col, Culvert City, California, or approved equal.

K. Galvanizing: All galvanizing, where called for in the Contract Documents, shall be hot-dip process conforming to ASTM A-123:

1. Surface Preparation: All surfaces to be clean and free of contaminants prior to application of the coating system.

2. Prime Coat: Series 104 H.S. Epoxy; one coat 4-5 mils DFT.

3. Finish Coat: Series 104 H.S. Epoxy; one coat 4-54 mils DFT.

L. Concrete Semi-Gloss Latex:

1. Surface Preparation: All surfaces to be clean and free of contaminants prior to application of the coating system.

2. Prime Coat: Series 7 Tneme-Cryl; one coat 2-3 mils DFT.

3. Finish Coat: Series 7 Tneme-Cryl; one coat 2-3 mils DFT.

M. Ductile and Cast Iron (Exterior Exposure):

1. Surface Preparation: Solvent scrub with stiff bristle brush followed by brush-off abrasive blast cleaning to a minimum surfaces profile depth of 1.5 mils.

2. Prime Coat: Series 69-1255 (beige) H.B. Epoxoline II: one coat 3-5 mils DFT.

3. Finish Coat: Series 73 Endura-Shield; one coat 3-4 mils DFT.

N. Ductile and Cast Iron (Interior Exposure):

1. Surface Preparation: Clean, dry, and free of contaminants
2. Prime Coat: Series 135 Chembuild; one coat 4-6 mils DFT.
3. Finish Coat: Series 69 H.B. Epoxoline II; one coat 4-6 mils DFT.

O. Ductile and Cast Iron (Buried):

1. Surface Preparation: Solvent scrub with stiff bristle brush followed by brush-off abrasive blast cleaning to a minimum surface profile depth of 1.5 mils.
2. Prime Coat: Series 69-1255 (beige) H.B. Epoxoline II; one coat 3-5 mils DFT.
3. Finish Coat: Series 69 H.B. Epoxoline II; one coat 4-6 mils DFT.

P. Ductile and Cast Iron (Immersions):

1. Surface Preparation: Solvent scrub with stiff bristle brush followed by brush-off abrasive blast cleaning to a minimum surface profile depth of 1.5 mils.
2. Prime Coat: Series 66 H.B. Epoxoline; one coat 4-6 mils DFT.
3. Finish Coat: Series 69 H.B/ Epoxoline II; one coat 4-6 mils thick.

Q. Stainless Steel Duct (Buried):

1. Surface Preparation: SSPC-SP6 Commercial Blast Cleaning or manufacturer's recommendations, whichever is more stringent.
2. Prime Coat: Polyken 1019 or 1027, or approved equal.
3. Finish Coat: Polyken 905 tape, or approved equal.

2.4 Surfaces Not to be Coated

A. Do not field paint any of the following items unless specifically noted otherwise.

1. Factory finished equipment, except for touch-up.

2. Metal surfaces of aluminum, stainless steel, copper, bronze and similar finished materials.

3. Equipment nameplates, valve stems, moving shafts and linkages.

2.5 Color Coding of Piping

A. Color Coding of Piping: Exterior and interior by color coding entire pipe.

1. General

a. Coat piping with solid colors as specified below for entire length of pipe in exposed finished and unfinished areas. Exclude areas in pipe chases and furred areas.

b. Coat all other piping in colors matching adjacent surfaces. If adjacent area is unfinished, paint in color determined by Engineer/Architect.

c. Identify piping with letters, arrows and bands as specified below. Apply after completion of finish coating.

2. Color Scheme

Description	Pipe and Band Color	Letter and Arrow Color
Potable Water (hot or cold)	Light blue	Black
Nonpotable or Raw Water	Light blue with red bands	Black
Seal Water	Dark blue with red bands	White
Low Pressure (Air) Aeration supply	Light green	Black
Sewage	Light gray	Black
Sludge	Light brown	White
Scum	Dark brown	White
Drain	Dark gray	White
Sample	Light gray with green bands	Black
Sprinkler Piping	Red	White

In addition, special painting of the following items will be required.

Item	Color
Valve handwheels and levers	Red

Number at least 2 inches high shall be painted on or adjacent to all accessible valves, pumps, flowmeters, and other items of equipment which are identified on the drawings or in the specifications by number.

3. Location of Letters, Arrows and Bands

a. Place letters, arrows and bands on piping near connections to equipment, adjacent to valves or fittings, on both sides of walls penetrated, and at intervals not to exceed 25 feet.

b. Place arrows adjacent to or below letters depending upon visibility. Place arrows in direction of flow. For dual-flow piping, indicate both directions.

c. Locate letters to be visible from normal line of vision above floor level. Letter locations subject to approval of Engineer/Architect.

d. Band to be full circumference of pipe.

4. Letter, Arrow and Band Size

a. Block-style letters, all capitals, conforming to ANSI A13.1 and as follows:

Outside Diameter of Letters Pipe or Covering	Size of Letters and Arrows	Width of Banding
Less than 3/4"	Approved metal tag or band	6"
3/4" to 1-1/4"	1/2"	8"
1-1/2" to 2"	3/4"	8"
2-1/2" to 6"	1-1/4"	12"
8" to 10"	2-1/2"	24"
Over 10"	3-1/2"	32"

5. Vent lines, electrical conduit and related electrical accessories shall be painted to match adjacent wall surfaces as directed by ceiling space shall be painted same as surfaces adjacent to the wall surfaces.

PART 3 - EXECUTION

3.1 Surface Preparation

A. Prepare surfaces for each coating system conforming to SSPC or ASTM surface preparation specifications listed.

1. If grease or oils are present, SSPC-SP1 must precede any other method specified.

2. Remove surface irregularities such as weld spatter, burrs, or sharp edges prior to specified surface preparation.

3. Undertake specified surface preparation in accordance with the coating manufacturer’s recommendations.

B. Depth of profile will be as specified or as recommended by the manufacturer for each system, but in no instance shall it exceed one-third of the total dry film thickness of complete system.

C. Prepare only those areas which will receive the first coat of the system on the same day.

1. On steel substrates, apply coating before rust bloom forms.

D. Concrete surfaces shall be adequately cured in accordance with SECTION 3300 and a minimum of 28 days old prior to coating application.

E. Abrasives for blasting shall be free of oil, washed and dry, unused silica sand, coal, copper or nickel slag that have sharp and hard cutting surfaces. Abrasives approved by Powertech Laboratories are strongly recommended.

F. Sharp projections and weld splatter shall be ground smooth. All areas ground smooth shall be reblasted prior to the coating application.

G. Sharp edges shall be ground round and smooth to radius = 1/8 prior to the coating applications for structural steel in Highly Corrosive Areas and for Immersion Services.

H. After abrasive blasting, steel surfaces must be completely dust free (cleaned by vacuum and/or blown off with oil/water-free compressed air), oil and grease free, and have a chloride concentration of less than 3 μg/cm2.

I. Unless otherwise specified, the steel profile must be 1.5 - 2.5 mils in depth and jagged as opposed to a peen pattern.

J. All welds shall be stripe coated by brush with the primer, prior to the application of the full primer coat. Note that inorganic zinc coatings shall not be applied by brush except to very small areas. Stripe coating shall be by spray.

K. Unless approved by the Paint Manufacturer to the contrary, the blast surface shall be primed prior to the development of rust bloom or other contaminants and not later than 8 hours after surface preparation.

L. Oxidation of the steel due to deleterious conditions may necessitate reblasting or sweepblasting the surface to restore the specified cleanliness standard.

3.2 Application

A. Apply coatings in accordance with coating manufacturer's recommendations.

B. All work shall be undertaken by skilled applicators who are qualified to perform the required work and have a minimum of 5 years experience in similar applications. The work shall be done in a manner comparable to the best standards of practice found in that trade. All materials shall be evenly applied so as to be free from sags, runs, crawls, wrinkles, holidays, or any other defects. All coats shall be of the minimum of brush marks. When finished and dried, brush strokes shall appear in one direction only, and there shall be no curved brush marks showing. All coats shall be thoroughly dry before the succeeding coat is applied. All coats that are intended to hide shall be given another coat if the coating does not properly hide the undercoat.

C. Use properly designed brushes, rollers, and spray equipment for all applications.

D. Spraying shall be done in the cross lap method of spraying, streaking first in one direction and shortly later spraying across this section at right angles to the first set of passes.

E. On unprimed surfaces apply first coat of the system the same day as surface preparation.

F. Dry film thickness of each system shall meet the minimum specified. Maximum dry film thickness shall not exceed the minimum more than 20% or coating manufacturer's requirements if less. Where a dry film thickness range is specified, the range shall not be less than or exceeded.

G. Shop and field painting shall remain 3 inches away from unprepared surface of any substrate such as areas to be welded or bolted. H. Environmental Conditions:

1. Do not apply coatings when inclement weather or freezing temperature may occur within coating curing time requirements. Atmospheric temperature must be maintained between 60°F and 85°F for at least 48 hours prior to and during application, unless otherwise approved by coating manufacturer.

2. Wind velocities for exterior applications shall be at a minimum to prevent overspray or fallout and not greater than coating manufacturer's limits.

3. Relative humidity must be less than 85% and the temperature of the surface to be painted must be at least 5°F above the dew point.

4. Provide adequate ventilation in all areas of application to ensure that at no time does the content of air exceed the Threshold Limit Value given on the manufacturer's Material Safety Data Sheets for the specific coatings being applied.

I. Recoat Time: In the event a coating, such as an epoxy, has exceeded its recoat time limit, prepare the applied coating in accordance with manufacturer's recommendations.

J. Protection

1. Cover or otherwise protect surfaces not to be painted. Remove protective materials when appropriate.

2. Provide signs to indicate fresh paint areas.

3. Provide daily cleanup of both storage and working areas and removal of all paint refuse, trash, rags, and thinners. Dispose of leftover containers, thinners, rags, brushes, and rollers which cannot be reused in accordance with applicable regulations.

4. Do not remove or paint over Equipment data plates or code stamps on piping.

5. Mask, remove, or otherwise protect finish hardware, machined surfaces, grilles, lighting fixtures, and prefinished units as necessary.

6. Provide cover to prevent paints from entering orifices in electrical or mechanical equipment.

3.3 Inspection

A. Contractor shall provide and use a wet film gauges to check each application approximately every 15 minutes in order to immediately correct film thickness under or over that specified.

B. Contractor shall provide and use a dry film gauge to check each coat mm (mil) thickness when dry, and the total system mm (mil) thickness when completed.

C. Use holiday or pinhole detector on systems over metal substrates to detect and correct voids when indicated on system sheet.

D. Furnish a sling psychrometer and perform periodic checks on both relative humidity and temperature limits.

E. Check temperature of the substrate at regular intervals to be certain surface is 5^{o}F or more above the dew point.

3.4 Cleaning and Repairs

A. Remove spilled, dripped, or splattered paint from surfaces.

B. Touch up and restore damaged finishes to original condition. This includes surface preparation and application of coatings specified.

PART 4 - MEASUREMENT AND PAYMENT

4.1 Measurement: No measurement will be made for this item, Protective Coatings.

4.2 Payment: Payment will be made at the contract lump sum price bid and shall be considered full payment for providing labor and materials to perform this work.

COATING REPORT

Contract Name: _____ Contract No.:_____
Coating Contractor: _____ Foreman: _____
Unit or Surface Identification: _____
Unit or Surface Location: Exterior: _____, Interior: _____

Surface Preparation:
Date _____; Air Temp _____°F; Relative Humidity _____%
Method of Surface Preparation: _____
Profile achieved _____ mils (if applicable).

Touch-Up:
Date _____; Time _____; Air Temp _____°F; Surface Temp _____°F
Relative Humidity _____%; Dew Point _____°F
Coating Used _____; Dry Film Obtained _____mils.

First Coat:
Date _____; Time _____; Air Temp _____°F; Surface Temp _____°F
Relative Humidity _____%; Dew Point _____°F
Coating Used _____; Dry Time Before Recoat _____hrs.
Dry Film Obtained _____ mils.

Second Coat:
Date _____; Time _____; Air Temp _____°F; Surface Temp _____°F
Relative Humidity _____%; Dew Point _____°F
Coating Used _____; Dry Time Before Recoat _____hrs.
Dry Film Obtained _____ mils.

Third Coat:
Date _____; Time _____; Air Temp _____°F; Surface Temp _____°F
Relative Humidity _____%; Dew Point _____°F
Coating Used _____; Dry Film Obtained _____mils.

END OF SECTION 9900

DIVISION II

EQUIPMENT

SECTION 11005

EQUIPMENT: GENERAL REQUIREMENTS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes
1. Requirement of this Section apply to all equipment provided on the Project, including that found in Divisions 11, 15 and 16, even if not specifically referenced as a related section in those Specifications.
2. Premium efficiency motors shall be supplied.

B. Related sections include, but are not necessarily limited to:
1. Division 1 - General Requirements.
2. Section 09800 - Special Coatings.
3. Individual equipment specifications in Divisions 11 through 15.

1.02 QUALITY ASSURANCE

A. Referenced Standards:
1. American Society for Testing and Materials (ASTM):
a. A307 - Standard Specification for Carbon Steel Bolts, Studs and Threaded Rods 60,000 psi Tensile Strength.
b. F593 - Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
2. Institute of Electrical and Electronics Engineers (IEEE):
a. 112 - Standard Test Procedure for Polyphase Induction Motors and Generators.
3. National Electrical Manufacturers Association (NEMA):
a. 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
b. ICS 6 - Enclosures - Industrial Control and System.
c. MG1 - Motors and Generators.
4. NSF International:
a. 61 - Drinking Water System Components

B. Unit Responsibility:

1. Where indicated in these documents, equipment systems made up of two or more components shall be manufactured and assembled as a unit by the responsible manufacturer. The responsible manufacturer shall select all components of the system to assure compatibility, ease of construction and efficient maintenance. The responsible manufacturer shall coordinate selection and design of all system components, such that all equipment furnished under the specification for the equipment system, including equipment specified elsewhere, but referenced in the specification, is compatible and operates properly to achieve the performance requirements specified. Unless otherwise specified, the responsible manufacturer

shall be the manufacturer of the driven equipment. This requirement for unit responsibility shall in no way relieve CONTRACTOR of his responsibility to the OWNER for performance of all systems.

2. CONTRACTOR shall assure that all equipment systems provided for the Project are products for which unit responsibility has been accepted by the responsible manufacturer. Where the detailed specification requires CONTRACTOR to furnish a certificate from the Unit Responsibility Manufacturer, such certificates shall be provided prior to Shop Drawing review. No other submittal material will be processed until a Certificate of Unit Responsibility has been received and has been found to be satisfactory. Failure to provide acceptable proof that the unit responsibility requirement has been satisfied will result in withholding approval of progress payments for the subject equipment even though the equipment may have been installed in the Work.

1.03 DEFINITIONS

A. Product: Manufactured materials and equipment.

B. Equipment: One or more assemblies capable of performing a complete function. Mechanical, electrical, instrumentation or other devices requiring an electrical, pneumatic, electronic or hydraulic connection. Not limited to items listed under "Equipment" article within Specifications.

1.04 SUBMITTALS

A. Shop Drawings:

1. General for all equipment:
   a. See Section 01340 – Technical Submittals for shop drawing procedures.
   b. Acknowledgement that products submitted comply with the requirements of the standards referenced.
   c. Manufacturer's delivery, storage, and handling instructions.
   d. Equipment identification utilizing tagging system and name utilized in Drawings.
   e. Equipment installation details:
      1) Location of anchorage.
      2) Type, size, and materials of construction of anchorage.
      3) Anchorage setting templates.
      4) Manufacturer's installation instructions.
   f. Equipment area classification rating.
   g. Shipping and operating weight.
   h. Equipment physical characteristics:
      1) Dimensions (both horizontal and vertical).
      2) Materials of construction and construction details.
   i. Equipment factory primer and painting and coating data.
   j. Manufacturer's recommended spare parts list.
   k. Piping and duct connection size, type and location.

2. Mechanical and Process Equipment
   a. Operating characteristics:
      1) Technical information including applicable performance curves showing specified equipment capacity, rangeability, and efficiencies.
      2) Brake horsepower requirements.
      3) Copies of equipment data plates.
   b. Piping and duct connection size, type, and location.
   c. Equipment bearing life certification.
   d. Field noise testing reports if such testing is specified in specific equipment sections.
   e. Equipment foundation data:
      1) Equipment center of gravity.
      2) Criteria for designing vibration, special or unbalanced forces resulting from equipment operation.
3. Electrical and control equipment:
   a. Electric motor information:
      1) Nameplate data.
      2) Service factor on motors ½ HP and above.
      3) Motor enclosure type.
      4) NEMA frame size, if applicable.
      5) NEMA design code, if applicable.
      6) Insulation type.
      7) Efficiency and power factor at full load, 3/4 load, ½ load and 1/4 load.
   b. Control panels:
      1) Panel construction.
      2) Point-to-point wiring diagrams.
      3) Scaled panel face and subpanel layout.
      4) Technical product data on panel components.
      5) Panel and subpanel dimensions and weights.
      6) Panel access openings.
      7) Nameplate test.
      8) Panel anchorage.
   c. Motor tests reports.
   d. Certification that equipment has been installed properly, has been initially started up and is ready for operation.
   e. Certification prior to Project closeout that electrical panel drawings for manufacturer-supplied control panels truly represent panel wiring including any field-make modifications.

B. Operations and Maintenance Manuals:
   1. Section 01340.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Motors: US Motors
   2. GE
   3. Emerson
   4. Baldor
   5. Preapproved equal.

2.02 MANUFACTURED UNITS

A. Electric Motors:
   1. Provide premium efficiency motors designed and applied in compliance with NEMA, IEEE, and the NEC for specific duty imposed by driven equipment.
   2. Where used in conjunction with adjustable speed drives, provide motors fully compatible with the variable speed controllers. These motors shall be inverter duty.
   3. Where frequent starting applications are specified, design for frequent starting duty equivalent to duty service required by driven equipment.
   4. Rate for continuous duty at 50 Degree C ambient. Design in accordance with NEMA standards for Class F insulation with Class B temperature rise above 50 Degree C ambient on continuous operation or intermittent duty at nameplate horsepower.
   5. Design for full or reduced voltage starting, as appropriate.
   6. Design bearing life based upon actual operating load conditions imposed by driven equivalent.
   7. Size for altitude of Project.
   8. Size so that, under maximum continuous load imposed by driven equipment, motor nameplate horsepower for continuous operation is minimum of 15 percent more than driven load.
   9. Provide encapsulated windings in wet/corrosive and for outdoor applications.
      a. Provide encapsulation using a silicone or epoxy seal after the windings have been dried to less than 1 percent moisture.
   10. Furnish with clamp-type grounding terminals inside motor conduit box.
   11. Furnish with oversized external conduit boxes.
   12. Furnish with stainless steel nameplates with information to include all data as required by paragraph 430-7 of the National Electric Code, NFPA 70.
   13. Provide high efficiency motors that are Totally Enclosed, Fan-Cooled (TEFC) unless specified otherwise.

2.03 ACCESSORIES

A. Guards:

1. Provide each piece of equipment having exposed moving parts with full length, easily removable guards, meeting OSHA requirements.
2. Interior Applications:
   a. Construct from expanded galvanized steel rolled to conform to shaft or coupling surface.
   b. Utilize non-flattened type 16 GA galvanized steel with nominal ½ IN spacing.
   c. Connect to equipment frame with hot-dip galvanized bolts and wing nuts.
3. External Applications:
   a. Construct from 16 GA stainless steel or aluminum.
   b. Construct to preclude entrance of rain, snow, or moisture.
   c. Roll to conform to shaft or coupling surface.
   d. Connect to equipment frame with stainless steel bolts and wing nuts.

B. Anchorage:

1. Cast-in-place anchorage:
   a. Provide ASTM F593, Type 316 stainless steel anchorage for exposed equipment.
   b. For continuously submerged anchorage, utilize ASTM A307 anchorage. For intermittently submerged applications, use 316 stainless steel.
   c. Configuration and number of anchor bolts shall be per manufacturer's recommendations.
   d. Provide two nuts for each bolt.
2. Drilled anchorage:
   a. Epoxy grout per Section 03600.
   b. Threaded rods same as cast-in-place.

C. Data Plate:

1. Attach a stainless steel data plate to each piece of rotary or reciprocating equipment. Permanently stamp information on data plate including manufacturer's name, equipment operating parameters, serial number and speed.

2.04 FABRICATION

A. Design, fabricate, and assemble equipment in accordance with best modern engineering and shop practices.

B. Manufacture individual parts to standard sizes and gages so that repair parts, furnished at any time, can be installed in field.

C. Furnish like parts of duplicate units to be interchangeable.

D. Assure that equipment has not been in service at any time prior to delivery, except as required by tests.

E. Furnish equipment which require periodic internal inspection or adjustment with access panels which will not require disassembly of guards, dismantling of piping or equipment or

similar major efforts. Quick opening but sound, securable access ports or windows shall be provided for inspection of chains, belts, or similar items.

F. Provide common, lipped base plate mounting for equipment and equipment motor where said mounting is a manufacturer's standard option. Provide drain connection for tubing.

G. Machine the mounting feet of rotating equipment.

H. Shop or Factory Finishes shall be in accordance with Section 09800.

PART 3 - EXECUTION

3.01 ERECTION/INSTALLATION/APPLICATION

A. Install equipment as shown on Drawings and in accordance with manufacturer's directions.

B. Utilize templates for anchorage placement for slab mounted equipment.

C. For equipment having drainage requirements such as seal water, provide 3/4-inch PVC or clear plastic tubing from equipment base to nearest floor or equipment drain. Route clear of major traffic areas and as approved by OWNER.

D. Extend all non-accessible grease fittings using stainless steel tubing to a location which allows easy access of fittings.

E. Construct subbases, either concrete, steel or cast iron, level in both directions. Particular care shall be taken at hold-down bolt locations so these areas are flat and level.

F. Machine Base:

1. Mount machine bases of rotating equipment on subbases in manner that they are level in both directions according to machined surfaces on base. Use machinist level for this procedure.
2. Level machine bases on subbases and align couplings between driver and driven unit using steel blocks and shims.
    a. Size blocks and shims to provide solid support at each anchor bolt location. Area size of blocks and shims shall be approximately 1-1/2 times area support surface at each anchor bolt point.
    b. Provide blocks and shims at each anchor bolt. Blocks and shims shall be square shape with "U" cut out to allow blocks and shims to be centered on anchor bolts.
    c. After all leveling and alignment has been completed and before grouting, tighten anchor bolts to proper torque value.
    d. Do not use nuts below the machine base on anchor bolts for base leveling.

G. Grouting:

1. After machine base has been shimmed, leveled, couplings aligned and anchor bolts tightened to correct torque value, a dam or formwork shall be placed around base to contain grouting. Dam or formwork shall extend at least ½ IN above the top of leveling shims and blocks.
2. Grouting mixture shall be non-shrink grout per Division 3 requirements.
3. When the grout has sufficiently hardened, remove dam or framework and finish the exposed grout surface to fine, smooth surface. Cover exposed grout surfaces with wet burlap and keep covering sufficiently wet to prevent too rapid evaporation of water from the grout. When the grout has fully hardened (after a minimum of 7 days) tighten all anchor bolts and recheck driver-driven unit for proper alignment.

H. Identification of Equipment and Hazard Warning Signs:

1. Identify equipment and install hazard warning signs in accordance with Section 10400.

I. Field coat in accordance with Section 09800.

3.02 WIRING CONNECTIONS AND TERMINATION

A. Clean wires before installing lugs and connectors.

B. Coat connection with oxidation eliminating compound for aluminum wire.

C. Terminate motor circuit conductors with copper lugs bolted to motor leads.

D. Tape uninsulated conductors and connectors with electrical tape, 150 percent of insulation value of conductor.

E. Connections to carry full ampacity of conductors without temperature rise.

F. Terminate spare conductors with electrical tape.

3.03 FIELD QUALITY CONTROL

A. Furnish equipment manufacturer services as specified in the individual equipment specifications.

B. Inspect wire and connections for physical damage and proper connection.

C. Check rotation of motor before connection to driven equipment, before couplings are bolted or belts installed. Before motor is started to check rotation, determine that motor is lubricated.

END OF SECTION

SECTION 11210

PUMPING EQUIPMENT: GENERAL STATEMENT

PART 1 - GENERAL

1.01 SUMMARY

A. General work included in this Section:
   1. All pumping equipment.

B. Related Sections include, but are not necessarily limited to:
   1. Division 1.
   2. Division 17 – Instrumentation and Control.
   3. Section 01340 - Technical Submittals.
   4. Section 01650 - Demonstration of Systems/Commissioning.
   5. Section 01715 - Equipment Operation and Maintenance Instructions.
   6. Section 09800 - Special Coatings.
   7. Section 11005 - Equipment: General Requirements.
   8. Section 11227 - Pumping Equipment: Submersible Non-Clog.

C. Reference Standards:
   1. NSF International Standards 60- 61 - Drinking Water System Components.

1.02 QUALITY ASSURANCE

A. The pumping equipment shall include furnishing and installing the specific type of pumps as shown, together with all accessories and appurtenances necessary for a complete installation. The work includes furnishing motors, variable frequency drives if required and all electrical and other controls:
   1. The pumps including drive units, controls and other accessories and appurtenances, shall be furnished by a single pumping manufacturer for each particular process category of pump types. The pumps shall be arranged as shown and suitable for installation in the space as shown. The equipment shall be designed for the foundation arrangements shown and piping connections shall be located to preclude any appreciable change in the arrangement of the suction and discharge lines shown.
   2. Fully coordinate all mechanical seal and seal water systems specified to assure pump/seal compatibility.
   3. For variable speed pumping applications, the pump manufacturer is designated to have single source responsibility for coordination for the pump motor/VFD drive system.

B. DEFINITIONS

C. NPSHR - Net Positive Suction Head Required.

D. NPSHA - Net Positive Suction Head Available.

E. VFD - Variable Frequency Drive.

F. Pump Service Category - Pump or pumps having identical names (not tag numbers) used for specific pumping service.

1.03 SUBMITTALS

A. Shop Drawings:
1. Certified pump performance curves.
2. Pump accessories data.
3. Pump bearing supports, brackets, shafting details and lubrication provisions.
4. Solids passage information.
5. Anchor bolt sizes and locations.
6. See Section 11005.
7. NSF 61 Certification for all parts that are contact with water.

B. Operation and Maintenance Manuals.

PART 2 - PRODUCTS

2.01 ACCESSORIES

A. See Section 11005.

2.02 SOURCE QUALITY CONTROL

A. If specifically required in the individual pump Sections, provide factory tests.
1. Adjustable speed units:
a. Head (FT) versus flow (gpm) pump curves:
1) Maximum, minimum and two equally spaced intermittent speeds.
2) Efficiencies along each curve.
3) Brake horsepowers along each curve.
4) NPSHR along each curve.

b. Hydrostatic test at 150 percent of shutoff head for a minimum of 5 minutes.

2. Constant speed units:

a. Head (FT) versus flow (gpm) pump curves:
1) Efficiencies along curve.
2) Brake horsepower along each curve.
3) NPSHR along each curve.

B. Balance:

1. All rotating parts accurately machined and in as near perfect rotational balance as practical.
2. Excessive vibration is sufficient cause for equipment rejection.
3. Unit mass and distribution is such that resonance is avoided.
4. Max. shaft vibration displacement (peak-to-peak) at stuffing box face: 2.0 mils
5. Max. vibration displacement (peak-to-peak) at any point on the machine

Nominal Rotative Speed	Maximum Displacement
3,500 rpm	2.0 mils
1,800 rpm	2.0 mils
1,200 rpm	3.0 mils
900 rpm	3.5 mils
720 rpm	4.0 mils
600 rpm & below	5.0 mils

Ratio of rotative speed to critical speed of a unit or components thereof less than 0.8 or more than 1.3.

6. Each pump motor will have an electrical disconnect that is not integral to the motor, but located adjacent to the motor, for quick disconnection of electrical power supply. The local disconnect shall be NEC code approved.

PART 3 - EXECUTION

3.01 ERECTION/INSTALLATION/APPLICATION

A. See Section 11005.

B. Floor/pad mounted units (Non-Submersible):

1. Vertically and horizontally align, level, wedge and plumb units to match piping interface.
2. Assure no unnecessary stresses are transmitted to equipment flanges.
3. Tighten flange bolts at uniform rate and manufacturer's recommenced torque for uniform gasket compression.
4. Support and match flange faces to uniform contact over entire face area prior to bolting pipe flange and equipment.
5. Permit piping connecting to equipment to freely move in directions parallel to longitudinal centerline when and while bolts in connection flange are tightened.
6. Grout equipment into place prior to final bolting of piping but not before initial fitting and alignment.

7. Assemble connecting piping with gaskets in place and minimum of four bolts per joint installed and tightened. Test alignment by loosening flange bolts to see if there is any change in relationship of piping flange with equipment.
8. Coat units as defined in Section 09800.
9. Provide pressure gauge on discharge of all pumps and on suction of all non-submersible units.

3.02 FIELD QUALITY CONTROL

A. Employ and pay for services of equipment manufacturer's field service representative(s) to:
   1. Conduct initial startup of equipment and perform operational checks.

   2. Provide a written statement that manufacturer's equipment has been installed properly, started up and is ready for operation by OWNER's personnel.

   3. Instruct OWNER's personnel for start-up testing for specified minimum number of hours at jobsite on operation and maintenance of the pumping equipment.

END OF SECTION

SECTION 11227

SUBMERSIBLE NON-CLOG PUMPS

PART 1 - GENERAL

1.01 SUMMARY

A. Scope:
   1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown on the Drawings, specified, and required to furnish and install submersible pumps complete and operational with control panel and accessories:

B. Related Sections include but are not necessarily limited to:
   1. Division 01 - General Requirements.
   2. Division 16 - Electrical.
   3. Division 17 - Instrumentation and Controls.
   4. Section 01340 - Technical Submittals.
   5. Section 01715 - Operation and Maintenance Equipment Instructions.
   6. Section 09800 - Special Coatings.
   7. Section 11005 - Equipment: General Requirements.

C. See Drawings.

D. Equipment Identification: Equipment to be installed are identified in the Drawings and Specifications as follows:

Equipment Name	Identifier
Lift Station Pumps	LP101 and LP102

1.02 QUALITY ASSURANCE

A. Manufacturer's Qualifications:
   1. Manufacturer shall have a minimum of five years of experience of producing substantially similar equipment and shall be able to show evidence of at least five installations in satisfactory operation for at least five years.

B. Referenced Standards:
   1. American National Standard Institute (ANSI).
   2. American Society for Testing and Materials (ASTM):
      a. A48 - Standard Specification for Gray Iron Castings.
   3. American Water Works Association (AWWA).
   4. Factory Mutual (FM).
   5. Hydraulic Institute Standards for Centrifugal, Rotary and Reciprocating Pumps (HI).
   6. Institute of Electrical and Electronic Engineers (IEEE).
   7. National Electrical Manufacturer's Association (NEMA):
      a. 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

b. ICS 6 - Industrial Control and Systems: Enclosures.

8. National Fire Protection Agency (NFPA):
   a. 70 - National Electrical Code (NEC).
9. Underwriters Laboratories, Inc. (UL).

1.03 SYSTEM DESCRIPTION

A. Lift Station Pumps:
1. Classic duplex system: pumps will work in lead-lag with Lead lag signals provided by RTU PLC.
2. Provide single source coordination responsibility through the pump manufacturer for the entire system including, but not limited to, the following:
   a. Pumps.
   b. Motors.
   c. Pump local control panel
3. Pumps will be controlled primarily by a submersible loop powered transducer. (See Electrical specifications #16902). Secondary control will be provided by four float level switches. High level shall start both pumps. Low level shall stop both pumps.
4. One control panel shall be provided by the manufacturer to control the pumps.

1.04 SUBMITTALS

A. Shop Drawings: Submit for approval the following:
1. Manufacturer's literature, illustrations, specifications, and engineering data including dimensions, materials, size, weight, performance data and curves showing overall pump efficiencies, flow rate, head, brake horsepower, motor horsepower, speed, and shut-off head.
2. Fabrication, assembly, installation, and wiring diagrams.
3. Deviations from Contract Documents.
4. Control Panel Diagrams.

B. Operations and Maintenance Manuals:
1. Submit complete installation, operation, and maintenance manuals, maintenance data and schedules, description of operation, and spare parts information.
2. Furnish Operation and Maintenance Manuals in conformance with the requirements of Section 01340.
3. Professional quality DVD color program of at least one hour duration that details operation and maintenance of pumps.

1.05 MOTOR REQUIREMENTS

A. Submersible Pumps:
1. 480V, 60Hz, 3-phase power supply.
2. Class H insulation rated for 311℉.
3. Current motor / insulation: air-filled, squirrel cage induction type, housed in air-filled watertight chamber.
4. Stator insulated using Class H insulation to minimum 95% winding fill factor.

1.06 WARRANTY

A. The pump manufacturer shall warrant the units being supplied to the OWNER against defects in workmanship and material for a period of five years or 10,000 hours under normal use, operation, and service. The pro-rated warranty shall cover parts and labor and shall be in printed form and apply to all units.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Flyght

2.02 PERFORMANCE AND DESIGN

A. All Units:
1. Pump case: Cast Iron ASTM A48 Class 35B.
2. Motor Housing: Cast Iron ASTM A48 Class 35B.
3. Impeller: Cast Iron/Polyamide 66.
4. Shaft: Stainless Steel.
5. O-rings: BUNA “N”.
6. Bolts and Nuts: Stainless Steel.
7. Volute, Impeller, Motor Housing, Discharge Elbow, and Other: Gray cast iron ASTM A-48, Class 35 B, with smooth surfaces devoid of blow holes or other casting irregularities.
8. Mechanical Seal: Tandem seals with all seal faces to be tungsten carbide.

2.03 EQUIPMENT

A. MHLS-P1 and MHLS-P2: Performance and Configuration Requirements:
1. Design Capacity: 400 gpm.
2. Design Head: 40 ft.
3. Pump configuration: Submersible.
4. Maximum pump speed: 1,754 rpm.
5. Nameplate driver horsepower: 10 HP, 480V, three phase, explosion proof.
6. Starter type: Across the line.
7. Hydraulic efficiency at design point: 50% minimum.
8. Model: Flyght 3127
9. All circuits entering the pond shall have intrinsically safe relays.

2.04 ACCESSORIES

A. Power Cables:
1. Provide power cable from controller to pump suitable for submersible applications in wastewater and indicated by a code or legend permanently embossed on cable.
2. Size cable in accordance with applicable NEC specifications.

3. Control panel is located approximately 20 ft. away from the lift station. Check Drawings to confirm lengths of power and control cables.
4. Provide cable with a strain relief.

B. Mechanical Controls:
1. Floats:
   a. There are four float switches for pump operation (from bottom: 1st float - pump off, 2nd float - lead pump on, 3rd float - lag and lead pump on, 4th float - high high level-alarm).
   b. All floats shall be N/O.
   c. Float 1 Low Low Lock out Alarm- Only in Alarm Mode
   d. Float 2 Low – Pump Stop
   e. Float 3 High – Pump Start
   f. Float 4 High High – Alarm
   g. Provide a cable holder to suspend floats.
2. Provide MiniCas relays for leak and over temperature alarm.
   a. Leak shall send alarm.
   b. Over temperature shall send alarm and shut down pump. In auto only.

C. Electrical Controls:
1. Pump supplier to provide NEMA 4 rated local control panel for the lift station pump operations.
   a. Cabinet shall be lockable. All Pilot Lights, Push Buttons and Selector Switches shall be 30 mm.
   b. Pilot lights shall be push to Test.
2. The local control panel will provide following status signals to the lift site auto dialer.
   a. Lift Station Pump 1 Run Status
   b. Lift Station Pump 1 Auto Status
   c. Lift Station Pump 1 Fault Alarm Soft Start Fault
   d. Lift Station Pump 1 Over temperature
   e. Lift Station Pump 1 Leak
   f. Lift Station Pump 2 Run Status
   g. Lift Station Pump 2 Auto Status
   h. Lift Station Pump 2 Fault Alarm Soft Start Fault
   i. Lift Station Pump 2 Over Temperature
   j. Lift Station Pump 2 Leak
   k. Lift Station Sump High - High Level Alarm
   l. Lift Station High – Float Mode Start
   m. Lift Station Low – Float Mode Stop
   m. Lift Station Low – Low Alarm

2.05 FABRICATION

A. General:

1. Submersible Pumps:
   a. Provide pumps capable of handling municipal sewage with solids that have 2.5" minimum sphere size.
   b. Design pumps to allow installation and removal of the pumps from concrete vaults. Pumps shall be removed using metal chains 304 SS.
   c. 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.
   d. Provide sliding guide rail for pump installation.
   e. Where a watertight seal is required, machine and fit mating surfaces with O-rings.
2. Impeller:
   a. Provide non-clog type dynamically balanced impeller in accordance with Hydraulic Institute Standards.
3. Discharge connection and lifting chains:
   a. Provide stainless steel chain to allow pulling the pump out of the lift station with a hook guided along the sliding rails.
4. Shaft:
   a. Design pump shaft of sufficient size to transmit full driver output.
   b. Use shaft which is accurately machined and constructed with sufficient materials.
   c. Design shaft for a maximum deflection of 0.002 inches measured at the stuffing box.
5. Shaft Seal:
   a. Seal shaft with tandem mechanical type seal running in an oil filled chamber.
   b. The lower seal between the pump and oil chamber shall contain one stationary and one positively driven rotating ring, both of corrosion resistant silicon carbide.
   c. The upper seal between the oil sump and motor housing shall contain one stationary ring and one positively driven rotating ring, both of corrosion resistant carbon/ceramic.
   d. Provide seals requiring neither routine maintenance nor adjustment, but capable of being easily inspected and replaced.
   e. Hold interface in contact by its own spring system
6. Bearings:
   a. Support shaft on upper and lower permanently lubricated bearings with B-10 life of 25,000 hrs.
7. Motors:
   a. The pump and motor shall be designed and wired for NEMA Class I, Division I, Group D service as rated by UL or FM.
   b. Provide motor of totally submersible design, constructed with epoxy or polyseal encapsulated windings, with Class F insulation and rated for continuous duty operation.
   c. 3 phase, 60 Hz, 480 V.

8. Coatings:
    a. Provide high solids epoxy interior and exterior coatings for pumps. Refer to Section 09800.
9. Lubrication System:
    a. Lubrication system shall use food grade mineral oil.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Per manufacturer's guidelines.

B. Seal pump cable end with a high quality protective covering, to make it impervious to moisture or water seepage prior to electrical installation.

3.02 MANUFACTURER'S SERVICES

A. The CONTRACTOR shall provide the services of a qualified, factory trained representative of the manufacturer to check and approve the installation before pumps are placed in service, supervise the initial operation and testing in the presence of ENGINEER, and instruct the OWNER's personnel in the operation and maintenance of the equipment.

B. Two (2) hours of training shall be provided for operation and maintenance of pumps. These two hours may not be consecutive if more than one training session is required.

END OF SECTION

DIVISION XV
MECHANICAL

SECTION 15050

BASIC PROCESS PIPING MATERIALS AND METHODS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Basic piping materials and methods.

1.02 REFERENCES

A. American Society of Testing and Materials (ASTM):
   1. A106/A106M - Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service.
   2. D2240-15e1 - Standard Test Method for Rubber Property - Durometer Hardness.
   3. A536-84(2019)e1 - Standard Specification for Ductile Iron Castings.

B. National Sanitation Foundation (NSF) 61 - Drinking Water System Components - Health Effects.

C. AWWA C111 - Rubber Gasket Joints for Ductile Iron Pressure Pipe and Fittings.

D. Refer to Section 09800 for coating requirements for exterior of exterior piping.

1.03 DEFINITIONS

A. Exposed Piping: Piping within buildings, vaults, tunnels, or other structures without regard to elevation of piping, or exposed piping outside buildings and structures.

B. Buried Piping: Piping actually buried in soil or cast in concrete.

C. Wet Wall: Wall with water on at least one side.

1.04 INTENT OF DRAWINGS AND SPECIFICATIONS

A. Except in details, piping is indicated diagrammatically. Sizes and locations are indicated on the Drawings. Not every offset and fitting, or structural difficulty that may be encountered has been indicated on the Drawings.

B. Perform minor modifications to piping alignment where necessary to avoid structural, mechanical, or other type of obstructions that cannot be removed or changed:
   1. Modifications are intended to be of minor scope, not involving a change to the design concept or a change to the Contract Price or Contract Time.

1.05 SYSTEM DESCRIPTION

A. Performance Requirements:
   1. Restraining Piping:
      a. Restrain piping as follows:
         1) When piping is underground, use mechanical restraints throughout. All buried piping shall be restrained.
         2) When piping is aboveground or under water, use mechanical or structural restraints.
      b. Provide restraints with ample size to withstand thrust forces resulting from test pressures.
   2. Connections to Existing Piping:
      a. Expose existing piping to which connections are to be made with sufficient time to permit, where necessary, field adjustments in line, grade, or fittings:
         1) Protect domestic water supplies from contamination:
            a) Make connections between domestic water supply and other water systems in accordance with requirements of public health authorities.
            b) Provide devices approved by owner of domestic water supply system to prevent flow from other sources into the domestic supply system.
      b. Make connections to existing piping and valves after sections of new piping to be connected have been tested and found satisfactory.
      c. Provide sleeves, flanges, nipples, couplings, adapters, and other fittings needed to install or attach new fittings to existing piping and to make connections to existing piping.
   3. Connections to In-Service Piping:
      a. Shutdown in-service piping in accordance with Section 01040:
         1) Establish procedures and timing in a conference attended by CONTRACTOR, ENGINEER, and OWNER of the in-service piping.
   4. Connections of Dissimilar Metals:
      a. Connect ferrous and nonferrous metal piping, tubing, and fittings with dielectric couplings especially designed for the prevention of chemical reactions between dissimilar metals.
      b. Nonferrous metals include aluminum, copper, and copper alloys.
      c. For flanged piping with dissimilar metals, use an insulated coupling or insulating gasket.
   5. All pipe tapping saddles are to be of bronze construction, unless noted otherwise on the Drawings.

PART 2 - PRODUCTS

2.01 ESCUTCHEONS (AS NEEDED)

A. Manufacturers: One of the following or pre-approved equal:
   1. Dearborn Brass Company, Model Number 5358.
   2. Keeney Manufacturing Company, Model Number 102 or Number 105.
   3. Beaton and Corbin, Model Number 1 or Number 13.

B. Material: Chrome plated steel plate.

2.02 MODULAR SEAL

A. Manufacturers: One of the following or pre-approved equal:
   1. Linx by Calpico, Inc.
   2. Link-seal by Thunderline Corporation.

B. Characteristics:
   1. Modular mechanical type, consisting of interlocking neoprene or synthetic rubber links shapes to continuously fill the annular space between the pipe and wall opening.
   2. Assemble links solely with stainless steel bolts and nuts to form a continuous rubber belt around the pipe.
   3. Provide a stainless steel pressure plate under each bolt head and nut. Isolate pressure plate from contact with wall sleeve.

2.03 COUPLINGS

A. Ductile Iron Couplings:
   1. Provide ductile iron couplings for use in connection of smooth end joints of ductile iron, steel or other types of pipe.
   2. General Requirements.
      a. Sleeve or center rings shall be of nominal O.D. size, range and length specified. Sleeve shall be of Ductile Iron ASTM A 536. Ends shall have a smooth inside taper to provide uniform gasket seal. Sleeve shall be given a shop coat of oil-modified urethane, corrosion-resistant paint.
      b. Follower flanges or end rings shall be of the thickness determined by the coupling size, and shall be of ductile iron, ASTM A 536. Flanges shall be identified by a color coded shop coat finish as described in Item 2a.
      c. Gaskets shall be compression-type, formed with Virgin Styrene Butadiene Rubber (SBR), compounded with ingredients to produce permanence and resistance to set after installation. O.D. range shall be imprinted on the gasket in permanent ink (minimum).
      d. Bolts and nuts shall be of high-strength, low-alloy steel, with nominal coarse thread, and hex nuts with black finish. Dimensions and minimum stress values shall be in accordance with AWWA/ANSIC111/A21.11.

e. Where specification states a cast transition or reducing coupling in place of a straight coupling, the sleeve and follower flange shall be of the same manufacturer and compatible for the specific use intended.
f. Quality control procedures shall be employed to ensure that the sleeve, follower flanges, and gaskets are properly fabricated and free of any visible defects. Coupling shall have pressure rating of 150 psi.

3. Manufacturer: EBAA Iron Inc., Romac Industries Inc., or Pre-approved equal.

B. Expansion Joint (Flexible Bellows Coupling):
1. Manufacturer: General Rubber or approved equal.
2. Performance and Design:
a. Provide single and double arch expansion joints, as shown on the Drawings, complete with restraining rods to prevent over-expansion. Provide flanged spool with single or multiple arches, designed to provide motion capability as specified. Rubber expansion joints shall be rated for 250℉ and 150 psi.
3. Materials:
a. Tube - Provide single, seamless, leakproof tube made of Buna-N that extends through the bore to the outside edges of both flanges.
b. Body - Fabric reinforcement shall be used as the flexible and supporting member between the tube and the cover. Fabrics of high strength synthetic fibers shall be used. All Fabrics plies shall be impregnated with rubber or synthetic compounds to permit flexibility between the fabric plies to reduce service strain.
c. Cover - The exterior surface of the joint shall be formed from synthetic rubber to protect the body from outside damage. Utilize special polymers to resist sunlight.
d. Integral Flanges - Constructed of resilient rubber, and smooth finish, the full-faced flanges form a tight seal against the pipe flange without the need of gaskets. Provide standard AWWA flanges as specified in Section 15062.
e. Provide restraining rods attached to flanges for thrust protection.
4. Execution:
a. Install expansion joint as shown on the Drawings and in accordance with the manufacturer’s recommendations.

C. Flanged Coupling Adapter:
1. Description: One end of adapter shall be flanged and the other end shall have a sleeve type flexible coupling.
2. Pressure and Service: Same as connected piping.
3. Material: Cast iron or steel.
4. Bolts and Nuts: Type 316 stainless steel.

5. Harnessing:
    a. Harness adapters to restrain pressure piping. Test pressures for pressure pipelines shall conform to the requirements of Section 15050, Piping Systems.
    b. For adapters 12-inch diameter and less, provide 1/2-inch minimum stainless steel anchor studs installed in a pressure tight anchor boss. Provide number of studs required to restrain test pressure and service conditions. Harness shall be as designed and recommended by manufacturer; however, the following minimum anchor studs shall be provided, unless otherwise approved by ENGINEER:
        1) 6-inch diameter and less: Two.
        2) 8-inch diameter and less: Four.
        3) 10-inch diameter and less: Six.
        4) 12-inch diameter and less: Eight.
    c. For adapters larger than 12-inch diameter, provide split-ring harness clamps with a minimum of four Type 316 stainless steel bolts. Harness assembly shall be as designed and recommended by manufacturer. Dimensions, sizes spacings and materials shall be suitable for service and conditions encountered and shall be approved by ENGINEER.
6. Product and Manufacturer: Provide one of the following:
    a. Smith-Blair, Model 912.
    b. Romac Industries Inc., FC400/FCA501/RFCA.
    c. Ford FFCA.

D. Dismantling Joint:
1. Description: Adjustable telescoping restraint with tie-rods that can be adjusted to length to allow access for installation or removal of valves and other equipment.
2. Pressure and Service: Same as connected piping.
3. Material: Ductile iron or steel.
4. Bolts and Nuts: Type 316 stainless steel or ASTM A588 HSLA bolt material.
5. Product and Manufacturer: Provide one of the following:
    a. Romac Industries Inc., DJ400
    b. Or Approved Equal

2.04 CONTROLLED LOW STRENGTH MATERIAL

A. Controlled low strength material shall consist of Portland cement coarse and fine aggregate, and water.

B. Cement content shall be 0.5 sack of cement per yard.

C. The material shall have slump of 7 inches ± dye inch.

D. Compressive strength at 28 days shall be 70 psi ± 30 psi.

2.05 BURIED PIPING

A. All buried plastic piping shall have tracer wire placed 1 foot above the crown of the pipe. The magnetic tracer wire shall be 12 gauge insulated solid copper wire.

B. All buried piping shall also be provided with an identification tape (non detectible) placed 3 feet above the crown of the pipe. The tape shall be an inert polyethylene-plastic impervious to alkalis, acids, chemical reagents, and solvents likely to be encountered in the soil. The tape shall be a minimum of 4.0 mils thick and not less than 3" wide. The color of the tape and the text will be selected by OWNER. Lettering shall be minimum 1 ½" high. OWNER will select text for each pipe run using manufacturer's normally available stock.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verification of Existing Conditions:
   1. Locate and expose existing structures, piping, conduits, and other facilities and obstructions which may affect construction of underground piping before starting excavation for new underground piping and appurtenances.
   2. Verify sizes, elevations, locations, and other relevant features of existing facilities and obstructions. Determine conflicts for the construction of the new underground piping and appurtenances.
   3. Make piping location and grade adjustments to resolve conflicts between new piping and existing facilities and obstructions.

3.02 WALL AND SLAB PENETRATIONS

A. Provide sleeves for piping penetrations through masonry and concrete walls, floors, ceilings, roofs, pilasters, columns, piers, and beams unless specified or otherwise indicated on the Drawings.

B. For piping 1 inch in nominal diameter and larger, provide sleeves with minimum inside diameters of 1 inch plus outside diameter of piping. For piping smaller than 1 inch in nominal diameter, provide sleeve of minimum twice the outside diameter of piping:
   1. Arrange sleeves and adjacent joints so piping can be pulled out of sleeves and replaced without disturbing the structure.
   2. Cut ends of sleeves flush with surfaces of concrete, masonry, or plaster.
   3. Conceal ends of sleeves with escutcheons where piping runs through floors, walls, or ceilings of finished spaces within buildings.
   4. Seal spaces between pipes and sleeves.

C. Cast couplings or wall pieces in walls for penetrations of buried rigid piping including cast iron, ductile iron, reinforced concrete, and vitrified clay through structures:
   1. Provide couplings or wall pieces with mechanical push-ons, or similar flexible joints at outside of walls.
   2. Provide additional similar joints in piping at transition points between trenches and structure excavations.
   3. For steel piping, single joints may be used in lieu of two joints. Locate single joints outside within 2 feet from outside faces of walls.

D. Modular Seal for Pipe Penetration: Provide Link-Seal or approved equal. Provide two modular seals to seal at wet wall sleeves or penetrations. Mount one seal on the inside face of the wall and the other on the outside face of the wall. Coordinate the inside diameter of the wall sleeve with the size of the seal to provide watertight sealing. For dry wall penetrations, provide 1 modular seal.

3.03 EXPOSED PIPING

A. Install exposed piping in straight runs parallel to the axes of structures, unless indicated otherwise:
   1. Install piping runs plumb and level, unless otherwise indicated on the Drawings.

B. Install exposed piping after installing equipment and after piping and fitting locations have been determined.

C. Support piping in accordance with Section 15141 and as shown on Drawings:
   1. Do not transfer pipe loads and strain to equipment.

D. In addition to the joints indicated on the Drawings, provide unions, flexible couplings, flanged joints, and other types of joints or means which are compatible with and suitable for the piping system, and necessary to allow ready assembly and disassembly of the piping.

E. Assemble piping without distortion or stresses caused by misalignment:
   1. Match and properly orient flanges, unions, flexible couplings, and other connections.
   2. Do not subject piping to bending or other undue stresses when fitting piping. Do not correct defective orientation or alignment by distorting flanged joints or subjecting flange bolts to bending or other undue stresses.
   3. Flange bolts, union halves, flexible connectors, and other connection elements shall slip freely into place.
   4. After piping assembly to fit when proper fit is not obtained.
   5. Install eccentric reducers or increasers with the top horizontal for pump suction piping.

3.04 BURIED PIPING

A. Bury piping with minimum 4 foot cover without air traps, unless otherwise indicated on the Drawings.

B. Where 2 similar services run parallel to each other, piping for such services may be laid in the same trench. Lay piping with sufficient room for assembly and disassembly of joints, for thrust blocks, for other structures, and to meet separation requirements of public health authorities having jurisdiction.

C. Laying Piping:
   1. Lay piping in finished trenches free from water or debris. Begin at the lowest point with bell ends up slope.
   2. Place piping with top or bottom markings with markings in proper position.
   3. Lay piping on an unyielding foundation with uniform bearing under the full length of barrels.
   4. Where joints require external grouting, banding, or pointing, provide space under and immediately in front of the bell end of each section under and immediately in front of the bell end of each section laid with sufficient shape and size for grouting, banding, or pointing of joints.
   5. At the end of each day's construction, plug open ends of piping temporarily to prevent entrance of debris or animals.

3.05 CLEANING

A. Piping Cleaning:
   1. Upon completion of installation, clean piping interior of foreign matter and debris. Perform special cleaning when required by the Contract Documents.
   2. Maintain pipe in clean condition during installation.
   3. Before jointing piping, thoroughly clean and wipe joint contact surfaces and then properly dress and make joint.
   4. Immediately prior to pressure testing, clean and remove grease, metal cuttings, dirt, or other foreign materials which may have entered the system.
   5. At completion of work and prior to final acceptance, thoroughly clean work installed under these Specifications. Clean equipment, fixtures, pipe, valves, and fittings of grease, metal cuttings, and sludge which may have accumulated by operation of system, from testing, or from other causes. Repair any stoppage or discoloration or other damage to parts of building, its finish, or furnishings, due to failure to properly clean piping system, without cost to Owner.
   6. Clean chlorine piping by pulling a cloth saturated with trichloroethylene or other suitable chlorinated solvent through each length of pipe. Disassemble valves and clean with suitable solvent. All surfaces which may come in contact with chlorine shall be thoroughly dry, and free of oil or grease before placing in service.

B. Cleaning Potable Water Piping:
   1. Flush and disinfect potable water piping in accordance with Section 15495.

3.06 FIELD QUALITY AND CONTROL

A. General:
   1. Upon completion of piping, but prior to application of insulation on exposed piping or covering concealed/buried piping, test all piping systems.
   2. Test all piping systems at 200 psi for 2 hours, unless otherwise indicated. Pressure shall stabilize within 2% of 200 psi.
   3. Isolate equipment which may be damaged by the specified pressure test conditions.
   4. Perform pressure test using calibrated pressure gauges and calibrated volumetric measuring equipment to determine leakage rates. Select each gauge so that the specified test pressure falls within the upper half of the gauge's range. Notify the OWNER 24 hours prior to each test.
   5. Unless otherwise specified, completely assemble and test new piping systems prior to connection to existing pipe systems.
   6. Acknowledge satisfactory performance of tests and inspections in writing to OWNER prior to final acceptance.
   7. Provide all necessary equipment and perform all work required in connection with the tests and inspections.
   8. Bear the cost of all testing and inspecting, locating and remedying of leaks and any necessary retesting and re-examination.
   9. CONTRACTOR to dispose of testing water.

B. Pressure Testing Methods and Criteria:
   1. Types of pressure testing and inspection to be employed include hydrostatic pressure testing, and hydrostatic infiltration/exfiltration testing.
   2. Liquid systems:
      a. The following liquid piping systems shall have zero leakages at the specified test pressure throughout the specified duration:
         1) Exposed piping.
         2) Buried insulated piping and buried or exposed pressure piping.
   3. Hydrostatic pressure testing:
      a. All joints, including welds, are to be left exposed for examination during the test.
      b. Provide temporary restraints for expansion joints for additional pressure load under test. Equipment in piping system with rated pressure lower than pipe test pressure shall be isolated by valves or blind flanges.
      c. Do not paint or insulate exposed piping until successful performance of pressure test.
      d. Test soil, waste and drain piping at completion of installation of each stack or section of piping by filling system with water to highest point and checking joints and fittings for leaks. Leaks must be eliminated before proceeding with work or concealing piping. Minimum test heights shall be 10 ft.

3.07 PIPING SCHEDULE

A. See Drawings.

END OF SECTION

SECTION 15062
DUCTILE IRON PIPING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Ductile iron piping, joints, fitting, and pipe lining and coating.

1.02 REFERENCES

A. American National Standards Institute/American Society of Mechanical Engineers (ANSI/ASME):
   1. B 16.1 - Grey Iron Pipe Flanges and Flanged Fittings - Classes 25, 125, and 250.

B. American Society for Testing and Materials (ASTM):
   1. A 47 - Standard Specification for Ferritic Malleable Iron Castings.
   2. A 183 - Standard Specification for Carbon Steel Track Bolts and Nuts.
   3. A 536 - Standard Specification for Ductile Iron Castings.
   4. A 674 - Standard Practice for Polyethylene Encasement for Ductile Iron Pipe for Water or Other Liquids.
   5. D 792 - Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement.
   6. D 4976 - Standard Specification for Polyethylene Plastics Molding and Extrusion Materials.

C. American Water Works Association (AWWA):
   1. C 104 - Standard for Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water.
   2. C 105 - Polyethylene Encasement for Ductile-Iron Pipe Systems.
   3. C 110 - Ductile-Iron and Gray-Iron Fittings.
   4. C 111 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
   5. C 115 - Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges.
   6. C 150 - Thickness Design of Ductile-Iron Pipe.
   7. C 151 - Ductile-Iron Pipe, Centrifugally Cast.
   8. C 600 - Installation of Ductile-Iron Water Mains and Their Appurtenances.
   9. C 900 - Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 in. Through 60 in.

D. National Sanitation Foundation (NSF) 61 - Drinking Water Components - Health Effects.

1.03 SUBMITTALS

A. Layout Drawing: Detailed layout drawings showing alignment of pipes, location of valves, fittings, and appurtenances, types of joints, and connections to structures.

B. Product Data: Photographs, drawings, and descriptions of fittings, gaskets, couplings, grooving of pipe and fittings, and pipe lining.

C. Test Reports: Manufacturer's test reports for polyethylene lining certifying successful performance of the wet sponge spark tests.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Block piping material for shipment, prevent damage to castings and linings.

B. Carefully handle piping material during loading, unloading, and installation. Do not drop piping material from trucks. Lower piping material by mechanical means. Do not drop or pound pipe to fit grade.

C. Repair damaged pipe lining to match quality, thickness, and bonding or original lining. When lining cannot be repaired or repairs are defective, replace defective piping with undamaged piping.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Ductile Iron Piping:
   1. Yard piping shall be ductile iron in conformance with AWWA M41, C110, C115, C150, C151, C153 and MAG 750."

B. Joints:
   1. Flanged Joints:
      a. Flanges: One of the following with diameter, thickness, drilling, and other characteristics in accordance with ANSI B 16.1:
         1) Cast integrally with the pipe.
         2) Screw-on: Comply with the following:
            a) Ductile iron.
            b) Long hub, threaded, and specially designed for ductile iron pipe.
            c) After attaching to pipe, machine flange face to make pipe end and flange even and perpendicular to the axis of the pipe.
      b. Bolt Holes: Two-holed and aligned at both ends of pipe.
      c. Cap Screw or Stud Bolt Holes: Tapped.

d. Bolt and Nuts: ANSI/ASME B 16.1 or when connecting flanges underground, in concrete pipe valve boxes, or underwater, Type 316 stainless steel; cut and finished to project a maximum of 1/4 inch beyond nut when joints are assembled.
e. Class 150 flange (suitable for 250 psi).

2. Mechanical Joints: AWWA C 111/ANSI A 21.11.
3. Restrained Mechanical Joints:
   a. Mega-lug restrained joints.
   b. Or Pre-approved equal.
4. Gaskets for Flanged Ductile Iron:
   a. Suitable for pressures equal to and less than 150 psi, temperatures equal to and less than 100 degrees Fahrenheit.
   b. Neoprene with minimum durometer hardness value of 70 when tested in accordance with ASTM D 2240, Type A; minimum 3/32 inch thick for less than 10-inch pipe; minimum 1/8 inch thick for 10 inch and larger pipe. Provide gaskets with inserted 13-ounce nylon fabric cloth for pipes 20 inch or larger.
   c. Manufacturers: One of the following or equal:
      1) Griffin Pipe Products
      2) US Pipe
      3) American Cast Iron Pipe Co.

2.02 ACCESSORIES

A. Fittings: AWWA C 110/ANSI A 21.10 or AWWA C 153/ANSI A 21.53 with the same pressure rating and joint configuration as that of the associated piping.

2.03 PIPE LININGS

A. Lining and Coating: AWWA C 104/ANSI A 21.4, applied on clean bare metal surfaces; extended to faces of flanges, ends of spigots, and shoulders of hubs; painted with bituminous material.
   1. Coating: The exterior of the ductile iron yard piping shall be coated with a bituminous coating and wrapped in polyethylene encasement per MAG 610 and COS MAG Supplement and AWWA C105.
   2. Lining: The interior of all ductile iron piping (buried and above grade) shall be shop applied cement Protecto 401 Epoxy coating (40-50 mils). The exterior of all such piping located in the wetwell shall also be coated similarly with Protecto 401.

PART 3 - EXECUTION

3.01 INSTALLATION

A. General:
   1. Install ductile iron piping in accordance with AWWA C 600, modified as specified in Section 15050.
   2. Lay mechanical joint or bell and spigot pipe with 1/8-inch space between the spigot and shoulder of the pockets.
   3. All buried piping shall be restrained.

B. Special Techniques:
   1. Polyethylene Encasement: Wrap ductile iron pipe to be buried with polyethylene encasement in accordance with ASTM A 674. Repair tears and make joints with double plastic tape wrap.
      a. Polyethylene: AWWA C 105.
      b. Plastic Tape Wrap: Manufacturers shall be one of the followings or Pre-approved equal:
         1) Polyken Pipeline Coatings, Polyken Number 910.
         2) The Tapecoat Company, Tapecoat CT.

3.02 JOINTS

A. Install type of Joints as specified in Piping Schedule on Drawings.

3.03 FIELD QUALITY CONTROL

A. Clean and test ductile iron piping as specified in Section 15050.

END OF SECTION

SECTION 15110
VALVES

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Basic requirement for valves:
   1. Requirements indicated on the Drawings and specified elsewhere in these Specifications take precedence over the requirements specified under this Section.
   2. Furnish and install valves required for proper piping and equipment operation and maintenance, in addition to the valves indicated on the Drawings, and specified.

1.02 REFERENCES

A. American Society for Testing and Materials (ASTM):

   1. A126 - Standard Specification for Gray Icon Casting for Valves, Flanges, and Pipe Fittings.
   2. A48 - Standard Specification for Gray Iron Castings.
   3. A536 - Standard Specification for Ductile Iron Castings.

B. American Water Works Association (AWWA):
   1. C111 - Rubber-Gasket Joints for Ductile Iron Pressure Pipe and Fittings.
   2. C504 - Rubber Seated Butterfly Valves, 3 In. Through 72 In.
   3. C508 - Swing Check Valves for Waterworks Service, 2-In. through 24-In. NPS.
   4. C110 - Ductile-Iron and Grey-Iron Fittings.
   5. C207 - Steel Pipe Flanges for Waterworks Service, Sizes 4 In. Through 144 In.

C. Steel Structures Painting Council (SSPC):

   1. SP-2 - Hand Tool Cleaning.
   2. SP-10 - Near-White Blast Cleaning.

D. American National Standards Institute (ANSI):

   1. B1.20.1 - Pipe Threads, General Purpose.

E. NSF 61 - Drinking Water System Components - Health Effects.

1.03 DESIGN REQUIREMENTS

A. Pressure Rating: 250 psi.

B. Valve To Piping Connections:

1. Valves 3-inch nominal size and larger: Flanged ends unless otherwise specified on the Drawings.
2. Valves less than 3-inch nominal size: Screwed ends.

1.04 SUBMITTALS

A. Product Data: Submit detailed technical information relating to the valve including description of component parts, materials of construction, performance, dimensions, and weights.

B. Manufacturer's Published Instructions:

1. Submit instructions for installation, operation, and maintenance of valves.
2. Furnish bound sets of installation, operation, and maintenance instructions for each type of valve 3-inch nominal size and larger.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications:

1. Valves: Manufactured by manufacturers whose valves have had successful operational experience in comparable service.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Underground Bolts: Low-alloy steel in accordance with AWWA C111.

B. Bronze And Brass Alloys: Use bronze and brass alloys with not more than 6 percent zinc and not more than 2 percent aluminum in the manufacturing of valve parts.

C. Interior Protective Coating:
1. Epoxy coat interior non-working surfaces, except stainless steel surfaces.
2. Coating Types:
   a. Powder Epoxies:
      1) Manufacturers: One of the following or equal:
         a) 3-M Company, ScotchKote 134; certified to NSF 61 for drinking water use.

b) Michigan Chrome and Chemical Company, Micron 650 or 651.
c) Or Pre-approved equal.

b. High Solids Polyamine Cured Epoxy:

1) Manufacturers: One of the following or equal:
a) Tnemec: Series 140N Pota Pox
b) Or Pre-approved equal

3. Clean surfaces to meet SSPC-SP-10, near-white metal blast cleaning, with grit of size recommended by epoxy manufacturer.

4. Apply in accordance with manufacturer's published instructions:

a. High Solids Polyamine Cured Epoxy:
1) Not less than 2 coats to the specified thickness.

5. Coating Thickness: 12 mils except that:

a. Coating thickness in grooves for gaskets: 5 mils.
b. Do not coat seat grooves in valves with bonded seat.

6. Quality Control:

a. Coating Thickness: Measured with a nondestructive magnetic type of thickness gauge.
b. Verify coating integrity with a holiday detector set at 1,800 volts.
c. Consider tests successful when coating thickness meets specified requirements and when no pin holes are found:

1) Correct defective coating disclosed by unsuccessful tests, and repeat test.
2) Repair pinholes in accordance with manufacturer's published recommendations.

D. Underground Valves:

1. Provide underground valves with flanged, mechanical, or other type of joint required for the type of pipe to which the valve is to be connected.
2. Coating and Wrapping:
a. Paint buried valves with 3 coats of asphalt varnish in accordance with AWWA C 504:
1) Protect coating from damage during handling and installation; repair coating where damaged.

b. After installation, wrap valves in polyethylene as specified for ductile iron piping in Section 15062:
    1) Ascertain that polyethylene wrapping does not affect operation of valve.

3. All interior epoxy coatings shall be NSF 61 certified.

E. Valve Boxes:
1. Furnish and install access to operators of buried valves through cast-iron valve boxes, as shown on Drawings:
    a. Do not support boxes on valve, valve operator, or pipe.
    b. Boxes: Fabricated of cast-iron; provided with cover, asphalt varnished or enameled. Adjust to grade, install centered around the upper portions of the valve and valve operator.
    c. Use seamless pipe inside valve box. If seam is required, use a sealed bell joint.
    d. Minimum clear inside diameter of 6 inches.
    e. Install per MAG Detail 391-1 Type A.

F. Valve Operators:
1. Open counterclockwise.
2. Provide valves located below operating level or deck with extensions for key operation or floor stands and handwheels.
3. Provide manually operated valves and gates located not more than 6 feet above the operating level with levers, tee handles, wrenches, or handwheels, as shown on Drawings.
    a. Make the valve operator more conveniently accessible by rolling valves, located more than 5 feet but less than 6 feet above the operating level, toward the operating side.
    b. Secure tee handles and wrenches to the valve head or stem, except where a handle or wrench so secured constitutes a hazard to personnel; in which case, stow handle or wrench immediately adjacent to the valve on or in a suitable hanger, bracket, or receptacle.
4. Fit valves located more than 6 feet above operating level with chain operated handles or valve wheels:
    a. Chains: Sufficient length to reach approximately 4 feet above the operating level.
    b. Where chains constitute a nuisance or hazard to operating personnel, provide hold-backs or other means for keeping the chains out of the way.

G. Combined Air/Vacuum Release Valve:
1. Manufacturer: ARI, Val-Matic, Apco or Pre-approved equal.
2. Orifice: 5/16".
3. Size: See Drawings.
4. Body: stainless steel.
5. Float: HDPE.

6. Seat: Buna-N (soft seat).
7. Float Guide: stainless steel.
8. O Ring Seat: EPDM rubber.
9. Other internal parts: stainless steel.
10. Pressure rating: 250 psi.
11. Provide isolation valve upstream of air release valve.

H. Air Release Valve (ARV): Air release valves shall be provided in accordance with Chapter 6-1.410 of the City DSPM. The ARV shall have a pressure rating greater than or greater than the pipeline it is connected to. Approved manufacturers: ARI, Val-Matic, Apco or approved equal.

I. Valves equal to and larger than 6-inches and/or throttling service valves shall include handcrank and wormgear actuators. Valves located 60-inches or higher above finished floor level shall include chainwheel actuators. Chains shall hang down within 36-inches of the finished floor level.

2.02 FABRICATION

A. Valves:
1. End connections:
a. Provide end connections for valves as required in Piping Schedule.
b. Assure end connections meet the following standards:
1) Threaded: ANSI B1.20.1
2) Flanged: AWWA C207.
3) Bell and spigot or mechanical (gland) type: AWWA C111.

PART 3 - EXECUTION

3.01 PREPARATION

A. Once flanged valves and flanged check valves are selected, determine face-to-face dimensions of valves.

B. Fabricate piping to lengths taking into account the dimensions of flanged valves and flanged check valves.

3.02 INSTALLATION

A. Prior to installation, valves that will be electrically actuated shall have actuators mounted and tested by the valve manufacturer. Actuators will be shipped by the actuator manufacturer to the valve manufacturer for mounting and testing.

B. Provide incidental work and materials necessary for installation of valves including flange gaskets, flange bolts and nuts, valve boxes and covers, concrete bases, blocking, and protective coating.

C. Where needed, furnish and install additional valves for proper operation and maintenance of equipment and plant facilities under the following circumstances:
   1. Where such additional valves are required for operation and maintenance of the particular equipment furnished by CONTRACTOR.
   2. Where such additional valves are required as a result of a substitution or change initiated by CONTRACTOR.
   3. Install valves with their stems in vertical position above the pipe, except as follows:
      a. Butterfly valves, gate valves aboveground, globe valves, and angle valves may be installed with their stems in the horizontal position.

D. Install valves so that handles clear obstructions when the valves are operated from full open to fully close.

E. Place top of valve boxes flush with finish grade or as otherwise indicated on the Drawings.

3.03 ADJUSTING

A. Make sure all adjustments to valves, operators and appurtenant equipment prior to Project Acceptance. Operate valve, open/close, at system pressures.

END OF SECTION

SECTION 15111

BALL VALVES

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: DIP ball valves, plastic body ball valves and instrument isolation ball valves.

1.02 REFERENCES

A. American National Standards Institute/American Society of Mechanical Engineers (ANSI/ASME):
   1. B16.5 – Pipe Flanges and Flanged Fittings: NPS ½ through NPS 24 Metric/Inch.

B. American Petroleum Institute (API).

C. American Society for Testing and Materials (ASTM):
   1. A 351 – Standard Specification for Castings, Austenitic, for Pressure-Containing Parts.

D. American Water Works Association (AWWA):
   1. C 507 – Ball Valves, 6 In. Through 60 In.

E. National Sanitation Foundation (NSF) 61 - Drinking Water Components - Health Effects.

1.03 SYSTEM DESCRIPTION

A. General: Unless otherwise indicated on the Drawings use:
   1. Plastic body ball valves on plastic pipelines.
   2. Where valves are connected to electric actuators, the valve and actuator assembly shall be supplied by the same Supplier/Manufacturer.

PART 2 - PRODUCTS

2.01 BALL VALVE TYPES

A. Full Port Ductile Iron (DI) Ball Valves:
   1. Manufacturers: One of the following or equal.
      a. Conbraco.
      b. Dezurik.
      c. Or pre-approved equal.

B. Plastic Ball Valves:
   1. Manufacturers: One of the following or equal.
      a. Asahi America, Type 21.
      b. Spears.
      c. Hayward
      d. Or pre-approved equal.

C. General:
   1. Type: Non-lubricated and capable of sealing in either flow direction.
   2. End Connections: for PVC valves - flanged or socket end connections, True union; for DI valves - flanged end connections.
   3. Operator Handle: Lever.
   4. Valves bodies requiring actuators shall have integrally mounted molded stem support and platform to assure proper alignment of the actuator to the valve.
   5. 150 psi pressure rated.

D. Materials:
   1. Body: Ductile iron body for DI valves; PVC/CPVC body for plastic valves.
   2. Ball: PVC/CPVC for plastic valves.
   3. Seats: FKM (Viton) or EPDM or PTEF.
   4. O-rings: FKM (Viton) or EPDM.
   5. All ball valves installed on chemical system lines shall be made of CPVC/PVC as shown on Drawings.

E. Plastic Ball Valve Electric Operator
   1. Asahi America Series 94 Electric Actuator or approved equal.
   2. 120 VAC, single phase.
   3. Actuator will receive open/close command from New IX/GAC PLC.
   4. Valve shall provide open/close status signals to New IX/GAC PLC.
   5. Provide two limit switches for open/close status signals to PLC.

PART 3 - EXECUTION

3.01 INSTALLATION

A. General: Install each type of valve in accordance with manufacturers' printed instructions.

B. Schedule: All valves 3-inches and smaller are not shown on the Valve Schedule in the Drawings.

END OF SECTION

SECTION 15114

CHECK VALVES

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: silent check valves, and plastic body ball check valves

1.02 REFERENCES

A. American Society for Testing and Materials (ASTM):
   1. A 48 – Standard Specification for Gray Iron Castings.
   2. A 126 – Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
   3. A 276 – Standard Specification for Stainless Steel Bars and Shapes.
   4. B 582 – Standard Specification for Nickel-Chromium-Iron-Molybdenum-Copper Alloy Plate, Sheet and Strip.
   5. B 584 – Standard for Copper Alloy Sand Castings for General Applications.

B. American Water Works Association (AWWA):
   1. C 508 – Swing-Check Valves for Waterworks Service, 2 - 48 Inch NPS.

C. American Petroleum Institute (API).

D. National Sanitation Foundation (NSF) 61 - Drinking Water Components - Health Effects.

1.03 SYSTEM DESCRIPTION

A. Design Requirements:
   1. Check Valves: When not otherwise specified as indicated on the Drawings, provide check valves suitable for service as follows:
      a. In either horizontal or vertical position.
      b. Under pressures equal and less than 150 psig.
      c. Plastic body ball check valves on plastic pipelines.

PART 2 - PRODUCTS

2.01 SILENT CHECK VALVES (METAL BODY)

A. Globe Style Silent Check Valves 3 Inches through 24 Inches:
   1. Manufacturers: One of the following or equal:
      a. APCO
      b. Valmatic
      c. Clow
      d. Crispin
      e. Or pre-approved equal.
   2. Valve Design:
      a. Globe
      b. Valve plug will be spring loaded, normally closed, by means of one or more stainless steel springs.
      c. Check valve must be capable of silent operation when installed in the vertical or horizontal position - flow up or down.
      d. Spring must be helical or conical. Seat and plug shall be hand replaceable in the field for ease of maintenance.
      e. The flow area through the body shall be equal to or greater than the cross sectional area of the equivalent pipe size.
   3. Materials:
      a. Body: Cast-iron, ASTM A 126 Class B.
      b. Doors: Ductile iron ASTM A536.
      c. Hinge Pins: Stainless steel.
      d. Sealing element: Buna-N.
      e. End Connections: Flanged.

2.02 BALL CHECK VALVE (PLASTIC BODY)

A. Valves ¼ inch through 6 Inches:
   1. Manufacturers: One of the following or equal:
      a. Asahi/America
      b. Spears Manufacturing Company
      c. Chemtrol Division, NIBCO, Inc.
      d. Or pre-approved equal
   2. General:
      a. End Connection: True union; solvent or heat welded to piping.
   3. Materials:
      a. Body: CPVC or PVC.
      b. Ball: CPVC or PVC.
      c. Seats: FKM (Viton) or EPDM
      d. O-rings: FKM (Viton) or EPDM
      e. All ball check valves installed on chemical system lines shall be made of CPVC or PVC.

2.03 CAST IRON BALL CHECK VALVE

A. Manufacturers: Flomatic Model 408, 4082 & 408FB, or APCO
B. Size Range: 3”- 14”
C. Provide valves suitable for submersible water and wastewater industry applications.
D. Provide a clean-out port permitting access to the inside of the valve without removal from the pipe line.
E. Flanged ANSI 125 connections.
F. Equip with a “floating” rather than a “sinking” ball to prevent backflow from drains.
G. Provide phenolic ball with all stainless steel hardware.
H. Provide epoxy coated valve corrosion resistant vale suitable for wastewater.

PART 3 - EXECUTION

3.01 INSTALLATION

A. General: Install with proper orientation of flow direction arrow on valve body.

3.02 ADJUSTING

A. Adjust cushioned check valves in the field by means of external adjustment devices to minimize pressure surges.

B. Adjust weight on check valves to affect proper closing action on equipment shutdown.

END OF SECTION

SECTION 15116

ECCENTRIC PLUG VALVES,
OPERATIONS, AND APPURTENANCES

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Lubricated and non-lubricated plug valves.

1.02 REFERENCES

A. American Society for Testing and Materials (ASTM):
   1. A 126 – Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.

B. National Sanitation Foundation (NSF) 61 - Drinking Water Components - Health Effects.

PART 2 - PRODUCTS

2.01 NON-LUBRICATED PLUG VALVES

A. Manufacturers:
   1. DeZurik.
   2. Or approved equal.

B. Design:
   1. Type: Non-lubricated eccentric type.
   2. Plug Face: Resilient material which operates satisfactorily at a temperature of 180 degrees Fahrenheit continuous and 215 degrees Fahrenheit intermittent, except for valves in compressed air service.
   3. Compression Washer: Provide flat compression washer made of Teflon, or of a material having equal physical characteristics on valve stem between plug and bonnet.
   4. Stem Seals: Provide stem seals serviceable without unbolting the valve bonnet assembly.
   5. Clearly mark valves to indicate their open and closed positions.
   6. Provide valves with ends as required by piping details indicated on the Drawings.
   7. Provide corrosion resistant interior coatings suitable for domestic wastewater pplications.

C. Materials:
   1. Body and Plug: ASTM A 126, Class B, cast-iron with plug face of neoprene, Buna N, isoprene, or hycar material suitable for the intended service.

2. Body Seats in Valves 3 Inch Size and Larger: Provide with overlay of not less than 90 percent nickel and minimum thickness of 1/8 inch on surfaces contacting the plug face.
3. Stem Bearing and Bottom Bearing: Stainless steel Type 316.
4. Internal Parts, Except the Body and Plug: Type 316 stainless steel, Monel, or nickel.
5. Exposed Nuts, Bolts, and Washers: Zinc plated. Exception: exposed nuts, bolts, and washers for buried service: stainless steel.
6. Pressure Rating: 150 psi.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install valves so that in the closed position the pressure in the pipeline applies a seating head on the valves.

B. Lubrication: Lubricate plug valves and fill extended lubricant pipes with lubricant suitable for service intended.

3.02 SCHEDULE

A. See Drawings.

END OF SECTION

SECTION 15141

MECHANICAL - PROCESS PIPE SUPPORTS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Supports for pipe, fittings, valves, and appurtenances.

1.02 REFERENCES

A. American National Standard Institute or Manufacturer's Standardization Society (ANSI/MSS):
   1. SP 58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application and Installation.
   2. SP 69 - Pipe Hangers and Supports - Selection and Applications.

1.03 SUBMITTALS

A. Shop Drawings: Include schedule, indicating where supports will be installed, and drawings of pipe support system components.

PART 2 - PRODUCTS

2.01 PIPE SUPPORTS

A. Pipe Supports:
   1. 3-inch and larger: As indicated on the Drawings.
   2. 2-inch and smaller: Supplied by CONTRACTOR under constraints of these specifications. Locations for these supports are not specifically shown in drawings but are the responsibility of the CONTRACTOR.

2.02 MATERIALS

A. Materials: As indicated on the Drawings.

B. Materials Not Specifically Indicated on the drawings: Hot-dip galvanized steel with stainless fasteners.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Properly support, suspend or anchor exposed pipe, fittings, valves, and appurtenances to

prevent sagging, over-stressing, or movement of piping and to prevent thrusts or loads on or against connected pumps, valves, meters and other equipment.

B. Carefully determine locations of inserts. Anchor to form work prior to placing concrete.

C. Do not use stud type powder actuated fasteners for securing metallic conduit or steel pipe larger than 1 inch to concrete, masonry, or wood.

D. Suspend pipe hangers from hanger rods. Secured with double nuts.

E. Install continuously threaded hanger rods only where indicated on the Drawings.

F. Use adjustable ring hangers; or adjustable clevis hangers, for 6-inch and smaller diameter pipe.

G. Use adjustable clevis hangers for pipe larger than 6 inches in diameter.

H. Secure pipes with galvanized double nutted U-bolts or suspend pipes from hanger rods and hangers.

I. Support Spacing (unless otherwise specified on drawings):
   1. Support 2-inch and smaller piping on horizontal and vertical runs at maximum 5 feet on center, unless otherwise specified.
   2. Support larger than 2-inch piping on horizontal and vertical runs at maximum 8 feet on center, unless otherwise specified.
   3. Support exposed polyvinyl chloride and other plastic pipes at maximum 5 feet on center, regardless of size.
   4. Support tubing, copper pipe and tubing, fiber-reinforced plastic pipe or duct, and rubber hose and tubing at intervals close enough to prevent sagging greater than 1/4 inch between supports.

J. Install Supports at the following Locations (unless otherwise shown on Drawings):
   1. Horizontal bends.
   2. Both sides of flexible pipe connections.
   3. Base of risers.
   4. Floor penetrations.
   5. Connections to pumps, blowers and other equipment.
   6. Valves and appurtenances.

K. Securely anchor plastic pipe, valves, and headers to prevent movement during operation of valves.

L. Anchor plastic pipe between expansion loops and direction changes to prevent axial movement through anchors.

M. Size hanger rods, supports, clamps, anchors, brackets, and guides in accordance with ANSI/MSS SP 58 and SP 69.

N. Do not use chains, plumbers' straps, wire, or similar devices for permanently suspending, supporting, or restraining pipes.

O. Support plumbing drainage and vents in accordance with Uniform Plumbing Code.

P. Supports, clamps, brackets, and portions of support system bearing against copper pipe: Copper plates, copper throughout, or isolated with neoprene or PVC tape.

Q. Where pipe is insulated, install over-sized supports and hangers.

R. Install insulation shield in accordance with ANSI/MSS SP 69, Type 40. Shield shall be galvanized steel unless specified elsewhere.

S. Install riser clamps at floor penetrations and where indicated on the Drawings.

T. Paint or Coat support system components as specified in Section 09800.

END OF SECTION

Division XVI
Electrical

SECTION 16000

GENERAL ELECTRICAL REQUIREMENTS

PART 1 GENERAL

1.1 DESCRIPTION OF WORK

A. Furnish and install all electrical Work as shown on the Drawings and specified. Work includes electrical connections to equipment, wiring devices, disconnects, panelboards for electrical distribution, service entrance, conduit, conductors, and control panels.

1.2 RELATED WORK

A. Refer to all drawing sheets for the scope of the electrical work.

1.3 QUALITY ASSURANCE

A. All work to be completed to latest edition of National Electrical Code.
B. All material to be U.L. listed.
C. All equipment to conform to ANSI and NEMA standards.

1.4 SHOP DRAWINGS

A. Submit complete Shop Drawings for:
   1. Wiring Devices
   2. Sanitary Lift Station Pump Control Panel (See Section 16901)
   3. SCADA Telemetry System (See Section 16902)

1.5 CERTIFICATES AND FEES

A. The Electrical Contractor will pay for all fees, connection charges, permits and inspections.

1.6 GROUNDING

A. All grounding, as a minimum, will be according to the latest edition of the National Electrical Code, Article 250. Provide a full-size grounding conductor in all conduits.

1.7 DELIVERY, STORAGE AND HANDLING

A. Deliver all materials and equipment direct to the job site utilizing Contractor's personnel and not to the Owner's receiving area.
B. Store all materials and equipment in a dry area, protected from the weather. Verify location of storage areas with the Owner.

1.8 EXISTING CONDITIONS

A. Visit the site and become familiar with existing conditions and limitations.

B. Perform all cutting necessary to install the electrical work indicated and all patching, painting, etc. to return the finished surfaces to the original condition. All wiring devices to be installed flush unless noted otherwise.

PART 2 PRODUCTS

2.1 CONDUIT

A. PVC below grade. Rigid steel conduit (RSC) for exterior above grade.

2.2 CONDUCTORS

A. Copper, THHN-2. Minimum size is #12 with other sizes as shown on Drawings.

2.3 WIRING DEVICES

A. Equal to Hubbell, specification grade, ivory in color.

2.4 DEVICE PLATES

A. Plastic, ivory, equal to Sierra "P" series.

2.5 MANUAL MOTOR STARTERS

A. Equal to Square D, size as required for motor, fractional horsepower controller.

PART 3 EXECUTION

3.1 GENERAL

A. Install all electrical Work as shown on the Drawings.

B. Utilize conduit for all feeders, branch circuiting, and control wiring.

C. Coordinate service requirements with Unisource Energy Services.
Contact Ron Holmgreen 928-505-7031

SECTION 16010

GENERAL REQUIREMENTS

PART 1 - GENERAL

1.1 Description

A. This Division includes the complete installation of power, control, instrumentation, wiring, lighting, and other electrical systems as specified in the Sections of Division 16. In general, work includes, but is not limited to, the following:

1. Electrical work associated with this Project. This includes the provision and installation of grounding, power distribution, lighting, instrumentation, process equipment, and data gathering systems (SCADA System).
2. Provision and installation of wiring connections to equipment specified in this and all other divisions, unless indicated otherwise.
3. Provision and installation of wiring connections to Equipment furnished by Owner.
4. Assist electrical utility with installation of utility equipment dedicated to this project.
5. SCADA System equipment installation (PLC, Radio, Termination Cabinet, etc.)
6. All necessary SCADA System programming modifications required to make system operational.

B. Related Work Specified Elsewhere

1. All sections this Division.

1.2 References

A. As specified in each applicable section, this Division.

B. National Fire Protection Association
National Electrical Code, NFPA 70
Standard for Electrical Safety in the Workplace, NFPA 70E

C. National Electrical Safety Code, IEEE C2.

D. Occupational Safety and Health Administration, OSHA.

1.3 Submittals

A. As specified in each applicable Section, this Division.

PART 2 - MATERIALS

2.1 General

A. All equipment and materials shall be in accordance with the latest edition of the National Electrical Code (NEC) as adopted by Lake Havasu City.

B. All equipment conductor termination provisions shall be UL listed for the conductor temperatures specified.

C. All electrical and control equipment and material shall bear the recognized Underwriters Laboratories, Inc. (UL) seal of approval. It is Vendor's responsibility to obtain local inspection approval for all non-UL labeled equipment and pay all fees in connection with the same.

2.2 Systems to be Installed

A. Power - 480-VAC, 3-phase, 60-Hertz, 4-wire power system.

B. Power – 208/120-VAC, 3- phase, 60-Hertz, 4-wire power system.

C. Grounding systems.

D. Control systems.

E. Underground conduit system.

F. Instrumentation systems.

G. Electrical utility transformer secondary conduits and wiring and metering equipment, CT cabinet, and assistance to local utility.

H. SCADA System equipment (radio, PLC, antenna mast antenna, wiring) and programming.

I. Temporary lighting and power facilities during construction.

2.3 Warranty

A. All electrical equipment and workmanship shall be warranted for a minimum period of one (1) year or as designated in Section 700 of this document by the contractor. Where manufacturers' warranty exceeds the one (1) year general warranty period of the contractor, the manufacturers' extended warranty period shall be the governing factor.

PART 3 - EXECUTION

3.1 Installation

A. As specified in each applicable section, this Division.
B. All work shall be in accordance with the National Electrical Code (NEC) and all other applicable standards, refer to clause 1.2 above.
C. Equipment power ratings, horsepower and kilowatt indicated are approximate. If equipment of a different size is furnished, the Contractor shall furnish and install the proper motor starter, fuses, circuit breaker, disconnect switch, wire, and conduit required for the equipment furnished, at no additional cost to the Owner.
D. Provide temporary power to all on site construction trailers.
E. Provide temporary power as required to support construction trades.
Note: all work, including temporary construction related activities shall be in accordance with the NEC, and all other requirements of the standards and safety codes.

3.2 Work on Existing Equipment

A. Do not remove any Equipment from service without obtaining permission from Owner and Engineer. A minimum of 48 hours notice to be given to the Owner and Engineer by contractor before work is begun.
B. Perform work that requires taking Equipment out of service at times designated by Owner so as to cause minimum interruption in plant operation.
C. Continue work with as many workmen as can be efficiently used from the time any Equipment is removed from service until Equipment is tested and back in service.
D. Connect electrical equipment to provide same phasing as existing equipment, unless otherwise specified or indicated.
F. Any work on energized (live) equipment shall meet the requirements of NEC 2005 110.16.

3.3 Testing

A. Test all electrical equipment upon completion of installation to ensure that the equipment operates satisfactorily and to conform to Contract Documents.
B. Furnish temporary power source of proper type for testing purposes when normal supply is not available at the time of testing.
C. Upon successful completion of testing and acceptance by owner provide physical protection of equipment to prevent damage.

3.4 Coordination and Scheduling

A. Coordinate Electrical Installation with other trades to avoid interference of exposed conduit, lighting fixtures, or other equipment until all piping, pipe hangers, ducts, and equipment which are above or behind have been installed, unless release is given in specific cases by Engineer.

B. Coordinate installation of equipment and wiring with the established construction schedule.

PART 4 - MEASUREMENT AND PAYMENT

4.1 Measurement

A. No measurement will be made for this item.

4.2 Payment

A. Payment will be made at the contract lump sum price bid and shall be considered full payment for providing labor and materials to perform this work.

** END OF SECTION 16010 **

SECTION 16111

CONDUIT, FITTINGS AND ACCESSORIES

PART 1 - GENERAL

1.1 Description: This Section includes all conduit, fittings and accessories.

1.2 References

1. American National Standards Institute (ANSI)
   ANSI C80.1 - Rigid Steel Conduit, Zinc-Coated.
2. American Society For Testing and Materials (ASTM)
   ASTM A123 - Zinc (Hot Galvanized) Coating on Products Fabricated from Rolled, Pressed, and Forged Steel Shapes, Plates, Bars and Strips.
   ASTM A153 - Zinc Coating (Hot Dip) on Iron and Steel Hardware.
3. National Electrical Code (NEC)
4. National Electrical Manufacturers Association (NEMA)
   FB1 - Fittings and Supports for Conduit and Cable Assemblies.
   RN1 - Polyvinyl-Chloride Externally Coated Galvanized Rigid Steel Conduit and Electrical Metallic Tubing.
5. Underwriters' Laboratories, Inc. (UL)
   1 - Flexible Metal Electric Conduit.
   6 - Rigid Metal Electrical Conduit.
   263 - Fire Tests of Building Construction and Materials.
   360 – Liquid tight Flexible Steel Conduit
   514A - Metallic Outlet Boxes, Electrical.
   514B - Fittings for conduit and Outlet Boxes.
   514C - Nonmetallic Outlet Boxes, Flush Device Boxes and Covers.
6. Steel Structures Painting Council (SSPC)
   SP3 - Power Tool Cleaning.
   SP11 - Power Tool Cleaning to Bare Metal.
7. All electrical and control equipment and material shall bear the recognized Underwriters Laboratories, Inc. (UL) seal of approval. It is Vendor’s responsibility to obtain local inspection approval for all non-UL labeled equipment and pay all fees in connection with the same.

1.3 Submittals

. Submit as specified in SECTION 1330.

PART 2 - MATERIALS

2.1 Acceptable Manufacturers

A. Rigid Steel Conduit
   1. Allied Tube and Conduit Corporation.
   2. LTV Steel.

B. Rigid Steel Conduit with Bonded Polyvinyl Chloride (PVC) Jacket
   1. OCAL Inc.
   2. Robroy Industries.
   3. Perma-Cote Industries.

C. Liquid-tight: Flexible Metal Conduit:
   1. Anamet, Inc.
   2. Electri-Flex Company.

D. Rigid Polyvinyl Chloride (PVC) Conduit
   1. Cantex
   2. Allied Tube & Conduit
   3. Carlon

   Or equal.

E. Rigid Steel Conduit Fittings
   1. Heavy-duty Cast Malleable Iron Fittings
      a. Appleton Electric Company.
      b. Crouse Hinds Company.
   2. Conduit Expansion and Deflection Fittings
      a. O-Z /Gedney Company.

F. Rigid Steel Conduit Boxes
   1. Indoor and Outdoor Boxes
      a. Hoffman Engineering Company of Anoka, Minnesota.
   2. Conduit Hubs
      a. Appleton Electric Company.
      b. Myers Industries, Inc. (ITT).
      c. Crouse-Hinds Company.
      d. O-Z /Gedney Company.

G. Supports
   1. B-Line Company.
   2. Midland-Ross Corporation.
   3. Unistrut Products Corporation.
   4. U.S. Gypsum Company.
   5. Van-Huffel Tube Corporation.

H. Wall Entrance Seals
1. O-Z/Gedney Company.

I. Explosion-proof Fittings
1. Crouse-Hinds Company
2. Appleton Electric Company

J. Fire-stopping Materials
1. 3M, (Minnesota Mining and Manufacturing Company)
2. Thomas and Betts
3. Hilti
4. Dow Corning
5.

K. Duct Seal
1. Ideal Industries
2. 3M, (Minnesota Mining and Manufacturing Company)

2.2 Design Requirements

A. Each length of threaded conduit furnished with coupling on one end and metal or plastic thread protector on other end.
B. UL listed and labeled conduit, on each length, fittings and accessories.
C. Sizes of conduit, fittings and accessories as indicated, specified or as required by Electrical Codes and Standards.
D. Provide and meet the requirements of the following sections for the conduit, fittings and accessories indicated.

2.3 Rigid Steel Conduit

A. Conform to ANSI C80.1 and UL-6.
B. Mild ductile steel, circular in cross section with uniform wall thickness sufficiently accurate to cut clean threads.
C. Each length threaded on both ends with threads protected.
D. All scale, grease, dirt, burrs and other foreign matter removed from inside and outside prior to application of coating materials.
E. Galvanized by the hot-dip process as follows:
1. Interior and exterior surfaces coated with a solid, unbroken layer of 99% virgin zinc by dipping.
2. Coating not to show fixed deposits of copper after four 1-minute immersions in a standard copper sulfate solution.
3. One coat of zinc chromate finish on inside and outside surfaces to prevent oxidation and white rust.
F. Couplings and elbows fabricated, coated and finished by the same process as conduit.

2.4 Rigid Steel Conduit and Fittings with Bonded Polyvinyl Chloride (PVC) Jacket

A. Conform to hot-dipped galvanized rigid steel conduit as specified in NEMA-RN1, RIGID STEEL CONDUIT, this Section, and as follows.
B. Prior to application of PVC coating, clean interior and exterior surfaces to remove contaminates to provide a suitable surface for bonding.
C. Bond the PVC coating to the conduit. Extruded PVC jackets are unacceptable.
D. Coated externally with PVC to a nominal 40 mils, 0.035-inch to 0.045-inch.
E. Uniformly coat around outside diameter and full length of the conduit.
F. Coat the prethreaded ends with a urethane coating having a nominal thickness of 2 mils (0.002-inch).
G. Coat the interior surfaces of all conduits and feed-through fittings (except where prohibited by design) with a two-part, chemically cured, urethane coating having a nominal thickness of 2 mils (0.002-inch).
H. Exceed the tensile strength of coating with bond between metal and jacket.
I. Couplings, elbows, and other conduit fittings, boxes, cover-plates, supports, hardware and related items shall be treated and coated with the same process as conduit.
J. Each coupling and fitting shall include a PVC sleeve that overlaps the conduit.
K. Length of the overlapping sleeve equals diameter of the conduit or 2 inches, whichever is least.
L. Final cured PVC coating capable of withstanding a minimum electrical potential of 2000V.
M. All conduit accessories, clamps, and hardware that are uncoated shall be stainless steel.

2.5 Liquid-Tight Flexible Metal Conduit

A. Conform to UL-360.
B. Liquid-tight conduit with flexible galvanized-steel core and a synthetic rubber, polyvinyl chloride, or thermoplastic covering.
C. Spiral encased copper bonding conductors for conduit in sizes 1-1/4 inches and smaller.
D. External grounding jumper as required.
E. Polyvinyl chloride (PVC) jacket, Type HA or Type O.R. "Seal-Tite" for oil-resistant applications.

2.6 Rigid Polyvinyl Chloride (PVC) Conduit

A. Fabricated from self-extinguishing high-impact polyvinyl chloride designed for aboveground and underground installations.
B. Type EPC Schedule 80 heavy-wall rigid conduit.
C. Fittings and accessories fabricated from same materials as conduit.
D. Solvent-cement-type joints as recommended by manufacturer.

2.7 Rigid Steel Fittings

A. Heavy-Duty Cast Malleable Iron Fittings

1. Mogul type for conduit sizes 1-1/2 inches and larger.
2. LBD or roller action type LB for right angle fittings for conduit sizes 2 inches and larger.
3. Full-threaded hubs and rubber-gasketed covers.
4. Zinc, cadmium-plated or bronze hardware bolts and screws for assembly.
5. Finish with cadmium-plated or galvanizing.
6. Standard and junction fittings.

B. Conduit Expansion Fittings

1. Line of Conduit Type
   a. Galvanized expansion fittings for rigid conduit movement up to 4 inches.
   b. Insulated metal bushing on ends of the conduit, bonding jumper, and with expansion head sealed with a high-grade graphite packing.
   c. O-Z/Gedney Company, Type AX with Type AJ bonding jumper or Thomas and Betts Corporation, Type XJG.
2. End Type
   a. For conduit terminating in a junction box.
   b. O-Z/Gedney Company, Type EXE with Type BJ-E bonding jumper.

C. Conduit Expansion and Deflection Fittings

1. Provide for movement of 3/4-inch from normal in all directions between two rigid conduits.
2. Integral bonding jumper.
3. O-Z/Gedney Company, Type DX.

D. Conduit Wall Entrance Seals

1. Provide where required or indicated.
2. O-Z/Gedney Company Type FSK.

E. Conform to NEMA Type 3R enclosure in all nonhazardous areas except as specified or indicated otherwise.

2.8 Fittings, Couplings and Boxes for Rigid Steel Conduit

A. Fittings

1. Explosion-proof or weather-proof as specified.
2. Cast malleable iron.
3. Threaded cover to conform to NEC.
4. Full thread hubs.
5. Seal compound well for seal.
6. Drain seals as indicated or required to provide a continuous automatic drain of water.

7. Chico compound for all sealing fittings.
8. PVC jacketed in corrosive areas and where indicated.

B. Couplings
1. Explosion-proof or weather-proof as specified.
2. Flexible.
3. Conform to NEC.
4. Threaded, steel or bronze end fittings securely fastened to the core and braided to ensure electrical continuity.
5. Vinyl plastic coating in severely corrosive locations as indicated.

2.9 Rigid Steel Conduit Boxes

A. Indoor Boxes
1. Hot-dipped galvanized steel.
2. Galvanized steel covers.
3. For special boxes where it is not possible to provide hot-dip galvanizing, apply organic zinc-rich primer at 3 mils dry film thickness after SSPC-SP3 Power Tool Cleaning.
4. Minimum gage requirements:

No surface area exceeds	No single dimension exceeds	Steel Gage
1000 sq in.	40 in.	14
1500 sq in.	60 in.	12
over 1500 sq in.	over 60 in.	10

5. Explosion-proof or weather-proof as specified.
6. Threaded conduit entrances or rigid conduit hubs on all boxes.
7. Include piano-hinged, gasketed cover, and interior mounting panel when used for enclosing terminal blocks and control relays.
8 Oiltight JIC boxes modified for NEMA Type 3R or Type 4 enclosure for non-explosion-proof areas. Stainless steel as required on engineering drawings.

B. Outdoor Boxes
1. 11-gauge minimum galvanized steel with drip lip and galvanized-steel covers fastened with bronze or cadmium-plated screws or bolts, or cast iron with galvanized finish and flanged bolted covers.
2. For special boxes where it is not possible to provide hot-dip galvanizing, apply organic zinc-rich primer at 3 mils dry film thickness after SSPC-SP3 Power Tool Cleaning.
3. Threaded conduit entrances or rigid conduit hubs on all boxes.

4. Rubber or neoprene gasket for cover.
5. Explosion-proof or weather-proof as specified. Conform to NEMA Type 3R enclosure for non-explosion-proof applications in all outdoor installations unless indicated otherwise.
6. Include piano-hinged, gasketed cover, and interior mounting panel when used for enclosing terminal blocks and control relays.
7. Oiltight JIC boxes modified for NEMA Type 3R or Type 4 enclosure in non-explosion-proof applications.

C. Metallic Barriers

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1. Designed not to separate phases of a power circuit.
2. Provide as indicated for the isolation of power circuits from other type circuits.

D. Box size as required, or as indicated, for each particular installation.

E. Include provisions for mounting cable supports where indicated, specified or as required by NEC.

F. Provide as required for cable pulling, junctions, terminals, and for mounting of switches, outlets and control devices.

2.10 Support System

A. Fabricated from structural steel or manufactured framing members equal to "Unistrut" P-3000 series as manufactured by Unistrut Corporation.

B. Minimum 12 gage.

C. Construct as required to rigidly support all conduit runs and boxes.

D. Hot-dip galvanized steel conduit clamps or stainless steel, sized for the specific conduit size, to support all exposed metallic conduit.

E. Nonmagnetic clamps to support nonmetallic conduits.

F. Provide stainless steel rods, anchors, inserts, bolts, washer, and nuts.

G. Materials shall be compatible with the equipment supported.

H. Manufactured Framing Members

1. Wet Locations
   a. Channel hot-dipped galvanized after all manufacturing operations are completed.
   b. Galvanizing zinc weight of 2 ounces per square foot on surface to conform to ASTM A123 and ASTM A153.

2.11 Fire-stopping and Duct Seal

A. Fire-stopping

1. Weather-resistant silicone sealant.
2. Provide 4-hour fire rating.
3. UL tested system.

B. Duct Seal

1. Non-corrosive, permanently soft compound.
2. Nontoxic.
3. Provide flexible re-enterable and repairable seal around cables in conduit.

4. Prevent air movement and drafts through conduits.

PART 3 - EXECUTION

3.1 Preparation

A. Provide suitable protection for conduit risers against damage during construction.

B. Cap ends of all conduits before concrete is poured.

C. Cap all conduits and provide pullstring after cleaning where conduits are to be left empty by this contract.

D. Carefully ream ends of all conduit lengths after cutting to eliminate sharp burrs.

E. Clean out all conduit before pulling wire.

F. Clean out all conduits immediately after concrete work is finished.

3.2 Installation

A. General Requirements

1. Location

a. Install conduit as near as possible to the routing indicated.

b. Shift locations as required to avoid interference with other equipment and piping being installed.

c. Where routing of conduit is not indicated, such as for lighting home run circuits and other systems requiring small conduit runs, route conduit as specified subject to approval by Engineer.

2. Do not use conduit in sizes smaller than 3/4-inch, except 1/2-inch may be used for connections to control devices and thermocouples where necessary.

3. Holes and Sleeves

a. Provide through floors, walls and roofs as necessary for conduit runs, including approved flashing and weather proofing at outside walls and on roofs.

b. Install sleeves or forms for all openings in new work.

c. Provide the required inserts and holes, completely sleeved, bonded, curbed, flashed and finished off in an approved manner, whether in concrete, steel grating, metal panels or roofs.

d. Core-drill all holes required in existing building work using a dustless method.

e. Place nonshrinking grout or Dow Corning 3-6548 Silicone RTV (or equivalent General Electric RTF 762) foam as specified, in the following locations:

(1) All holes in concrete, walls, floor and roof slabs after installation of conduit.

(2) All unused holes and sleeves as approved by Engineer.

f. Install wall entrance seals where conduit enters the building or vaults from exterior underground.

g. Install fire-stopping at all conduit penetration of fire rated walls, ceilings and floors. Fire-stopping shall equal or exceed the fire rating of the wall, ceiling or floor in which it is installed.

4. Make connections to boxes, panels, and other equipment as follows:
   a. For Indoor Dry Locations: Double locknuts, one inside and one outside.
   b. For Outdoor and Damp Locations: Rigid weather-proof conduit hubs.
   c. For Explosion-proof Locations: Use conduit connector seals approved for the hazardous location specified.
   d. Bushings
      (1) Threaded malleable iron or steel.
      (2) Insulated with Bakelite, molded and bonded into the bushing.
      (3) Placed on end of conduit in addition to locknuts.
      (4) Install with integral grounding connector and conductor where all conduits pass through multiple concentric panel knockouts and where the conduit must be bonded to equipment it is not attached to.
   e. Install duct seal in conduits around cables in non-hazardous locations at all conduit terminations at control panels and boxes containing terminations and splices.
5. Running threads will not be permitted.
6. Coat all field cut threads in galvanized conduit with aluminum paint.
7. Comply with applicable requirements of NEC pertaining to installation of conduit systems.
8. Place drainage fittings or weep holes at unavoidable low points where moisture can collect.
9. Install an entire conduit system that is electrically continuous with bonding jumpers provided as necessary to conform to NEC.
10. Install expansion fittings at all building expansion joints and every 100 feet of continuous conduit.
11. Provide all spare or empty conduits with pullstrings for future use.

B. Rigid Steel Conduit
   1. Exposed
      a. Install where specified or indicated on drawings.
      b. Install above grade outdoors.

c. Install horizontal runs as high above floor as possible and in no case lower than 7 feet above floor, walkway or platforms in passage areas.

d. Run conduit parallel or perpendicular to walls, ceiling, beams, and columns unless indicated otherwise.

e. Route to clear all doors, windows, access wells, and openings.

f. Group parallel runs in neatly aligned banks where possible with minimum of 1-inch clearance between conduits.

g. Maintain 6-inch clearance between conduit and coverings on all hot lines; steam, hot water, etc.

h. Do not exceed a distance of 8 feet between supports on horizontal or vertical runs.

i. When terminating at cable tray, attach conduit to tray and electrically bond conduit with ground wire to the cable tray. Install duct seal in conduits around cables to prevent ingress of water. \

2. Concealed

a. Conceal conduit for lighting, convenience outlets, and other circuits in walls, ceiling and floors where possible.

b. Do not install conduit in concrete where conduit outside diameter exceeds one-third of concrete thickness.

c. Install parallel runs with a minimum spacing of three conduit diameters between conduits.

d. Use expansion and deflection fitting with bonding jumpers at all concrete expansion joints.

e. Tie securely in place to prevent movement when concrete is poured.

f. Install in floor slabs in as straight a run as possible. Conduit crossovers are not permitted unless conduit total outside diameter is one-third of the concrete thickness or less.

g. Use long radius elbows except on risers where curved portion of elbow would extend above the finished floor or foundation.

h. Make all joints watertight after installation by coating all finished joints with coal tar solution applied at 15 mils minimum dry film.

(1) Kop-Coat - No. 50.

(2) Tnemec - 46-449.

3. Buried

a. Place where indicated.

b. Use PVC jacketed conduit or rigid PVC Schedule 80 as indicated.

c. Make all joints watertight by field-applied coat of vinyl plastic compound or PVC welding solution furnished by the conduit manufacturer.
d. Use bender one size larger for conduit sized 1 inch or less and conventional bender for conduit sized above 1 inch.
e. Use strap wrench to tighten conduit. Repair damaged coating with liquid patching compound recommended by conduit manufacturer.
f. Install in as straight a run as possible between termination points of exact routing to be determined in the field and subject to approval by Engineer.
g. Bury conduits a minimum of 24 inches (to top of conduit) below finish grade unless indicated otherwise or required by code.
h. Slope conduit away from conduit risers where possible.
i. Maintain 6-inch separation from underground piping.
j. Use long radius bends at all risers unless indicated otherwise.
k. After trench bottom has been finished to grade, lay conduit. Backfilling shall be as specified in DIVISION 2.
l. Cap ends of all conduit risers before backfilling.
m. Provide watertight seal around wires where conduit terminates in pull box.
n. Use PVC coated rigid galvanized steel conduit when making transitions from buried to above ground conduit runs.

C. Liquid-Tight Flexible Metal Conduit
1. Use between rigid conduit and motor terminal boxes except where conduit runs down from above and cannot be conveniently supported by a floor flange.
2. Place between rigid conduit or conduit box and control device cases where direct connection is not desirable for reasons of equipment movement, vibration, or for ease of maintenance.
3. Install at all points of connection to equipment mounted on supports to allow for expansion and contraction.
4. Conform to NEC with installation of conductors.
5. Install at locations where rigid conduit connections are impractical.
6. Use minimum length consistent with manufacturer's standard lengths, the acceptable bending radius, and with required movement of equipment.
7. Maximum length of 3 feet unless otherwise approved by Engineer.
8. Install an external bonding jumper to conform to NEC on conduit sized 1-1/2 inches and larger.

D. Flexible Metal Conduit

1. Use between rigid conduit and devices, except in hazardous areas and areas subject to dampness, water, and corrosive fumes. Do not use with vapor-tight fixtures. Use in accordance with the National Electrical Code Article 350.
2. Use in lieu of direct connection of rigid conduit where it is not desirable for reasons of equipment movement, vibration, or for ease of maintenance.
3. Install as required for expansion and contraction.
4. Use minimum length consistent with manufacturers' standard lengths, the acceptable bending radius, and with required movement of equipment.
5. Maximum length of 3 feet unless otherwise approved by Engineer.
6. Install in sizes smaller than 3 inches.
7. Install an external bonding jumper to conform to the National Electrical Code on conduit sized 1-1/2 inches and larger.

E. Conduit Fittings

1. Installations of special fittings as required.
2. All materials shall be compatible.
3. Install as required.

F. Boxes

1. Install special boxes as indicated of size required for conduits and cables entering and leaving box.
2. Install where required for pull or junction boxes and for mounting or connecting to switches, outlets, intermediate terminal blocks or control devices.
3. Provide 1/4-inch weep holes in interior boxes where conduits enter from exterior or buried installation.

G. Supports

1. Construct with sufficient rigidity to hold all mounted equipment and material in permanent and neat alignment.
2. Design to provide 1/4-inch space between equipment housings and walls or columns upon which they are mounted.
3. Do not exceed load requirements in NEC and NEMA standards.
4. After Power Tool Cleaning SSPC-SP11, paint all welds, field cuts and damaged areas with organic zinc-rich primer at 3 mils dry film thickness.
    a. Ameron - 68HS.
    b. Carboline - Carbozinc 858.
    c. Porter - Zinc-Lock 308.
    d. Tnemec-Tneme Zinc 90-93.
5. Use electrogalvanized steel conduit clamps and nonmagnetic conduit clamps to support electrogalvanized steel conduit and nonmagnetic conduit, respectively.
6. Provide stainless steel rods, anchors, inserts, bolts, washers and nuts.

I. Explosion-proof Fittings
   1. Install explosion-proof fittings in the rigid steel conduit system as required by the NEC.
   2. Install necessary fittings where not indicated, but required by code.

PART 4 MEASUREMENT AND PAYMENT

4.1 Measurement
   A. No measurement will be made for this item.

4.2 Payment
   A. Payment will be made at the contract lump sum price bid and shall be considered full payment for providing labor and materials to perform this work.

** END OF SECTION 16111 **

SECTION 16120

WIRE, CABLE, AND ACCESSORIES

PART 1 - GENERAL

1.1 Description

A. This Section includes furnishing and installing (including terminations) of all electrical wire, cable, and accessories.

B. Related Work Specified Elsewhere

Lighting	Section 16500
Grounding	Section 16450
Field Testing	Section 16950
Instruments and Controls	Sections 16900-16950

1.2 References

1. American Society for Testing and Materials (ASTM)
   ASTM B3 - Soft or Annealed Copper Wire.
   ASTM B8 - Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft.
   ASTM B33 - Tinned Soft or Annealed Copper Wire for Electrical Purposes.
   ASTM B172 - Rope-Lay-Stranded Copper Conductors, Having Bunch Stranded Members, for Electrical Conductors.
   ASTM B189 - Lead-Coated and Lead-Alloy-Coated Soft Copper Wire for Electrical Purposes.

2. Insulated Cable Engineers Association (ICEA)
   S-19-81 - Rubber Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.
   S-61-402 - Thermoplastic-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.
   S-66-524 - Cross-Linked Thermosetting-Polyethylene-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.
   S-68-516 - Ethylene-Propylene-Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.
   S-81-570 – 600-Volt Rated Cables of Ruggedized Design for Direct Burial.
   S-105-692 – 600Volt Single Layer Thermoset Insulated Utility Underground Distribution Cables.
   T-29-520 – Vertical Cable Tray Flame Tests at 210,000 Btu.

3. National Electric Manufacturers Association (NEMA) and Insulated Cable Engineers Association (ICEA)
WC55/S-82-552 – Instrumentation Cables and T.C. Wire.
WC57/S-73-532 – Standard for Control Cables.
WC70/95-658 - Non-Shielded Power Cables Rated 2000V or Less.

4. Institute of Electrical and Electronic Engineers (IEEE)
48 - Test Procedures and Requirements for High Voltage Alternating-Current Cable Terminations.

5. National Fire Protection Association
National Electrical Code (NEC) NFPA-70.
Standard for Electrical Safety in the Workplace, NFPA 70E

6. Underwriters Laboratories, Inc. (UL)
44 - Rubber-Insulated Wires and Cables.
83 - Thermoplastic-Insulated Wires and Cables.
263 - Fire Tests of Building Construction and Materials.
854 - Service Entrance Cables.
1277 - Electrical Power and Control Tray Cables with Optional Optical Fiber Members.

7. National Electrical Safety Code, IEEE C2.

8. Occupational Safety and Health Administration, OSHA.

9. All electrical and control equipment and material shall bear the recognized Underwriters Laboratories, Inc. (UL) seal of approval. It is Vendor's responsibility to obtain local inspection approval for all non-UL labeled equipment and pay all fees in connection with the same.

1.3 Submittals

A. Submit as specified in Section 1330.
B. Includes, but not limited to, the following:
   1. Data sheets for each wire and cable type specified.
   2. Data sheets for wire and cable accessories.
   3. Cable manufacturer's approval of splicing and terminating materials.
   4. Cable manufacturer's approval of pulling compounds.
   5. Cable manufacturer's installation requirements such as maximum pulling tensions, sidewall pressures, minimum bending radii, etc.
   6. Other equipment and materials to be used.

PART 2 - MATERIALS

2.1 Acceptable Manufacturers

A. Wire and Cable

Acceptable manufacturers for each wire and cable type will be manufacturers that have been manufacturing the specified cable for a minimum of five years and meet all the requirements listed on the Wire and Cable Specification Sheets.

B. Wire and Cable Accessories

1. Cable Connectors for Control and Instrument Cable
   a. AMP Special Industries.
   b. Hollingsworth Solderless Terminal Company.
   c. Panduit Corporation.
   d. Minnesota Mining and Manufacturing (3M).
   e. Thomas and Betts Company, Inc.

2. Cable Connectors for Power Cable
   a. AMP Special Industries.
   b. Thomas and Betts Company, Inc.
   c. Minnesota Mining and Manufacturing (3M).
   d. Panduit Corporation.

3. Termination and Splice Kits
   a. Minnesota Mining and Manufacturing (3M).
   b. Raychem.

4. Tape and Insulation Putty: Minnesota Mining and Manufacturing (3M).

5. Cable Ties
   a. AMP Special Industries.
   b. Dennison Manufacturing Company.
   c. Panduit Corporation.
   d. Minnesota Mining and Manufacturing (3M).
   e. Thomas and Betts Company, Inc.

6. Cable Supports

   a. O-Z/Gedney Company.

   b. Hubbell, Kellems Grips.

7. Terminal Blocks
   a. Allen-Bradley.
   b. Buchanan.
   c. Phoenix Contact.
   d. Weidmuller.

8. Cable Identification Tags
   a. Allen Marking Products, Kansas City, MO.
   b. Floy Tag and Manufacturing Co., Seattle, WA.
   c. Panduit Corporation (Panduit).
   d. Specialty Products Company, Rock Hill, SC.
   e. Thomas and Betts Company, Inc. (Thomas and Betts).

9. Cable Fire and Smoke Stop Fittings
   a. Crouse Hinds. \
   b. Nelson Electric.
   c. O-Z/Gedney Company.

2.2 Wire and Cable

A. Building Wires

1. Conductors: stranded for 12 AWG and larger. Minimum size: 12 AWG.

2. Copper conductors: size as indicated, with 600 V insulation of chemically cross-linked thermosetting polyethylene material rated RW90 or as indicated on drawings.

B. MC, Metal Clad Cables

1. Conductors:

.1 Grounding conductor: copper.
.2 Circuit conductors: copper, size as indicated.
.3

2. Insulation: Chemically cross-linked thermosetting polyethylene rated type RW90, 600 V or as indicated on drawings.

3. Inner jacket.

4. Armour: continuous aluminum.

5. Overall covering: flame retardant polyvinyl chloride material meeting requirements of Vertical Tray Fire Test.

C. Instrument Cable – Shielded Twisted Pairs/Triads

1. Conductors: stranded for 16 AWG and larger. Minimum size: 16 AWG.
2. Copper conductors: size as indicated, with 600 V insulation of PVC material rated RW90. Color code shall use pigmented compounds, white and black for pairs, white, black and red for triads. Each conductor shall include sequential numbers printed on surface of conductors.
3. Conductor jacket: nylon.
4. Shields: aluminized mylar or polyester tape with tinned copper drain wire.
5. Jacket: Polyvinyl chloride (PVC).
6.

D. Control Cables

1. Class B or C soft annealed stranded copper conductors, sized as indicated, with cross-linked thermosetting polyethylene, outer PVC jacket rated for outdoor use.
2. 600 V type: with cross-linked polyethylene type, RW90 (x-link) and overall jacket.
3.

E. Temperature Rating

Cables shall be suitable for operation with a maximum conductor temperature of 90ºC, continuous, wet or dry locations.

F. Insulation and Jacket Thickness

See references, Section 1.2.

G. Factory Tests

See references, Section 1.2, including the flame test requirement, ICEA T-29-520 and UL 1277.

H. Certification

Cables shall be certified to be in conformance with all applicable codes and standards as referenced.

All cables shall include surface identification showing manufacturer's name, insulation type, conductor size, conductor type, voltage rating and UL label.

2.3 Connectors

A. General Requirements
1. Designed and sized for specific cable being connected.
2. Solderless, pressure-type connectors constructed of non-corrodible tin-plated copper.
3. Rated current-carrying capacity equal to or greater than the cable being connected.
4. Application tooling for connectors shall contain die or piston stops to prevent over-crimping and cycling or pressure relief to prevent under-crimping. Dies of all application tooling shall provide dot or wire size coding for quality control verification. All tooling shall be manufactured by the connector manufacturer.
5. All terminations shall be installed with protective heat shrink.

B. Power Connectors (10 AWG and Smaller) 600V and Below
1. "Scotchlok" preinsulated spring wire connectors.
2. Buchanan open-end copper splicing caps, applied with "Lok-Seal" tool, with nylon snap-on insulators.

C. Power Connectors (sizes 8-4 AWG) 600V and Below
1. Noninsulated ring-tongue type.
2. Ring tongue sized to match terminal stud size.
3. Brazed barrel seam.
4. Application tooling designed to crimp the wire barrel (conductor grip) with a one-step crimp.

D. Power Connectors (sizes 2 AWG - 750 kcmil) 600V and Below
1. Non-insulated one-hole rectangular tongue for sizes 2 AWG through 3/0 AWG and two-hole rectangular tongue for 4/0 AWG through 750 kcmil.
2. Application tooling shall be hydraulically operated.

E. Control, Instrument, and Specialty Cable Connectors
1. Tin-plated copper.
2. Vinyl preinsulated spring-type spade terminals. (Hollingsworth "Mini Spring Spades"; Thomas and Betts "Locking-Fork"; Panduit "Locking Fork.")
3. Sized to match terminal stud size.
4. Have insulation grip sleeve to firmly hold to cable insulation.
5. Insulation grip sleeve shall be funneled to facilitate wire insertion and prevent turned-back strands.
6. Application tooling designed to crimp the wire barrel (conductor grip) and the insulation grip sleeve with a one-step crimp.

2.4 Motor Lead Termination/Splice (Low-Voltage, 600v and Below, Power Cable)

A. Splices shall be made using compression-type connectors bolted together. The compression-type connectors shall be properly sized for the cables.
B. Splice to be covered with heat-shrinkable tubing connector insulators or slip-on rubber boot or sleeve.
C. Splicing shall be done in accordance with the instructions provided with the Raychem brand MCK Motor Connector Kit or 3M Company 5300 Series Motor Lead Splice Kit.

2.5 Cable Supports

A. Cable supports for cables in vertical conduit risers shall be O-Z/Gedney Type "R" wedging plug type or approved equal.
B. Kellems basket type wire mesh grip for cables in vertical installations.

2.6 Cable Ties

A. Nylon self-locking type.
B. Have a normal service temperature range of -40°C to 85°C.
C. Be weather-resistant and sun-light resistant type for outdoor use.
D. Meet requirements of Military Specifications MIL-S-23190D.
E. AMP Special Industries "AMP-TY," Dennison Manufacturing Company "BAR-LOK," Panduit Corporation "PAN-TY," Thomas & Betts "TY-RAP," or Minnesota Mining and Manufacturing 3M Brand cable ties.

2.7 Terminal Blocks

A. For mounting in terminal boxes (TBs)

1. Designed and sized for the cables being terminated.
2. Block rated 600V.
3. Binding screw-type terminals for power cables and strap screw or tubular clamp terminals for control and instrument cables.
4. Rated current carrying capacity equal to or greater than the cable being terminated.
5. Marking strip.

B. For Mounting in Cabinets, Panels, Control Boards, Etc.

1. Designed and sized for the cables being terminated.
2. Block rated 600V.

3. Binding screw type terminals for power cables and current transformer circuits and strap screw or tubular clamp terminals for control and instrument cables.
4. Rated current carrying capacity equal to or greater than the cable being terminated.
5. Marking strip on blocks for power cables and control and instrument cables.
6. Short-circuit strips with one shorting screw for each terminal for current transformer circuits.

2.8 Cable Identification Tags

A. Designed to provide a permanent wire and cable identification system.
B. Show complete cable number. Cable numbers are defined in the Cable Schedule and/or Contract Drawings.
C. Cable numbers may be stamped or typed in a legible and permanent manner. Hand-lettering is not acceptable.
D. Character size for cable numbers shall be a minimum of 1/8-inch.
E. Material shall be nonmetallic and impervious to moisture and resistant to fading in sun-light.
F. Be securely attached to cables and accessible for inspection.
G. Cable identification tags, marking and attachment methods shall be subject to approval of the Engineer.

2.9 Fastenings

1. One hole malleable iron straps to secure surface cables 2 inch diameter and smaller. Two hole steel straps for cables larger than 2 inches.
2. Channel type supports for two or more cables.
3. Threaded rods: 3/8 inch dia. stainless steel to support suspended channels.

PART 3 – EXECUTION

3.1 Installation

A. Wire and Cable
1. General Requirements
a. Install in conduit, duct system or tray as indicated.
b. Do not subject cable to pulling tensions or sidewall pressures in excess of manufacturer's recommendations.
c. Attach pulling grips over the cable sheath to prevent slipping of the insulation.

d. Do not subject cable to bending radius less than those recommended by the cable manufacturer or as noted below (whichever is greater) during or after installation:
   (1) Eight times the cable outside diameter for 600V or lower rated cables.

e. Install intermediate splices only as indicated or as required to avoid subjecting cable to excessive pulling tension or sidewall pressures. Cable splicing locations shall be approved by Engineer prior to cable installation.

f. Support cables at connections or termination points such that any strain on cable will not be transmitted to the connection or termination.

g. Install cable supports in vertical runs of conduit, at boxes and at terminations in equipment, and as required to meet intermediate support requirements of National Electrical Code (NEC).

h. All pulling compounds shall be approved by wire and cable manufacturer as being compatible with cable materials.

i. Attach a cable identification tag to each cable at all termination or end points.

j. Install fire and smoke stop fittings at all cable penetration of fire rated walls, floors and ceilings.

2. Power (600V and Below), Control, Instrument, and Specialty Cable

a. Install metallic barrier in all tray and boxes to separate power, control and instrumentation from low-level signal (50V or less) instrumentation circuits where run in the same box.

b. Cables in vertical trays shall be secured every 3 feet or less.

c. Tie together with cable ties all single conductor cable on each individual circuit in each junction box, and equipment at intervals not to exceed 6 feet.

d. Attach a cable identification tag to each cable.
   (1) At each terminal to identify the circuit and cable.
   (2) Use nylon ties and identification tabs color coded as follows:
      (a) 480V circuits - Red.
      (b) 277, 240, or 208Vac circuits - Orange.
      (c) 120V circuits - White.
      (d) Control cables - Natural Nylon.

e. Insulation Color Coding
   (1) Conductors shall be coded or numbered over the entire length.
   (2) Colors shall not be changed between source and device. No white wire shall be used in lighting and convenience outlets except as a grounded neutral conductor.

f. Tag each individual conductor or wire with wire markers as follows:
   (1) With terminal designation indicated on schematic diagrams or given on manufacturer's equipment drawings.
   (2) At each terminal.
   (3) In addition to specified circuit tags.

g. Terminate and ground, control, instrument, and specialty cable shields as indicated and recommended by the manufacturer of the equipment being connected. In general, ground the shields at the control boards for control cables and at the receiving end equipment for instrumentation and specialty cables.

h. Control and instrument cable splices shall be as follows:
   (1) Made only in junction or terminal boxes.
   (2) Made on terminal blocks with marking strips.
   (3) Conductor color coding shall be maintained.
   (4) For shielded cables, shield continuity and isolation shall be maintained.

i. Power cable (600V or below) splices and motor terminations shall be as follows:
   (1) Made only in junction or terminal boxes.
   (2) Splices shall be made using compression type connectors bolted together.
   (3) Splice to be covered with a heat-shrinkable connector insulator.

j. Lighting Cable: Install as specified in this Division.

k. Ground Cable: Install as specified in this Division.

l. Install fire and smoke stop fittings at all cable penetrations of fire-rated walls, floors, and ceilings.

3. Cable Connections and Terminations
   a. Make up clean and tight to assure a low-resistance joint.
   b. Make only in terminal boxes, equipment or other accepted enclosures and not in conduit.
   c. Install all connectors with tooling manufactured by the connector manufacturer and as specified.

3.2 Field Quality Control
   A. Manufacturer's Field Services: Provide as specified in DIVISION 1.
   B. Field Testing: Specified in Section 16950.

PART 4 - MEASUREMENT AND PAYMENT

4.1 Measurement
   A. No measurement will be made for this item.

4.2 Payment
   A. Payment will be made at the contract lump sum price bid and shall be considered full payment for providing labor and materials to perform this work.

** END OF SECTION 16120 **

SECTION 16150

MOTORS, ACCESSORIES, VARIABLE FREQUENCY DRIVES

PART 1 - GENERAL

1.1 Summary

A. This Section includes the following

1. Motors for all mechanical equipment or other equipment.
2. Motor 3/4-horsepower or larger shall be polyphase.
3. Variable-frequency drives.

B. Related Sections

1. Submersible Sewage Pumps as specified in Section 11313.

1.2 References

A. American National Standards Institute (ANSI)

B. Anti-Friction Bearing Manufacturers Association (AFBMA)

C. Institute of Electrical and Electronic Engineers (IEEE)
112 - Test Procedures for Polyphase Induction Motors and Generators.
519 - Harmonic Control and Reactive Compensation of Static Power Converters.

D. National Electrical Manufacturers Association (NEMA)
MG1 - Motors and Generators.

E. National Safety Council

F. Sheet Metal and Air Conditioning Contractors National Association (SMACNA)
Low-Velocity Duct Manual.

G. National Fire Protection Association
National Electrical Code, NFPA 70
Standard for Electrical Safety in the Workplace, NFPA 70E

H. National Electrical Safety Code, IEEE C2.

I. Occupational Safety and Health Administration, OSHA.

J. All electrical and control equipment and material shall bear the recognized Underwriters Laboratories, Inc. (UL) seal of approval. It is Vendor's responsibility to obtain local inspection approval for all non-UL labeled equipment and pay all fees in connection with the same.

1.3 Submittals

A. Submit as specified in Section 1330.

B. Include, but not limited to, the following

1. Nameplate information consisting of the following
   a. Manufacturer's name and serial number.
   b. Horsepower output.
   c. Temperature rise and method indicated.
   d. Maximum ambient temperature.
   e. Insulation class.
   f. Rpm at rated load.
   g. Frequency.
   h. Number of phases.
   i. Voltage.
   j. Rated load amperes.
   k. Locked rotor amperes or code letter.
   l. Service factor.
   m. Maximum noise level of pump/motor unit (dBA).
   n. Efficiency, determined in accordance with IEEE Standard 112, Method B.
2. Dimensions for enclosure and shafts.
3. Weight.
4. Bearing information.
5. Certification from motor manufacturer for motors controlled by variable frequency drives that the motor is "inverter ready" and complies with NEMA MG1 – Part 31 for all operational load and speed conditions specified as required.

PART 2 - PRODUCTS

2.1 Acceptable Manufacturers

A. Variable-Frequency Drives
   1. Allen-Bradley.
   2. Square "D".

2.2 Vertical Submersible Polyphase Motors

A. See also Section 11315. Rated for 460-volt, 3-phase operation with Adjustable Frequency drive.
B. Squirrel cage, induction type.
C. Hollow shaft design with nonreversing ratchet.

D. NEMA Design
   1. Minimum starting torque 100% of full load.
   2. Maximum starting torque greater than 200% of full load.
   3. Maximum starting current 650% of full load.

E. NEMA Class F insulation or higher with temperature rise limited to Class-B over a 40ºC ambient, except for installations where a higher class is recommended by the manufacturer for the application.

F. Submersible Type enclosure unless specified otherwise.

G. Horsepower Rating Requirements
   1. Ambient Temperature: 50˚ C.
   2. Temperature Rise Per Table:

Continuous Rated Motors (all enclosures)	Class B Insulation	Class F Insulation	Class H Insulation
	Temperature Rise by Resistance - °C		
S.F. 1.0	80	105	125
S.F. 1.15	90	115	---
	Temperature Rise by Embedded Detector - °C		
S.F. 1.0 (1500 hp & less)	90	115	140
S.F. 1.15 (1500 hp & less)	100	125	---

   3. Service factor of 1.15.
   4. 1800 rpm unless specified or indicated otherwise.
   5. Adequate to drive equipment without using service factor except in emergency conditions.
   6. Rated for continuous duty and capable of withstanding unlimited number of starts per hour when operating with adjustable speed drive.

H. Bearings

   1. Designed for static and dynamic, and continuous and momentary thrusts as required by the drive equipment.
   2. Grease- or oil-lubricated bearings with relubrication fittings and flushing system.
   3. Antifriction or Kingsbury type.
   4. Visual level indicator for oil-lubricated bearings.
   5. Minimum L10 bearing life for continuous operation of 50,000 hours to conform to AFBMA.

I. Screened openings or other suitable means for safety and protection from rodents or other animals.

J. Stainless steel nameplate with all electrical and lubrication information.

K. Provide water seal leak detector between first and second mechanical seals with wiring included in power cable.

2.3 Variable-Frequency Drives

A. Furnish AC variable-frequency drives to control the speed of the pumps.

B. Basic Drive

1. An input circuit breaker shall be supplied to provide NEC required branch circuit protection. The circuit breaker shall have a door interlocked external operator. Circuit breaker shall be 480-volt, 3-phase, 25,000-AIC rms symmetrical minimum.
2. Current limiting fuses shall be installed in the drive input.
3. A converter stage shall change fixed voltage, fixed frequency, ac line power to a fixed dc voltage. The converter shall consist of a 3-phase, full-wave bridge configuration. The converter shall be insensitive to the phase rotation of the ac line and shall not cause displacement power factor of less than 0.95 lagging under any speed and load conditions. Provide filtering per IEEE 519 (Total Harmonic Distortion (THD) not more than 5%voltage and 10% current at the drive terminals). The controller shall not require an isolation transformer and shall not produce voltage/current spikes and notches back into the power supply.
4. An inverter stage shall change fixed dc voltage to variable frequency, variable voltage, ac for application to a standard NEMA design B squirrel cage motor. The inverter shall utilize gate-turn-off (GTO) or giant-transistor-technology devices switched in a manner to produce a sinusoidal pulse-width-modulation (PWM) output waveform.
5. The drive shall be furnished in a NEMA 1 enclosure with gaskets to be installed in an Electrical Room.
6. Minimum acceptable efficiency shall be 96% at full load.
7. The drive shall be capable of supplying 115% of rated full load current for one minute at maximum ambient temperature.
8. The drive shall be designed to operate from a nominal 480-volt, 3-phase, 60-hertz system and control an induction motor rated 460 volts.
9. Adjustable full-time current limiting shall limit the current to a preset value that shall not exceed 150% of the controller rated current. The current limiting action shall maintain the V/Hz ratio constant. Short-time starting override shall allow starting current to reach 175% of controller rated current to maximize starting torque.

10. The drive shall be capable of producing an output frequency over the range of 30 to 60 hertz (2 to 1 speed range) without low speed cogging. Over frequency protection shall be included such that a failure in the controller electronics circuitry shall not cause frequency to exceed 110% of the maximum controller output frequency selected (60 hertz).
11. Minimum and maximum output frequency shall be adjustable over the following ranges:

    a. Minimum frequency 50% to 70% of maximum selected frequency.
    b. Maximum frequency 40 hertz to 60 hertz.

12. The time for drive acceleration (0-100%) and deceleration (100%-0) shall be independently adjustable from 0-5 minutes.
13. The drive shall be capable of being restarted into a motor coasting in either the forward or reverse direction without tripping.
14. Protection of power semiconductor components shall be accomplished without the use of fast acting semiconductor output fuses. Subjecting the controller to any of the following conditions shall not result in component failure or the need for fuse replacement:
    a. Short circuit at drive output.
    b. Open circuit.
    c. Input undervoltage.
    d. Dc bus overvoltage.
    e. Loss of input phase.
    f. Ac line switching transients.
    g. Instantaneous overload.
    h. Sustained overload exceeding 100 percent of controller-related current.
    i. Overtemperature.

15. Solid-state motor overload protection shall be included such that current exceeding an adjustable threshold shall activate a 60-second timing circuit. Should current remain above the threshold continuously for the timing period, the controller will automatically shut down. The timing circuits shall include a memory such that current exceeding the threshold for less than 60 seconds and dropping back below the threshold momentarily shall not cause the time to reset to zero but shall cause the timing circuit to pick up at a point dependent upon the length of the time the current was below the threshold.

16. A slip compensation circuit shall be included which will sense changing motor load conditions and adjust output frequency to provide speed regulation of NEMA B motors to within +0.5% of maximum speed without the necessity of a tachometer generator.

17. The drive electronics shall contain displays to monitor and indicate the following conditions:
    a. Drive lockout.
    b. Undervoltage.
    c. Overvoltage.
    d. Overtemperature.
    e. Ground fault.
    f. Shoot through.
    g. Overload threshold exceeded.
    h. Overload shutdown.
    i. Power up delay.
    j. Instantaneous overcurrent.
    k. Power supply OK.
    l. Controller enabled.
    m. Current limit operating (motor mode).
    n. Input follower signal loss.
    o. Contact for drive failure.
    p. Contact for normal run.

18. Harmonic Filtering:
    a. Provide Input and Output line reactors and filters. Manufacturer equal to TCI HG7 Filter with Line Reactor. Provide filters and reactors matched appropriately to drive and load.
    b. The drive shall have sufficient harmonic filtering and suppression, when operated from the normal power source over its entire load and speed range, that it will not cause operational problems or degrade the performance of any of the electrical equipment on the equipment rack, such as the lighting, instrumentation and control systems. (max. THDv = 5%, THDi = 10%)

19. Door-mounted control devices shall include
    a. Local-off-remote switch.
    b. Elapsed time meter, Electro/Mechanical type.
    c. Red and green indicating lights.
    d. Start-stop push buttons.
    e. Ammeter for motor running currents.
    f. Potentiometer for manual speed adjustment.
    g. Output speed 0-100%.

20. In automatic mode speed will be controlled by a remote 4-20 mA input signal from a PLC. In manual mode, speed will be controlled by a potentiometer on front of unit.
    a. Provide terminals for remote start-stop push buttons, or contacts, where indicated on schematic diagrams.

21. The VFD controls shall be wired to the motor overtemperture switches or protective device to automatically stop the motor from operating if required.

PART 3 - EXECUTION

3.2 Installation

A. Install to conform to manufacturer's instruction.

3.3 Manufacturer's Field Services

A. Provide as specified in Section 1750.

B. For adjustable frequency drives provide the services of a manufacturer's representative for a period of one day to assist in start-up tests and instruct Owner's personnel in the operation of the equipment.

3.4 Field Testing

A. Provide as specified in Section 16950.

PART 4 - MEASUREMENT AND PAYMENT

4.1 Measurement

A. No measurement will be made for this item.

4.2 Payment

A. Payment will be made at the contract lump sum price bid and shall be considered full payment for providing labor and materials to perform this work.

** END OF SECTION 16150 **

SECTION 16180

STARTERS, RELAYS, SWITCHES, CIRCUIT BREAKERS AND TRANSIENT VOLTAGE SURGE SUPPRESSORS

PART 1 - GENERAL

1.1 Description: This Section includes relays, switches, circuit breakers, and surge suppressors for equipment.

1.2 References

1. National Fire Protection Association (NFPA)
2. National Electrical Code (NEC)
3. National Electrical Manufacturers Association (NEMA)

   250 - Enclosures for Electrical Equipment (1,000V maximum).
   KS1 - Enclosed Switches.
   AB1 - Molded-Case Circuit Breakers.
   ICS - Industrial Controls and Systems.

4. Underwriters Laboratories (UL)

   50 - Electrical Cabinets and Boxes.
   98 - Enclosed and Dead-Front Switches.
   489 - Molded-Case Circuit Breakers and Circuit Breaker Enclosures.
   508 - Electrical Industrial Control Equipment.
   869 - Electrical Service Equipment.
   977 - Fused Power Circuit Devices.
   1449 - Transient Voltage Surge Suppressors.

5. National Electrical Safety Code

6. Standard for Electrical Safety in the Workplace – NFPA 70E

7. Occupational Safety and Health Administration, OSHA.

8. All electrical and control equipment and material shall bear the recognized Underwriters Laboratories, Inc. (UL) seal of approval. It is Vendor's responsibility to obtain local inspection approval for all non-UL labeled equipment and pay all fees in connection with the same.

1.3 Submittals

. Submit as specified in Section 1330.

A. Includes, but not limited to, the following:
   1. Enclosure details.
   2. Schematic diagrams.

PART 2 - MATERIALS

2.1 Acceptable Manufacturers
   A. Allen-Bradley Company.
   B. Cutler-Hammer/Westinghouse Incorporated.
   C. General Electric Company.
   D. Benshaw Inc.
   E. Siemens Energy & Automation.
   F. National Lightning Protection Corp.
   G. Current Technology

2.2 Design Requirements

   A. Provide equipment with the rated enclosures as indicated in the Contract Drawings.
   B. Phenolic nameplate on cover of each unit with wording as approved by Engineer.
   C. All enclosures housing variable speed controller to be equipped with A/C unit to keep operating equipment within design parameters with an exterior ambient temperature of 120ºF (50ºC).

2.3 Magnetic Starters

   A. Full-voltage, nonreversing, reversing or two speed with disconnect switch, thermal-magnetic circuit breaker or motor circuit protector circuit breaker as specified or indicated.
   B. Three overload heaters in 3-phase units to match motor nameplate data.
   C. Built-in 120V control transformer of adequate capacity for all control devices as indicated on wiring diagrams.
   D. Necessary auxiliary contacts as required by means of starter or relay.
   E. Low-voltage protection.
   F. Starter shall be provided with 2 auxiliary contacts.

2.4 Disconnect Switches

A. Provide as required by NEC, specified or indicated.
B. Positive quick-make, quick-break mechanism, visible blades, and line terminal shield.
C. Fused type where indicated with time delay fuses.
D. Coordinate fuses with the ratings of the switch.
E. Furnish heavy-duty type.

2.5 Circuit Breakers

A. Rated 480 VAC, 3-phase, (240VAC, 1-phase for individual loads) 60-hertz, with interrupting rating as indicated on drawings.
B. External handle which clearly indicates when breaker is "ON," "OFF," or "TRIPPED" and is lockable in the "OFF" position.
C. Molded-case, manually-operated, 3-pole.
D. Trip-free from handle.
E. Inverse time thermal element overload protection.
F. Instantaneous magnetic short-circuit protection on all poles.
G. Coordinate trip ratings with magnetic starter ratings and overload relays.
H. Circuit breakers used as service equipment to be labeled and rated “suitable for use as service entrance equipment”.

26 Push Buttons and Selector Switches

A. Heavy-duty oil-tight type.

2.7 Auxiliary Relays

A. Coils rated 120-VAC.
B. Contacts rated 6 A up to 300V.
C. Contacts as required for control of associated equipment.
D. General Electric CR120A 300V industrial or CR2810 600V machine-tool type relays.

2.8 Time Delay Relays

A. Solid state type.
B. Adjustable timing range.
C. On delay, off delay, or on-and-off delay as indicated.
D. Contact arrangement as indicated.
E. Contacts rated 5 amperes continuous at 75% power factor at 120Vac, and 5 amperes make or break at 24Vdc, except as indicated otherwise.

F. Operating voltage as indicated.
G. Repeat accuracy "1% for constant voltage and temperature.
H. Operating temperature range: -10°C to +55°C.
I. Transient protection: 2,000V for 100 microseconds.
J. Enclosure for bolted mounting or plug-in type as indicated.
K. Timing indication provided by LED which flashes during timing, glows steadily after timing, and is off when timer is deenergized.
L. Furnish relays as manufactured by Eagle Signal Co., Agastat, Allen Bradley, General Electric Co., or Potter & Brumfield.

2.9 Transient Voltage Surge Suppressors

A. Main Service Protector

1. UL 1449 listed.
2. Provide NEMA 4 enclosure capable of being rack mounted.
3. Surge capacity minimum: 160 KA independent of load current.
4. 25% threshold above nominal line voltage.
5. Replaceable fuse for each phase.
6. Failure mode indicator for each protected phase.
7. Terminal strip connectors.
8. Relative humidity, 0 to 95% noncondensing.
9. Temperature: -40 to 85°C.
10. For operation on 480VAC, 3 phase, 3 wire system.
11. Integral deadfront disconnect.
12. Furnish Model, as manufactured by Current Technology, or approved equal.13. Install and connect as indicated to equipment to be protected.

PART 3 - EXECUTION

3.1 Installation

A. Install relays, switches, and circuit breakers at locations indicated or as follows:
1. Mount on equipment rack not to exceed 6 feet in height above the ground when possible.
2. Arrange with proper clearances from other equipment and material to obtain accessibility for operation and maintenance.
3. Provide engraved phenolic nameplates on cover of each device identifying the loads connected.
4. Ground all neutral buses to the ground system.

3.2 Field Testing: Specified in Section 16950.

PART 4 - MEASUREMENT AND PAYMENT

4.1 Measurement

A. No measurement will be made for this item.

4.2 Payment

A. Payment will be made at the contract lump sum price bid and shall be considered full payment for providing labor and materials to perform this work.

** END OF SECTION 16180 **

SECTION 16450

GROUNDING

PART 1 - GENERAL

1.1 Description

A. This Section includes the following:

1. Facility ground grid and ground rod system.
2. Ground riser extensions to structural steel, electrical equipment, and mechanical equipment.

B. Related Work Specified Elsewhere

Field Testing **.....**Section 16950

1.2 References

1. American Society For Testing and Materials (ASTM)

ASTM B8 - Concentric-Lay Stranded-Copper Conductors, Hard, Medium-Hard, or Soft.

2. National Electrical Safety Code (NESC)
3. National Fire Protection Association (NFPA)
70 - National Electrical Code.
70E – Standard for Electrical Safety in the Workplace
4. Underwriters' Laboratories (UL)
467 - Electrical Grounding and Bonding Equipment.
5. Occupational Safety and Health Administration, OSHA.
6. All electrical and control equipment and material shall bear the recognized Underwriters Laboratories, Inc. (UL) seal of approval. It is Vendor's responsibility to obtain local inspection approval for all non-UL labeled equipment and pay all fees in connection with the same.

1.3 Submittals

A. Submit as specified in Section 1330.
B. Includes, but not limited to, catalog cuts for the following:
1. Ground Rods.
2. Cable.
3. Grounding Lugs.

PART 2 - MATERIALS

2.1 Acceptable Manufacturers

A. Ground Rods
1. ERICO
2. A.B. Chance Company
3. Harger

Or Equal.

B. Cable-to-Equipment Ground Lugs
1. Burndy Corporation (Burndy).
2. Knight-Metalcraft, Division of Whitaker Cable.
3. Harger

2.2 Wire and Cable

A. Type BC2 as specified in this Division (Section 16120).
B. Conductor Sizes
1. As indicated for specific connections.
2. For required connections not indicated, use conductor size not less than No. 2/0 AWG if buried in earth or cast in concrete, or No.2 AWG at other locations, unless otherwise noted.

2.3 Ground Rods

A. Copper-clad steel or copper-alloy sectional-type rods.
B. One end pointed to facilitate driving.
C. 3/4-inch diameter x 10 feet long with diameter and length stamped near top of rod.

2.4 Connection Materials

A. Cable-to-cable and cable-to-rod cable-to-connector connections of exothermic-welding-type process.

B. Cable-To-Equipment Ground Lugs

1. Compression type.

2. Bolted to equipment housing with silicon bronze bolts and lock washers.

2.5 Coatings

A. Coal Tar

1. Kop Coat - No. 50.

2. Tnemec - 46-449.

PART 3 - EXECUTION

3.1 Inspection: Do not cover up connections before they are inspected by Engineer.

3.2 Installation

A. Wire and Cable

1. Install using as few joints as possible.

2. Protect against abrasion by several wrappings of rubber tape at all points where cable leaves concrete in exposed areas.

3. Suitably protect cable against damage during construction.

4. Replace or suitably repair cable if damaged by anyone before final acceptance.

5. All Connections to be metal to metal. Remove all paint, grease, dirt, etc. before making connections.

6. In Exposed Installations

a. Route runs as indicated.

b. Route along the webs of columns and beams, and in corners where possible for maximum physical protection.

c. Support at intervals of 3 feet or less with nonmagnetic clamp-type supports.

d. Where exposed and no natural protection available, provide physical protection as required to protect ground conductor.

7.In Buried Installations

a. Lay in bottom of trench or in other excavations at least 30 inches below finished grade.

b. Maintain clearance of at least 12 inches from all underground metal piping or structures, except where connections thereto are specifically indicated.

c. Backfill as specified in DIVISION 2.

B. Ground Rods

1. Install rods as indicated by driving and not by drilling or jetting.

2. Drive rods into undisturbed earth where possible.

3. Where rods must be installed in excavated areas, drive rods into earth after compaction of backfill is completed.

4. Drive to a depth such that top of rods will be approximately 18 inches below final grade or subgrade, and connect main grid ground cable thereto.

C. Connections

1. Conform to manufacturer's instructions.

2. Chemically degrease and dry completely before welding.

3. Apply one coat of coal tar coating at 15 mils dry film thickness to all exothermic-welded connections to be buried.

4. Make connections to equipment as follows:

a. Make up clean and tight to assure a low-resistance connection with resistance not exceeding 1 ohm.

b. Install so as not to be susceptible to mechanical damage during operation or maintenance of equipment.

c. Provide direct copper connection to buried ground grid system.

d. Prior to making connections remove all paint, grease, etc. from connection location.

D. Metallic Conduit Grounds

1. Adequately and properly ground at all terminal points and wherever isolated from equipment or grounded steel.

2. Where extending into floor-mounted equipment from below, connect to equipment ground bus or frame.

3. Where extending into manholes, handholes, or cable trenches, connect to the ground riser or cable at that structure using grounding bushings.

E. Rack Grounds

1. Ground at intervals not to exceed 20 feet.
2. Ground all continuous runs as well as isolated sections at least at one point.

F. Box Grounds: Unless grounded by conduit system, ground all boxes by direct copper connection to the buried ground grid system.

G. Motor Grounds: Ground all motors with "identified" ground conductor in addition to conduit system. Route in conduit with phase conductors unless external ground is indicated.

3.3 Field Testing: Specified in Section 16950.

PART 4 MEASUREMENT AND PAYMENT

4.1 Measurement

A. No measurement will be made for this item.

4.2 Payment

A. Payment will be made at the contract lump sum price bid and shall be considered full payment for providing labor and materials to perform this work.

**** END OF SECTION 16450 ****

SECTION 16462

PANELBOARDS

PART 1 - GENERAL

1.1 Summary

A. This Section includes:

1. Panelboards.

B. Related Work Specified Elsewhere

Circuit Breakers…….Section 16180
Grounding…….…..Section 16450
Field Testing……..Section 16950

2.2 References

1. Federal Specifications

W-P-115b - Panelboards.
W-C-375b - Molded-Case Circuit Breakers.

2. National Fire Protection Association (NFPA)

3. National Electrical Code (NEC)

4. National Electrical Manufacturers Association (NEMA)

AB1 - Molded-Case Circuit Breakers.
ICS - Industrial Control and Systems.
PB1 - Panelboards.
ST20 - Dry-Type Transformers for General Applications.

5. Underwriters' Laboratories, Inc. (UL)

50 - Electrical Cabinets and Boxes.
67 - Electric Panelboards.
508 - Electric Industrial Control Equipment.

6. **National Electrical Safety Code**
7. **Standard for Electrical Safety in the Workplace – NFPA 70E**
8. **Occupational Safety and Health Administration, OSHA.**
9. All electrical and control equipment and material shall bear the recognized Underwriters Laboratories, Inc. (UL) seal of approval. It is Vendor's responsibility to obtain local inspection approval for all non-UL labeled equipment and pay all fees in connection with the same.

2.3 Submittals

A. Submit as specified in Section 1330.

B. Includes, but not limited to, the following:

1. Physical size, number of poles, ratings and nameplate information on panelboards.
2. Overall dimensions, weight, ratings, impedance and taps on transformers.
3. Schematic diagrams.
4. Factory test data if required.
5. Coating system.

PART 2 - PRODUCTS

2.1 Acceptable Manufacturers

A. Power Distribution Panelboards:

1. Square D Company.

B. Lighting Panelboards:

1. Square D Company.

2.2 Lighting and Small Power Panel-boards

A. Required final arrangement of breakers determined by system design.

B. Provide required components with ratings and voltages as indicated on the plans.

C. Heavy-duty type with size, number of poles, and quantity of breakers as indicated.

D. Enclosure:

1. NEMA Type 1 (located in electrical room) or as indicated on drawings.
2. Code gauge, hot-galvanized sheet steel boxes for surface and flush mounting.
3. Code gauge steel trim.

E. Wiring trough at top and bottom.

F. inged door with lock and latch combination in the front trim.

G. Phenolic nameplate approximately 1-inch x 3 inches on front of panel engraved with the panelboard title and designation such as shown on the project documentation.

H. Main circuit breaker for incoming line as indicated.

I. Spare space filler plate if required for panel symmetry.

J. Minimum symmetrical interrupting rating of as indicated on the plans.

K. Circuit directory in each panelboard filled in by typed lettering identifying the loads connected to each breaker.

L. Bus bar material to be copper

2.3 Painting

A. Paint all items this section with manufacturers standard system suitable for the service intended. System shall include surface preparation, prime and finish coats.

B. Submit with Submittals the type, color, and manufacturer of paint system used.

PART 3 - EXECUTION

3.1 Panelboard Installation

A. Install at locations indicated.

B. Surface-mount on wall (or equipment rack), as indicated, at an elevation 6’-6” to top of panel.

C. Arrange with proper clearances from other equipment and material to obtain good accessibility for operation and maintenance.

D. Install circuit directory in each panelboard.

E. Ground all neutral buses to the building ground system.

F. Connect feeder circuits as indicated in the panel schedules to obtain best balance of load between phases.

3.2 Field Painting

A. Preparation of surfaces and touch-up of scratched or damaged painted surfaces is specified in Section 9900.

PART 4 MEASUREMENT AND PAYMENT

4.1 Measurement

A. No measurement will be made for this item.

4.2 Payment

A. Payment will be made at the contract lump sum price bid and shall be considered full payment for providing labor and materials to perform this work.

**** END OF SECTION 16462 ****

SECTION 16482

SOLID STATE MOTOR CONTROLLERS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes
1. Solid state motor controllers (SSMC) for use with NEMA Design “B” 460 VAC motors to reduce the current inrush as well as mechanical shocks that can result from starting or stopping a motor across the line.
2. This section pertains to stand-alone solid state motor controllers in addition to those provided as part of a Motor Control Center.
3. Provide SSMC fully assembled as part of a Motor Control Center or as a standalone controller, ready for field installation, testing, and startup.

B. Related Sections include but are not necessarily limited to:
1. Section 16000 Electrical: Basic Requirements.
2. Section 16901 Control Panels.
3. Section 16450 Grounding.
4. Section 16180 Starters, Relays, Switches, Circuit Breakers, TVSS

1.02 SUBMITTALS

A. Submit the following in accordance with Specification 16000:
1. Complete electrical data on the SSMC and all accessories.
2. Dimensional and weight information on the enclosure (if applicable).
3. Fully developed ladder style elementary diagrams complete with terminal and wire designations. Label or tag all control devices.
4. Comprehensive bill of material for all components used to assemble the finished product.
5. Anticipated heat load for sizing of building HVAC system.
6. Verification that unit is listed by an independent testing laboratory in accordance with Electric Industrial Control Equipment Specification UL508.
7. List of recommended spare parts for 1 year operation.

1.03 QUALITY ASSURANCE

A. Final assembly to be provided with a UL508 label installed at the point of manufacturer.

B. The manufacturer shall be a certified ISO 9002 facility.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Package unit to protect against shipping damage.

B. Store unit in a clean, dry, controlled environment until scheduled installation.

C. Handle units in accordance with manufacturer's recommendations and in such a manner as to prevent damage.

D. Replace any unit damaged as a result of improper shipping, storage, or handling.

1.05 PROJECT/SITE CONDITIONS

A. Unit shall be designed specifically for the environment into which it will be installed.

B. Provide weather protection, space heating to prevent condensation, and cooling or ventilation as recommended by SSMC manufacturer.

C. Provide sufficient clearance and housekeeping pads to allow air circulation and to prevent damage from standing water.

1.06 WARRANTY

A. Provide a 2 year warranty on materials and workmanship from date of startup.

PART 2 - PRODUCT

2.01 MANUFACTURERS

A. Eaton

B. Allen-Bradley

C. Square-D/Schneider Electric

D. Engineer and Owner approved equal.

2.02 GENERAL DESCRIPTION

A. Provided in a configuration suitable for panel mounting.

B. Uses a thyristor bridge consisting of at least two SCRs per phase to control the starting and stopping of industry standard motors. A soft start/current limit will be obtained by a timed voltage ramp of the thyristors. The thyristors will be controlled

in such a manner that a smooth and stable acceleration ramp is ensured, independent of motor load.

C. Controlled by a microprocessor that continuously monitors the current and thyristor phasing of the starter.

D. All soft start power ratings shall use the same control module.

2.03 RATINGS

A. Designed to operate in an ambient temperature of 0^{o} to 40^{o} C.

B. Storage temperature range shall be -25^{o} to 70^{o} C.

C. Maximum relative humidity shall be 93% at 40^{o} C, non-condensing.

D. Designed to operate in attitudes up to 3300 feet. For higher altitudes, derate by 1.2% for each additional 330 feet.

E. Capable of operation within -15% to +10% of nominal voltage rating and automatically adapt for 50 or 60 Hz.

F. Capable of supplying 300% of rated full load current for 60 seconds at maximum ambient temperature.

G. The SCRs shall have a minimum P.I.V. rating of 1400V. Lower rated SCRs with "protection" by MOVs will not be acceptable.

2.04 ADJUSTMENTS AND CONFIGURATIONS

A. All dialog functions, display units, remote functions, terminal blocks, configuration switches and adjustment potentiometers shall be accessible on the front of the control module. Exposure to control circuit boards or electrical power devices during routine adjustments shall be prohibited.

B. Dialog indication shall provide, as a minimum, the following conditions:
1. Soft start ready for start.
2. Soft start starting/stopping motor.
3. Soft start running at full voltage.
4. Thermal pre-alarm condition.
5. Thermal fault.
6. Soft start internal fault.
7. Power supply fault.

C. Dip switches shall be used for configuring the soft start and will select:
1. Manual or automatic reset.

2. Freewheel or controlled stopping.
3. Stop by deceleration ramp or DC injection braking.
4. Full voltage boost on start (on or off).

D. Potentiometers or keypads shall be used for adjusting the operating parameters and will provide:
1. Motor full load amps adjustable from 50 to 100% of the controller's current rating.
2. Current limitation on starting adjustable from 2 to 5 times rated motor current.
3. Voltage ramp adjustable from 1 to 30 seconds.
4. Deceleration ramp or DC injection time adjustable from 2 to 60 seconds.

E. Output relays shall provide the following status indications:
1. Fault trip or soft start: one form A and one form B minimum.
2. Thermal pre-alarm: one form A and one form B or one form C minimum.
3. End of start (voltage ramp complete and current below 130% motor FLA): one form A.
4. Brake (for control of braking contactor if this function is specified): one form A.
5. Relay functions listed above must be isolated with respect to common.

2.05 PROTECTION

A. A microprocessor controlled thermal protection system shall be included which continuously calculates the temperature-rise of the motor and soft start and provides:
1. An overload pre-alarm which indicates by relay contact that the motor has exceeded its rated temperature rise by 100%. This function shall be annunciated only without resulting in fault trip of the motor.
2. A thermal fault condition which stops the motor if the temperature-rise exceeds 120% of the motor thermal capability.
3. An analog electronic circuit with a time constant adjustable to the motor's thermal cooling time constant ensuring the memorization of the thermal state even after power supply disconnection or shorting out of the power semiconductors.

B. The soft start shall have phase loss, phase unbalance and undervoltage protection.

2.06 CONTROL OPTIONS

A. Provide lockable disconnecting means to isolate the SSMC from incoming power. Disconnect may be either fused or circuit breaker style as shown on the contract drawings.

B. Provide lights, pushbuttons, selector switches, indicators, run time meters, and

other accessories as shown on the contract documents. These accessories are to be full size, NEMA 4 rated, heavy duty type. Lights are to be 120 VAC, transformer style, LED, with push-to-test feature.

C. Control relays are to be plug in style, 120 VAC, provided with DIN rail mounting sockets and shall have an indicating light to show when relay is energized. Contact sets to be rated at minimum 5 amps, 250 VAC.

D. Provide a control power transformer, 480-120V, sized to accommodate all the control circuit requirements in addition to 25% spare capacity.

E. The soft start shall accept control logic either by operator devices (push buttons, selector switches, etc.) wired directly into the unit or from external relay logic.

F. Provide warning label in accordance with the NEC if power is available from more than one source.

G. Provide nameplates identifying all panel mounted equipment and operator controls.

2.07 SHORTING CONTACTOR

A. A microprocessor shall control the operation of the shorting contactor via an output relay.

B. The shorting contactor shall close, shorting the thyristors after the motor current is below 130% of motor FLA and voltage is below nominal voltage (indicating the acceleration ramp is complete), and open on a stop command to allow a deceleration ramp or DC injection stop.

C. Overload protection shall continue to protect the motor when shorting is used.

2.08 BRAKING CONTACTOR

A. If required by contract drawings, a microprocessor shall control the operation of the braking contactor via an output relay.

B. If an overload condition occurs during the injection brake period, braking shall continue as set. When braking is complete, restart shall be prohibited until the motor has cooled.

2.09 ISOLATION AND BYPASS CONTACTORS

A. If required by contract drawings, provide NEMA rated three-pole isolation contactor to completely isolate the SSMC from the incoming power in the event of a shorted SCR or another defined fault condition.

B. If required by contract drawings, provide NEMA rated three-pole reversing style contactor to both isolate the output of the SSMC as well as allow across-the-line starting of the motor.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Mount the SSMC in accordance with manufacturer's recommendations.

B. Provide sufficient clearance for air circulation and operation of any vent fans or cooling equipment.

C. Install conduit, pull and terminate all power and control conductors.

3.02 TESTING

A. Test in accordance with Specification 16920 - ELECTRICAL ACCEPTANCE TESTING.

END OF SECTION

SECTION 16500

LIGHTING

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. The Contractor shall provide all labor, materials, equipment and incidentals as shown, specified and required to furnish and install lighting fixtures.

B.

C. Interior and exterior lighting shall use LED technology unless otherwise shown on the drawings or in the specifications.

1.02 QUALITY ASSURANCE

A. LED lighting products shall comply with the following reference standards:
   1. National Electrical Code (NEC)
   2. UL Standard 844, Standard for Luminaires for Use in Hazardous (Classified) Locations
   3. ANSI/UL 8750, Safety Standard for Light Emitting Diode (LED) Equipment for Use in Lighting Products
   4. UL Standard 1571, Incandescent Lighting Fixtures
   5. UL Standard 1598, UL Standard for Safety Luminaires
   6. Illuminating Engineering Society (IES) Light Measurement LM-79: Electrical and Photometric Measurements of Solid-State Lighting Products.
   7. IES LM-80: Measuring Lumen Maintenance of LED Light Sources.
   8. IES Technical Memorandum TM-21: Projecting Long Term Lumen Maintenance of LED Light Sources.
   9. IEEE C62.41.2: Recommended Practice on Characterization of Surges in Low-Voltage (1,000 V and Less) AC Power Circuits.
   10. All applicable local lighting ordinances.

B. Miscellaneous:
   1. Lamps are identified for each luminaire in the Lighting Fixture Schedule on the Drawings.
   2. Lighting fixtures and electrical components:
      a. UL labeled, complete with lamps.
      b. Rated for area classification as indicated.
   3. Location of lighting fixtures on Drawings are intended to be used as a guide.
      a. Field conditions may affect actual locations.
      b. Coordinate with other trades to avoid conflicts in mounting of fixtures and other equipment.

4. The quality standard is established by the fixture listed in the Lighting Fixture Schedule.
    a. This quality standard includes, but is not necessarily limited to construction features, materials of construction, finish, and photometrics.
5. LED lighting systems manufacturer shall have a minimum of 10 years' experience producing LED lighting systems.

1.03 SUBMITTALS

A. The following shall be submitted to the Engineer for review for each type of luminaire:
    1. Documentation proving that products submitted meet requirements of standards referenced in Section 1.02.A and B above.
    2. Submit test report on manufacturer's standard production model luminaire. Submittal shall include all photometric and electrical measurements, as well as all other pertinent data outlined under "14.0 Test Report" in IES LM-79.
    3. Manufacturer's technical information on products to be used including photometric performance curves for the fixture and ballast data.
    4. Life, output (lumens, CCT, and CRI), Kelvin temperature, and energy-efficiency data for LED light bars.
    5. Acknowledgment that products submitted are UL or ETL listed.
    6. When general data sheets constitute part of the submittal, identify the products to be used on this project.
    7. Manufacturer's installation instructions.
    8. Identification of fixtures by Lighting Fixture Schedule.
    9. UL nameplate data (Voltage, wattage, etc.).
    10. Finishes, colors, and mounting type.
    11. Pole, fixture, and accessories.
    12. Pole wind loading.

B. Contractor shall submit shop drawings, manufacturer's data sheets, and a complete wiring diagram detailing all connections to the electrical system in accordance with Section 16000, and other requirements of the Contract Documents.

C. Submit warranty: Products specified herein shall have a 5 years warranty on complete mechanical assembly, electrical components of LED lamps, drivers, and fixture body.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Luminaires, fixtures, and lamps shall be manufactured by Eaton, General Electric, Lithonia, Phillips, or equal.

B. Lighting fixtures shall be provided as indicated on the Lighting Fixture Schedule on the Drawings.

C. Light poles shall be as indicated on the Drawings. Include base template, anchor bolts, cadmium-plated hardware and pole grounding lug, handhole, anchor base and bolt covers. Pole foundations shall be as indicated on the Drawings.

2.02 MATERIALS

A. General:
   1. Lamps:
      a. See lighting fixture schedule on Drawings for wattage, voltage and number required.
   2. All Fixtures:
      a. There shall be no live parts normally exposed to contact.
      b. LEDs shall be high efficiency with minimum output of 100 lumens per watt.
      c. LEDs and driver system lifespan shall be greater than 50,000 hours.
      d. LED color temperature shall be warm white in the range of 2700-3500 Kelvin. Mixing of color temperatures with different LEDs is not permitted.
      e. LED drivers or fixtures shall have inrush current limiting circuits or devices to prevent tripping of breakers on startup or switching of LED lighting loads.
      f. Outdoor LED systems shall be protected by UL 1449 listed surge-protection devices.
      g. LED drivers shall be electronic, labeled as compliant with radio frequency interference (RFI) requirements of FCC Title 47 Part 15, comply with NEMA SSL 1, have a sound rating of "A," and be rated for a THD of less than 20% at all input voltages with a minimum power factor of 0.90.
      h. When intended for use in wet area mark fixtures "suitable for wet locations."
      i. When intended for use in damp areas mark fixtures "suitable for damp locations" or "suitable for wet locations."
      j. In wet or damp area, install fixtures so that water cannot enter or accumulate in the wiring compartment, lamp holder or socket, or other electrical parts.
      k. Gasket seals: Urethane foam
      l. Diffusers: UV stabilized acrylic plastic
   3. Underground wiring:

a. Provide all wiring runs with separate green grounding conductor.
b. Ground all pole bases.

B. Furnish a minimum of 2 lamps, or ten percent spare lamps of each type and wattage, whichever is greater.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install, test, and commission lighting contactor controls, motion sensors, photocell controls, astronomical time clock controls, and switches as shown on the Drawings.

B. Replace all failed lamps with new lamps prior to final acceptance by Owner.

C. Surface and flush mounted fixtures shall be solidly connected to a junction box. Suspended fixtures shall be hung utilizing pendant mounting or stainless steel chains and hooks. Each suspended fixtures, shall be electrically connected by a length of Type SO flexible cord. 3 conductor No. 14 AWG, minimum, with a twist-lock receptacle mounted in an individual junction box. Plugs and receptacles shall be as manufactured by Hubbell, General Electric Company, or equal.

D. Provide mounting brackets and/or structural mounting support for fixtures.
1. Do not support fixture from conduit system.
2. Do not support fixture from outlet boxes.

E. Install with approved mounting hardware following manufacturer's recommendations.

F. Pole mounted fixtures shall be mounted on steel or aluminum poles as indicated on the Drawings. All metal poles shall be bonded to the facility ground system. Poles shall have adequate handholes and weatherproof receptacles where indicated.

G. All anchor bolts and nuts shall be stainless steel and insulated to prevent galvanic corrosion between dissimilar metals.

H. Fixture mounting heights and locations indicated on the Drawings are approximate and are subject to revision in the field where necessary to avoid conflicts and obstructions.

3.02 ADJUSTING AND CLEANING

A. Wipe all lighting fixture reflectors, lenses, lamps, and trims clean after installation

and prior to acceptance of Project by Owner.

END OF SECTION

SECTION 16620

EMERGENCY POWER GENERATOR

PART 1 – GENERAL

1.1 Description

A. This Section includes the requirements for a diesel fuel driven standby generator complete with weatherproof sound attenuating enclosure. Provide engine/generator set (genset) as indicated on the design documents including but not limited to the following:

Diesel fueled engine
Electric starting system with batteries, charger
Electric generator
Sound attenuating enclosure
Fuel system, tank, pumps, and filters
Muffler
Control panel
Accessories
Emission control for State of Arizona

B. Contractor shall be responsible for the modifications to the equipment location, conduit and cable/wiring layout, concrete pad dimensions, pad penetrations and other changes which will be required to meet the actual equipment supplied. All modifications shall be approved by the Engineer prior to installation.

C. Contractor shall provide standby equipment that is in compliance with the Federal and State of Arizona clean air and emissions requirements.

D. One acceptable manufacturer shall accept prime responsibility through Contractor for complete power unit.

E. Provide the size of the unit as indicated for soft start loads. If a unit of greater kW capacity than the unit specified is supplied, Contractor shall be responsible for any changes in size of conduit, wire, circuit breakers, transfer switch, fuel system, building, or related equipment which will be required to meet the applicable codes and standards.

1.2 References

1. American National Standards Institute (ANSI)

ANSI C37 Series - Power Switchgear.
ANSI C50.10 - General Requirements for Synchronous Machines.
ANSI C50.13 - Cylindrical Rotor Synchronous Generators.
ANSI C50.14 - Combustion Gas Turbine Driven Cylindrical Rotor Synchronous Generators.

2. Institute of Electrical and Electronic Engineers (IEEE)

43 - Recommended Practice for Testing Insulation Resistance of Rotating Machinery.
115 - Test Procedures for Synchronous Machines.

3. National Electrical Code (NEC)
4. National Electrical Manufacturing Association (NEMA)
5. National Electrical Safety Code (NESC)
6. Society of Automotive Engineers (SAE)
7. Underwriters Laboratories, Inc. (UL)
UL50 - Electrical Cabinets and Boxes.
UL508 - Electric Industrial Control Equipment.
UL1008 - Automatic Transfer Switches.
8. International Electrical Testing Associations
7.22 Emergency System
9. Standard for Electrical Safety in the Workplace, NFPA 70E
10. Occupational Safety and Health Administration, OSHA.
11. All electrical and control equipment and material shall bear the recognized Underwriters Laboratories, Inc. (UL) seal of approval. It is Vendor's responsibility to obtain local inspection approval for all non-UL labeled equipment and pay all fees in connection with the same.

1.3 Factory Tests

1. Conform to Standard Engine Field Test Codes to determine the following
- **a.** Engine-generator set net power output.
- **b.** Fuel consumption.
- **c.** Overall engine-generator set efficiency.
- **d.** Certification that engine-generator meets Federal and State emissions limits.

2. Correct test results for estimated field operating conditions of 500 ft. elevation MSL and 122 degrees F ambient air temperature.

3. Submit actual and corrected test results as specified in Section 1330.

1.4 Submittals

A. Submit as specified in Section 1330.

B. Complete drawing and wiring diagrams including, but not limited to showing coordination and connections between the following:

1. Engine generator.
2. Generator control panel.
3. Automatic starting controls.
4. All auxiliaries.
5. Engine Emissions Data for use with commercially available No. 2 diesel fuel.
6. Complete genset dimensions, weights, foundation requirements and connection locations for all piping, cabling
7. Weatherproof enclosure dimensions and weights
8. Exhaust System
9. Sound attenuation guarantees
10. Complete O & M Manuals

PART 2 – MATERIALS

2.1 Acceptable Manufacturers

A. Engine

1. Caterpillar Inc.
2. Cummins Inc, Onan Division
3. Kohler Company.
4. Generac Power Systems

B. Generator

1. Caterpillar, Inc.
2. General Electric Company.
3. Onan Division of Cummins Inc.
4. United States Motor Corporation.
5. Generac Power Systems

2.2 Design Criteria

A. Preassembled power module.

B. Conform to NEC, NESC, NEMA. and IEEE C62.1.

C. Completely self-contained and integrally assembled, with the engine, generator, exciter, starter, batteries, charger, intake air cleaner, radiator

and fan, fuel system, fuel tank, muffler, air handling system, weatherproof sound attenuated enclosure, base and all necessary parts to make a complete installation.

D. Complete with all auxiliaries, interconnecting piping, instruments, wiring, rigid steel base, tools, and spare parts.

E. Compactly assembled and rigidly mounted on a steel skid ready for installation and external connections.

F. All engine and generator controls required for proper operation, including generator output breaker.

G. Outside power connection cabinet, inside light, duplex convenience receptacle, (and a screened, baffled, and louvered air intake and hot air discharge).

H. Power for battery charger and water jacket heater from an outside source.

I. Designed for maximum reliability and dependability of operation.

J. Capable of being brought up to full speed, placed on the line, and brought up to full load in 10 seconds or less at full power.

K. Size guaranteed to start the motor load as specified with a maximum voltage drop of 15%.

L. Arranged to provide control as follows:

1. Micro-processor based control panel for monitoring and control genset operation.

2. Local start-stop engine test switch to allow testing system without operating transfer switch.

3. When unit is up to speed and voltage required, transfer switch shall close automatically and unit shall pick up load, provided the engine has not been started by the engine test switch.

2.3 Engine

A. General

1. Conform to SAE Internal Combustion Engine Standards.

2. Operate on No. 2 Diesel fuel.

3. Designed for emergency power service.

4. Starts from batteries, either automatically or manually.

5. Suitable for continuous operation at nameplate rating.

6. Operate in efficient manner free from all roughness and vibrations.

7. Basic 4 cycle engine with governor for speed regulation within 5%.

8. Maximum operating speed of 1,800 rpm.

9. Safety devices to shut down engine in case of low oil pressure, overcranking, high-water temperature, and overspeed protection independent of governor.

10. Lubricating oil pumps.

11. Integral cooling water radiator sized for 122 degrees F ambient, fan, temperature control hardware, water pump, and closed water cooling system.
12. Electric starting motor: 24Vdc.
13. Air filters**:** Dry type.
14. Cranking contactor with overcranking alarm and cranking limiter. Limit to 4 cranking cycles of 15 seconds each.
15. Lube oil filter: Cartridge type.
16. Water jacket heater for 120VAC operation, to maintain 140 degrees F minimum jacket water temperature during idle periods, thermostatically controlled.
17. Automatically regulated, battery charging alternator.

B. Fuel System

1. No. 2 Diesel fuel.
2. Double wall UL listed diesel fuel tank integral to genset skid base.
3. Provide leak detection.
4. Size tank for a minimum of 24 hours supply of fuel.
5. Normal and emergency venting.
6. Provide all tank nozzles and openings.
7. Provide spill containment at tank fill location.
8. Provide all necessary pumps, filters, piping, valves.
9. Fuel train components shall be engine mounted.
10. Provide access for all electrical cabling to engine controls, generator without compromising tank and containment.
11. Tanks shall be equipped with a level transmitter which shall generate a 4-20 mA signal to indicate fuel level. Provide terminal blocks in the generator control panel for connection to Owner's control system.
12. Provide a backup low fuel level switch for Owner's alarm.
13. Coordinate fuel fill with site requirements.
14. Provide paint specification data.

C. Muffler

1. Provide critical grade type exhaust silencer for use in residential area to be mounted inside the genset enclosure.
2. Provide all mounting accessories including mounting brackets, flexible fittings, elbows, piping, rain cap and rain skirt with all hardware.
3. Provide exhaust outlet at an elevation of 14 feet above finished grade level. Provide flexible section to connect to muffler.

D. Batteries

1. 2-12V lead-acid type storage battery, minimum ampere-hour rating as specified by manufacture or capacity described in item #2 below, or 90 A.H. whichever is greater.

2. Size for full cranking speed for 10 cycles of 15-second cranking with engine at 0ºF ambient temperature.

3. Filled with proper quantity of electrolyte and fully charged at time of installation.

4. Suitable hydrometer mounted on a support adjacent to batteries.

5. Suitable racks for mounting batteries.

E. Battery Charger

1. Conform to UL50 and UL508.

2. Automatic, self-regulating, constant voltage type with silicon diode rectifiers and regulating system.

3. Designed for floating charge and equalizing, charge.

4. Operate from 120-V, single-phase, 60-Hz ac supply.

5. Capable of fully charging batteries within 24 hours.

6. Transformer, silicon diode stacks, ammeter, voltmeter, switches, and other components as required to accomplish trickle charging of batteries.

7. Enclosed in all steel cabinet for wall mounting, and conduit connection.

8. Screens on top and bottom of steel cabinet to cover ample size opening for ventilation.

9. Alarm contracts available for Owner's use:

a. Battery charger off

b. Battery charger malfunction and/or battery low voltage

F. Instrumentation

1. Totally enclosed gauge panel to be located approximately 5'-0" above the ground in the final installation with following instrumentation installed:

a. Lubricating oil pressure gauge.

b. Water temperature gauge.

c. Engine battery charging amperage.

2. Isolated (no voltage) alarm contacts suitable for operation on 120 VAC for each of the following alarm points (contacts close on alarm for remote alarm):

a. High engine lube oil temperature.

b. Low engine lube oil pressure.

c. High jacket water temperature.

d. Engine Overcranking.

e. Engine Overspeed.

f. Engine failure to start.

3. Local indicating lights for each alarm point specified.

4. Completely shop-wired and tagged with terminations properly identified and located to provide entrance for external piping and wiring connections at top of panel.

5. Low lube oil pressure, high jacket water temperature overspeed, and overcranking shall shut engine down only when these values reach dangerous limits.

2.4 Generator

A. Alternator

1. Conform to IEEE 43, 56, and 115, ANSI C37 Series, and C50.10, C50.13, and C50.14.

2. Full load rating as indicated at 0.8 power factor prime/continuous duty.

3. Suitable for solid grounding of generator neutral.

4. Voltage: 480/277VAC, Dual wiring configuration (Delta or Wye), 3-phase, 3-wire, or 3-phase, 4-wire, 60-Hz. Alternator to be delivered in the Wye Configuration.

5. Maximum speed: 1,800 rpm.

6. Temperature rise of 80ºC above 40ºC ambient.

7. Air cooled, self-ventilated.

8. Open type enclosure.

9. Excitation by brushless permanent magnet.

10. Stator and rotor insulation, Class F or H limited to a Class B rise.

11. Overload rating: 110% rated load for 2 hours.

12. Maximum balanced telephone influence factor (TIF): 300.

13. Short circuit ratio: 1.0.

14. Generator field discharge resistor mounted and connected in control panel.

B. DC Exciter

1. Conform to IEEE 43, 56, and 115, ANSI C37 Series and C50.10, C50.13, and C50.14.

2. Rating as required.

3. Silicon controlled rectifier type or engine-driven type.

4. Air cooled, self-ventilated.

5. Designed to permit voltage build-up from residual magnetism. Field flashing from separate source is not acceptable.

6. Excitation controls including, but not limited to, the following

a. Voltage level and field limiting device.

b. Voltage drop.

c. Voltage gain.

C. Voltage Regulator

1. Conform to IEEE 43, 56, and 115, ANSI C37 Series and C50.10, C50.13, and C50.14.

2. Rating as required.

3. Modular construction, solid state design.

4. Voltage regulation from no load to rated load within a band of ±2% of rated voltage.

5. Steady state voltage within ±1/2% of rated voltage.

D. Generator Control Panel

1. Control panel shall be genset mounted for complete control and monitoring of the engine, generator and accessories. Panel shall incorporate self-diagnostics and fault logging. Provide suitable enclosure to meet the environmental conditions. Enclosure shall include a hinged door with provision for padlocking.

2. Control shall be micro-processor based.

3. The control panel shall include the following as a minimum:

a. Automatic start/stop operation

b. Adjustable cycle cranking

c. Digital AC metering unit with the following metering capabilities and features:

RMS line current (each phase)

RMS line-to-line voltage (all three)

RMS line-to-ground voltage (each phase)

Megawatts (instantaneous and peak block or rolling block demand)

Megawatt hours

Megavars (instantaneous and peak block or rolling block demand)

Megavar hours

Power Factor

Frequency

ANSI C12.20 0.2 accuracy compliant

Harmonics (individual, even, odd, total) to 50th harmonic

d. Engine monitoring

e. Shutdown sensors and alarms with horn and reset

f. Adjustable cool-down timer

g. Emergency stop push-button

h. Lamp test

i. Voltage control

4. Control Panel displays:
    a. Engine oil pressure
    b. Coolant temperature
    c. Engine speed
    d. DC volts
    e. Engine running time
    f. Percentage of rated power
    g. Digital meter outputs listed above.
5. Control panel indications for protection and diagnostics:
    a. Low oil pressure
    b. High coolant temperature
    c. Low coolant level
    d. Over-speed
    e. Over-crank
    f. Eng stop shutdown

    g. Approaching high coolant temperature
    h. Approaching low oil pressure
    i. Low coolant temperature
    j. Low dc voltage
    k. Control switch out of "Auto"
    l. Low fuel level
    m. Battery charger failure
    n. High battery voltage

6. Protective relay function including:
    a. Under-voltage
    b. Over-voltage
    c. Over-frequency
    d. Under-frequency
    e. Reverse power
    f. Over-current
    g. Overload – kW level
7. Dry contacts for remote alarm annunciation. Provide connection as inputs to the control system PLC.
    a. Generator run status
    b. Generator failure
    c. Low coolant alarm
    d. Low fuel level
    e. Battery status
8. Instrument transformers, terminal blocks, and wiring.

2.5 Enclosure

A. Construction:

1. Pre-fabricated weatherproof, sound attenuated metal enclosure with base mounted fuel tank.
2. All bolted construction suitable for installation on a concrete slab.
3. Seismic mounts, snubbers and vibration isolation.
4. Enclosure rated to a wind load of 120 mph.
5. Access doors with provision for locking in closed position.
6. Corrosion resistant hardware.
7. All openings flashed and sealed for a weatherproof installation.
8. The enclosure shall attenuate the generator noise when running at full load not to exceed 72 dBA at 20 feet in any direction.
9. Provide supports, brackets, hardware to install all equipment.
10. The installation shall be complete with all equipment and accessories assembled, factory tested and ready for external piping and wiring connection.
11. Provide engineered lifting system with integral rings, spreader bars all labeled.

B. Ventilation:

1. Baffled ventilation system outside air intake louvers.
2. Insect screens.
3. Intake and discharge ducting.
4. Flexible connections on hot air discharge.
5. Fans and controls/interlocks.

C. Electrical Systems:

1. Install and pre-wire all electrical components and system in accordance with the References and Division 16.
2. Install a GFCI duplex receptacle strategically located to allow maintenance on the Genset.
3. Provide all necessary conduit, boxes and fittings for a complete installation.

2.6 Starting System and Equipment

A. Complete electric starting system.

B. Interlock preventing automatic restart attempts if engine has been stopped by low lube oil pressure, high water temperature, or failure to start.

C. All automatic equipment coordinated with the engine generator.

D. Operate from 24 VDC.

E. Necessary starting control equipment to perform required functions.

2.7 Accessories:

A. All filters for 1 year operation.
B. First fill of fuel, lubrication oils, coolant and water.
C. Lube oil requirements for first year of operation.
D. Special engine tools.
E. Recommended spare parts.
F. Touch-up paint for each color used.

2.8 Automatic Transfer Controls – See Also Section 16442-Switchboards

A. Conform to ANSI C37 Series, UL50, UL508, UL1008 and NEC Articles 517, 700, 701 and 702.

B. Automatic transfer controls consisting of a two breaker source transfer system. Incorporate controls as described in this section to control the Main and Generator breakers in the switchgear as specified in Section 16442.

C. Operates when any phase drops to 70% rated voltage and transfer back to normal when all phases are 90% or more of rated voltage.

D. Hand-Off-Test-Automatic Selector Switch

1. Hand position, manual starting with load transfer.

2. OFF position, engine-generator cannot be started. no load transfer.

3. Test position. manual starting, no load transfer.

4. Automatic position. automatic starting diesel engine and load transfer during power failure.

E. Adjustable time delay 0-15 seconds on engine starting.

F. Adjustable time delay 0-30 seconds on transfer to emergency.

G. Adjustable time delay 0-2 minutes on transfer to normal.

H. Adjustable time delay 0-10 minutes engine cool-down after transfer to normal.

I. Engine starting contacts.

J. Indicating lights to show switch position.

K. Isolated output contact for remote alarm or indication of transfer. Provide connection as inputs to the control system PLC.

L. Exerciser to automatically start the unit a minimum of 15 minutes once each week to any multiple of 15 minutes as often as needed.

2.9 Accessories

A. Two sets of special engine tools.

B. Vibration isolators for base rail-equipment, pad mounted.

C. Two spare lube oil filter cartridges.

D. One spare air filter if dry type.

E. Sufficient lube oil for start-up and one oil change for each engine/ generator unit.

F. 15 gallons of permanent type anti-freeze for cooling system for each engine/generator unit.

G. Two spare fuses of each type provided.

H. One quart of equipment touch-up paint.

I. Weatherproof enclosure for the engine/generator set.

PART 3 – EXECUTION

3.1 Installation

A. Install as indicated on concrete slab. Installation shall meet the site seismic requirements.

B. Anchor skids as recommended by the engine-generator manufacturer.

C. Connect all electrical connections as required for satisfactory operation.

D. Ground genset and generator.

3.2 Field Quality Control

A. Manufacturer's Field Services: Provide as specified in Section 1750.

B. Testing shall be in accordance with NETA standards.

C Performance Tests

1. Provide as specified in DIVISION 1.

2. Particular attention shall be given to the following:

a. Automatic starting and reliability of operation.

b. Ability to pick up full load in 10 seconds or less.

c. Performance at 110% rated load.

3.2 Acceptance Testing

A. Load Bank Test.

1. 25% Rated load 30 minutes.

2. 50% Rated load 30 minutes.

3. 75% Rated load 30 minutes.

4. 100% Rated load 3 hours.

Record voltages, frequency, load current, oil pressure, and coolant temperature at 10 minute intervals on each Load Bank Test.

B. Perform vibration baseline testing plot amplitude versus frequency for each bearing cap.

C. Automatic transfer testing. Record transfer time for each of the conditions

1. Loss of normal power.

2. Return to normal power.

3. Loss of emergency power.

4. All single phase conditions.

D. Upon completion of tests, fill fuel tank.

E. Upon completion of tests, verify all fluid levels. Top off any fluids as necessary.

PART 4 MEASUREMENT AND PAYMENT

4.1 Measurement

A. No measurement will be made for this item.

4.2 Payment

A. Payment will be made at the contract lump sum price bid and shall be considered full payment for providing labor and materials to perform this work.

**** END OF SECTION 16620 ****

SECTION 16712

FIBER OPTIC COMMUNICATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Materials and procedures for installing and testing fiber optic communication systems

1.02 RELATED SECTIONS

A. Section 02582 - Underground Electrical Ducts and Manholes

1.03 REFERENCES

A. Electronic Industries Association(EIA) and Telecommunications Industry Association(TIA) Specifications
B. National Electrical Code(NEC).
C. Underwriters Laboratory(UL)

1.04 DEFINITIONS

A. OTDR - Optical Time Domain Reflectometer
B. SMF - Single Mode Fiber
C. OSP - Outside Plant

1.05 SUBMITTALS

A. Provide all submittals in accordance to Section 01300.
1. Provide evidence of training and experience for all fiber optic staff, including but not limited to installation technician, splice technicians and test technicians.
2. For approval:
a. A detailed construction an installation procedure covering all aspects for the fiber optic cable installation on this project.
b. All Materials for the fiber optic cable installation on this project.
c. Fiber labeling setup
3. Submit OTDR test results to the engineer in a neatly bound and printed form for acceptance. Include the current calibration certificate for the OTDR being used.
4. Submit Power Meter/Light Source test results to the engineer for acceptance.

1.06 QUALITY ASSURANCE

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

B. Installer Qualifications: Company specializing in performing the work of this section with minimum 3 years of experience.

1.07 WARRANTY

A. Correct defective Work within a 2 year period after Date of Substantial Completion.

PART 2 PRODUCTS

2.01 GENERAL

A. All materials are UL listed

B. Provide all incidental materials including but no limited to fiber optic jumpers, cable ties, labels, and connectors.

C. All materials meet Fluid Penetration Test standards (TIA/EIA-455-82B)

2.02 FIBER OPTIC CABLE

A. Fiber must be approved by the USDA Rural Electrification Administration (PE-90).

B. The fiber optic cable is an Outside Plant (OSP) type, armored dielectric loose tube, single-mode cable.

C. Include the manufacturer's test documentation. This documentation indicates the attenuation of each cable fiber in dB/km, measured at 1310 nm and 1550 nm for single-mode.

D. Outside Plant (OSP) Single-mode.

1. Fiber Optic Glass: Corning SMF-28E or approved equal.
2. Gel-Free Fiber Optic Cable: Corning ALTOS Lite or approved equal.

E. Fiber optic cable must comply with TIA/EIA-4720000-A.

F. Outer jacket labeling:

1. The date of manufacture and the manufacturer's name.
2. A numerical sequence, at intervals no greater than 10 ft, to determine the length of cable and amount of cable remaining on the reel.
3. "Fiber Optic Cable" at an interval of no greater than 10 ft.
4. Height of the markings is 1/8 inch nominal.

2.03 FIBER OPTIC CONNECTORS

A. With the following characteristics and as specified in the contract:

1. LC – Connectors (Standard)

a. Factory installed pre-polished or field installed Camlock LC connectors.

b. Ceramic ferrules.

c. Maximum insertion loss: 0.30 dB.

. Connector back reflection: greater than 35 dB.

2. ST – Connectors (to be used only where approved)

a. Factory installed or field installed ST or ST compatible connectors.

b. Ceramic ferrules and metallic connector bodies.

c. Maximum insertion loss: 0.30 dB.

d. Connector back reflection: greater than 35 dB.

e. Clean all connectors with alcohol wipes and a compressed cleaning gas.

2.04 FIBER OPTIC CABLE SPLICE ENCLOSURES

A. Provide enclosure with the following minimum characteristics:

1. Provide a water and airtight seal for fiber optic splices in any environment (aerial, buried, underground and vault).

2. Corrosion resistant shell

3. Allow re-entry without replacing the cable seals

4. Strength member tie-off

5. Mechanism to resist cable pull-out.

6. All required accessories to complete the splice

B. Accommodates up to 48 splices

C. Contains 2 or more 12-count splice trays

1. Coyote Runt Closures for Underground, Arial and buried Splices.

2.05 SPLICE ENCLOSURE FIBER DETAILS

A. Provide 3 ft of buffer tube slack from end plate.

B. Provide label for each buffer tube located 1 inch from the splice tray. Description on label will identify as to which fiber cable and direction cable is coming from.

C. Provide 3 to 4 ft of fiber optic strands, outside of buffer tube, from each cable before splicing.

PART 3 EXECUTION

3.01 INSTALLERS

A. Demonstrate two years total and one year continuous work experience with the splicing, termination and testing of fiber optic cable.

B. Perform all work with qualified staff

3.02 PREPARATION

A. Do not perform fiber splices that are not shown in approved splice details without prior written authorization engineer.

B. Restore Contractor damaged facilities within 48 hours.

C. Lubricate cable with a lubricant designed for fiber optic cable installation**.**

D. Use shear pins or other failsafe means to prevent exceeding the maximum cable pulling tension specified by the cable manufacturer.

E. Maintain the following minimum bend radii:

1. 20 times Cable Diameter during installation.
2. 10 times Cable Diameter installed.

F. Maintain the following minimum slack requirements:

1. Splice Points: 100 ft from installed splice enclosure to conduit on all cables.
2. All Other Junction Boxes: 50 ft.
3. Cabinets: 50 ft.

G. Replace any fiber optic cable segment not meeting the requirements of the specifications in its entirety between full splice points shown in the contract.

3.03 FIBER OPTIC CABLE PREPERATION

A. Solvent requirements:

1. Must not remove any color from individual fibers (Refer to TIA/EIA-598-A) or buffer tubes.
2. Not harmful to the polyethylene cable jacket.

3.04 ENTRY AND REENTRY OF FIBER OPTIC SPLICE ENCLOSURES

A. Perform all work in an environmentally controlled atmosphere. Acceptable environments to work on splice enclosures include office type environments in buildings, splice trailers, and splicing tents with floors. All splicing, testing, connecting, or opening of fiber ends must not occur in locations with freezing temperatures, rain, snow, or wind-blown dust.

3.04 ENTRY AND REENTRY OF FIBER OPTIC SPLICE ENCLOSURES (Cont'd)

B. Perform fusion splices as follows:

1. Use equipment with automatic fiber alignment and automatic light injection with detection devices or profile alignment algorithms to estimate splice losses.

2. Provide splice enclosure as a protection for all splices and stripped cable.

3. House all splices in splice trays or organizers.

4. Use glass capillaries, heat shrink tubing, or silicone sealant to provide additional protection and strain relief.

5. Comply with maximum splice loss allowance of 0.05 dB.

3.06 CABLE LABELING REQUIREMENTS

A. Label all fiber optic cables in every accessible location with a high quality permanent label, indicating the location and type of circuit (e.g., drop cable, distribution-48 count).

B. Use Panduit MP-150-C or equivalent.

3.07 ACCEPTANCE TESTING

A. Contact the Engineer five business days before performing all acceptance testing (Post Termination and Splicing OTDR and Power Meter).

B. Perform all fiber optic testing with an OTDR capable of producing output files compatible with the Siecor OTDR 383PCW Version 1.21 or higher.

C. Repair any damaged fiber strands using fusion splicing methods and repeat all tests described below.

D. OTDR Testing Requirements:

1. After completing the required work, test every fiber strand passing through any open splice tray.

2. Conduct all traces with a pigtail or fiber box between the OTDR and the fiber under test. Use pigtail of sufficient length as to show the connector, or the start of the strand under test.

3. Do not exceed launch transition of 0.6 dB.

4. Conduct all traces at both 1310 nm and 1550 nm.

5. Unless otherwise noted, uni-directional traces are acceptable.

6. Provide traces with the following information:

a. Horizontal Axis: Distance in Feet and Kilometers.

b. Vertical Axis: Attenuation scale in dB.

c. Traces showing attenuation versus distance.

d. Cursors positioned at cable ends.

7. Tabulate for each trace: method, fiber type, wavelength, pulse width, refractive index, range, search threshold, reflection threshold, end threshold, warning threshold, backscatter, jumper length, file date, file time, fiber ID, cable ID, OTDR location, far end location, operator initials.
8. Provide an event table showing all events having more than 0.05 dB loss, containing event type, position from OTDR end, loss and reflectance.
9. For cables less than 3300 ft (1 km) in length, the maximum total attenuation is 1.0 dB.
10. Identify fibers by strand number.
11. Submit results in printed form on 8 ½-inch x 11-inch paper in a suitable binder organized by cable and strand number.
12. A cover sheet is required for each binder indicating which cable(s) were tested, the OTDR users name, the reviewers name, the type of test performed and the date(s) of the test.
13. Cover sheets for final test results bearing the reviewers signature, the date, and a statement indicating that the installation complies with the requirements of this section is required.
14. The Contractor's employee who has reviewed the traces is required to sign or initial them. A check mark is required on all traces that satisfy the requirements identified herein. For intermediate test results, flag any discrepancies that may exist with a short description of the proposed corrective action (e.g. resplice).

E. Post Installation / Pre-Splicing Test:

1. Fibers Tested: Normally, one strand per buffer tube. Test every strand when evidence of physical damage, excessive pulling tension, and kinks exist, or when any damaged strand is found.
2. Light Frequency: 1310 nm and 1550 nm.
3. Direction: Uni-directional.
4. Location of test: One field location for each cable installed.
5. Test after installing cable in duct but before splicing.
6. Tested by: Qualified Staff.
7. Acceptance Criteria:
   a. Cable attenuation 0.4 dB/km at 1310 nm.
   b. Cable attenuation 0.25 dB/km at 1550 nm.
   c. Strand lengths are consistent.
   d. Launch Transition < 0.6 dB.
   e. No event > 0.10 dB.
8. Trace available for one strand in every buffer tube in the cable.

F. Post Termination and Splicing Test:

1. Test every strand in all cable segments including connectorized strands of drop cables.
2. Light Frequency: 1310 nm and 1550 nm.
3. Direction: Unidirectional.
4. Location of test: Every field location required to obtain access to each cable segment.
5. Test after terminating and splicing at all points described in the contract.
6. Cable Tested by: Certified Staff.
7. Acceptance Criteria:
a. Cable attenuation 0.4 dB/km at 1310 nm excluding splices described in the contract or authorized by the Engineer.
b. Cable attenuation 0.25 dB/km at 1550 nm excluding splices described in the contract or authorized by the Engineer.
c. Strand lengths are consistent.
d. Launch Transition < 0.6 dB.
e. No event > 0.30 dB.
f. Maximum splice attenuation 0.05 dB per splice unless otherwise described in the contract.
8. Trace available for each strand in all cable segments.

G. Power Meter/Light Test:

1. Connect the light source to the connectorized fiber at the location identified on the Fiber Optic Light Source Power Meter Test Form provided by the Resident Engineer or Department Fiber Representative at the pre-construction meeting. Connect a power meter to the other end of the fiber at the location identified on the Test Form. Record the results and submit the completed form to the Engineer.
2. Use the light frequencies of 1310 nm and 1550 nm, or as indicated in test forms.
3. Perform the test bi-directional.
4. Test every field location required to obtain access to each cable segment.
5. Perform all testing using a qualified staff member.
6. Acceptance Criteria:
a. Cable attenuation as called for in test plans.
b. Test is available for each strand indicated in test plans. Otherwise, test will be available for each strand in each cable segment.
7. All work to conform to the NEC.

**** END OF SECTION 16712 ****

SECTION 16900

GENERAL REQUIREMENTS - INSTRUMENTS AND CONTROLS

PART 1-GENERAL

1.1 Description

A. This Division includes instruments, meters, control devices. and control panels as specified in each Section.

B. Related Work

1. Section 11315 – Submersible Sewage Pumps.
2. Section 16901 - Control Panels (including Sewage Lift Station Pump Control.)
3. Section 16902 – Measuring and Controlling Instruments and Loops
4. Section 16924 – Programmable Logic Controller (PLC) and accessories. (including Supervisory Control and Data Acquisition SCADA RTU.)
5. Section 16950 – Field Testing

1.2 References

1. Instrument Society of America (ISA)

S20 - Specification Forms for Process Measurement and Control Instruments, Primary Elements and Control Valves.

2. Others as specified in applicable Sections.

3. National Fire Protection Association

National Electrical Code, NFPA 70

Standard for Electrical Safety in the Workplace, NFPA 70E

4. National Electrical Safety Code, IEEE C2.

5. Occupational Safety and Health Administration, OSHA.

6. All electrical and control equipment and material shall bear the recognized Underwriters Laboratories, Inc. (UL) seal of approval. It is Vendor's responsibility to obtain local

inspection approval for all non-UL labeled equipment and pay all fees in connection with the same.

1.3 Work Progress Reports and Photographs

A. Conform to DIVISION 1.

1.4 Submittals

A. Compliance Submittals

1. Submit as specified in Section 1330.

2. Manufacturer with prime responsibility shall assume responsibility for all Compliance Submittals.

3. Includes, but not limited to, the following:

a. Fabrication drawings, front elevation, wiring, diagrams, and bills of material for control panels.

b. Engraving schedule and physical dimensions for nameplates and phenolic overlays.

c. Electrical and mechanical connection diagrams for all separately mounted instruments.

d. Individual specification or descriptive sheets for instruments, annunciators and similar major system components to conform to ISA S20.

e. Instruction Books

For all instruments, transducers, and similar major system equipment.

In addition to the requirements as specified in DIVISION 1, submit single-page specification sheets for each instrument which lists the type, model number, function, scale, input, actuation, output and other specific features of that instrument.

1.5 System Responsibility – System Integrator

Systems may utilize equipment of different manufacturers but one System Integrator is to assume overall responsibility for the complete system.

A. Approved System Integrator

1. Alliance Service and Control Specialists, Inc. Contact Rod Robertson, Vice President. Email: rodrobertson@as-cs.com. Cell: 602-920-7078.

2. Primex Controls. Contact Jeremy Drinkwine, Business Development Manage. Email: Jeremy.Drinkwine@sjeinc.com. Phone: (218)844-8733. Cell: (218)850-2491. Address: 22650 County Highway 6, Detroit Lakes, MN 56501.

3. Engineer prior approved equal.

1.6 System Integrator Pre-Qualification

A. System Integrator shall be provided by a firm specializing in control panel construction. Request for approval shall be submitted to engineer a minimum of 10 days prior to bid.

PART 2 - MATERIALS - Specified in applicable sections, SECTIONS 16900-16950.

PART 3 - EXECUTION

3.1 Factory Tests

A. As a minimum, the manufacturer's standard tests and calibration procedures shall be conducted on all instruments.

B. All field devices to be calibrated at factory prior to shipment to site. Applicable test reports to be shipped with field device.

3.2 Lightning and Surge Protection

A. Provide lightning and surge protection to all instruments, power supplies, electronic equipment and input and output control and signal lines specified in this Section. This protection shall be in accordance with the applicable standards and shall be suitable to

protect the equipment during electrical storms which occur in the area of the project.

3.3 Installation: Specified in applicable Sections, SECTIONS 16900-16950.

3.4 Manufacturer's Field Services

A. Provide as specified in Section 1750.

B. Provide supervision for a minimum of three working days, with days in excess of this as required during the test and start-up period by the prime responsibility manufacturer.

C. Test and start-up supervision shall continue until the system is in proper operating condition as determined by the Engineer.

D. Provide manufacturer's supervision during Work to correct deficiencies in equipment manufactured by them and to correct deficiencies in the installation and wiring of equipment. Corrections shall be at no increase in the contract price.

E. Also provide supervision for a minimum of three working days to instruct Owner's personnel in proper operation and maintenance of the equipment. Instruction shall take place after equipment start-up is complete.

F. Manufacturer's field services required for all instruments, control devices, and other devices furnished as a part of the control panel or instruments and associated control devices separately mounted to assure proper installation, setting, connection. and functioning.

3.5 Field Testing - Instrument and Control Systems

A. General Requirements

1. Conform to requirements as specified in DIVISION 1.

2. Conduct all tests in the presence of Engineer or Owner under the supervision of equipment manufacturer's field engineer.

3. Notify Engineer two weeks prior to the commencement of all tests.

4. Include all tests recommended by the equipment manufacturer unless specifically waived by Engineer.

5. Include all additional tests recommended by Engineer that he deems necessary because of field conditions, to determine that equipment and material and systems meet requirements of Contract Documents.

6. Be responsible for all damage to equipment and material due to improper test procedures or test apparatus handling.

B. Test Reports

1. Submit as specified in DIVISION 1.

2. Maintain a written record in quadruplicate of all tests showing date, personnel making tests, equipment or material tested, tests performed, and results.

3.6 Coordination and Scheduling: Coordinate installation of equipment and materials with construction schedule.

PART 4 MEASUREMENT AND PAYMENT

4.1 Measurement

A. No measurement will be made for this item.

4.2 Payment

A. Payment will be made at the contract lump sum price bid and shall be considered full payment for providing labor and materials to perform this work.

**** END OF SECTION 16900 ****

SECTION 16901
CONTROL PANELS - INSTRUMENTS AND CONTROLS

PART 1 - GENERAL

1.1 Description

A. This Section includes the furnishing and installation of the Pump control panel and other control enclosures for the pumps and instruments for the pumping Project.

B. The SCADA System will interface with the new base system. The main operators stations for the system are located at the Island Wastewater Treatment Plant.

C. The Contractor shall have overall responsibility for providing a complete operable system and shall have sole responsibility for the functioning of every iece of equipment in the pump control and radio telemetry panel.

D. The Contractor having overall responsibility for providing a complete operable system shall have sole responsible for the following work:

1. Pump motor starting, protection, and control (motor starting to utilize variable frequency drives).

2. Provision of and installation of a PLC, with analog and digital input/output for local pump station control.

3. New SCADA telemetry equipment including coordination of equipment programming and modifications to the existing SCADA programming. Programming shall be by others.

4. Coordination of all necessary programming to the main machine interface (MMI) to incorporate this project into the SCADA System. Programming shall be by others.

5. Pump wet well level controls for this project includes (level transmitters for control, floats for redundant high and low wet well level alarms); alarms and pump operation.

6. Integrate all motor starters and wet well controls into the control system.

7. Provide, install and calibrate float switches for system redundant high and low wet well level alarms and pump emergency start / stop functions. Level transducer/transmitter is required by control panel to provide VFD speed control, normal pump start/ stop functions and wet well high and low level alarms.

8. Provide, install and calibrate level transmitters in the wet well.

9. Provide, install and calibrate pressure switches on each pump discharge line.

10. Provide, install and calibrate flow transmitter.

1.2 References

1. **American Society for Testing and Materials (ASTM)**
   ASTM D1248 - Polyethylene Plastics Molding and Extrusion Materials.
2. **National Electrical Manufacturers Association (NEMA)**
   ICS - Industrial Controls and Systems.
3. As specified in each applicable section, this Division.
4. National Fire Protection Association
   National Electrical Code, NFPA 70
   Standard for Electrical Safety in the Workplace, NFPA 70E
5. National Electrical Safety Code, IEEE C2.
6. Occupational Safety and Health Administration, OSHA.
7. All electrical and control equipment and material shall bear the recognized Underwriters Laboratories, Inc. (UL) seal of approval. It is Vendor's responsibility to obtain local inspection approval for all non-UL labeled equipment and pay all fees in connection with the same.

1.3 Submittals: Submit as specified in Section 01330.

PART 2 - MATERIALS

2.1 Acceptable Manufacturers

A. Prefabricated Control Panel and Console Enclosures
1. Hoffman Engineering Company (Hoffman).
2. Engineer approved equal.

B. Wire Terminals and Connectors
1. Alpha Wire Corporation (Alpha).
2. Amp, Inc.
3. Belden Corporation (Belden).
4. General Electric Company (General Electric).
5. Thomas and Betts.

C. Wire Markers
1. Brady.
2. Electrovert.
3. Floy Tag & Manufacturing, Inc. (Floy Tag).
4. Panduit Corporation.

D. Terminal Blocks and Test Switches
1. Allen-Bradley.
2. Phoenix Contact.

E. Circuit Breakers
1. Allen Bradley
2. Square D
3. IDEC

Or Equal.

F. Interior Illumination (LED)

1 Lithonia or Equal.

2.2 Control Panels

A. Pre-Fabricated Panel Design Requirements

1. Totally enclosed cabinet with front door and continuous hinge.
2. Formed and welded construction, 14 gauge minimum steel.
3. NEMA type 3R enclosure outdoors, type 4 enclosure corrosive areas.
4. Interior 12-gauge minimum steel mounting panel.
5. Sized to house all equipment and devices indicated.
6. Provide lockable design.
7. Wall-mounted or floor mounted design as required.
8. Furnish Hoffman vapor action corrosion inhibitor sized for enclosure volume
9. Prepare all surfaces and paint as specified in SECTION 09900.
10. Painting
  a. Paint system shall be manufacturer's standard system, suitable for service intended.
  b. Prepare all surfaces prior to painting.
  c. Provide special color finish of light gray.
  d. Provide one pint of touch-up paint of each color.
11. Manufactured by Hoffman Engineering Company.

2.3 Control Panel and Recording and Indicating Instruments Nameplates

A. Fabricate from laminated phenolic sheeting with white core and satin finish melamine overlay.
B. Color shall be Manufacturers standard (if not specified designate black).
C. Thickness: 1/16-inch nominal.
D. Bevel edges to expose white core on perimeter.
E. Engraved legend through overlay to expose core.
F. Attach to panels and instruments with contact cement or double-faced tape.

2.4 Pump Control Panel and Pump Control

A. Pump control will be implemented using a PLC with inputs and outputs as required to complete the control system as described. Pump control starters will be provided as separate standalone panels, containing the pump starter and primary logic control scheme. One common control panel will contain all backup controls.
B. The backup lift pump control panel/section logic shall operate on a service voltage of 120VAC, 1-phase, 3-wire, 60 hertz.
C. The pump controller panels will control the variable frequency drives operating the pumps which utilize the 480VAC, 3-phase, 3-wire, 60 Hertz system.

D. I/O configuration and tag names shall be compatible with the existing established standards established by the City. This is necessary so as to eliminate duplication of tag names with other existing lift stations connected to the common SCADA system.

E. Provide the necessary inputs/outputs as shown on the drawings.

F. Field calibrations of zero and span shall be programmable from the front keypad.

G. Backup alarm settings shall be accomplished by raising and lowering float switches in wet well. Pump start and stop elevation's settings accomplished by programming wet well level transmitter.

H. Provide capability to sample one to thirty readings for each input taking one reading every second. This shall be programmable from the front keypad. The number of samples averaged over a period of time shall be the basis of control.

I. Adjustable on-delay and off-delay timing logic shall be programmable from the front keypad. After a power failure, provide staggered pump starting.

J. Control and alarm setpoints shall be programmable from the keypad. They shall be furnished for each analog signal specified in this section.

K. The following PLC based set points for primary control that shall be provided for the pumps are as follows:

1. Lead pump on.

2. Lag pump on.

3. Lag-lag pump on. This second lag pump is to operate only in the event of a failure of another pump or in manual mode.

4. Lead / Lag pumps off.

L. The pump control panel/section shall have a combination alarm light/audible beacon mounted on the panel that shall be activated whenever a high-high wet well level condition occurs or is detected.

2.5 Intrinsic Safe Barriers and Relays

A. Provide intrinsically safe barriers and relays in the pump controller panels for the float switch and instrumentation connections into the panels as applicable per the drawings

2.6 Radio Telemetry SCADA

A. Provide extension of existing SCADA System. Provide new Remote Telemetry Unit. See Sections 16924-2.5.

2.7 Electrical System

A. Wiring

1. Belden 600V, 105ºC, UL style 1015 wire or equal. Dc signal wiring shall be as specified in this Division. Single conductor wiring shall be flexible, stranded, with copper or tinned copper conductors. Insulation shall be 300 volt MTW, SIS, or equal. THHN or THWN style insulation is not allowed.

2. Wire Sizes

a. No. 14 AWG, 41 strand, for all convenience outlets, interior lighting, and other similar loads.

b. No. 16 or 18 AWG, 16- to 41-strand, for low power loads of 115V or lower voltage.

3. Wire Markers

a. UPDATE TO BE BRADY OR PHOENIX CONTACT, HEAT SHRINK STYLE

b. Identify both ends of wire with the same unique wire number.

c. Assign wire numbers where specific designations are not indicated.

4. Wiring Methods

a. Route main groups of wires in plastic nonflammable wiring duct.

b. Smaller groups of wire shall be cabled and secured with nylon cable clamps and ties or plastic spiral wraps.

c. Route instrument dc signal wiring in separate ducts or groups from ac power and control wiring.

d. Equipment and Terminal Block Connections

(1) Make all connections with insulated locking spade lug terminals except where devices specified are available only with solder type terminals, or tubular clamp terminals.

(2) Install terminals with tool as recommended by manufacturer to apply required amount of pressure correctly.

e. Solder Connections: Soldering iron used shall not exceed 100 W.

f. Provide terminal blocks for all external connections.

B. Terminal Blocks

1. 600V, sectional type nylon polypropylene blocks.

2. Tubular clamp contacts.

3. Slide-in vinyl marking strip for terminal identification.

4. Provide a minimum of 10% spare terminals.

C. Switch Action Fuse Blocks

1. Rated 600V, 30-A.
2. Sectional type nylon or polypropylene blocks.
3. Tubular clamp contacts.
4. Pressure sensitive marking tape for terminal identifications.

D. Circuit Breakers

1. Eaton, Square D, Allen Bradley or equal.
2. Type and Trip rating as indicated or recommended by manufacturer of equipment being protected.
3. Necessary space on panel for a minimum of three future circuit breakers.
4. Mounted on a panel inside control panel in a readily accessible location.

E. Push Buttons and Selector Switches

1. Heavy-duty oiltight units with contacts rated 10-A continuous at 120Vac.
2. Provide the number of contacts and contact development as indicated.
3. Start or On push buttons shall have a black operator.
4. Stop or Off push buttons shall have a red operator.

F. Illuminated Push Buttons

1. Heavy-duty oiltight units with contacts rated 10-A continuous at 120Vac.
2. Provide the number of contacts and contact development as indicated.
3. Color caps as indicated above.

G. Multilight Oiltight Controls

1. Honeywell Type CMC.
2. Provide with four lighted quadrants.
3/ Provide number of contacts, arrangements, and positions as indicated.
4. Provide cover plates, legend plate and color inserts; color and engraving to be Manufacturers Standard.
5. Provide with four transformers and No. 755 lamps.
6. Provide all mounting hardware and mount on the control panels as indicated.

H. General-Purpose Control Relays

1. IDEC, Allen Bradley, Square D or Equal.
2. Provide with coil voltage as indicated with a neon coil energization indicator on 120Vac coils.
3. Number of contacts required rated at 10-A at 120VAC.
4. Provide plug-in relay with socket.

I. Time Delay Relays

1. IDEC, Allen Bradley, Square D or Equal.
2. Solid-state timing relay, plug-in type with matching socket.
3. Time range and voltage as required or indicated.
4. Contact rating of 10-A at 120Vac.
5. Contact action as required or indicated.

J. Pilot Lights

1. Heavy-duty oiltight units.

2. High intensity LED Type

3. Color caps as follows:
Red – motor running
Green – motor stopped
Amber – motor overload

4. Push-to-test type.

K. Interior Illumination

1. One foot LED strip light, rated 6W minimum, cool white color temperature.

2. Single-pole switch mounted in handy box.

3. Includes the following panels

a. Pump Controller Panels.

b. Pump Control Panel/Section

L. Mounting of Relays and Control Devices

1. Complete accessibility to all terminals, relay sockets, and other devices without dismantling of panel equipment.

2. Do not block access to any instruments or control devices mounted on face sheet.

3. Installed on swing-out panels if necessary.

4. Mount all diodes, resistors and similar equipment between terminal points on terminal blocks.

N. Float Switches

2. Rigid high-density polypropylene tear-drop-shaped float, mercury free.

3. One internal mechanical tilt switch, with two sets of contacts, both NO, rated 10 amps at 120 VAC, noninductive load.

4. Furnish with necessary length of cable and weight kit for cable suspension.

5. Flygt or Engineer approved equal.

6. Interface with intrinsically-safe relays in the pump control panel/section.

PART 3 - EXECUTION

3.1 Installation

A. Control Panels

1. Seal all unnecessary openings in enclosures and cast or drilled in the housekeeping pad.
2. Mount to equipment rack as indicated using compatible metal nuts and bolts.
3. Shim plumb and level.
4. Install all electrical connections to remote mounted controls as specified in DIVISION 16.
5. Close all unnecessary and unused openings in the enclosures with Dow Corning 3-6548 silicone RTV or General Electric RTF762 foam after piping and wiring are installed to prevent dirt from entering the panel.

B. Electrical Connections

1. Install wire and cable as specified in Section 16120.
2. Install circuits to field-mounted equipment as indicated and required.
3. Connect all lightning and surge arresters to panels and ground system.

C. Commissioning and Start-Up Services

1. Install the pump control panel, PLC, and connection to the new SCADA RTU per the design requirements Coordinate I/O checks with the system integrator and ensure all I/O functionality as required per design requirements.
2. Coordinate start up and commissioning procedures, operational tests, relay settings and PLC program adjustments with Owner. Programming and startup shall be by others.
3. At a minimum, provide 4 days of Field Commissioning Services under 2 separate trips. Failed start-up procedures shall be corrected, re-tested at no additional costs, and shall not count towards the minimum field commissioning days.

D. Training of the Owner's Personnel The system manufacturer's factory trained representative shall provide start-up services and training for the Owner's personnel. Provide a minimum of One day for instructing the Owner's operating personnel in the operation and maintenance of the control equipment

3.2 Field Quality Control

A. Manufacturer's Field Services: Provide as specified in Section 01750.
B. Factory Tests: Specified in Section 16900.
C. Field Tests: Specified in Section 16902.

PART 4 MEASUREMENT AND PAYMENT

4.1 Measurement

A. No measurement will be made for this item.

4.2 Payment

A. Payment will be made at the contract lump sum price bid and shall be considered full payment for providing labor and materials to perform this work**.**

**** END OF SECTION 16901****

SECTION 16902

MEASURING AND CONTROLLING INSTRUMENTS AND LOOPS

PART 1 - GENERAL

1.1 Summary

A. This Section includes the following

1. Indicators.
2. Controllers.
3. Transducers and function modules.
4. Float Switches.
5. Instrument loops.

1.2 References

1. American National Standards Institute (ANSI)
ANSI B16.1 - Cast-Iron Pipe Flanges and Flanged Fittings.
2. National Electrical Manufacturers Association (NEMA)
3. As specified in each applicable section, this Division.
4. National Fire Protection Association
National Electrical Code, NFPA 70
Standard for Electrical Safety in the Workplace, NFPA 70E
5. National Electrical Safety Code, IEEE C2.
6. Occupational Safety and Health Administration, OSHA.
7. All electrical and control equipment and material shall bear the recognized Underwriters Laboratories, Inc. (UL) seal of approval. It is Vendor's responsibility to obtain local inspection approval for all non-UL labeled equipment and pay all fees in connection with the same.

1.3 Submittals: Submit as specified in Section 1330.

PART 2 - MATERIALS

2.1 Acceptable Manufacturers

A. Digital Panel Meters

1. Newport Electronics, Inc.
2. Dixson, Inc.
3. Triplett Corp.

B. Transducers and Function Modules

1. Keller
2. Druck
3. Endress+Hauser

C. Float Switches (High & Low Level Backup)

1. Flygt

2. or equal.

D. Magnetic Flowmeters

1. Rosemount

2. Endress+Hauser

3. ABB

4. Engineer Approved Equal.

E. Level Transducers

1. Keller

2. Druck

3. Endress+Hauser

2.2 General

A. Transmitters shall have an output signal of 4 to 20 mA dc into a minimum load range of 0-600 ohms at 24Vdc.

B. All analog indicating and recording receivers shall have evenly graduated scales.

C. Provide all mounting brackets, pipe stands and accessories required to install all field-mounted instruments.

D. Furnish and install all accessories required for complete and working systems as specified and indicated.

2.3 Indicators

A. Digital Panel Meters

1. 7-segment light emitting diode (LED) display.

2. 0.5-inch high digits, number as specified.

3. Input signal shall be 4-20 mA dc (or BCD from PC output module).

4. Readout shall be in engineering units specified.

5. A/D conversion shall be dual slope integration method.

6. Zero offset and span adjustments shall be factory set as specified and shall be field adjustable.

7. Shall operate from a 120Vac, 60 hertz power supply.

8. Field selectable decimal point.

9. Normal Mode Rejection Ratio shall be 40 db or greater at 60 hertz and Common Mode Rejection Ratio shall be 80 db or greater from dc to 60 hertz.

10. Provide barrier terminal strips for external connections.

11. Furnish with mounting brackets and trim strips.

2.4 Transducers and Function Modules

A. Solid-state design.

B. Housed in a NEMA 1 enclosure designed for surface mounting on control panel interior.

C. Provide with terminals for external connections.

D. Designed to operate from a 120Vac power source.

E. Signal Transducers

1. Input/output signal ranges shall be standard 1-5Vdc, 4-20 mA dc, or 3-15 psi as indicated.

2. Provide where required, indicated, or specified to change signal to one compatible with the equipment furnished.

2.5 Float Switches

A. Rigid, high-density polyurethane tear-drop-shaped float.

B. Two internal independent mercury free switches, both NO, rated 10 amps at 150Vac, noninductive.

C. Furnished with necessary length of cable and weight kit for cable suspension.

D. Flygt or equal.

2.6 Magnetic Flowmeters

A. Flowmeter system shall consist of a flow element and an indicating transmitter mounted remotely from the meter tube assembly.

B. System shall be accurate to within (1% of flow rate for velocities between 3 and 30 feet per second.

C. Meter Body

1. 304 stainless steel tube with flanged ends.

2. 150-pound steel with flange that matches the piping provided.

3. Electrodes shall be 316 stainless steel and conical shaped for self-cleaning action.

4. Liner shall be polyurethane.

5. Size as specified in this Section.

D. Transmitter

1. Magnetic flowmeter shall have "DC" excited coils.

2. The transmitter electronics shall be microprocessor based.

3. Shall accept the millivolt input from the meter and provide a (4-20 mA) linear output signal proportional to flow.

E. Accessories

1. Provide a stainless steel grounding ring on the inlet and outlet.

2. Flow element terminations shall be factory potted and cable ordered to length.

2.7 Level Controllers (Part of Pump Controller)

A. Level Controller to be a pressure transmitter/ transducer
B. Transducer cable to be 100 foot long
C. Output of transmitter to be 4-20 ma
D. Max. pressure 150 PSIG
E. Input power – 120Vac, 60 Hz, single phase

2.8 Instrument Loops

A. Pump Station Flow

1. Flow Indicating Transmitter (FIT-1)

a. Provide a mag flow meter as specified
b. Install the meter and ground it as indicated
c. Calibrate the remote transmitter for 0-10,000 gpm.
d. Mount remote transmitter on equipment rack, and power it from 120 volt panelboard
e. Provide a linear 4-20 mA output signal over the specified range. As indicated, wire the output signal to the flow indicating controller and than to the PLC and RTU unit

2. Speed Control of Pumps

a. Speed control of pumps to be determined by pump controls manufacturer.

PART 3 - EXECUTION

3.1 Installation

A. Panel Mounted Devices: As specified in Section 16901.

B. Field Mounted Devices

1. Install as follows

a. Mount on floor or wall as required using 2 inch pipe mounts.
b. Mount plumb and level.
c. Mount on walls with bottom of box or instrument 4 feet above floor unless indicated otherwise and instrument case spaced at least 1/2-inch away from wall.
d. Install supports as specified in this Division.
e. Provide sunshade for all instrument displays located outdoors to prevent UV damage to instrument displays.

2. Connect inputs and outputs as indicated on the manufacturer's shop drawings and as follows:

a. Transmitters requiring electric power are supplied from the control panels.

3.2 Manufacturer's Field Services: As specified in Section 16900.

3.3 Field Testing

A. Instrument Tests and Adjustments

1. All instruments to be calibrated at factory, where possible, prior to installation.

2. With each system variable transmitter disconnected from its normal source of input signal, apply an input with manometer, instrument potentiometer, or other device and adjust span and zero on all instruments transmitting, receiving, or retransmitting the resulting variable current or voltage signal and on all final control devices. Check instruments and final control devices at several points over the instrument measuring or control device span.

3. Apply manually adjustable time duration or current signals directly to receivers where required to adjust zero and span and to check operation of the instrument over the measuring span.

4. Accurately measure variable current and voltage signals as required to adjust all receivers, transmitters, transducers, and final control devices.

5. With input signals as specified in 1 above, adjust zero and span of each controller; check operation of controller with various set points and system variable inputs; adjust controller proportional band, reset, and rate to conform to instructions from manufacturer's representative and Engineer.

6. Check operation of each instrument with system in actual operation.

7. Readjust controller settings as required to obtain desired control of the associated system variables.

B. Functional Testing of Controls

1. Perform before equipment is placed in service.

2. Include operating control system from each control point.

3. Completely check each annunciated point and equipment alarm.

4. Operate by hand all relays and other system components that cannot be operated in normal manner with plant not in service.

5. Repeat with plant in operation.

PART 4 MEASUREMENT AND PAYMENT

4.1 Measurement

A. No measurement will be made for this item.

4.2 Payment

A. Payment will be made at the contract lump sum price bid and shall be considered full payment for providing labor and materials to perform this work.

**** END OF SECTION 16902 ****

SECTION 16903

SUPERVISORY CONTROL AND DATA ACQUISITION SYSTEM
(Extension of Existing System)

PART 1 GENERAL

1.1 DESCRIPTION OF WORK

A. Provide an extension to the existing PLC based Sanitary Sewer SCADA System. This shall include Remote Telemetry Units, and modifications and interface to existing MTU and personal computer operator interface.

B. Network communication telemetry between the Master Telemetry Unit (MTU) and the Remote Telemetry Units (RTU's) shall be via Managed Network Switches using the city's fiber optic network. Provide SCADA fiber network communication to match existing.

C. Provide RTU PLC configuration to accomplish monitoring and control functions as indicated for each RTU. Establish typical lift station configurations.

D. Modify Wonderware graphics software and configuration to display the additional SCADA system information. Configure software and graphics at direction of Owner and Engineer. Utilize Contractor Wonderware development package to make changes to Owners system. Provide complete update of system changes for O&M Manuals.

E. Provide installation of system. Provide all documentation and O&M Manuals for hardware. Provide electronic and hardcopy printouts of software configuration. Programming and commissioning is by others.

1.2 QUALITY ASSURANCE

A. All Wonderware programming and integration shall be performed by a company certified in Wonderware software.

B. All PLC programming and radio interface shall be performed by owner.

C. All Work completed according to the latest edition of the National Electric Code.

D. All material to be U.L. listed.

E. All equipment to conform to ANSI and NEMA standards.

1.3 QUALIFICATIONS OF BIDDERS

A. To ensure a complete and totally integrated system, a single system supplier (Systems Integrator) who has had at least five years experience in furnishing similar microcomputer based control and telemetry systems shall supply all specified equipment and services. This shall include: hardware, software, communications equipment, training, installation coordination, startup and warranty services as required. To ensure an integrated and operational system it is required that one supplier be the manufacturer of remote telemetry units and be responsible for all application software and thus have overall responsibility of the system. The supplier shall supply all necessary control equipment and employ the personnel necessary to provide and support the system.

B. Hardware: Include product literature and installation literature.

C. Software Configurations: Include printouts of proposed PLC programming and color printouts of graphics screen displays for Owner and Engineer review.

1.4 APPROVAL SUBMITTAL

A. Provide shop drawings of Hardware separate from software to allow delivery and fabrication of hardware while software configuration is being developed.

B. Provide shop drawings for software and software configuration. Coordinate software configuration with Owner and Engineer. Include color printouts for initial shop drawing submittal. Provide "live" software configuration during review of second submittal.

1.5 EXISTING CONDITIONS

A. Visit the site and become familiar with existing conditions and limitations.

PART 2 PRODUCTS

1.6 CONTROL PANELS

A. Manufacturer: Alliance Service and Control, Primex, OR by engineer approved equal.

B. Control panels, including Remote Telemetry Units and PLC's are to be completely factory assembled, wired and tested prior to shipment. Factory testing shall include software configuration and telecommunication techniques.

1.7 PROGRAMMABLE LOGIC CONTROLLER (PLC)

A. Remote Telemetry Unit (RTU) shall be PLC based.

B. Remote Telemetry Unit :

RTU shall be PLC based and shall include Allen-Bradley - CompactLogix 5000 series and the following components.

5069-L320ER	Controller Module
5069-IF8	8 Channel Analog Input Card (As Needed)
5069-OF4	4 Channel Analog Output Card (As Needed)
5069-IB16	16 Channel 24V DC Digital Input (As Needed)
5069-OW16	16 Point Isolated AC/DC Relay Output (As Needed)
5069-ECR	Right End Cap (as Needed)
1769-PA2	120VAC Power Supply

C. RTU Components and PLC Accessories (as applicable).

Surge Protection:	ASCO 331
Power Supplies:	IDEC PS6R-G24, IDEC PS9Z-6RM2 (1 ea required per RTU)
Relay	Allen-Bradley 700-HB33A1
Relay Socket	Allen-Bradley 700-HN154
Intrinsic Barrier	Gems Zener Barrier 111956
Relays	P&B R10-E172-v700
Socket	P&B 27E126
Fuses:	Littlefuse FLM Series
Fuse holders & Accessories:	Allen-Bradley 1492 Series
Radio Modem:	Esteem Horizon 4.9. See Section 16901
Isolation Transformer:	Quality QTC2517 250VA 120-120v
Batteries:	Interstate DCS-33 (Note 2 per each power supply)
Lighting Protector:	Polyphaser LSXL RF Surge Protector 1.8GHz-6GHz.

1.8 REMOTE TELEMETRY UNITS (RTU)

A. The basic function of the RTU shall be to transmit and receive data from the MTU.

1. Communication shall be over the city fiber network.

2. A Self-diagnostic program with LED indicators shall be provided to indicate:

a. CPU Power-On, indication of all RTU inputs and outputs communicating properly including analog signals.

b. Communication operation shall be via Ethernet/IP protocol.

3. Provide a 24 VDC power supply and 12 VDC power supply (for radio). Uninterruptable power supply (UPS) with minimum rating of 4.0 amp/hours. UPS shall be DIN rail mount type. Sola SDU500A with SDUCRELAYCARD or equal.

4. All wiring shall be marked with wire labels numbered at both ends as referred to on the system schematics.

5. All wiring diagrams shall be prepared in ladder logic format with individual prints for each panel. Diagrams shall be laminated and affixed to the inside of the door on all panels. Diagrams shall be prepared utilizing AutoCAD and also be provided electronically to the engineer and the owner.

1.9 MANAGED ETHERNET SWITCH

A. Manufacturer: Moxa

B. Model: EDS-510E-3GTXSFP

C. Managed Ethernet switch with 3 Gigabit and 7 10/100Base Ethernet ports. Three FSP ports are available for hot-pluggable network interface modules.

1. FSP Module
   a. Manufacturer: Moxa
   b. Model: Moxa SFP-1GSXLC
   c. SFP module with 1 1000BaseSX port with LC connector.

1.10 PATCH PANEL

A. See Specification 16712 – Fiber Optic Communication for patch panel details.

PART 3 CONSTRUCTION REQUIREMENTS

1.11 RTU's

A. Install and commission each RTU one at a time.

1.12 EXISTING SCADA SYSTEM

A. The existing SCADA system shall remain in operation throughout the entire construction process.

PART 4 EXECUTION

1.13 INSTALLATION

A. Securely mount equipment where shown on the Drawings.

B. Complete all conductor connections to remote sensing devices, control relays and monitor relays as shown on the Drawings. Use same color coding of conductors throughout.

C. Securely mount equipment where shown on the Drawings.

1.14 STARTUP PROCEDURES

A. Provide a certified technical representative from the system integrator for the purpose of final connections, testing, calibration and startup.

B. Prior to startup, the system shall be factory tested for proper connections and installation to assure that the monitoring system is properly installed. This factory test may be inspected by the Engineer.

C. The system integrator shall test and verify that all software is running properly and that all alarms and status changes are being properly logged.

D. System integrator shall provide documentation of testing. Include point address, description, and point type. Where applicable, provide calibration and scaling information.

E. The system integrator shall submit a letter of certification starting that the system is fully operable as verified by field test results.

1.15 SPARE PARTS

A. Provide the following Spare Parts. Turn over to Owner upon completion of project.

B. RTU Power Supplies. (qty 1 each)
Lightning Protector (qty 1 each)

C. Intrinsic Barriers. (qty 1 each)

1.16 SYSTEM WARRANTY

A. Provide a full ONE-YEAR parts, labor and software support warranty for all materials, work and software associated with the system.

B. Replace all defective material, work and software during this period at no cost to the Owner.

**** END OF SECTION 16903 ****

SECTION 16924

PROGRAMMABLE LOGIC CONTROLLER (PLC) AND ACCESSORIES

PART 1 GENERAL

1.1 Summary

A. Contractor shall furnish the PLC's, touchscreens and required programming as specified.

B. Furnish factory training and training courses to meet the requirements of PART 2 of this Section.

C. Related Work:

1. Section 16900 thru 16950

1.2 References:

A. Applicable Codes and Standards:

1. Contractor shall furnish Equipment which conforms in all respects to applicable industry standards and sound engineering practice.

2. Design, fabricate, assemble, install, and test Equipment to conform to the applicable provisions of the following standards:

a. Institute of Electrical and Electronics Engineers (IEEE):

1) 472 – Surge Withstand Capability Test.

b. 518- IEEE Guide for the Installation of Electrical Equipment to Minimize Electrical Noise Inputs to Controllers from External Sources.National Fire Protection Association (NFPA):

1) 70 - National Electrical Code (NEC).

c. National Electrical Manufacturers Association (NEMA):

1) ICS – Industrial Controls and Systems.

d. Underwriters Laboratories (UL):

1) 508 - Industrial Control Equipment

e. Scientific Apparatus Manufacturer's Association (SAMA).

f. Instrument Society of America (ISA).

g. National Electrical Safety Code (NESC).

3. Safety Codes:

a. National Fire Protection Association

i. National Electrical Code, NFPA 70

ii. Standard for Electrical Safety in the Workplace, NFPA 70E

b. National Electrical Safety Code, IEEE C2.

c. Occupational Safety and Health Administration, OSHA.

1.3 Submittals:

A. Submit as specified in SECTION 16900.

B. Specific Submittals to be furnished for Equipment shall include at least the following:

1. Device list and bills of material.

2. Data sheets on all PLC and touchscreen components.

3. System architecture drawing (Control System Block Diagram) showing all input/output cabinets, communications interfaces controller cabinets, operator interfaces devices, data storage devices, prefabricated cables and interfaces to other systems, and related components. This drawing shall represent the physical composition of the system.

4. Program documentation for all software operating systems, editors, compilers, utilities, application, control, and logic programs, both for the control, data acquisition, and processing functions.

5. Instruction manuals.

6. Description of operation of control Equipment.

7. Description of power failure and restoration mode.

C. Provide an O&M Manual for the complete system including hard copy documentation of all PLC and touchscreen programming and I/O addressing including programming documentation comments.

1.4 Quality Assurance

A. Experience:

1. All Equipment and Materials furnished shall have an acceptable history of satisfactory reliable service in similar use for a period of at least two years.

2. Equivalent newly developed Equipment with less than two years' actual service will be considered from established manufacturers, if it has been adequately tested, meet the requirements of this Contract, and is approved by Engineer. Such Equipment shall be noted in the proposal for review.

1.5 Training:

A. Provide qualified factory trained personnel to provide a training session at Owner's facility to train Owner's personnel in the configuration, operation, and maintenance of all hardware/software provided. The training session shall be of sufficient content and duration to provide a basic understanding of the hardware/software in general and specific instruction on the Site-specific implementation. Training shall include implementation and development of control and monitoring schemes specific to control of Owner's Equipment. **This training shall be a minimum of 3 days in duration.** The training session shall be coordinated with Owner and Engineer. Document

B. Owner may videotape all on-Site training for future use. Any charges for this videotaping shall be included in this proposal.

PART 2 - PRODUCTS

2.1 Acceptable Manufacturers:

A. PLC's:

1. Allen-Bradley – Compact Logix Series.

B. Operator Interface Touchscreen:

1. N/A

2.

2.2 General

A. Contractor shall provide a complete system with all I/O, communications modules, processors, power suppliers, and other necessary items to meet the functional requirements of this Part.

B. The system shall consist of at least the following:

1. Base unit including power supply.
2. Processor, including memory.
3. Communication hardware.
4. Input/output hardware.
5. Real-time clock/memory module.
6. Cables.
7. Touchscreen.
8. Spare parts.

2.3 Programmable Logic Controller (CompactLogix):

A. General:

1. The programmable controller shall receive status intelligence, perform logic functions, issue control commands, and provide alarms and status information for this systems described in these Specifications.

2. The programmable controller Equipment shall consist of a solid-state control system which has user programmable memory for storage of instructions to implement specific functions.

3. The PLC Equipment shall be purposely designed as an industrial control system which can perform functions equivalent to a relay panel or a wired sold-state logic system.

4. All PLC Equipment provided shall be capable of operation in ambient temperatures of 0ºC to 55ºC, and 5 to 95% relative humidity (non-condensing), without fans or other cooling equipment.

5. All external connection points shall be capable withstanding the ANSI surge withstand capability (SWC) test as defined in ANSI C37.90a.

6. The PLC's shall operate without damage according to IEEE Standard 281.

7. The PLC's shall be capable of reporting by exception to a master PLC.

8. The PLC shall operate from 120 VAC, 60-hertz, single-phase power.

B. Controller Module (5069-L320ER):

1. The processor shall provide a minimum of 2MB of user configurable memory and two ethernet communication ports.

2. The processor shall be of solid-state design and modular printed circuit boards.

3. The processor shall have user-programmable memory with provisions to prevent unauthorized changes.

a. All memory shall be non-volatile.

4. The processors shall continuously perform diagnostics analysis with a predetermined failure mode in the event of a fault.

5. The ladder diagram logic shall be scanned and solved at a rate not to exceed 1 milliseconds per kiloword of logic.

6. All I/O including analog shall be scanned and updated at a rate not to exceed 0.3 milliseconds for all I/O.

7. The ladder logic programming shall include support for subroutines.

8. The processor shall have at least Two (2) operating modes: Run and Program. These operating modes shall be user changeable over the PLC communications network.

9. The processor shall allow the logic to be modified, in ladder logic format, while the processor is in the Run mode without affecting the operation of those portions of the logic not being modified.

10. The processor shall allow disabling and forcing on and off of individual input and output when the processor is in the Run mode.

11. The processor shall provide selectable timed interrupt capabilities for the user to incorporate into the ladder logic.

12. The processor shall provide user defined fault routine capabilities.

13. The processor shall automatically clear all output and update all input on power-up and prior to scanning and solving any logic.

14. The processors shall provide the user with a status bit for use in the ladder logic for initialization purpose. This status bit shall be set/reset based on the indicating the first ladder logic scan.

15. The processor shall provide a comprehensive instruction set including:

- **a.** Relay Contact Input:
  - **1)** Normally open
  - **2)** Normally closed
  - **3)** Transitional
- **b.** Relay Coil Output:
  - **1)** Standard.
  - **2)** Retentive.
- **c.** Timers:
  - **1)** On delay.
  - **2)** Off delay.
  - **3)** Duration.
  - **4)** Retentive
  - **5)** Time bases of 1.0 sec, 0.1 sec, and 0.01 sec.
- **d.** Counters:
  - **1)** Count up.
  - **2)** Count down.
- **e.** Arithmetic
  - **1)** Single-precision.
  - **2)** Double-precision.
  - **3)** Signed Integer.
  - **4)** Add.
  - **5)** Subtract.
  - **6)** Multiply.
  - **7)** Divide.
  - **8)** Square root.
  - **9)** Less than.
  - **10)** Greater than.
  - **11)** Equal.
  - **12)** Floating point.

f. Logical:
- **1)** And.
- **2)** Or.
- **3)** Exclusive or.
- **4)** Compare.

g. PID.

h. Data Manipulation
- **1)** Copy.
- **2)** Move.
- **3)**

i. Program Flow Instruction
- **4)** Jump.
- **5)** Subroutine.

16. The module shall provide a real time clock allow the PLC to perform operation at set times.

E. PLC Input and Output Module:

1. The PLC shall be provided with the following modules as required by engineering design I/O:

2. Digital Input Modules (5069-IB16):

a. Provide 16, 24 Vdc digital inputs.
b. Maximum signal delay time of 20 ms
c. Provide modules as required.

3. Digital Output Modules (5069-OW16):

a. Provide 8 point isolated AC/DC relay outputs.
b. Provide modules as required.

4. Analog Input Modules (5069-IF8):

a. Provide 4 4-20mA inputs.
b. 16 bit resolution.
c. Provide modules as required.

5. Analog Output Modules (5069-OF4):

a. Provide 8, 4-20mA outputs.
b. 16 bit resolution.
c. Provide modules as required.

F. Power Supply (1769-PA2):

1. Provide power supply as required by manufacturer.

2. Input voltage 120Vac.

3. Output of 2 Amps at 5Vdc and 0.8 Amps at 24Vdc.

4. Over-voltage and short circuit protection.

2.4 Operator Interface Touchscreen (as Required):

A. Provide as required for control and monitoring of equipment.

B. Touchscreen display shall be 256-color minimum, TFT type, with a minimum resolution of 640 x 480 pixels.

C. LCD type with backlight.

D. Shall be quipped with an Ethernet type RJ-45 communication port and RS-232 port for programming and communication of data with the PLC.

E. Display size shall be a minimum of 10-inches measured diagonally.

F. NEMA 4 rated.

G. Operated temperature of 50˚C.

H. Minimum of 16 Mbytes of memory.

I. Designed for panel mounting.

J. Hard and soft copies of the touchscreen program shall be provided to the Owner.

K. Provide Allen Bradley Panelview Plus 7 or approved equal.

2.5 Software:

A. Provide the Owner with one license of the latest version of RSLogix 5000 pro programming.

B. Provide the Owner with one license of the latest version of the Windows based touchscreen programming software.

C. Include any cables connecting to the PLC or HMI to a remote laptop for programming confirmation.

2.5 SCADA RTU PLC and SCADA Interface:

A. Provide equipment, installation and interface to the existing radio based Sanitary Lift Station SCADA System. Provide new Remote Telemetry Unit (RTU) and interface with existing SCADA System.

1. See specification section 16903 for requirements.

2.6 Spare Parts:

A. Provide the following spare parts:

2. RTU/SCADA PLC processor unit. (1 Ea)

3. One spare input/output module of each type provided.

B. Provide five (5) spare fuses of each type used.

2.7 Test Equipment: Any special test kits, cables, software, or other test accessories that are unique to the manufacturers' Equipment, used in operation or maintenance of this Equipment shall be provided.

PART 3 - EXECUTTON

3.1 Installation:

A. Programmable Logic Controllers:

1. Install PLC in enclosure as indicated and specified.

2. Wire all inputs and outputs to terminal blocks within the PLC Panel.

3. Install all communication modules and required cables.

B. Touchscreen:

1. Install touchscreen on swing out panel located within the PLC Panel.

2. Install communication cable between the PLC and touchscreen.

3. Configure touchscreen for proper communication with the PLC.

3.2 PLC and Touchscreen Programming:

A. PLC:

1. Programming shall be by Owner.

B. Touchscreen:

1. Programming shall be by Owner.

3.3 Field Testing: Specified in SECTION 16950

PART 4 MEASUREMENT AND PAYMENT

4.1 Measurement

A. No measurement will be made for this item.

4.2 Payment

A. Payment will be made at the contract lump sum price bid and shall be considered full payment for providing labor and materials to perform this work.

**** END OF SECTION 16924 ****

SECTION 16950
FIELD TESTING

PART 1 - GENERAL

1.1 Description

A. This Section covers field testing of all wire, cable, and electrical equipment.

B. Related Work Specified Elsewhere

Grounding ..... Section 16450

1.2 References

1. American Society For Testing and Material (ASTM):
ASTM D877 - Dielectric Breakdown Voltage of Insulating Liquids Using Disk Electrodes.

2. Insulated Cable Engineers Association (ICEA):
S-19-81 - Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.
S-66-524 - Cross-Linked Thermosetting Polyethylene - Insulated Wire and Cable for the Transmission and Distribution of Electric Energy.
S-68-516 - Ethylene-Propylene-Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.

3. American National Standards Institute/Institute of Electrical and Electronic Engineers (ANSI/IEEE):
C37.20 - Switchgear Assemblies, Including Metal-Enclosed Bus.

4. National Electrical Code (NEC).

5. National Electrical Manufacturers Association (NEMA).

6. International Electrical Testing Association (NETA)

7. National Fire Protection Association

8. Standard for Electrical Safety in the Workplace, NFPA 70E

9. National Electrical Safety Code,.IEEE C2.

10. Occupational Safety and Health Administration, OSHA.

11. As specified in each applicable section, this Division.

1.3 Quality Assurance

A. Test Reports

1. Submit as specified in Section 1330.

2. Maintain a written record of all tests showing date, personnel making tests, equipment used, equipment or material tested, tests performed, and results.

3. Notify Engineer two weeks prior to commencement of all testing except for megger tests.

PART 2 - MATERIALS

2.1 Acceptable Manufacturers

A. Ground Test Set

1. Associated Research, Inc.

2. James G. Biddle Company.

B. Multimeter

1. Simpson Electric Company.

C. Insulation Test Set

1. Associated Research, Inc.

2. James G. Biddle Company.

2.2 Provide all testing equipment required which includes all or some of the following

A. Wet- and dry-bulb thermometer.

B. 500V meggers.

C. Battery-powered portable telephone sets and portable radios.

D. One Multimeter (Volt-Ohm-Milliammeter) rated 20 K ohms per volt (dc) or better, or digital readout multimeter.

E. One phase rotation meter, 60-Hz.

F. Commercial model three-point ground test set, James G. Biddle Company "Megger" Ground Tester or Associated Research, Inc., "Vibroground" tester.

G. Miscellaneous cable, test lights, buzzers, bells, switches, receptacles, plugs, and other equipment as required.

PART 3 - EXECUTION

3.1 General Requirements

A. Test all wire, cable, and electrical equipment installed or connected by Contractor to assure proper installation, setting, connection, and functioning as indicated or to conform to Contract Documents and manufacturer's instructions.

B. Conduct all tests except megger insulation testing in the presence of Engineer or Owner and under the supervision of equipment manufacturer's field engineer.

C. Include all tests recommended by the equipment manufacturer unless specifically waived by Engineer.

D. Include all additional tests issued by Engineer that he deems necessary because of field conditions to determine that equipment and material and systems meet requirements of Contract Documents.

E. Be responsible for all damage to equipment or material due to improper test procedures or test apparatus handling.

F. Provide written reports of all testing to engineer within five (5) days of completion of test and prior to energizing.

3.2 Execution

A. Molded Case Circuit Breaker Tests

1. Visually inspect and manually operate each breaker, to insure proper alignment and smooth operation note any defects or operational problems.
2. Check nameplate data to drawing and specifications.
3. Check adjustable magnetic trip settings against values furnished by Engineer.
4. Megger each pole for freedom from grounds.
5. For breakers provided with shunt trips, check operation of shunt trip circuit.
6. Check all connections.
7. Check for proper current rating for circuit to which breaker is connected.

B. Motor Tests on All Motors

1. Check equipment ground to assure continuity of connections as specified in this Division.
2. Measure the insulation resistance of the stator winding before applying voltage. Compare this measured value against the manufacturer's value. If there is no insulation resistance value furnished by manufacturer, use the following:

Motor Voltage	Insulation Resistance
600 volts and below	5 megohms

   If measured resistance values are lower than above, record room temperature and humidity and submit readings to Engineer before energizing. Dry out motors as required by accepted method of application of external heat, and do not apply voltage to motor until substandard resistance condition is corrected. Megger readings are to be one-minute duration, using a 500V megger for all motors 600V and below.
3. Prior to final equipment alignment, disconnect motor from driven equipment where necessary to check lubrication, starter, and control circuits. If motor is free of dirt and dust, rotate rotor by hand to determine that motor turns freely. Clean out motor if necessary. Apply voltage momentarily and note direction of rotation. Correct rotation if necessary. Reconnect motor to driven equipment.
4. After the motor is placed in operation, observe the motor for heating at the bearings or windings. If the motor appears to be running hot, notify Engineer. Note: General purpose motors may reach temperatures up to 176 degrees F with a room temperature of 104 degrees F.
5. If motor is conrolled by a VFD, Take motor load ampere readings (on all three legs of three-phase motors) at 60%, 70%, 80%, 90% and 100% of full speed. Submit results to Engineer.

C. Power Switches (Disconnects and Safety)

1. Inspect contacts and clean if required.

2. Inspect arc chutes if provided on switch.

3. Inspect fuses for proper rating if furnished on switch.

4. Operate switches (de-energized) for proper functioning.

D. Float Switches

1. Inspect and test switches to conform to manufacturer's recommended field tests.

2. Adjust switches to perform the design function for proper equipment operation.

E. Wire and Cable Tests: (Feeders and Control Circuits Only)

1. Megger all 600V insulated wire with a 500V megger for one minute, and values must be approximately as follows:

Conductor Capacity	Resistance
Amperes	Ohms
0-24	1,000,000
25-50	250,000
51-100	100,000
101-200	50,000
201-400	25,000
501-800	12,000
Over 800	5,000

Determine the values with all switchboards, panelboards, fuse holders, switches, and overcurrent devices in place. Do not connect motors and transformers during meggering. Megger wire and cable after installation and not on the cable reel.

2. Check all control cable by megger tests similar to those described for 600V insulated wire. Check all control wiring for tightness of terminal contacts and continuity (especially of current transformer leads) through each "run" of control circuiting. Thoroughly verify all wiring by means of battery-powered lights, buzzers, bells, or telephones.

After completing these checks and tests on a given control circuit, attach a temporary cardboard tag on each end of cable tested which bears date and name of Contractor's representative responsible for checking. Follow this procedure for each control circuit cable. Provide all phasing tests and make all changes necessary to assure proper rotation of all motors, the correct phasing and phase sequence

of all circuits susceptible to being paralleled, the proper polarity on all instrument transformer wiring, and such other phasing tests as may be required for the equipment being connected under this Contract.

Do not test cable with an ac test set. Disconnect cables from all equipment during testing. Testing cable on reel will not be acceptable. Make testing after installation but before final connection of equipment. Make high-potential tests phase-to- ground on each individual conductor.

F. Control Schemes Tests

1. Test all electrical controls by trial operation of control equipment after all wiring is completed to see that each interlock and control function operates to conform to the description of operation, as well as with the manufacturer's operating instructions.

G. Miscellaneous Equipment Tests

Test all miscellaneous equipment furnished by equipment manufacturer as recommended by manufacturer.

H. Lighting Tests

1. Test all systems for proper operation and correct phasing prior to final acceptance.

I. Grounding Tests

1. Measure resistance of ground system at each ground riser.

2. Record results and notify Engineer if any reading exceeds 1 ohms.

3. Test at least three of each type of ground connections and not less than 25 percent of all ground connections.

4. Test by one of the following methods for resistance measurement:

a. Three-point method using an ammeter and voltmeter with ac or dc power supply.

b. Commercial instrument method using equipment as specified in this Section.

J. SCADA SYSTEM TESTING

1. Activate each monitored point in the new pump station and verify that the associated signal is received at the Central Monitoring Station at the Island Wastewater Treatment Plant.

PART 4 MEASUREMENT AND PAYMENT

4.1 Measurement

A. No measurement will be made for this item.

4.2 Payment

A. Payment will be made at the contract lump sum price bid and shall be considered full payment for providing labor and materials to perform this work.

**** END OF SECTION 16950 ****