APPENDIX

CITY OF MERCED STANDARD DESIGNS

THE FOLLOWING STANDARDS ARE FOR REFERENCE ONLY
REFER TO THE CITY OF MERCED WEBSITE FOR THE COMPLETE LISTING OF STANDARD DETAILS

http://www.cityofmerced.org/depts/engineering_division/standard_designs/default.asp

STATE GENERAL PREVAILING WAGE RATES

General prevailing wage determination
Made by the Director of Industrial Relations

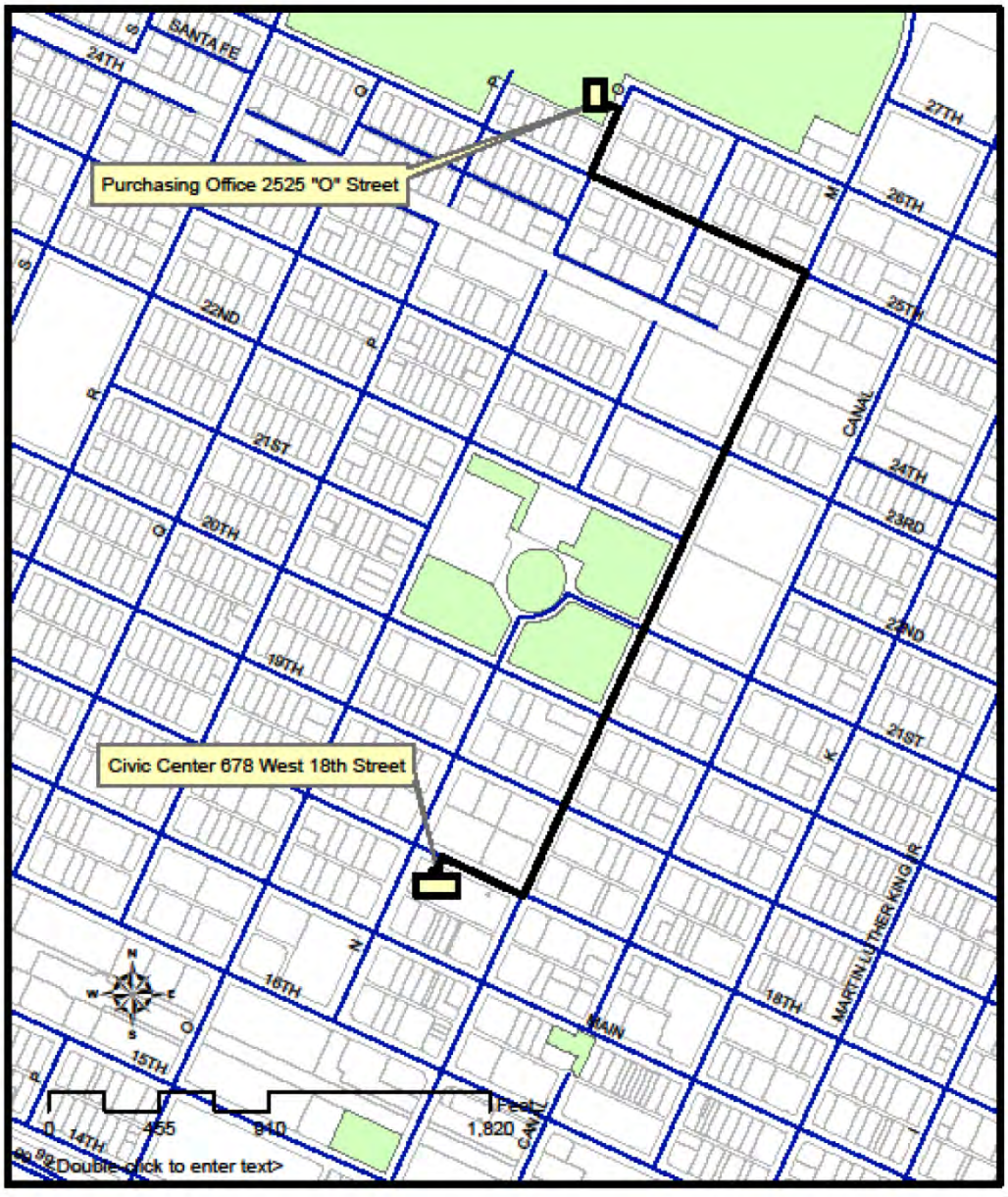
Pursuant to California Labor Code part 7,
Chapter 1, article 2, sections 1770, 1773, and 1773.1

State of California Department of Industrial Relations Website:
http://www.dir.ca.gov/OPRL/PWD/index.htm

LOCATION MAP

PUCHASING DEPARTMENT DRIVING DIRECTIONS

DRIVING DIRECTIONS
CIVIC CENTER TO
PURCHASING OFFICE



DIRECTIONS: DRIVE NORTH ON "M" STREET
TURN LEFT ON WEST 25TH STREET
TURN RIGHT ON "O" STREET

REGULATION VIII – FUGITIVE PM10 PROHIBITIONS

San Joaquin Valley
Air Pollution Control District

COMPLIANCE ASSISTANCE BULLETIN
August 2006

Regulation VIII – Fugitive PM10 Prohibitions
Requirements on Paved and Unpaved Public Roads

District Rule 8061(*Paved and Unpaved Roads*) of Regulation VIII (*Fugitive PM10 Prohibitions*) specifies the design criteria for constructing new or modifying existing paved roads and the types of control measures required for limiting fugitive dust emissions from unpaved roads and shoulders. Several compliance dates and deadlines described in the rule apply specifically to city, county, and state agencies. The purpose of this bulletin is to summarize the new requirements for public agencies that own or maintain paved and unpaved roads. The entire rule may be found at www.valleyair.org/rules/1ruleslist.htm - reg8.

- **Constructing New Unpaved Roads:** Effective October 1, 2004, constructing a new unpaved road is prohibited in all urban areas unless the unpaved road is used for a temporary activity that does not exceed six months of use over a consecutive three-year period. Temporary activities may include construction access roads, special events, or traffic detours. The unpaved surface must be maintained in a stabilized condition at all times in order to control fugitive emissions.

- **PM10-Efficient Street Sweepers**: These requirements apply to the routine cleaning of existing paved public roads within urban areas. Effective July 1, 2005, an agency or its contractor may only purchase PM10-efficient street sweepers for their fleets and at least one sweeper must be placed into service by July 1, 2008. PM10-efficient street sweepers are to be used along routine street sweeper routes, which have been predetermined and prioritized by the agency as having paved curbs with the greatest actual or potential for dirt and silt loading. If an agency cannot meet these provisions due to budgetary constraints, a statement of financial hardship must be submitted to the District and the USEPA for review and approval.

- **Cleaning Paved Roads after a Storm Event:** Within 24 hours of discovery, the agency or contractor responsible for maintaining the roadway must remove the accumulated mud and dirt from the paved road or restrict vehicles from traveling over the mud and dirt until the materials can be removed. This requirement applies if the accumulated mud and dirt is a result of wind or water erosion and runoff, is at least one inch thick, and covers an area of at least 50 square feet. Cleanup may be performed manually with a shovel and broom, or with a conventional or PM10-efficient street sweeper, but must be performed in a manner that minimizes fugitive dust. Using a blowing device or a dry rotary brush or broom is prohibited. Redirecting traffic is one way to restrict vehicles from traveling over the mud and dirt. Upon agency notification, the District may approve an extension of the 24-hour cleanup requirement if restricting vehicles is deemed unsafe and removing the mud and dirt is not possible within 72 hours because crews are not available over a weekend or holiday.

Northern Region Office
4800 Enterprise Way
Modesto, CA 95356-8718
(209) 557-6400 ♦ FAX (209) 557-6475

Central Region Office
1990 East Gettysburg Avenue
Fresno, CA 93726-0244
(559) 230-6000 ♦ FAX (559) 230-6062

Southern Region Office
2700 "M" Street, Suite 275
Bakersfield, CA 93301-2373
(661) 326-6900 ♦ FAX (661) 326-6985

- **Posting Speed Limit Signs on Unpaved Roads:** Effective October 1, 2005, public agencies must establish a maximum speed limit of 25 miles per hour for the unpaved roads under their jurisdictions. This requirement applies to the unpaved road segments where vehicle traffic reaches or exceeds 26 annual average daily trips (AADT). At a minimum, agencies are to post at least one speed limit sign in each direction for every mile of unpaved road located within an urban area, and one sign in each direction for every two miles of unpaved road within a rural area. For example, an unpaved road located within an urban area that is ½ mile long and exceeds 26 AADT requires at least one sign posted in each direction. The unpaved surface must be maintained in a stabilized condition at all times in order to control fugitive emissions.

- **Paving Existing Unpaved Roads and Paving or Stabilizing Unpaved Shoulders:** On January 1, 2005, agencies provided the District with a report listing each unpaved road located within an urban area and each paved road with unpaved shoulders within urban and rural areas. On July 1, 2005, agencies provided a report listing each unpaved road located within a rural area. These reports include the length in miles and the AADT for each subject road and unpaved shoulder within the agency's jurisdiction.

  As of January 1, 2005, agencies are to pave an annual average of 20 percent of the unpaved roads listed in their urban area unpaved road report, thereby paving 100 percent of these unpaved roads by January 1, 2010. This requirement does not apply to rural unpaved roads.

  In urban areas, agencies are to pave or stabilize at least four-feet of unpaved shoulders on at least 50 percent of the existing paved roadways having the highest AADT. In rural areas, this is required on at least 25 percent of the existing paved roadways with the highest AADT. Compliance with these provisions must be complete by January 1, 2010.

  If an agency cannot meet these provisions due to budgetary constraints, a statement of financial hardship must be submitted to the District and the USEPA for review and approval.

- **Incremental Progress Reports:** Due on April 1 of each year, from 2006 through 2010, agencies must report their incremental progress to the District by reporting the total miles of urban unpaved roads that were paved over the previous calendar year, the total miles of unpaved shoulders that were paved or stabilized over the previous calendar year, and the percentage of cumulative miles treated relative to the original reports.

For more information please contact the Compliance Department of the District office nearest to you. Information on Regulation VIII is available on the District's website at:

www.valleyair.org

San Joaquin Valley
AIR POLLUTION CONTROL DISTRICT

COMPLIANCE ASSISTANCE BULLETIN
April 2007

Fugitive Dust Control at Construction Sites: New Requirements

Regulation VIII, Fugitive PM10 Prohibitions, of the District's Rules and Regulations apply to many activities that generate fugitive dust, and particularly to construction sites.

Fugitive dust is emitted into the air by activities that disturb the soil, such as earthmoving and vehicular/equipment traffic on unpaved surfaces. Windblown dust is also of concern where soil has been disturbed at construction sites.

The District adopted Regulation VIII in 1993 and its most recent amendments became effective on October 1, 2004. This is a basic summary of the regulation's requirements as they apply to construction sites.

These regulations affect all workers at a regulated construction site, including everyone from the landowner to the subcontractors. Violations of Regulation VIII are subject to enforcement action including fines.

Visible Dust Emissions (VDE) may not exceed 20% opacity during periods when soil is being disturbed by equipment or by wind at any time. Visible Dust Emissions opacity of 20% means dust that would obstruct an observer's view of an object by 20%. District inspectors are state certified to evaluate visible emissions. Dust control may be achieved by applying water before/during earthwork and onto unpaved traffic areas, phasing work to limit dust, and setting up wind fences to limit wind blown dust.

Soil Stabilization is required at regulated construction sites after normal working hours and on weekends and holidays. This requirement also applies to inactive construction areas such as phased projects where disturbed land is left unattended. Applying water to form a visible crust on the soil and restricting vehicle access are often effective for short-term stabilization of disturbed surface areas. Long-term methods including applying dust suppressants and establishing vegetative cover.

Carryout and Trackout occur when materials from emptied or loaded vehicles falls onto a paved surface or shoulder of a public road or when materials adhere to vehicle tires and are deposited onto a paved surface or shoulder of a public road. Should either occur, the material must be cleaned up at least daily, and immediately if it extends more than 50 feet from the exit point onto a paved road. The appropriate clean-up methods require the complete removal and cleanup of mud and dirt from the paved surface and shoulder. Using a blower device or dry sweeping with any mechanical device other than a PM10-efficient street sweeper is a violation. Larger construction sites, or sites with a high amount of traffic on one or more days, must prevent carryout and trackout from occurring by installing gravel pads, grizzlies, wheel washers, paved interior roads, or a combination thereof at each exit point from the site. In many cases, cleaning up trackout with water is also prohibited as it may lead to plugged storm drains. Prevention is the best method.

Unpaved Access and Haul Roads, as well as unpaved vehicle and equipment traffic areas at construction sites must have dust control. Speed limit signs limiting vehicle speed to 15 mph or less at construction sites must be posted every 500 feet on uncontrolled and unpaved roads.

Northern Region Office
4800 Enterprise Way
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Storage Piles and Bulk Materials have handling, storage, and transportation requirements that include applying water when handling materials, wetting or covering stored materials, and installing wind barriers to limit VDE. Also, limiting vehicle speeds, loading haul trucks with a freeboard of six inches or greater along with applying water to the top of the load, and covering the cargo compartments are effective measures for reducing VDE and carryout from vehicles transporting bulk materials.

Demolition activities require the application of water to the exterior of the buildings and to unpaved surfaces where materials may fall. A Dust Control Plan will be required for large demolition projects. Consider all structures slated for demolition as possibly being regulated due to potential asbestos, per District Rule 4002 - *National Emission Standards for Hazardous Air Pollutants*. Contact the District well before starting because a 10 working-day notice will likely be required before a demolition can begin.

Dust Control Plans identify the dust sources and describe the dust control measures that will be implemented before, during, and after any dust generating activity for the duration of the project. Owners or operators are required to submit plans to the District at least 30 days prior to commencing the work for the following:

- Residential developments of ten or more acres of disturbed surface area.
- Non-residential developments of five or more acres of disturbed surface area.
- The relocation of more than 2,500 cubic yards per day of materials on at least three days.

Operations may not commence until the District has approved the Dust Control Plan. A copy of the plan must be on site and available to workers and District employees. **All work on the site is subject to the requirements of the approved dust control plan. A failure to abide by the plan by anyone on site may be subject to enforcement action.**

Owners or operators of construction projects that are at least one acre in size and where a Dust Control Plan is not required, must provide written notification to the District at least 48 hours in advance of any earthmoving activity.

Record Keeping is required to document compliance with the rules and must be kept for each day any dust control measure is used. The District has developed record forms for water application, street sweeping, and "permanent" controls such as applying long term dust palliatives, vegetation, ground cover materials, paving, or other durable materials. Records must be kept for one year after the end of dust generating activities (Title V sources must keep records for five years).

Exemptions exist for several activities. Those occurring above 3,000 feet in elevation are exempt from all Regulation VIII requirements. Further, Rule 8021 – *Construction, Demolition, Excavation, Extraction, and Other Earthmoving Activities* exempts the following construction and earthmoving activities:

- Blasting activities permitted by California Division of Industrial Safety.
- Maintenance or remodeling of existing buildings provided the addition is less than 50% of the size of the existing building or less than 10,000 square feet (due to asbestos concerns, contact the District at least two weeks ahead of time).
- Additions to single family dwellings.
- The disking of weeds and vegetation for fire prevention on sites smaller than ½ acre.
- Spreading of daily landfill cover to preserve public health and safety and to comply with California Integrated Waste Management Board requirements.

Nuisances are prohibited at all times because District Rule 4102 – *Nuisance* applies to all construction sources of fugitive dust, whether or not they are exempt from Regulation VIII. It is important to monitor dust-generating activities and implement appropriate dust control measures to limit the public's exposure to fugitive dust.

For more information please contact the Compliance Division of the District office nearest to you. Information on Regulation VIII, where you may obtain copies of record keeping forms, the Dust Control Plan template, and the Construction Notification form, is available on the District's website at:

www.valleyair.org, under Compliance Assistance/Dust Control.

April 14, 2023

CITY OF MERCED
DEPARTMENT OF PUBLIC WORKS (ENGINEERING)
678 W. 18th Street, Merced, CA 95340

ADDENDUM NO. 1

To **ALL PROSPECTIVE BIDDERS**
Under Specifications for the Construction of the

WWTP PHASE VI PROJECT HEADWORKS IMPROVEMENTS
PROJECT NUMBER CP230035

For which bids are to be received by the City of Merced Purchasing Agent, at the Purchasing Conference Room, at 2525 "O" St., Merced, CA 95340, until 2:00 PM on Thursday 16, 2023.

The following revision to the specifications shall be made:

ITEM 1: SPECIFICATIONS: – PAGE V, INSTRUCTION TO BIDDERS – ADDENDA

Remove "The last day to submit questions for the project will be April 18, 2023" and replace it with "**The last day to submit questions for the project will be April 25, 2023"**

Michael R. Beltran II, P.E.
City Engineer

Name of Bidder or Firm: GSE Construction Company Inc.

THIS ADDENDUM MUST BE SIGNED AND RETURNED WITH BID PROPOSAL.

ADDENDUM NO. 1 has been received and incorporated into the bid proposal.

Received By: _____

Date : 4/17/23 Planholder : Steve Mazza

NOTE: RECEIPT OF THIS ADDENDUM MUST ALSO BE ACKNOWLEDGED IN THE CONTRACTOR'S BID PROPOSAL.

April 17, 2023

CITY OF MERCED
DEPARTMENT OF PUBLIC WORKS (ENGINEERING)
678 W. 18th Street, Merced, CA 95340

ADDENDUM NO. 2

To **ALL PROSPECTIVE BIDDERS**
Under Specifications for the Construction of the

WWTP PHASE VI PROJECT HEADWORKS IMPROVEMENTS
PROJECT NUMBER CP230035

For which bids are to be received by the City of Merced Purchasing Agent, at the Purchasing Conference Room, at 2525 "O" St., Merced, CA 95340, until 2:00 PM on Thursday May 4, 2023.

The following revision to the specifications shall be made:

ITEM 1: ADDENDUM NO 1.

Addendum No. 1 dated April 14, 2023, had an incorrect bid opening of Thursday 16, 2023. It should have read **"Thursday May, 4, 2023"**.

Michael R. Beltran II, P.E.
City Engineer

Name of Bidder or Firm: GSE Construction Company Inc.

THIS ADDENDUM MUST BE SIGNED AND RETURNED WITH BID PROPOSAL.

ADDENDUM NO. 1 has been received and incorporated into the bid proposal.

Received By: _____ Steve Mazza, Chief Operating Officer

Date : 04/18/2023 Planholder : GSE Construction Company Inc.

NOTE: RECEIPT OF THIS ADDENDUM MUST ALSO BE ACKNOWLEDGED IN THE CONTRACTOR'S BID PROPOSAL.

April 26, 2023

CITY OF MERCED
DEPARTMENT OF ENGINEERING
678 W. 18th Street, Merced, CA 95340

ADDENDUM NO. 3

To **ALL PROSPECTIVE BIDDERS**
Under Specifications for the Construction of the

WWTP PHASE VI PROJECT HEADWORKS IMPROVEMENTS
PROJECT NUMBER 230035

For which bids are to be received by the City of Merced Purchasing Agent, at the Purchasing Conference Room, at 2525 "O" St., Merced, CA 95340, until 2:00 PM on Thursday, May 4, 2023.

The following revision to **the Specifications and Drawings** shall be made:

Item 1. In the Bid Forms, Bidder Experience (page XXXI), remove "Changes Occurring Since Prequalification" paragraph in its entirety.

Item 2. In Specification Section 03906, part 1.1.A.2, replace paragraph in its entirety with the following "The extent of the concrete rehabilitation shall be 200 square feet in each of the two influent pump station wetwells and 300 sf of each of the two grit basins, as shown on the Contract Drawings. The extent of the protective lining shall be the entire influent pump station wetwells interior surfaces (both wetwells) and entire grit basins interior surface (both basins), including the walls, floors, and ceilings of the pump station wetwells and grit basins."

Item 3. In Specification Section 09900, part 3.13.C, remove "and grit basins" from the first sentence.

Item 4. In drawing MA21, replace pump discharge pipe coating callouts (throughout) with "Re-coat all (e) 20" SS with 100% Solids epoxy (System C) below elevation 128.0 and amine cured epoxy, polyurethane (System D) above elevation 128.0. See Spec Section 09900 (typ of 4)."

Item 5. In Specification Section 01020-3.9.D.2, add sub-paragraph "d. Only one influent pump station wetwell shall be removed from operation at a time."

Item 6. In Specification Section 01020-3.9.D.3, replace paragraph in its entirety with the following:

3. The installation of the new raw sewage metering manhole and IPS flap gates shall be done during low flow periods (June 1st to August 31st). Shutdowns shall be limited to a 4-hour window during low diurnal flows (1am-5am).
   a. If the Contractor requires a shutdown longer than 4-hours, Contractor shall provide temporary pumping facilities with compatible variable frequency drives for raw sewage pumping capable of handling a peak combined total

flow of 7,000 gpm at 34 feet TDH. Contractor shall provide duty and standby equipment including but not limited to: Pumps, generators, alarms, etc., at all times during temporary pumping. Standby pumps may be connected to existing power supply (and on-site backup generator).

b. Contractor shall submit a detailed temporary pumping facilities plan for review and approval by the Engineer at least four (4) weeks before beginning the temporary raw sewage pumping. This plan shall provide specific manufacturer's product information for all temporary equipment, piping, instrumentation and electrical to be used by Contractor. All equipment used for temporary pumping facilities shall be in excellent condition.

4. Contractor shall provide temporary pumping facilities, as specified in part 3.9.D.3, for coating of the common screening influent channel. Alternatively, Contractor may install cofferdam or inflatable plug to isolate part of the screening influent channel (prior to shifting the plug and coating other part of the channel).

Item 7. In specification section 08310-2.1.A, replace in its entirety with "Existing floor hatches are manufactured by Nystrom Inc (original part number is FGA7260HC). Replacement parts shall be supplied by Nystrom Inc (FD-KIT parts), or equal."

Item 8. In Specification Section 08310-2.1.B and 2.1.C, replace "316SST" with "aluminum"

Item 9. In Specification Section 08310-2.1.D, replace in its entirety with "Frame: existing ¼-inch aluminum gutter frame to remain in place."

Michael R. Beltran II, P.E.
City Engineer

Beth Cohen, P.E.
Project Engineer

Name of Bidder or Firm: GSE Construction Company Inc.

THIS ADDENDUM MUST BE SIGNED AND RETURNED WITH BID PROPOSAL.

ADDENDUM NO. 3 has been received and incorporated into the bid proposal.

Received By: _____ Steve Mazza, Chief Operating Officer

Date : 04/27/23 Planholder : GSE Construction Company Inc.

NOTE: RECEIPT OF THIS ADDENDUM MUST ALSO BE ACKNOWLEDGED IN THE CONTRACTOR'S BID PROPOSAL.

CONTRACT DRAWINGS FOR

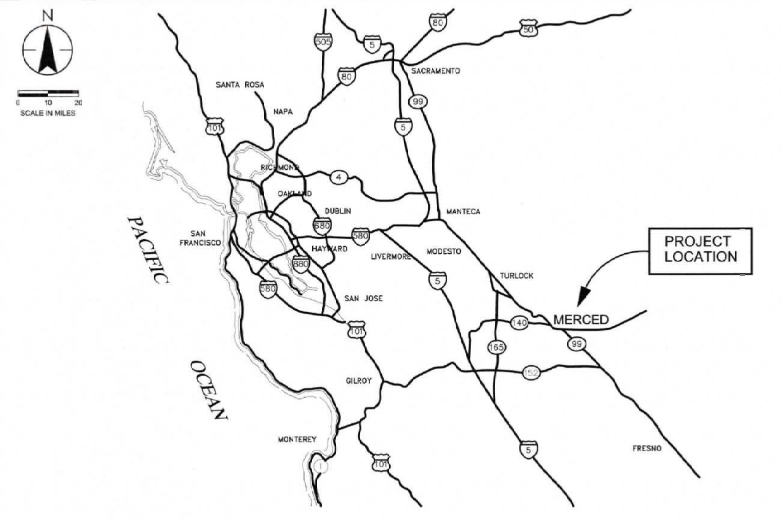
CITY OF MERCED, CALIFORNIA

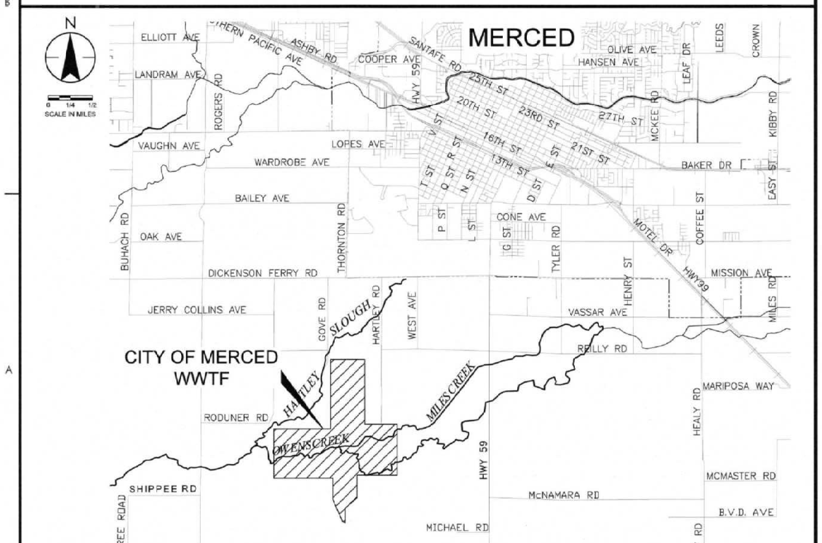
WWTF PHASE VI PROJECT
HEADWORKS IMPROVEMENTS

PROJECT NO. 230035

VOLUME 2
March, 2023

Stantec





CONTRACT DRAWINGS FOR

CITY OF MERCED, CALIFORNIA

WWTF PHASE VI PROJECT
HEADWORKS IMPROVEMENTS

PROJECT NO. 230035

VOLUME 2
March, 2023

Project Manager, Steven L. Beck PE C43799

Public Works Director, Ken Elwin, PE

City Engineer: Michael Beltran, PE

0				FINAL	ASB	SLB	2023.03.14
Revision	By	Appd	YYYY.MM.DD	Issued	By	Appd	YYYY.MM.DD

Permit/Seal: REGISTERED PROFESSIONAL ENGINEER STEVEN L. BECK No. 43799 Exp. 6/30/23 CIVIL STATE OF CALIFORNIA — 2023/03/14

Consultant

Stantec

Stantec Consulting Services Inc.
3875 Atherton Road
Rocklin CA 95765-3716
Tel: (916) 773-8100
www.stantec.com

Client/Project Logo

Client/Project
City of Merced
WWTF PHASE VI PROJECT
HEADWORKS IMPROVEMENTS
City of Merced, California

File Name: 313298-G001 & COVER — ASB (Dwn.) SLB (Dgn.) BPC (Chkd.) 2023.03.14 (YYYY.MM.DD)

Title
PROJECT TITLE
VICINITY MAP AND LOCATION MAP

Project No. 184031329 — Scale AS SHOWN
Revision 0 — Sheet 1 of 39 — Drawing No. G001

DRAWING INDEX

SHT No.	DWG No.	DWG TITLE
1	G001	PROJECT TITLE, LOCATION AND VICINITY MAP
2	G002	INDEX OF DRAWINGS, AREA DESCRIPTIONS AND STANDARD NOTES
3	G003	STANDARD NOTES (CONTINUED)
4	G004	ABBREVIATIONS, AREA DESIGNATIONS, LEGENDS, PIPING SYSTEM AND SYMBOLS
5	G005	ABBREVIATIONS
6	G006	GENERAL SITE PLAN
7	DA01	EXISTING HEADWORKS DEMOLITION OVERALL PLAN
8	DA02	EXISTING HEADWORKS DEMOLITION SECTION
9	DA30	EXISTING HEADWORKS SCREENING CHANNELS DEMOLITION PLAN AND SECTIONS
10	DA40	EXISTING HEADWORKS GRIT BASINS DEMOLITION PLAN
11	DA41	EXISTING HEADWORKS GRIT BASINS DEMOLITION SECTIONS
12	C001	CIVIL TYPICAL DETAILS
13	C010	GENERAL CIVIL NOTES, SURVEY CONTROL POINTS AND KEY MAP
14	CS43	YARD PIPING PLAN FLOW METERING MANHOLE AND HEADWORKS AREA
15	CT10	NEW FLOW METERING MANHOLE PLANS AND SECTIONS
16	S001	STRUCTURAL NOTES
17	S002	STRUCTURAL NOTES
18	S003	TYPICAL STRUCTURAL DETAILS
19	M001	TYPICAL MECHANICAL DETAILS
20	MA01	HEADWORKS OVERALL PLAN
21	MA02	HEADWORKS OVERALL SECTION
22	MA10	HEADWORKS METERING AND SAMPLING VAULT PLANS, SECTIONS AND DETAILS
23	MA20	HEADWORKS INFLUENT PUMP STATION PLANS
24	MA21	HEADWORKS INFLUENT PUMP STATION SECTIONS
25	MA30	HEADWORKS SCREENING CHANNELS PLAN AND SECTIONS
26	MA31	HEADWORKS SCREENING CHANNELS SECTIONS AND DETAILS
27	MA40	HEADWORKS GRIT BASINS PLAN
28	MA41	HEADWORKS GRIT BASINS SECTIONS
29	E01	ELECTRICAL SYMBOLS & ABBREVIATIONS
30	E10	EXAMPLE INTERCONNECTION DIAGRAM
31	E41	TYPICAL ELECTRICAL DETAILS 1
32	E44	TYPICAL ELECTRICAL DETAILS 4
33	E49	TYPICAL ELECTRICAL DETAILS 9
34	E51	ELECTRICAL OVERALL SITE PLAN
35	EA30	HEADWORKS SCREENING CHANNELS ELECTRICAL PLAN
36	P01	INSTRUMENTATION SYMBOLS AND ABBREVIATIONS
37	PT10	FLOW METERING MANHOLE P&ID
38	PA31	HEADWORKS SCREENING UNIT 1 P&ID
39	PA32	HEADWORKS SCREENING UNIT 2 P&ID

MERCED WWTP UPGRADE PLANT PROCESS AREA DESCRIPTIONS

AREA A

HEADWORKS
RAW SEWAGE PUMP STATIONS
SEPTAGE FACILITY
BAR & GRIT SCREENS

AREA B

PRIMARY TREATMENT
PRIMARY CLARIFIERS
PRIMARY SLUDGE PUMP STATION

AREA C

SECONDARY TREATMENT
AERATION BASINS
SECONDARY CLARIFIERS
WAS/RAS PUMP STATIONS

AREA D

CHLORINATION
TERTIARY TREATMENT
TERTIARY PUMP STATION
FLOCCULATION BASINS
UV DISINFECTION

AREA E

SLUDGE THICKENING
POLYMER ADDITION

AREA F

ANAEROBIC DIGESTION
SOLIDS HOLDING TANK
GAS HOLDER
GAS TREATMENT
BOILER BUILDING

AREA G

INSTRUMENT AIR
FUEL OIL

AREA H

AERATION AIR BLOWERS

AREA J

STANDBY GENERATOR

AREA K

CHEMICAL FEED

AREA L

SLUDGE DEWATERING
CENTRATE PUMP STATION
CENTRATE EQ TANK

AREA M

ACTIVE SOLAR DRYERS

AREA N

OPERATIONS BUILDING

AREA S

SITE WORK

AREA T

YARD STRUCTURES

DRAWING NUMBERING SYSTEM

1. THE DRAWINGS ARE SUBDIVIDED INTO BROAD TRADE SECTIONS AND HAVE THE FOLLOWING PREFIXES TO THEIR NUMBERS ACCORDING TO CATEGORY AND ARE BOUND IN THE FOLLOWING ORDER.

   G GENERAL
   C CIVIL
   D DEMOLITION
   CP CATHODIC PROTECTION
   A ARCHITECTURAL
   S STRUCTURAL
   M MECHANICAL
   E ELECTRICAL
   I INSTRUMENTATION

2. THE DRAWINGS WITHIN THIS SET ARE NUMBERED PER THE FOLLOWING EXAMPLE:

   M 3 2 1
   1 — DRAWING NUMERICAL SEQUENCE
   2 — SUB AREA
   3 — PLANT PROCESS AREA
   M — TRADE

STANDARD NOTES:

GENERAL

1. THESE STANDARD NOTES APPLY TO ALL DRAWINGS.
2. ALL WORK SHALL CONFORM TO THE CONTRACT SPECIFICATIONS AND TO THE OWNER'S DESIGN STANDARDS. IN CASE OF CONFLICT, THE MOST STRINGENT REQUIREMENT SHALL APPLY.
3. NO WORK SHALL BE STARTED WITHOUT FIRST NOTIFYING THE ENGINEER 48 HOURS PRIOR TO COMMENCEMENT OF WORK.
4. CONTRACTOR SHALL BE RESPONSIBLE FOR SCHEDULING REQUIRED INSPECTIONS AND SHALL GIVE 48 HOURS NOTIFICATION TO THE ENGINEER.
5. THE CONTRACT DRAWINGS AND SPECIFICATIONS REPRESENT THE FINISHED PRODUCT. THEY DO NOT INDICATE THE METHOD OF CONSTRUCTION, UNLESS SPECIFICALLY INDICATED OTHERWISE.
6. WHERE NO SPECIFIC DETAILS ARE SHOWN, CONSTRUCTION SHALL CONFORM TO SIMILAR WORK ON THE PROJECT AND TO APPLICABLE CODES. TYPICAL DETAILS, NOT REFERENCED ON DRAWINGS, APPLY UNLESS NOTED OTHERWISE.
7. WORK DESCRIBED IN THE SPECIFICATIONS AND NOT SHOWN ON THE DRAWINGS, OR SHOWN ON THE DRAWINGS AND NOT DESCRIBED IN THE SPECIFICATIONS, SHALL BE OF LIKE EFFECT AS IF SHOWN OR DESCRIBED IN BOTH. IN CASE OF DIFFERENCES BETWEEN SPECIFICATIONS AND DRAWINGS, THE MORE STRINGENT REQUIREMENT SHALL GOVERN.
8. ALL DIMENSIONS AND DISTANCES ARE TO FACE OF CURB, CURB RETURN, FACE OF BUILDING, FACE OF WALL, FLOW LINE, PROPERTY LINE, CENTER OF STRIPING, CENTERLINE OF PIPE OR LIMITS OF IMPROVEMENTS.
9. ALL QUANTITIES SHOWN IN THE CONTRACT DRAWINGS ARE APPROXIMATE AND USED FOR PERMIT AND BOND PURPOSES ONLY. THEY SHALL NOT BE USED IN ANY WAY FOR BIDDING OR CONSTRUCTION. IT SHALL BE THE CONTRACTOR'S RESPONSIBILITY TO CONDUCT QUANTITY TAKE-OFFS FOR BIDDING AND CONSTRUCTION PURPOSES.
10. CONTRACTOR SHALL BE RESPONSIBLE FOR CONDUCTING HIS/HER OPERATION ENTIRELY OUTSIDE OF ANY FLOODPLAIN BOUNDARIES OR "NO GRADING AREAS". FLOODPLAIN BOUNDARIES SHALL BE CLEARLY DELINEATED IN THE FIELD PRIOR TO CONSTRUCTION.
11. THE CONTRACTOR SHALL PROVIDE THE PROJECT ENGINEER WITH A RECORD OF ALL FIELD CHANGES FROM THESE PLANS AND THE PROJECT ENGINEER SHALL SUPPLY THE CITY WITH MYLAR "AS-BUILT" PLANS UPON COMPLETION OF THE PROJECT.

SAFETY

1. CONTRACTOR AGREES THAT THE CONTRACTOR SHALL ASSUME SOLE AND COMPLETE RESPONSIBILITY FOR JOB SITE CONDITIONS DURING THE COURSE OF CONSTRUCTION OF THIS PROJECT, INCLUDING SAFETY OF ALL PERSONS AND PROPERTY. THIS REQUIREMENT SHALL APPLY CONTINUOUSLY AND NOT BE LIMITED TO NORMAL AND CITY WORKING HOURS. THE CONTRACTOR SHALL DEFEND, INDEMNIFY AND HOLD THE OWNER AND THE PROJECT ENGINEER HARMLESS FROM ANY AND ALL LIABILITY, REAL OR ALLEGED, IN CONNECTION WITH THE PERFORMANCE OF WORK ON THIS PROJECT, EXCEPTING FOR LIABILITY ARISING FROM THE SOLE NEGLIGENCE OF THE OWNER OR PROJECT ENGINEER.
2. THE CITY OF MERCED IS A MEMBER OF THE UNDERGROUND SERVICE ALERT (U.S.A.) ONE-CALL PROGRAM. THE CONTRACTOR OR ANY SUBCONTRACTOR FOR THIS CONTRACT SHALL NOTIFY MEMBERS OF U.S.A. TWO (2) WORKING DAYS IN ADVANCE OF PERFORMING ANY EXCAVATION WORK BY CALLING THE TOLL FREE NUMBER (800) 227-2600
3. CONTRACTOR SHALL COMPLY WITH THE RULES AND REGULATIONS OF THE STATE CONSTRUCTION SAFETY ORDER.
4. CONTRACTOR SHALL PROVIDE PROPER SHORING IN ALL TRENCHES DEEPER THAN FIVE FEET. ANY DAMAGE RESULTING FROM LACK OF SHORING SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR. CONTRACTOR SHALL COMPLY WITH ALL OSHA SAFETY REQUIREMENTS.
5. THE CONTRACTOR SHALL MAINTAIN AN ONGOING DUST CONTROL PROGRAM, INCLUDING WATERING OF OPEN AREAS, IN ORDER TO CONFORM WITH THE LATEST STATE AND COUNTY AIR POLLUTION REGULATIONS.
6. CONTRACTOR SHALL PROVIDE ALL LIGHTS, SIGNS, BARRICADES, FLAG PERSONS, OR OTHER DEVICES NECESSARY TO PROVIDE PUBLIC SAFETY AND TO MAINTAIN TRAFFIC CONTROL AT ALL TIMES.
7. ALL EXCAVATION SHALL BE COMPLETE OR BACKFILLED AT THE END OF THE DAY OR COVERED WITH PLATING, UNLESS ALTERNATIVE PROTECTION MEASURES ARE APPROVED BY THE ENGINEER.
8. WHEN STREET WORK OR TRENCHING IS DONE THAT WOULD INTERFERE WITH EMERGENCY RESPONSE TRAFFIC, THE CONTRACTOR SHALL NOTIFY THE FIRE AND POLICE DEPARTMENTS 24-HOURS IN ADVANCE OF THE TIME AND LOCATION OF SUCH CLOSURES. THE CONTRACTOR SHALL AGAIN CONTACT THESE DEPARTMENTS AS SOON AS THE STREET IS REOPENED.
9. THE CONTRACTOR SHALL MAINTAIN AN ONGOING PROCESS OF REMOVAL OF ALL SPILLAGE AND TRACKING OF EXCAVATION MATERIAL ON ALL PAVED STREETS.
10. CONSTRUCTION EQUIPMENT THAT OPERATES AT A NOISE LEVEL IN EXCESS OF 85 DECIBELS (MEASURED ON THE A-WEIGHTED SCALE DEFINED IN ANSI-1.4), AT A DISTANCE OF 100 FEET FROM THE EQUIPMENT, IS PROHIBITED UNLESS AUTHORIZED BY THE ENGINEER.
11. THE CONTRACTOR SHALL PURSUE THE WORK IN A CONTINUOUS AND DILIGENT MANNER, CONFORMING TO ALL PERTINENT SAFETY REGULATIONS, TO ENSURE A TIMELY COMPLETION OF THE PROJECT.

STANDARD NOTES CONTINUED ON DRAWING G003

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2023/03/14

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Client/Project
City of Merced
WWTF PHASE VI PROJECT
HEADWORKS IMPROVEMENTS
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Title
INDEX OF DRAWINGS, AREA DESCRIPTIONS AND STANDARD NOTES

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ORIGINAL SHEET - ANSI D

STANDARD NOTES (CONT.):

EXISTING CONDITIONS

1. CONTRACTOR SHALL EXAMINE THE PROJECT WORK AREAS PRIOR TO BIDDING TO SATISFY HIMSELF AS TO THE NATURE AND EXTENT OF EXISTING SITE CONDITIONS THAT WILL BE ENCOUNTERED.
2. ALL MEASUREMENTS OF EXISTING TOPOGRAPHY, STRUCTURES AND UTILITIES ARE SUBJECT TO VERIFICATION IN THE FIELD BY THE CONTRACTOR. THE CONTRACTOR SHALL NOTIFY THE ENGINEER OF ANY DISCREPANCIES ON THE DRAWINGS PRIOR TO FABRICATION OR CONSTRUCTION. THE CONTRACTOR WILL BE RESPONSIBLE FOR ANY ERRORS WHICH MAY HAVE BEEN AVOIDED BY FIELD VERIFICATION.
3. DO NOT INTERRUPT EXISTING UTILITIES SERVING OCCUPIED OR USED FACILITIES, EXCEPT WHEN AUTHORIZED BY THE ENGINEER. PROVIDE TEMPORARY SERVICES DURING INTERRUPTIONS TO EXISTING UTILITIES AS REQUIRED.
4. THE TYPES, LOCATIONS, SIZES AND/OR DEPTHS OF EXISTING UNDERGROUND UTILITIES AS SHOWN ON THE IMPROVEMENT PLANS ARE OBTAINED FROM SOURCES OF VARYING RELIABILITY. THE CONTRACTOR IS CAUTIONED THAT ONLY ACTUAL EXCAVATION WILL REVEAL THE TYPES, SIZES, LOCATIONS AND DEPTHS OF SUCH UNDERGROUND UTILITIES. THE PROJECT ENGINEER ASSUMES NO RESPONSIBILITY FOR THE COMPLETENESS OR ACCURACY OF THE DELINEATION OF SUCH UNDERGROUND UTILITIES NOR FOR THE EXISTENCE OF OTHER BURIED OBJECTS OR UTILITIES WHICH ARE NOT SHOWN ON THESE PLANS. THE CONTRACTOR IS HEREBY NOTIFIED THAT, PRIOR TO COMMENCING CONSTRUCTION, HE/SHE IS RESPONSIBLE FOR CONTACTING THE UTILITY COMPANIES INVOLVED AND REQUESTING VISUAL VERIFICATION OF THE LOCATIONS OF THEIR UNDERGROUND FACILITIES SHOWN ON THESE IMPROVEMENT PLANS. THE PROJECT ENGINEER SHALL BE NOTIFIED BY THE CONTRACTOR OF THE SCHEDULED TIME AND PLACE OF SUCH VISUAL VERIFICATION TO ENABLE SAID FIRM TO HAVE A REPRESENTATIVE PRESENT. SHOULD A CONFLICT BECOME APPARENT, THE CONTRACTOR WILL CONTACT THE PARTIES RESPONSIBLE FOR RELOCATION OF THE CONFLICTING FACILITY.
5. THE CONTRACTOR SHALL REMOVE ALL OBSTRUCTIONS, BOTH ABOVE GROUND AND UNDERGROUND, EXCEPT AS NOTED IN ITEM ABOVE, AS NECESSARY FOR THE CONSTRUCTION OF THE PROPOSED IMPROVEMENTS.
6. CONTRACTOR SHALL COORDINATE UTILITY RELATED REQUIREMENTS, INCLUDING APPLICATION FOR SERVICE, WITH UTILITY COMPANIES.
7. REPLACE IN KIND ALL EXISTING STRUCTURES, PAVING AND LANDSCAPING DISTURBED BY CONSTRUCTION UNLESS NOTED OTHERWISE.
8. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE PROTECTION OF ALL EXISTING SURVEY MONUMENTS AND OTHER SURVEY MARKERS DURING CONSTRUCTION. ALL SUCH MONUMENTS OR MARKERS DESTROYED DURING CONSTRUCTION SHALL BE PLACED AT THE CONTRACTOR'S EXPENSE. CONTRACTOR SHALL NOT DISTURB ANY PERMANENT SURVEY MONUMENT WITHOUT THE CONSENT OF THE ENGINEER. A LICENSED SURVEYOR AT THE CONTRACTOR'S EXPENSE SHALL REPLACE ANY MONUMENTS DISTURBED.
9. THE CONTRACTOR SHALL, AT ALL TIMES DURING CONSTRUCTION, PROTECT FROM DAMAGE EXISTING IMPROVEMENTS ON AND AROUND THE SITE, INCLUDING, BUT NOT LIMITED TO , PAVEMENT, CURB AND GUTTER, SIDEWALK, LANDSCAPING, SIGNAGE, STORM AND SANITARY SEWER AND ALL UTILITIES. THE CONTRACTOR SHALL ASSUME SOLE RESPONSIBILITY FOR THE REPAIR OF ANY IMPROVEMENTS (EXISTING OR PROPOSED) DAMAGED THROUGHOUT THE COURSE OF CONSTRUCTION.
10. THE CONTRACTOR SHALL EXPOSE EXISTING SEWER AND DRAIN LINES FOR THE PROJECT ENGINEER TO VERIFY LOCATION AND ELEVATION PRIOR TO PLACEMENT OF PIPE, WHERE NOTED ON THE DRAWINGS. ALL COSTS OF SUCH EXCAVATION AND BACKFILL SHALL BE INCLUDED IN THE PRICES PAID FOR VARIOUS ITEMS OF WORK.
11. THE CONTRACTOR SHALL ADJUST ALL EXISTING MANHOLES AND VALVE BOXES WITHIN THE WORK AREA TO GRADE UNLESS NOTED OTHERWISE.
12. PRIOR TO WORK ON DRAWINGS THAT TIE INTO EXISTING FACILITIES, THE CONTRACTOR SHALL VERIFY ELEVATIONS SHOWN. IF ELEVATIONS DIFFER FROM THAT SHOWN ON THE PLANS, ADJUSTMENTS TO CONFORM WILL BE MADE BY THE PROJECT ENGINEER.
13. IF UNUSUAL AMOUNTS OF BONE, STONE OR ARTIFACTS ARE UNCOVERED, WORK WITHIN 50 METERS OF THE AREA SHALL CEASE IMMEDIATELY AND A QUALIFIED ARCHAEOLOGIST SHALL BE CONSULTED TO DEVELOP, IF NECESSARY, MITIGATION MEASURES TO REDUCE ANY ARCHAEOLOGICAL IMPACT TO A LESS THAN SIGNIFICANT EFFECT BEFORE CONSTRUCTION RESUMES IN THE AREA.
14. ALL AREAS OF CONSTRUCTION DISTURBANCE WHERE NATURAL COVER AND VEGETATION HAVE BEEN REMOVED SHALL BE HYDRO-SEEDED FOR EROSION CONTROL IN ACCORDANCE WITH THE SPECIFICATIONS.
15. THE CONTRACTOR IS TO VERIFY DEPTH AND LOCATION OF ALL EXISTING UTILITY STUBS PRIOR TO INSTALLATION OF ANY PIPE.

REGULATIONS AND PERMITS

1. WORKMANSHIP, MATERIALS AND METHODS OF CONSTRUCTION SHALL CONFORM TO THE MOST CURRENT EDITIONS OF THE CALIFORNIA BUILDING CODE (CBC), CALIFORNIA MECHANICAL CODE (CMC), CALIFORNIA PLUMBING CODE (CPC), CALIFORNIA ELECTRICAL CODE (CEC), CALIFORNIA ENERGY CODE (CENC), CALIFORNIA GREEN BUILDING STANDARDS CODE (CGBSC), NATIONAL FIRE PROTECTION ASSOCIATION (NFPA), AS WELL AS APPLICABLE LOCAL CODES, TRADE ASSOCIATION STANDARDS, AND MANUFACTURER'S STANDARDS."
2. ALL WORK SHALL BE IN COMPLIANCE WITH APPLICABLE ORDINANCES AND REGULATIONS OF ANY AUTHORITY HAVING JURISDICTION. IF THE CONTRACT DOCUMENTS ARE IN VARIANCE THEREWITH, THE CONTRACTOR SHALL NOTIFY THE ENGINEER PRIOR TO PERFORMING SUCH WORK.
3. ALL MATERIALS AND INSTALLATIONS FOR BUILDINGS ACCESSIBLE TO THE PUBLIC SHALL BE IN CONFORMANCE WITH A.D.A. REQUIREMENT AND CHAPTER 11B OF THE CBC.
4. CONTRACTOR SHALL COMPLY WITH ALL ENVIRONMENTAL MITIGATION AND MONITORING REQUIREMENTS IN ACCORDANCE WITH THE SUPPLEMENTARY CONDITIONS OF THE SPECIFICATIONS.
5. CONTRACTOR SHALL FULFILL ALL OF THE STORM WATER POLLUTION PREVENTION PLAN (SWPPP) REQUIREMENTS PRIOR TO COMMENCEMENT OF CONSTRUCTION.
6. THE CONTRACTOR SHALL OBTAIN THE NECESSARY ENCROACHMENT PERMITS FROM THE CITY OF MERCED OR ANY OTHER AGENCIES HAVING JURISDICTION PRIOR TO COMMENCING ANY WORK. CONTRACTOR SHALL BE RESPONSIBLE FOR ALL CALTRANS ENCROACHMENT PERMITS.

STANDARD NOTES (CONT.):

EROSION AND SEDIMENTATION CONTROL NOTES

1. THE CONTRACTOR SHALL PREPARE SWPPP IN COMPLIANCE WITH THE CITY OF MERCED'S APPROVED NPDES PERMIT AND ANNUAL BEST MANAGEMENT PRACTICE (BMP) LISTING AND IN ACCORDANCE WITH REQUIREMENTS SET FORTH IN THE CONTRACT SPECIFICATIONS. THE SWPPP INCLUDING DETAILS, NOTES, AND CALCULATIONS SHALL BE SUBMITTED TO THE ENGINEER FOR REVIEW.
2. EROSION AND SEDIMENT CONTROL MEASURES SHALL BE EFFECTIVE FOR THE DURATION OF CONTROL ACTIVITY.
3. NO STORM RUNOFF WATER SHALL BE ALLOWED TO DRAIN DIRECTLY INTO THE EXISTING UNDERGROUND STORM SYSTEM BEFORE THE ONSITE STORM DRAIN SYSTEM IS INSTALLED.
4. AS SOON IS PRACTICAL AFTER THE NEW ONSITE SYSTEM IS INSTALLED, THE CATCH BASINS SHALL BE INSTALLED AND STRAWBALES OR APPROVED SCREENS SHALL BE PLACED AROUND THE CATCH BASINS, AS SHOWN IN THE DRAWINGS OR ON CITY STANDARD DETAILS.
5. SHOULD THE PROPOSED ONSITE STORM SYSTEM NOT BE INSTALLED BY OCTOBER 15, TEMPORARY SEDIMENT BASINS SHALL BE CONSTRUCTED AROUND THE OPENING OF ANY EXISTING STORM PIPES THAT DRAIN THE SITE, PER CITY STANDARD DETAILS OR PER A SPECIAL DETAIL SHOWN ON THE PLAN.
6. THE NAME, ADDRESS AND 24-HOUR TELEPHONE NUMBER OF THE RESPONSIBLE PERSON FOR IMPLEMENTATION OF EROSION AND SEDIMENTATION CONTROL PLAN SHALL BE PROVIDED.
7. A MINIMUM OF 50 LINEAR FEET BY 12 FEET WIDTH OF DRAIN ROCK, 1-1/2" DIAMETER OR LARGER AT A MINIMUM DEPTH OF 6", SHALL BE INSTALLED AT EACH SITE INGRESS/EGRESS, UNLESS NOTED OTHERWISE ON THE DRAWINGS. THIS DOES NOT NEED BE DONE AT INGRESS/EGRESS LOCATIONS, WHICH WILL BE CLOSED BY IMMOVABLE BARRICADES DURING CONSTRUCTION.
8. ALL EROSION AND SEDIMENTATION CONTROL MEASURES SHALL BE MAINTAINED UNTIL DISTURBED AREAS ARE STABILIZED. CHANGES TO THE EROSION AND SEDIMENTATION CONTROL PLAN SHALL BE MADE TO MEET FIELD CONDITIONS, BUT ONLY WITH THE APPROVAL OF OR AT THE DIRECTION OF THE PROJECT ENGINEER.
9. DURING THE RAINY SEASON AS SPECIFIED IN NOTE # 1, ALL SIDEWALK AND PAVED AREAS SHALL BE KEPT CLEAR OF EARTH MATERIAL AND DEBRIS. THE SITE SHALL BE MAINTAINED SO AS TO MINIMIZE SEDIMENT LADEN RUNOFF FROM ENTERING ANY STORM DRAINAGE SYSTEM.
10. THE CONTRACTOR SHALL BE RESPONSIBLE TO INSPECT AND REPAIR ALL EROSION CONTROL FACILITIES AT THE END OF EACH WORK DAY DURING THE RAINY SEASON.
11. THE CONTRACTOR SHALL BE RESPONSIBLE TO CLEAN OUT SEDIMENT BASINS WHENEVER THE LEVEL OF SEDIMENT REACHES THE SEDIMENT CLEAN OUT LEVEL INDICATED ON THE PLANS.
12. THE CONTRACTOR SHALL BE RESPONSIBLE TO PROTECT BORROW AREAS AND/OR STOCKPILES WITH APPROPRIATE EROSION CONTROL MEASURES SATISFACTORY TO THE CITY ENGINEER.
13. THE CLEANING OF PAVED STREETS, DURING AND AT THE COMPLETION OF CONSTRUCTION, SHALL BE PERFORMED WITH MECHANICAL SWEEPERS. THE USE OF WATER TRUCKS TO "WASH DOWN" THE STREET IS PROHIBITED.

MECHANICAL EQUIPMENT AND PIPING

1. PROVIDE ALL APPURTENANCES REQUIRED FOR PROPER OPERATION OF EQUIPMENT, IN ACCORDANCE WITH THE SPECIFICATIONS, WHETHER OR NOT THEY ARE SHOWN ON THE DRAWINGS.
2. PIPING CONNECTIONS TO EQUIPMENT SHALL BE VERIFIED AND ADJUSTED TO MATCH ACTUAL EQUIPMENT FURNISHED AT NO ADDITIONAL COST TO OWNER.
3. SUCTION AND DISCHARGE PIPING FOR PUMPS, BLOWERS, ETC. SHALL BE SUPPORTED SO THAT THE WEIGHT OF THE PIPING IS NOT DISTRIBUTED TO THE EQUIPMENT.
4. THE MOST STRINGENT REQUIREMENTS FOR EQUIPMENT SHALL GOVERN IN THE CASE OF A CONFLICT BETWEEN DRAWINGS AND SPECIFICATIONS.
5. PROVIDE WARNING SIGNS IN ACCORDANCE WITH THE SPECIFICATIONS FOR ALL REMOTELY CONTROLLED EQUIPMENT.
6. NOT ALL PIPE SUPPORTS ARE SHOWN ON THE DRAWINGS. FURNISH AND INSTALL SUPPORTS IN ACCORDANCE WITH THE SPECIFICATIONS AND TYPICAL DETAILS, AT NO ADDITIONAL COST TO THE OWNER.
7. NOT ALL PIPE FITTINGS ARE SHOWN ON THE DRAWINGS. FURNISH AND INSTALL ALL FITTINGS, AS REQUIRED FOR THE EQUIPMENT FURNISHED, AT NO ADDITIONAL COST TO THE OWNER.
8. EQUIPMENT LAYOUT SHOWN ON THE DRAWINGS IS FOR ONE MANUFACTURER. CONTRACTOR SHALL MAKE ALL NECESSARY STRUCTURAL, MECHANICAL, AND BUILDING MODIFICATIONS NECESSARY TO ACCOMMODATE ALTERNATIVE EQUIPMENT AT NO ADDITIONAL COST TO THE OWNER.

STANDARD NOTES (CONT.):

CIVIL, PIPELINES AND OTHER UTILITIES

1. GRADING SHALL INCLUDE ALL LABOR, MATERIALS AND EQUIPMENT NECESSARY TO CONSTRUCT GRADES AS SHOWN ON THE GRADING PLAN. NO ADDITIONAL COMPENSATION WILL BE ALLOWED FOR THE DISPOSAL OF EXCESS EXCAVATION PLACED AT THE DIRECTION OF THE PROJECT ENGINEER IN ADVANCE OF ANY CHANGES DEEMED NECESSARY TO OBTAIN A BALANCED GRADING PROGRAM TO MEET MINIMUM STANDARDS. MINIMUM COMPACTION OUTSIDE THE STREET RIGHT-OF-WAY SHALL BE 90%.
2. ALL GRADING SHALL BE COMPLETED IN ACCORDANCE WITH THE RECOMMENDATIONS OF THE GEOTECHNICAL SOILS REPORT.
3. THE TYPE, SIZE, LOCATION AND DEPTH OF EXISTING UNDERGROUND UTILITIES SHOWN ON THESE DRAWINGS WERE OBTAINED FROM SOURCES OF VARYING RELIABILITY. NO RESPONSIBILITY FOR THE COMPLETENESS AND/OR ACCURACY OF THE DELINEATION OF SUCH UNDERGROUND UTILITIES, WHICH MAY BE ENCOUNTERED, IS ASSUMED BY THE ENGINEER OR OWNER. IT SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR TO VERIFY THE EXISTENCE AND LOCATION OF ALL UNDERGROUND UTILITIES PRIOR TO COMMENCEMENT OF CONSTRUCTION.
4. THE COST FOR POTHOLING TO LOCATE EXISTING UNDERGROUND UTILITIES SHOWN ON THE DRAWINGS SHALL BE INCLUDED IN THE CONTRACTOR'S BID.
5. LOCATION OF PIPELINES SHOWN ON THE DRAWINGS ARE APPROXIMATE. CONTRACTOR IS RESPONSIBLE FOR PROVIDING PIPE FITTINGS (WHETHER OR NOT SHOWN ON THE DRAWINGS) TO PLACE THE ALIGNMENT OF THE PIPELINES AS CLOSE AS PRACTICABLE TO THAT SHOWN ON THE DRAWINGS.
6. PROVIDE 12 INCHES MINIMUM VERTICAL CLEARANCE BETWEEN PIPELINE AND EXISTING UTILITIES, UNLESS NOTED OTHERWISE.
7. PIPELINES SHALL SLOPE UNIFORMLY BETWEEN ELEVATIONS SHOWN ON PLANS AND PROFILE. ALL PIPE ELEVATIONS SHOWN REFER TO INVERT UNLESS NOTED OTHERWISE.
8. ALL PIPELINES SHALL HAVE A MINIMUM COVER OF 36 INCHES, UNLESS NOTED OTHERWISE.
9. GROUND PROFILE IS SHOWN ALONG CENTERLINE UNLESS OTHERWISE NOTED.
10. DEFLECT JOINTS ON STANDARD FITTINGS OR ADJACENT PIPE JOINTS TO OBTAIN VERTICAL OR HORIZONTAL CURVES SHOWN ON THE DRAWINGS, NOT TO EXCEED 1/2 OF MANUFACTURER'S RECOMMENDED MAXIMUM DEFLECTION.
11. UNDERGROUND FACILITIES SHALL BE INSTALLED PRIOR TO INSTALLATION OF CURB, GUTTER AND SIDEWALK.
12. CASTINGS COLLARS FOR UNDERGROUND UTILITIES SHALL BE ADJUSTED TO 3/8 INCH BELOW FINISH GRADE BY THE UNDERGROUND CONTRACTOR (AFTER COMPLETION OF PAVING).
13. LINE VALVES SHALL BE SHOP TESTED TO SEAT IN BOTH DIRECTIONS TO FACILITATE FIELD PRESSURE TESTING.
14. ALL CONCRETE VAULTS AND COVERS IN TRAFFIC OR PARKING AREAS SHALL BE DESIGNED FOR H-20 LOADINGS.
15. THRUST BLOCKS ARE NOT ALLOWED FOR PIPE AND FITTING RESTRAINT, UNLESS NOTED OTHERWISE. FITTINGS AND PIPE JOINTS SHALL BE RESTRAINED IN ACCORDANCE WITH THE SPECIFICATIONS AND AS SHOWN ON THE DRAWINGS.
16. CONTRACTOR SHALL BE RESPONSIBLE FOR DAMAGE DUE TO DUST OR EROSION RESULTING FROM THE WORK DONE BY THE CONTRACTOR.
17. IF SAW CUT IS WITHIN 2 FEET OF AN EXISTING PAVEMENT EDGE OR EXISTING PAVEMENT PATCH, REMOVE EXISTING PAVEMENT TO THAT EDGE AND REPLACE THE ENTIRE PAVEMENT.
18. ALL PIPE PENETRATIONS THROUGH WALLS AND SLABS SHALL BE PROVIDED WITH SLEEVES IN ACCORDANCE WITH THE TYPICAL DETAIL "M305", UNLESS NOTED OTHERWISE.
19. CONTRACTOR SHALL KEEP EXCAVATIONS FREE FROM WATER DURING CONSTRUCTION, STATIC WATER LEVEL SHALL BE DRAWN DOWN A MINIMUM OF 3 FEET BELOW BOTTOM OF EXCAVATIONS. DISPOSAL OF WATER SHALL NOT DAMAGE PROPERTY OR CREATE A PUBLIC NUISANCE.
20. THE CONTRACTOR SHALL MAINTAIN ALL EXISTING DRAINAGE FACILITIES AND PROVIDE NECESSARY EROSION CONTROL MEASURES WITHIN THE CONSTRUCTION AREA UNTIL THE DRAINAGE IMPROVEMENTS ARE IN PLACE AND FUNCTIONING. THE CONTRACTOR SHALL PROVIDE AN EROSION CONTROL PLAN TO THE ENGINEER FOR REVIEW.

ARCHITECTURAL
SEE ARCHITECTURAL DRAWINGS FOR GENERAL NOTES ON BUILDING CONSTRUCTION.

STRUCTURAL
SEE STRUCTURAL DRAWINGS FOR GENERAL NOTES ON CONCRETE CONSTRUCTION.

ELECTRICAL
SEE ELECTRICAL DRAWINGS FOR GENERAL NOTES ON ELECTRICAL AND INSTRUMENTATION CONSTRUCTION.

STANDARD NOTES (CONT.):

HVAC

1. INSTALL AND ADJUST HEATING, VENTILATION AND AIR CONDITIONING EQUIPMENT AND DUCTWORK TO AVOID INTERFERENCE WITH PIPING, ELECTRICAL CONDUITS, EQUIPMENT, AND STRUCTURES. DUCTWORK SHALL BE A MINIMUM OF 8 FEET ABOVE FINISHED FLOOR UNLESS NOTED OTHERWISE.
2. DUCTWORK SHALL BE FABRICATED AND INSTALLED FOR THE OPERATING PRESSURES INDICATED IN THE SPECIFICATIONS. ALL DUCTWORK SHALL HAVE A MINIMUM "SMACNA" PRESSURE CLASSIFICATION OF TWO INCHES.
3. NOT ALL DUCTING SUPPORTS ARE SHOWN ON THE DRAWINGS. FURNISH AND INSTALL SUPPORTS IN ACCORDANCE WITH THE SPECIFICATIONS AND TYPICAL DETAILS AT NO ADDITIONAL COST TO THE OWNER.
4. PROVIDE SEISMIC BRACING FOR ALL DUCTING IN ACCORDANCE WITH "SMACNA" RESTRAINT GUIDELINES.

MATERIALS AND PRODUCTS

1. ALL PRODUCTS AND MATERIALS SHALL BE INSTALLED IN ACCORDANCE WITH THE MANUFACTURER'S INSTRUCTIONS, UNLESS NOTED OTHERWISE.
2. ALL MATERIALS AND EQUIPMENT FURNISHED SHALL BE NEW AND FREE FROM DEFECTS. MATERIALS USED MUST HAVE THE MANUFACTURER'S WARRANTED SUPPORT.
3. MATERIALS, EQUIPMENT, ETC., NOT INDICATED ON THE DRAWINGS OR SPECIFIED, WHICH ARE MANIFESTLY OR REASONABLY REQUIRED, OR NECESSARY FOR A SUCCESSFUL, EFFICIENT AND COMPLETE INSTALLATION, SHALL NOT RELIEVE THE CONTRACTOR FROM PERFORMING SUCH WORK. THEY SHALL BE HELD TO BE IMPLIED, AND SHALL BE FURNISHED AND INSTALLED AT NO ADDITIONAL COST TO THE OWNER.
4. WHERE REFERENCE IS MADE TO VARIOUS TEST STANDARDS FOR MATERIALS, SUCH STANDARDS SHALL BE THE LATEST EDITION AND/OR ADDENDUM.
5. ALL BUILDING COMPONENTS, BUILDING SYSTEMS AND BUILDING PRODUCTS ARE TO BE LOCATED, FURNISHED, PROVIDED, AND INSTALLED WITH NECESSARY ACCESSORIES INCLUDING BUT NOT LIMITED TO EXPANSION/CONTRACTION CONTROL, BRACING, FLASHING, ELECTRONIC DEVICES, VALVES, ACCESSORIES, SUPPORTS, CONNECTIONS, DRAINAGE, VENTILATION, ETC., FOR A COMPLETE AND WORKING ASSEMBLY, PER CODES, DRAWINGS AND SPECIFICATIONS, AND PER THE RECOMMENDATIONS OF ALL MANUFACTURERS, INCLUDING THOSE DIRECTLY INVOLVED AND THOSE RELATED OR INTERFACING.
6. CONTRACTOR SHALL VERIFY ALL CONTROLLING DIMENSIONS PRIOR TO PREPARATION OF SHOP DRAWINGS AND ORDERING OF MATERIALS.
7. CONTRACTOR SHALL BE REQUIRED TO ARRANGE FOR ALL STORAGE/STAGING AREAS, WHICH MAY NOT BE SHOWN ON THE DRAWINGS, AND PROVIDE SECURITY AT NO ADDITIONAL COST TO THE OWNER.
8. ALL STAINLESS STEEL SHALL BE TYPE 304 OR 316, UNLESS NOTED OTHERWISE.
9. ALL NUTS AND BOLTS TO BE INSTALLED UNDERGROUND SHALL BE STAINLESS STEEL TYPE 316, UNLESS NOTED OTHERWISE.
10. ISOLATE ALL COPPER PIPE FROM OTHER MATERIALS WITH PVC TAPE.
11. SEPARATE DISSIMILAR METALS AND ALUMINUM IN CONTACT WITH CONCRETE, WITH BITUMINOUS PAINT OR AN ALTERNATIVE PRODUCT APPROVED BY THE ENGINEER.

WORKMANSHIP

1. CONTRACTOR DAMAGED WORK MUST BE REPLACED AT NO ADDITIONAL COST TO THE OWNER. REPAIR OF CONSTRUCTION DAMAGE TO EXISTING FACILITIES AND UTILITIES IS THE CONTRACTOR'S RESPONSIBILITY.
2. THE ENGINEER RESERVES THE RIGHT TO DIRECT THE CONTRACTOR TO REMOVE AND REINSTALL WORK, WHICH IN THE ENGINEER'S OPINION DOES NOT MAINTAIN WORKMANSHIP AND CRAFTSMANSHIP STANDARDS.
3. THE CONTRACTOR SHALL PROVIDE ALL MEASURES NECESSARY TO PROTECT BUILDINGS AND STRUCTURES DURING CONSTRUCTION. SUCH MEASURES SHALL INCLUDE, BUT ARE NOT LIMITED TO, BRACING AND SHORING. OBSERVATION VISITS TO THE SITE BY THE DESIGN ENGINEER SHALL NOT INCLUDE INSPECTION OF THE ABOVE ITEMS.
4. CONSTRUCTION MATERIAL SHALL BE SPREAD OUT IF PLACED ON FRAMING FLOORS OR ROOF. LOAD SHALL NOT EXCEED THE DESIGN LIVE LOAD PER SQUARE FOOT.
5. CONTRACTOR SHALL MAINTAIN THE JOB SITE IN CLEAN, SAFE AND USABLE CONDITION THROUGHOUT THE COURSE OF CONSTRUCTION. ALL SPILLS OF SOIL, ROCK, CONSTRUCTION DEBRIS, ETC., SHALL BE REMOVED IMMEDIATELY FROM PUBLIC ACCESS AREAS. ALL TRASH, CONSTRUCTION DEBRIS AND MATERIALS SHALL BE CONTAINED WITHIN THE CONSTRUCTION AREA UNTIL OFF-SITE DISPOSAL CAN BE ARRANGED.

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2023/03/14

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Title
STANDARD NOTES (CONTINUED)

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Revision 0 | Sheet 3 of 39 | Drawing No. G003

SYMBOLS

- SECTION IDENTIFICATION LETTER (A / M101) — SHEET OR DRAWING NUMBER WHERE SECTION APPEARS
- SECTION IDENTIFICATION LETTER (D / S201) — SHEET OR DRAWING NUMBER WHERE SECTION IS TAKEN
- DETAIL IDENTIFICATION NUMBER (3 / S201) — SHEET OR DRAWING NUMBER WHERE DETAIL IS TAKEN OR APPEARS
- FME 30021 — EXISITNG EQUIPMENT TAG
- MTR 12011 — NEW EQUIPMENT TAG
- MOV 17115 — EXISTING VALVE TAG
- SLG 17013 — NEW VALVE TAG
- NEW FACILITIES
- EXISTING FACILITIES
- FUTURE FACILITIES
- xx — NEW FENCE
- X — EXISTING FENCE
- 54 — NEW CONTOUR
- 54 — EXISTING CONTOUR
- NEW EMBANKMENT
- EXISTING PIPE OR STRUCTURE TO BE ABANDONED OR REMOVED
- TOW 12.01 — NEW SPOT ELEVATION
- TOW 12.0 — EXISTING SPOT ELEVATION
- 12" — TREE & TRUNK DIAMETER
- 12" — TREE TO BE REMOVED
- NEW MANHOLE & PIPELINE
- EXISTING MANHOLE & PIPELINE
- FUTURE MANHOLE & PIPELINE
- NEW POWER POLE
- EXISTING POWER POLE
- GAS — EXISTING UNDERGROUND SERVICE (TYPE NOTED)
- PROPERTY LINE
- CONCRETE LINED DITCH
- CONCRETE CURB & GUTTER
- DRAINAGE SWALE
- CONCRETE V-GUTTER
- COBBLE LINED CHANNEL
- VALLEY GUTTER W/ UNDERDRAIN
- DRAINAGE SWALE W/ UNDERDRAIN SYSTEM

PIPING SYMBOLS

- AIR RELEASE VALVE / AIR & VACUUM VALVE / COMBINATION AIR VALVE
- KNIFE GATE VALVE
- GATE VALVE
- CHECK VALVE
- CT — CATHODIC PROTECTION TEST STATION
- SPLIT DISK CHECK VALVE
- SOLENOID VALVE
- MOTOR OPERATED VALVE
- PRESSURE REDUCING VALVE
- BACK-FLOW PREVENTER
- DIAPHRAGM/PINCH VALVE
- PRESSURE RELIEF VALVE
- PRESSURE GAUGE OR SWITCH
- PRESSURE RELIEF VALVE PLASTIC
- ROTARY LOBE PUMP
- THERMOMETER
- MIXER
- ULTRA SONIC LEVEL SENSOR
- PLUG VALVE
- PLUG VALVE
- BALL VALVE
- GLOBE VALVE
- ANGLE VALVE
- BUTTERFLY VALVE
- NEEDLE VALVE
- UNION
- REDUCER
- STRAINER
- CLEANOUT
- HOSE VALVE
- 3W FIRE HYDRANT
- 1W FIRE HYDRANT
- POST INDICATOR VALVE (PIV)
- FIRE DEPARTMENT CONNECTION (FDC)
- SEWAGE ARV
- ACCESS DOOR
- PROGRESSIVE CAVITY PUMP
- MECHANICAL JOINT OR BELL & SPIGOT FITTING (OR)
- FLANGE X MJ ADAPTOR
- FLANGED FITTING
- GROOVED COUPLING
- FLANGED COUPLING ADAPTER
- WALL SLEEVE
- FLEXIBLE COUPLING
- BELL RING PENETRATION

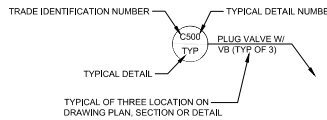
GATE & VALVE ABBREVIATIONS

ARV	AIR RELEASE VALVE
ASV	ANGLE STOP VALVE
AVV	AIR & VACUUM VALVE
BCV	BALL CHECK VALVE
BFV	BUTTERFLY VALVE
BV	BALL VALVE
CAV	COMBINATION AIR VALVE
CP	CATHODIC PROTECTION
CT	CATHODIC TEST STATION
CV	CHECK VALVE, CONTROL VALVE
DCDA	DOUBLE CHECK DETECTOR ASSEMBLY
DV	DIAPHRAGM VALVE
FCV	FLEXIBLE CHECK VALVE
FDC	FIRE DEPARTMENT CONNECTION
FG	FLAP GATE
FH	FIRE HYDRANT
FSCV	FLEXIBLE SWING CHECK VALVE
GLV	GLOBE VALVE
GTV	GATE VALVE
GTV & B	GATE VALVE & BOX
HGV	HOSE GATE VALVE
HOG	HYDRAULICALLY OPERATED GATE
HV	HOSE VALVE
KG	KNIFE GATE
LV	LINE VALVE
MBV	MOTORIZED BALL VALVE
MOG	MOTORIZED OPERATED GATE
MOV	MOTORIZED OPERATED VALVE
MV	MUD VALVE
MWR	MOTORIZED WEIR
NV	NEEDLE VALVE
PARV	PLASTIC AIR RELEASE VALVE
PBV	PLASTIC BALL VALVE
PCHV	PINCH VALVE
PCV	PLASTIC CHECK VALVE
PH	POST HYDRANT
PIV	POST INDICATOR VALVE
PRFV	PRESSURE RELIEF VALVE PLASTIC
PRV	PRESSURE REGULATING (REDUCING) VALVE
PRVP	PRESSURE RELIEF VALVE PLASTIC
PV	PLUG VALVE
RV	RELIEF VALVE
SARV	SEWAGE AIR RELEASE VALVE
SAVV	SEWAGE AIR VACUUM VALVE
SCAV	SEWAGE COMBINATION AIR VALVE
SCV	SPLIT DISC CHECK VALVE
SSG	SLUICE GATE
SLG	SLIDE GATE
SOLV	SOLENOID VALVE
STP	STOP PLATE
TV	THERMOSTATIC VALVE
VB	VALVE BOX

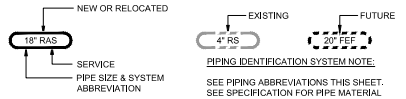
PIPING SYSTEM ABBREVIATIONS

AA	AERATION AIR
ACD	ACID
ALC	ALUM / CATIONIC POLYMER
ALM	ALUM
BRV	BRAIDED VINYL
BWS	BACKWASH SUPPLY
C	CONDUIT (CHEMICAL SERVICE)
CIP	CLEAN IN PLACE
CNT	CENTRATE
D	DRAIN
DAFS	DAF SLUDGE
DAFI	DAF INFLUENT
DAFR	DAF RECYCLE
DAFF	DAF FLOAT
DAFE	DAF EFFLUENT
DWS	DEWATERED SLUDGE
EPS	EMULSION POLYMER SOLUTION
EPSH	EPS HOGH PRESSURE
EXH	EXHAUST
FA	FOUL AIR
FE	FINAL EFFLUENT
FEF	FILTER EFFLUENT
FIF	FILTER INFLUENT
FOR	FUEL OIL RETURN
FOS	FUEL OIL SUPPLY
GRT	GRIT
HPA	HIGH PRESSURE AIR
HW	HOT WATER
IA	INSTRUMENT AIR
LMS	LIME SLURRY
ME	MEMBRANE EFFLUENT
ML	MIXED LIQUOR
MPE	MATURATION POND EFFLUENT
NEP	NEAT EMULSION POLYMER
ODI	OXIDATION DITCH INFLUENT
OF	OVERFLOW
PD	PUMPED DRAIN
PDW	PROCESS DEWATERING
PLA	ANIONIC POLYMER SOLUTION
PLC	CATIONIC POLYMER SOLUTION
PLE	EMILSION POLYMER SOLUTION
RAS	RECYCLE ACTIVATED SLUDGE
RASS	RAS SAMPLE
RS	RAW SEWAGE
SA	SERVICE AIR
SE	SECONDARY EFFLUENT
SHC	SODIUM HYPOCHLORITE SOLUTION
SHX	SODIUM HYDROXIDE SOLUTION
SMP	SAMPLE
SRS	SCREENED RAW SEWAGE
SSC	SECONDARY SCUM
STD	STORM DRAIN
UVE	UV DISINFECTION EFFLUENT
V	VENT
WAS	WASTE ACTIVATED SLUDGE
1W	POTABLE WATER
2W	NON-POTABLE WATER
3W	RECLAIMED WATER

TYPICAL IDENTIFICATION SYSTEM



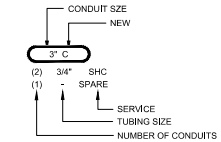
PIPING IDENTIFICATION SYSTEM



PIPING IDENTIFICATION SYSTEM NOTE:

SEE PIPING ABBREVIATIONS THIS SHEET.
SEE SPECIFICATION FOR PIPE MATERIAL NOT SPECIFICALLY CALLED OUT ON THE DRAWINGS

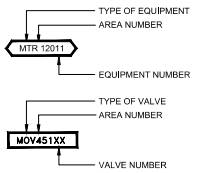
CHEMICAL CONDUIT IDENTIFICATION SYSTEM



CHEMICAL CONDUIT NOTE:

ONLY ONE (1) LINE OF CHEMICAL TUBING PER CONDUIT.

VALVE & EQUIPMENT IDENTIFICATION SYSTEM



EQUIP & VALVE ID NOTE:

SEE EQUIPMENT & VALVE ABBREVIATIONS THIS SHEET.

PIPE TYPE ABBREVIATIONS

ABS	ACRYLONITRILE-BUTADIENE-STYRENE
ACP	ASBESTOS CEMENT PIPE
BSP	BLACK STEEL PIPE
CCP	CONCRETE CYLINDER PIPE
CCSP	CEMENT MORTAR LINED & COATED STEEL PIPE
CIP	CAST IRON PIPE
CISP	CAST IRON SOIL PIPE
CMP	CORRUGATED METAL PIPE
CPVC	CHLORINATED POLYVINYL CHLORIDE PIPE
CU	COPPER PIPE
DIP	DUCTILE IRON PIPE
DUP	DURIRON PIPE
ELCS	EPOXY LINED & COATED STEEL PIPE
FRP	FIBERGLASS REINFORCED PIPE
GLCIP	GLASS LINED CAST IRON PIPE
GSP	GALVANIZED STEEL PIPE
PCMP	PERFORATED CORRUGATED METAL PIPE
PLAC	PLASTIC LINED ASBESTOS CEMENT PIPE
PRCCP	PRESTRESSED CONCRETE CYLINDER PIPE
PT	PLASTIC TUBING
PVC	POLYVINYL CHLORIDE PIPE
PVC-UVR	POLYVINYL CHLORIDE PIPE - UV RESISTANT
RCP	REINFORCED CONCRETE PIPE
SLS	SARAN LINED STEEL PIPE
SST	STAINLESS STEEL PIPE
WSP	WELDED STEEL PIPE

HATCHING LEGEND

- EXISTING AC PAVING (PLAN)
- NEW LIGHT DUTY AC PAVING (PLAN)
- NEW LIGHT DUTY AGGREGATE BASE (PLAN)
- NEW HEAVY DUTY AC PAVING (PLAN)
- EXISTING AC PAVING (SECTION)
- NEW AC PAVING (SECTION)
- NEW AGGREGATE BASE (SECTION)
- NEW HEAVY DUTY AGG BASE (PLAN)
- EXISTING GRADE & FILL (SECTION)
- ROCK SLOPE PROTECTION (PLAN & SECTION)
- EXISTING CONCRETE (PAN & SECTION)
- NEW CONCRETE (PLAN & SECTION)
- GRATING (TYPE A)
- GRATING (TYPE B)
- ENVIRONMENTALLY SENSITIVE AREA (ESA)

Revision	By	Appd	YYYY.MM.DD

Issued	By	Appd	YYYY.MM.DD
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Permit/Seal

REGISTERED PROFESSIONAL ENGINEER — STEVEN L. BECK — No. 43799 — Exp.6/30/23 — CIVIL — STATE OF CALIFORNIA

2023/03/14

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Client/Project

City of Merced

WWTF PHASE VI PROJECT
HEADWORKS IMPROVEMENTS

City of Merced, California

File Name: 313298-G004	ASB Dwn.	BPC Dsgn.	SLB Chkd.	2023.03.14 YYYY.MM.DD

Title

ABBREVIATION, AREA DESIGNATION, LEGENDS, PIPING SYSTEM AND SYMBOLS

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184031329	NONE
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NOTE: NOT ALL ABBREVIATIONS APPEARING ON THIS SHEET ARE USED ON THESE DOCUMENTS.

AB	ANCHOR BOLT, AGGREGATE BASE, ANOXIC BASIN
ABND	ABANDONED
ABS	ACRILONTRILE-BUTADIENE-STYRENE
AC	ASPHALT CONCRETE, ACRE
ACP	ASBESTOS CEMENT PIPE
ACST	ACOUSTIC
ADD	ADDENDUM, ADDITION(AL)
ADJ	ADJUSTABLE
ADPTR	ADAPTER
ADW	AVERAGE DRY WEATHER
AGG	AGGREGATE
AHR	ANCHOR
A/C	AIR CONDITIONER
A/D	ADD/DEDUCT
AL	ALUMINUM
ALTN	ALTERNATE
ALUM	ALUMINUM SULFATE
AMB	AMBIENT
AMP	AMPERES
APPROX	APPROXIMATE(LY)
ARCH	ARCHITECTURAL
ARV	AIR RELEASE VALVE
ASV	AIR STOP VALVE
AT	ALUMINUM THRESHOLD
ATM	ATMOSPHERE
ATS	ANODE TEST STATION
AUTO	AUTOMATIC
AUX	AUXILIARY
AVG	AVERAGE
AVV	AIR VACUUM VALVE
BC	BEGINNING OF CURVE
BD	BAR DIAMETER
BF	BLIND FLANGE
BFP	BACK FLOW PREVENTER
BLDG	BUILDING
BLK	BLOCK
BLKG	BLOCKING
BM	BEAM, BENCHMARK
BO	BLOW-OFF
BOD	BIOCHEMICAL OXYGEN DEMAND
BOT	BOTTOM
BRKR	BREAKER
BRKT	BRACKET
BRV	BRAIDED VINYL
BRZ	BRONZE
BSP	BLACK STEEL PIPE
BTU	BRITISH THERMAL UNIT
BU	BUILT-UP
BUV	BUTTERFLY VALVE
BV	BALL VALVE
BW	BARBED WIRE

CAP	CAPACITY
CAV	COMBINATION AIR VALVE
CB	CATCH BASIN
CC	CENTER TO CENTER
CCP	CONCRETE CYLINDER PIPE
CCSP	CEMENT LINED AND COATED STEEL PIPE
CD	CEILING DIFFUSER
CEM	CEMENT
CF	CUBIC FOOT
CFH	CUBIC FOOT PER HOUR
CFM	CUBIC FOOT PER MINUTE
CFS	CUBIC FOOT PER SECOND
C&G	CURB AND GUTTER
CHEM	CHEMICAL
CHKR	CHECKER
CIDM	CAST-IN-DRILLED HOLE
CIP	CAST IRON PIPE
CISP	CAST IRON SOIL PIPE
CJ	CONSTRUCTION JOINT
CKT	CIRCUIT
CL	CLEARANCE, CENTER LINE
CL2	CHLORINE
CLAR	CLARIFIER
CLG	CEILING
CMP	CORRUGATED METAL PIPE
CMPD GA	COMPOUND GAUGE
CLR	CLEAR
CMU	CONCRETE MASONRY UNIT
CMPA	CORRUGATED METAL PIPE ARCHED
CNCTRC	CONCENTRIC
CND	CONDUIT
CNDCT	CONDUCTOR
CNDS	CONDENSATE
CO2	CARBON DIOXIDE
CO	CLEANOUT
COTG	CLEANOUT TO GRADE
COD	CHEMICAL OXYGEN DEMAND
COL	COLUMN
COLL	COLLECTOR
COMPT	COMPARTMENT
CONC	CONCRETE
CONN	CONNECTION
CONST	CONSTRUCTION
CONT	CONTINUATION(OUS), CONTINUED
CP	CATHODIC PROTECTION
CPI	CONTROL POWER INTERLOCK
CPLG	COUPLING
CPT	CONTROL POWER TRANSFORMER
CPVC	CHLORINATED POLYVINYL CHLORIDE PIPE
CREJ	CORRUGATED RUBBER EXPANSION JOINT
CT	CURRENT TRANSFORMER, CATHODIC TEST STATION
CTR	CENTER
CTS	CATHODIC TEST STATION
CTSK	COUNTERSUNK
CU	CONTROL UNIT, COPPER PIPE
CV	CHECK VALVE, CONTROL VALVE
CW	COLD WATER
CYL	CYLINDER
DAF	DISSOLVED AIR FLOTATION
DBL	DOUBLE
DEG	DEGREE
DENS MTR	DENSITY METER
DET	DETAIL
DF	DOUGLAS FIR
DI	DROP INLET
DIA	DIAMETER
DIAG	DIAGRAM
DIAPH V	DIAPHRAGM VALVE
DIFF	DIFFERENTIAL
DIP	DUCTILE IRON PIPE
DISCH (DIS)	DISCHARGE
DIZ	DIONIZED WATER
DMPR MOT	DAMPER MOTOR
DN	DOWN
DO	DISSOLVED OXYGEN
DP	DEDUCT POINT
DR	DRAIN
DS	DIGESTED SLUDGE, DOWNSPOUT
DT	DRIP TRAP
DUP	DURIRON PIPE
DV	DIAPHRAGM VALVE
DW	DISHWASHER
DWG	DRAWING

EA	EACH
EB	EXPANSION BOLT
EC	END OF CURVE
ECC	ECCENTRIC
EE	EACH END
EF	EACH FACE
EFL	EFFLUENT
EL	ELEVATION
ELB	ELBOW
ELCS	EPOXY LINED AND COATED STEEL PIPE
ELECT	ELECTRIC(AL)
EMER	EMERGENCY
EP	EDGE OF PAVEMENT
EPS	EFFLUENT PUMP STATION
EQ	EQUAL
EQUIP	EQUIPMENT
ESA	ENVIRONMENTALLY SENSITIVE AREA
ESB	EMERGENCY STORAGE BASIN
EW	EACH WAY
EWC	ELECTRIC WATER COOLER
EX	EXTRA
EXH	EXHAUST
EXH FN	EXHAUST FAN
EXP	EXPOSED, EXPANSION
EXP JT	EXPANSION JOINT
EXIST (E)	EXISTING
EXT	EXTERIOR
FA	FRESH AIR
FAB	FABRICATE(D)(TION)
FAI	FRESH AIR INTAKE
FB	FLAT BAR, FLOOR BEAM, FACE OF BLOCK
FC	FLEXIBLE COUPLING
FCA	FLANGED COUPLING ADAPTER
FCO	FLOOR CLEANOUT
FCR	FINE CRUSHED ROCK
FD	FLOOR DRAIN
FDR	FEEDER
FE	METER(ELEMENT)
FES	FLARED END SECTION
FF	FILTER FEED, FINISHED FLOOR
F/G	FIBERGLASS
FG	FLAP GATE, FINISH GRADE
FH	FIRE HYDRANT
FIN	FINISH(ED)
FL	FLOOR, FLOW LINE
FLEX	FLEXIBLE
FLG	FLANGE(D)
FL CO	FLOOR CLEANOUT
FLH	FLAT HEAD
FLW	FLAT WASHER
FM	FORCE MAIN
FME	FLOW METER
FPM	FEET PER MINUTE
FPS	FEET PER SECOND
FRC	FLEXIBLE RUBBER COUPLING
FRP	FIBERGLASS REINFORCED PLASTIC
FS	FAR SIDE
FST	FASTENER (S)
FT	FEET, FOOT
FTG	FOOTING
FUT	FUTURE
G	GAS
G&P	GRADING AND PAVING
GA	GAUGE
GAF	GALVANIZE AFTER FABRICATION
GAL	GALLON
GALV	GALVANIZED
GC	GROOVED COUPLING
GENL	GENERAL
GL	GLASS
GLCIP	GLASS LINED CAST IRON PIPE
GLV	GLOBE VALVE
GND	GROUND
GPD	GALLONS PER DAY
GPH	GALLONS PER HOUR
GPM	GALLONS PER MINUTE
GR	GRADE
GRDR	GRINDER
GS	GALVANIZED STEEL
GSB/S	GALVANIZED STEEL BOLT/EXP SHIELD
GSKT	GASKET
GSP	GALVANIZED STEEL PIPE
GTV	GATE VALVE
GTV & B	GATE VALVE AND VALVE BOX
GWB	GYPSUM WALL BOARD
H	HEIGHT
H/A	HAND-AUTOMATIC
HC	HOLLOW CORE
HD	HEAVY DUTY
HDOT	HEAVY DUTY OIL TIGHT
HDR	HEADER
HDWD	HARDWOOD
HEX	HEXAGONAL
HGLV	HOSE GLOBE VALVE
HGR	HANGER
HGV	HOSE GATE VALVE
HHWL	HIGH HIGH WATER LEVEL
HM	HOLLOW METAL
HN	HEX NUT
HNDRL	HANDRAIL
HOA	HAND-OFF-AUTOMATIC
HORIZ	HORIZONTAL
HP	HORSEPOWER, HIGH PRESSURE

HR(S)	HOUR(S)
HS	HIGH STRENGTH, HEAVY STEEL
HSB	HIGH STRENGTH BOLT
HTR	HEATER
HV	HOSE VALVE, HOSE BIBB
H/V	HEATING AND VENTILATING
HWL	HIGH WATER LEVEL
HYD	HYDRAULIC
HZ	HERTZ(CYCLES PER SECOND)
ID	INSIDE DIAMETER
IE	INVERT ELEVATION
IF	INSIDE FACE
IJTS	INSULATED JOINT TEST STATION
IN	INCH
IND LP	INDICATING LAMP
INFL	INFLUENT
INST	INSTANTANEOUS
INSUL	INSULATED(ION)
INTLK	INTERLOCK
INTR	INTERIOR
INVT	INVERT
IP	IRON PIN
IPS	INFLUENT PUMP STATION
IT	INSTRUMENT TAP
J	JOIST
JB	JUNCTION BOX
JCT	JUNCTION
J HGR	JOIST HANGER
JT	JOINT
KG	KNIFE GATE
KSF	THOUSAND SQUARE FEET
KV	KILOVOLT
LAM	LAMINATED
LAT	LATERAL
LBS	POUNDS
LF	LENGTH FEET
LG	LONG
LI	LIFTING INSERT
LOS	LOCKOUT STOP
LP	LOW PRESSURE
LR	LONG RADIUS
LTG	LIGHTING
LV	LOW VOLTAGE, LINE VALVE
LVL	LEVEL
LVR	LOUVER
LWL	LOW WATER LEVEL
LWR	LOWER
MA	MILLIAMPERE
MAG	MAGNETIC
MAINT	MAINTENANCE
MAX	MAXIMUM
MBH	THOUSAND BTU'S PER HOUR
MBR	MEMBRANE SYSTEM
MBV	MOTORIZED BALL VALVE
MCC	MOTOR CONTROL CENTER
MCM	THOUSAND CIRCULAR MILS
MECH	MECHANICAL
MET	METAL
MFR	MANUFACTURER
MGD	MILLION GALLONS PER DAY
MG/L	MILLIGRAMS PER LITER
MH	MANHOLE
MI	MALLEABLE IRON
MIN	MINIMUM, MINUTE
MIR	MIRROR
MISC	MISCELLANEOUS
MJ	MECHANICAL JOINT
ML	MILLILITER, MIXED LIQUOR
MNL	MANUAL
MO	MOTOR OPERATOR
MOS	MOWING STRIP
MOT	MOTOR
MOV	MOTOR OPERATED VALVE
MM	MILLIMETER
MNTG	MOUNTING
MP	MATURATION POND
MPPS	MP PUMP STATION
MPN	MOST PROBABLE NUMBER
MS	METAL STUDS
MT	METAL THRESHOLD
MTD	MOUNTED
MV	MUD VALVE, MILLIVOLTS
MWS	MAXIMUM WATER SURFACE
MWL	MEAN WATER LEVEL
MX	AUXILLIARY RELAY
NA	NON-AUTOMATIC
NC	NORMALLY CLOSED
NFYD	NON FREEZE YARD DRAIN
NFYH	NON FREEZE YARD HYDRANT
NIC	NOT IN CONTRACT
NIS	NOT IN SERVICE
NO	NORMALLY OPEN, NUMBER
NPL	NAMPLATE

NPS	NON-PROJECTING STEM
NPSH	NET POSITIVE SUCTION HEAD
NRS	NON-RISING STEM
NTS	NOT TO SCALE
NV	NEEDLE VALVE
NWL	NORMAL WATER LEVEL
OA	OUTSIDE AIR
OC	ON CENTER
OD	OUTSIDE DIAMETER, OXIDATION DIAMETER
OF	OUTSIDE FACE
OPER	OPERATOR (ING)
OVLD	OVERLOAD
OPNG	OPENING
OPP	OPPOSITE
OX	OXIDATION
PB	PULL BOX
PBV	PLASTIC BALL VALVE
PIC	PLAIN CONCRETE (NO REINFORCING)
PCHV	PINCH VALVE
PCMP	PERFORATED CORRUGATED METAL PIPE
PCV	PLASTIC CHECK VALVE
PEJ	PREMOLDED EXPANSION JOINT
PG	PRESSURE GAUGE (SEE DWG M21)
PH	PHASE, POST HYDRANT
PI	POINT OF INTERSECTION
PIT	PRESSURE INDICATING TRANSMITTER
PK	PEAK
PL	PLACES, PLATE, PROPERTY LINE
PLAC	PLASTIC LINED ASBESTOS CEMENT
PLSTC	PLASTIC
PLWD	PLYWOOD
PLYWD	PLYWOOD
PMS	PLANT MIX SURFACING
PNEU	PNEUMATIC
PNL	PANEL, PANEL BOARD
PP	POWER POLE, PIPE PENETRATION
PPLN	PIPELINE
PRCCP	PRESTRESSED CONCRETE CYLINDER PIPE
PREFAB	PREFABRICATED
PRESS	PRESSURE
PRFV	PRESSURE RELIEF VALVE
PRV	PRESSURE REGULATING (REDUCING) VALVE
PS	PRESSURE SWITCH, PIPE SUPPORT, PUMP STATION
PSF	POUNDS PER SQUARE FOOT
PSI	POUNDS PER SQUARE INCH
PSL	PIPE SLEEVE
PT	PLASTIC TUBING
PV	PLUG VALVE
PVC	POLYVINYL CHLORIDE (PIPE)
PVC-UVR	POLYVINYL CHLORIDE PIPE-UV RESISTANT
PVT	PAVEMENT
QCPLG	QUICK COUPLING
R	RISER, RADIUS
RA	RETURN AIR
RAD	RADIUS
RB	REDUCTION BRASS
RBO	REMOVED BY OTHERS (TO BE)
RC	REINFORCED CONCRETE
RCDR	RECORDER
RCP	REINFORCED CONCRETE PIPE
RCPT	RECEPTACLE
RD	ROOF DRAIN
RECOM	RECOMMEND (ATION)
RED	REDUCER
REFRD	REFRIGERATED
REHAB	REHABILITATE
REINF	REINFORCE (ING)
REM	REMOVABLE
REQMT	REQUIREMENT (S)
REQ'D	REQUIRED
REV	REVISED (IONS)
RFRO	ROUND FLANGE ROUND OPENING
RGS	RIGID GALVANIZED STEEL
RM	ROOM
RMV	REMOVE
RPM	REVOLUTIONS PER MINUTE
RR	RAILROAD
R&R	REMOVE AND RELOCATE (REINSTALL)
R&S	REMOVE AND SAVE (SALVAGE)
RST	REINFORCING STEEL
RUB	RUBBER
RV	RELIEF VALVE
R/W	RIGHT OF WAY
R&W	REMOVE AND WASTE
RWD	REDWOOD
RWL	RAIN WATER LEADER
RWP	RAIN WATER PIPE
RX	AUXILIARY RELAY
S	START CONTACTOR
SA	SUPPLY AIR, SERVICE AIR
SARV	SEWAGE AIR RELEASE VALVE
SAVV	SEWAGE AIR VACUUM VALVE
SCAV	SEWAGE COMBINATION AIR VALVE
SCFM	STANDARD CFM
SCHED	SCHEDULE
SCV	SPLIT CHECK VALVE
SD	SPLITTER DAMPER, SOAP DISPENSER
SE	SEWER EASEMENT
SEC	SECOND
SECT	SECTION
SEL	SELECTOR
SFRO	SQUARE FLANGE ROUND OPENING
SFSO	SQUARE FLANGE SQUARE OPENING

SH	SHEET
SIM	SIMILAR
SLS	SARAN LINED STEEL
SO2	SULFUR DIOXIDE
SOLV	SOLENOID VALVE
SP	STRUCTURAL PLYWOOD, SLIDE GATE
S&P	SHELF AND POLE
SPEC	SPECIFICATIONS
SPRT	SUPPORT
SQ	SQUARE
SR	SHORT RADIUS
SRT	SOLIDS RETENTION TIME
SS	SERVICE SINK
SSB	SLUDGE STORAGE BASIN
SSB/S	STAINLESS STEEL BOLT W/ EXP SHIELD
S&S	STUB AND STOPPER
SST	STAINLESS STEEL
ST	START
STA	STATION
STD	STANDARD, STORM DRAIN
STIFF	STIFFENER
STL	STEEL
ST PR	STATIC PRESSURE
STR	STRAINER
STRG	STRONG
STRL	STRUCTURAL
SUC	SUCTION
SURF	SURFACE
SW	SWITCH
SWBD	SWITCHBOARD
SWD	SIDE WATER DEPTH
SX	AUXILIARY RELAY TO S
T&B	TOP AND BOTTOM
TB	THRUST BLOCK
TBA	TO BE ABANDONED
TC	TIME CLOSING CONTACT
TD	TANK DRAIN, TOWEL DISPENSER
TDH	TOTAL DYNAMIC HEAD
TE	TOTALLY ENCLOSED
TEL	TELEPHONE
TEMP	TEMPERATURE
T&G	TONGUE AND GROOVE
TH	TOILET PAPER HOLDER
THERM	THERMOMETER
THK	THICK
THY	THYRITE PROTECTOR
TIM	TIME METER - HOURS
TO	TIME OPENING
TOC	TOTAL ORGANIC CARBON, TOP OF CONCRETE
TOW	TOP OF WALL
TPI	TEST POWER INTERLOCK
TPU	TIME PICK-UP
TR	TIMING RELAY
TRANS	TRANSITION
TRD	STAIR TREAD
TS	STRUCTURAL TUBE
TSB	TERTIARY STORAGE BASINS
TSS	TOTAL SUSPENDED SOLIDS
TV	THERMOSTATIC VALVE
TYP	TYPICAL
UGND	UNDERGROUND
UHMW	ULTRA HIGH MOLECULAR WEIGHT
UN	UNION
UNO	UNLESS NOTED OTHERWISE
U/P	UTILITY POLE
UR	URNAL
V	VALVE, VENT, VOLTS
VAC	VACUUM, VOLTS, ALT CURRENT
VAR	VARIES (ABLE)
VAT	VINYL ASBESTOS TILE
VB	VALVE BOX, VACUUM BREAKER
VCP	VITRIFIED CLAY PIPE
VDC	VOLTS DIRECT CURRENT
VERT	VERTICAL
VG	VACUUM GAUGE
VSW	VACUUM SWITCH
VT	VINYL TILE
VTR	VENT THROUGH ROOF
W	WATTS, WIDTH
W/	WITH
WA	WEDGE ANCHOR
WC	WATER CLOSET, WATER COLUMN
WCO	WALL CLEANOUT
WD	WOOD
WG	WASTE GAS
WH	WATER HEATER, WHARF HYDRANT
WI	WROUGHT IRON
W/O	WITHOUT
WP	WEATHERPROOF
WPJ	WEAKENED PLANE JOINT
WS	WATER SURFACE
WSP	WELDED STEEL PIPE
WSTP	WATERSTOP
WTRPRF	WATERPROOF
WTRTT	WATERTIGHT
WWF	WELDED WIRE FABRIC
WWTP	WASTEWATER TREATMENT PLANT
WTHPRF	WEATHERPROOF
WWTRF	WASTEWATER TREATMENT AND RECLAMNTION FACILITY
XFMR	TRANSFORMER
YCO	YARD CLEANOUT
ZOP	ZINC ORTHOPHOSPHATE

Revision	By	Appd	YYYY.MM.DD

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REGISTERED PROFESSIONAL ENGINEER STEVEN L. BECK No. 43799 Exp.6/30/23 CIVIL STATE OF CALIFORNIA

2023/03/14

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WWTF PHASE VI PROJECT
HEADWORKS IMPROVEMENTS

City of Merced, California

File Name: 313298-G005	ASB	BPC	SLB	2023.03.14
	Dwn.	Dsgn.	Chkd.	YYYY.MM.DD

Title

ABBREVIATIONS

Project No.	Scale
184031329	NONE
Revision	Sheet
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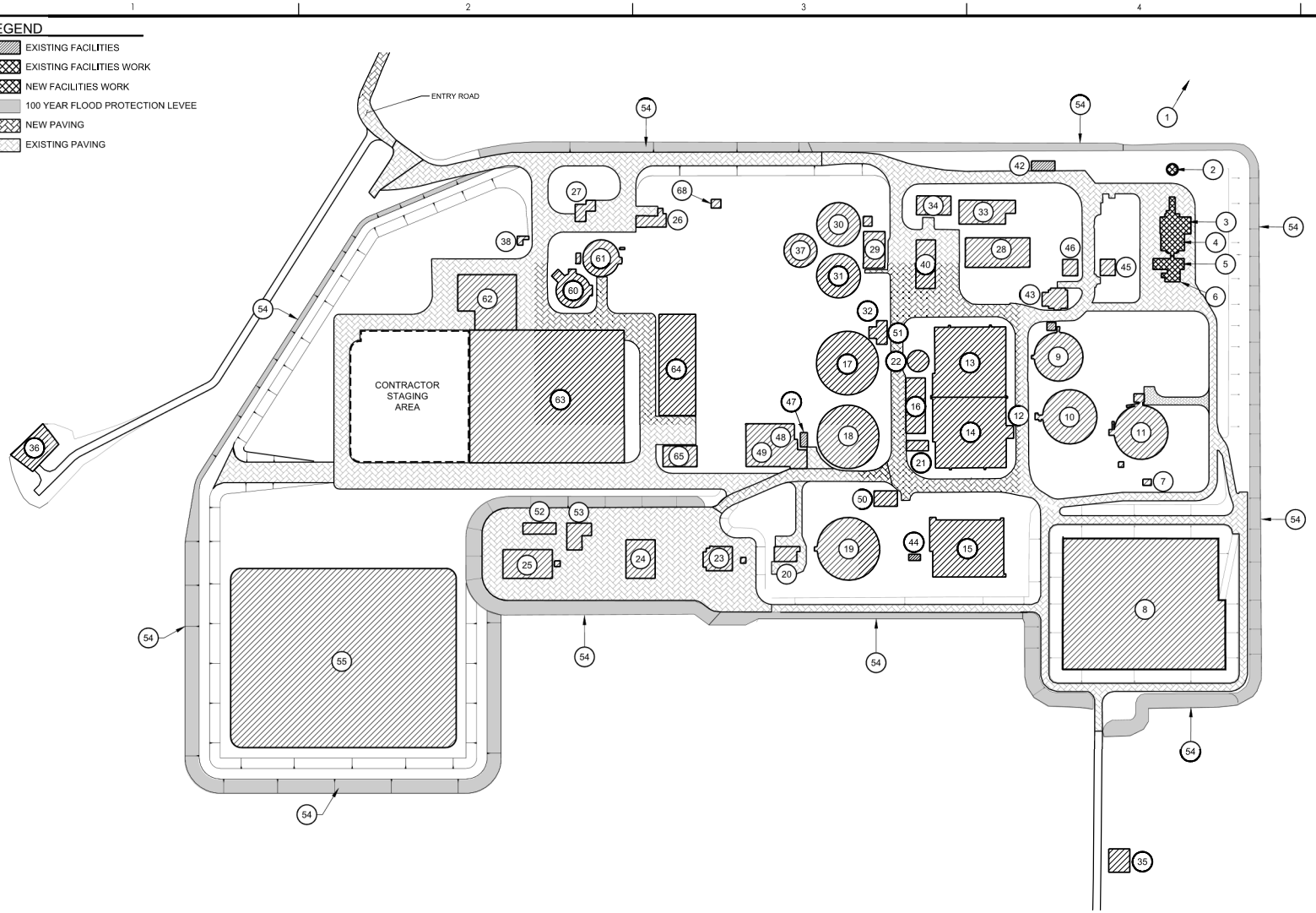
Drawing No. G005



FACILITIES INDEX

1 SEWER INFLUENT JUNCTION STRUCTURE (NOT SHOWN)
2 NEW METER MANHOLE
3 HEADWORKS - INFLUENT PUMP STATION
4 HEADWORKS - SCREENING CHANNELS
5 HEADWORKS - GRIT BASINS
6 HEADWORKS - PRIMARY CLARIFIER SPLITTER BOXES
7 EQUALIZATION BASIN INLET-OUTLET BOX
8 EQUALIZATION BASIN 1
9 PRIMARY CLARIFIER 1
10 PRIMARY CLARIFIER 2
11 PRIMARY CLARIFIER 3
12 AERATION SPLITTER BOX
13 AERATION BASIN 1
14 AERATION BASIN 2
15 AERATION BASIN 3
16 BLOWER BUILDING 1
17 SECONDARY CLARIFIER 1
18 SECONDARY CLARIFIER 2
19 SECONDARY CLARIFIER 3
20 TERITARY PUMP STATION
21 RAS PUMP STATION 1
22 DAFT 1
23 RAPID MIX AND FLOCCULATION BASINS
24 TERTIARY FILTERS
25 UV DISINFECTION FACILITY
26 DEBRIS RECEIVING STATION
27 SEPTAGE RECEIVING STATION
28 LAB
29 DIGESTER CONTROL BUILDING 1
30 PRIMARY DIGESTER 1
31 PRIMARY DIGESTER 2
32 WASTE GAS FLARE
33 OPERATIONS BUILDING
34
35 OFF-SITE RECLAMATION
36 OUTFALL STRUCTURE
37 CENTRATE EQUALIZATION TANK
38 CENTRATE PUMP STATION
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40 MAINTENANCE BUILDING
41
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43 ELECTRICAL BUILDING 2
44 ELECTRICAL BUILDING 3
45 MCC BUILDING 1
46 MCC BUILDING 2
47 STORAGE BUILDING
48 PLANT WATER PUMP STATION
49 PLANT WATER STORAGE BASIN
50 SODIUM HYPOCHLORITE FACILITY
51 CALCIUM THIOSULFATE FACILITY
52 CHEMICAL STORAGE FACILITY
53 CHEMICAL BUILDING
54 100-YEAR FLOOD CONTROL LEVEE
55 STORMWATER DETENTION BASIN
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60 SOLIDS HOLDING TANK
61 GAS HOLDING SYSTEM
62 SOLIDS DEWATERING BUILDING
63 ACTIVE SOLAR DRYERS
64 SOILDS STORAGE 1
65 SOILDS STORAGE 2
66
67
68 CONDENSATE TRAP

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REGISTERED PROFESSIONAL ENGINEER
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File Name: 313298-G006	ASB Dwn.	BPC Dsgn.	SLB Chkd.	2023.03.14 YYYY.MM.DD

Title

GENERAL SITE PLAN

Project No.	Scale
184031329	1" = 100'
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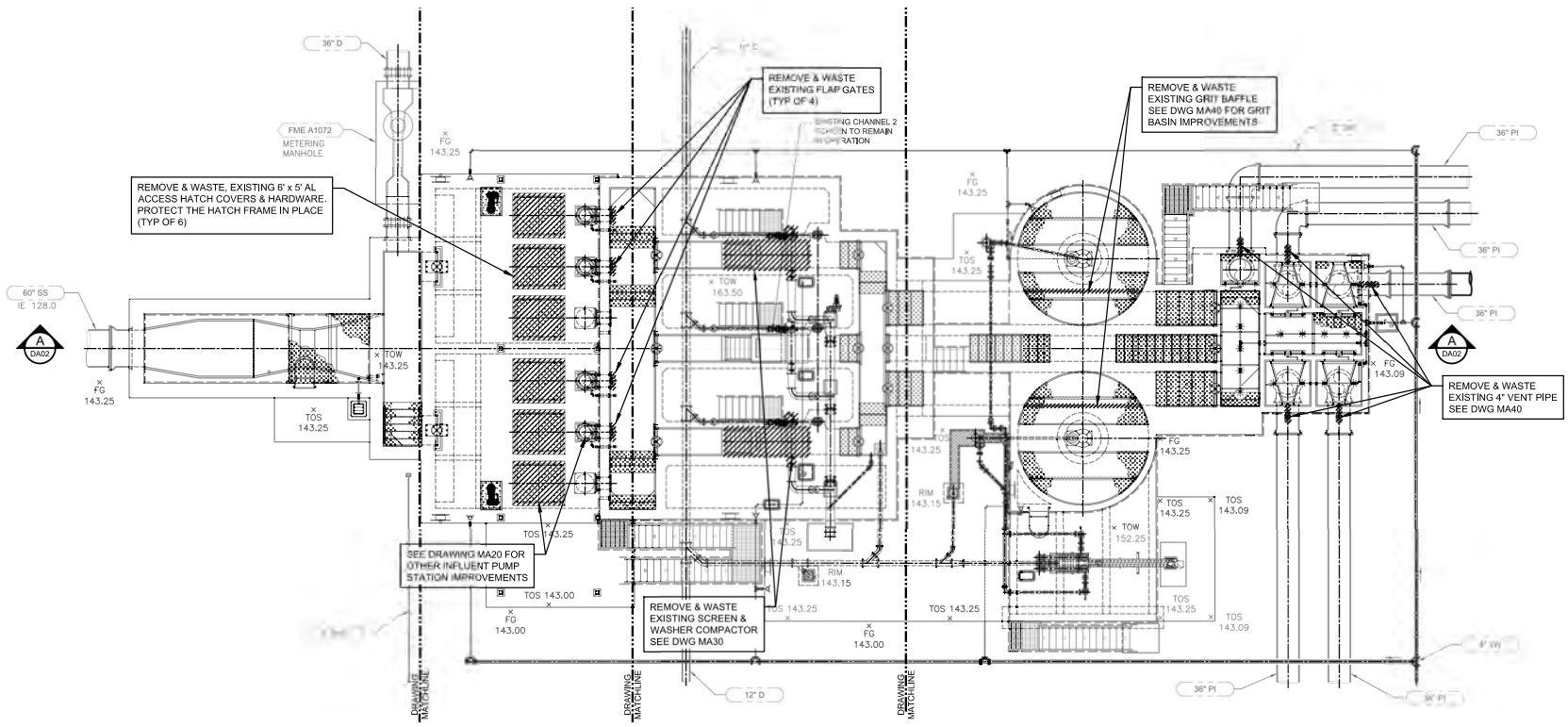
Drawing No.

G006



DEMOLITION OVERALL PLAN

SCALE: 1/8" = 1'-0"

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City of Merced, California

File Name: 313298-DA01

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EXISTING HEADWORKS
DEMOLITION
OVERALL PLAN

Project No.	Scale
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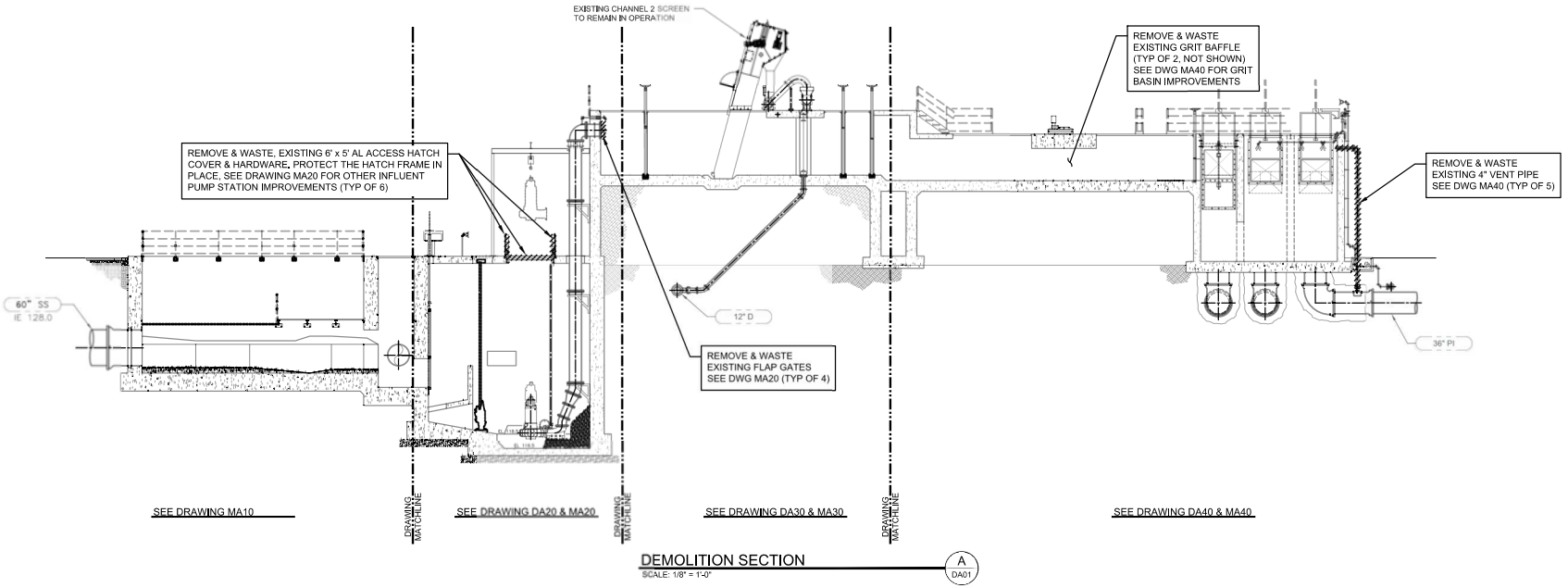
DA01	

ORIGINAL SHEET - ANSI D



DEMOLITION SECTION (A / DA01)
SCALE: 1/8" = 1'-0"

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Issued	By	Appd	YYYY.MM.DD
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File Name: 313298-DA01

Dwn.	Dsgn.	Chkd.	YYYY.MM.DD
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Title
EXISTING HEADWORKS
DEMOLITION SECTION

Project No.	Scale
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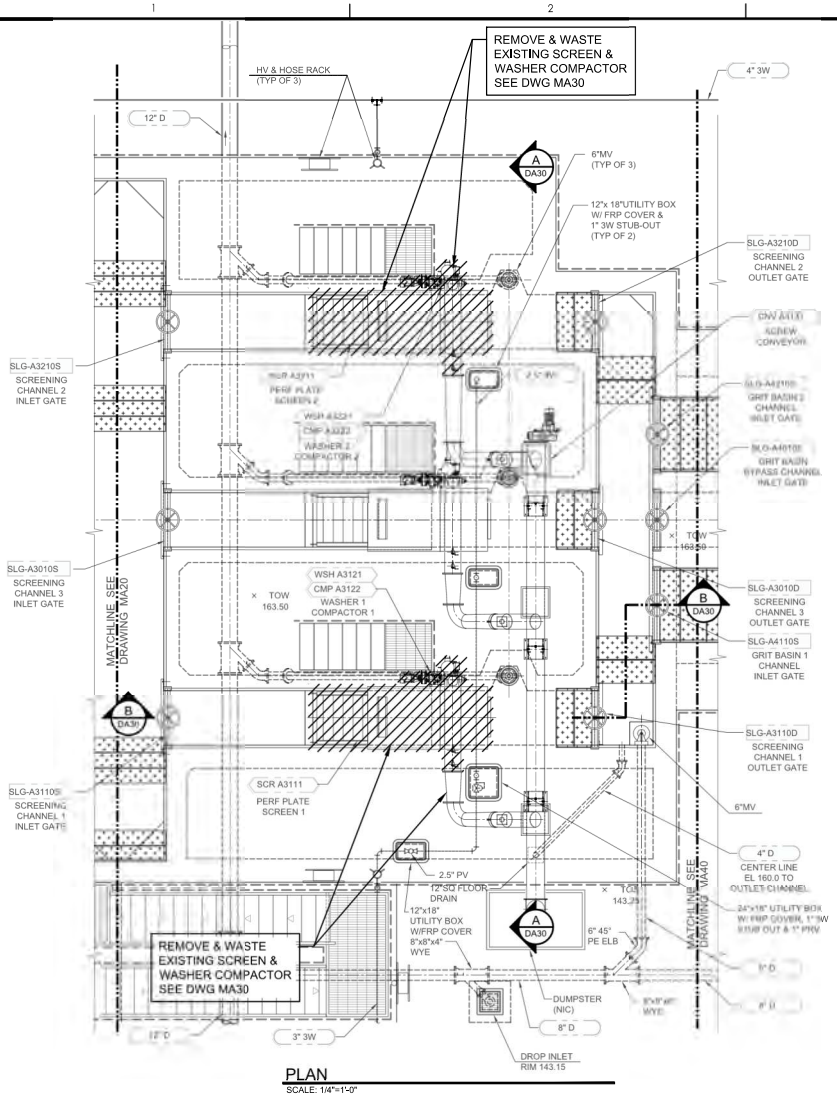
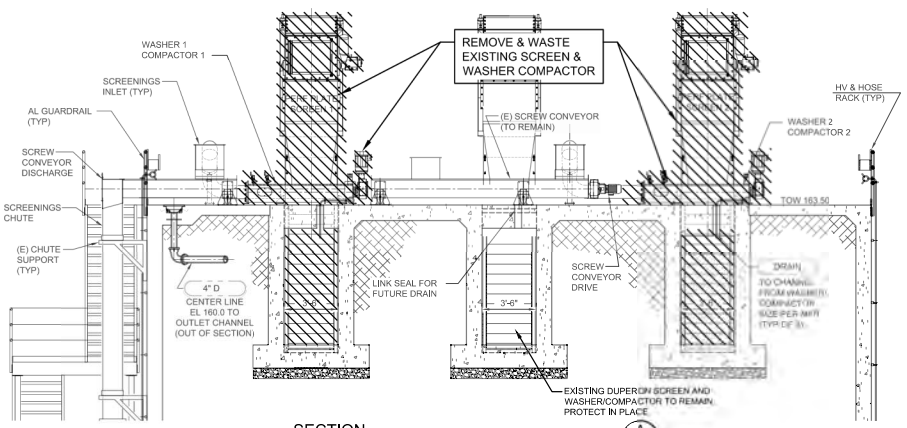
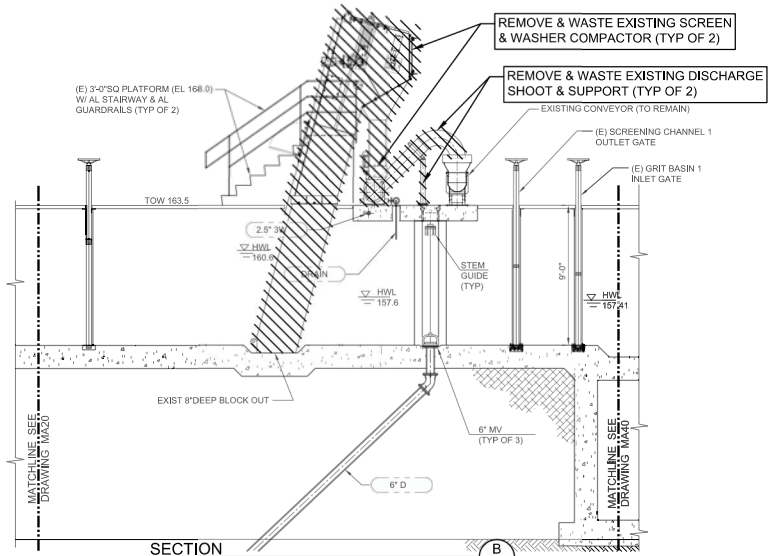
ORIGINAL SHEET - ANSI D



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



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



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

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File Name: 313298-DA30	ASB Dwn.	BPC Dsgn.	SLB Chkd.	2023.03.14 YYYY.MM.DD

Title
EXISTING HEADWORKS SCREENING CHANNELS DEMOLITION PLAN AND SECTIONS

Project No.	Scale
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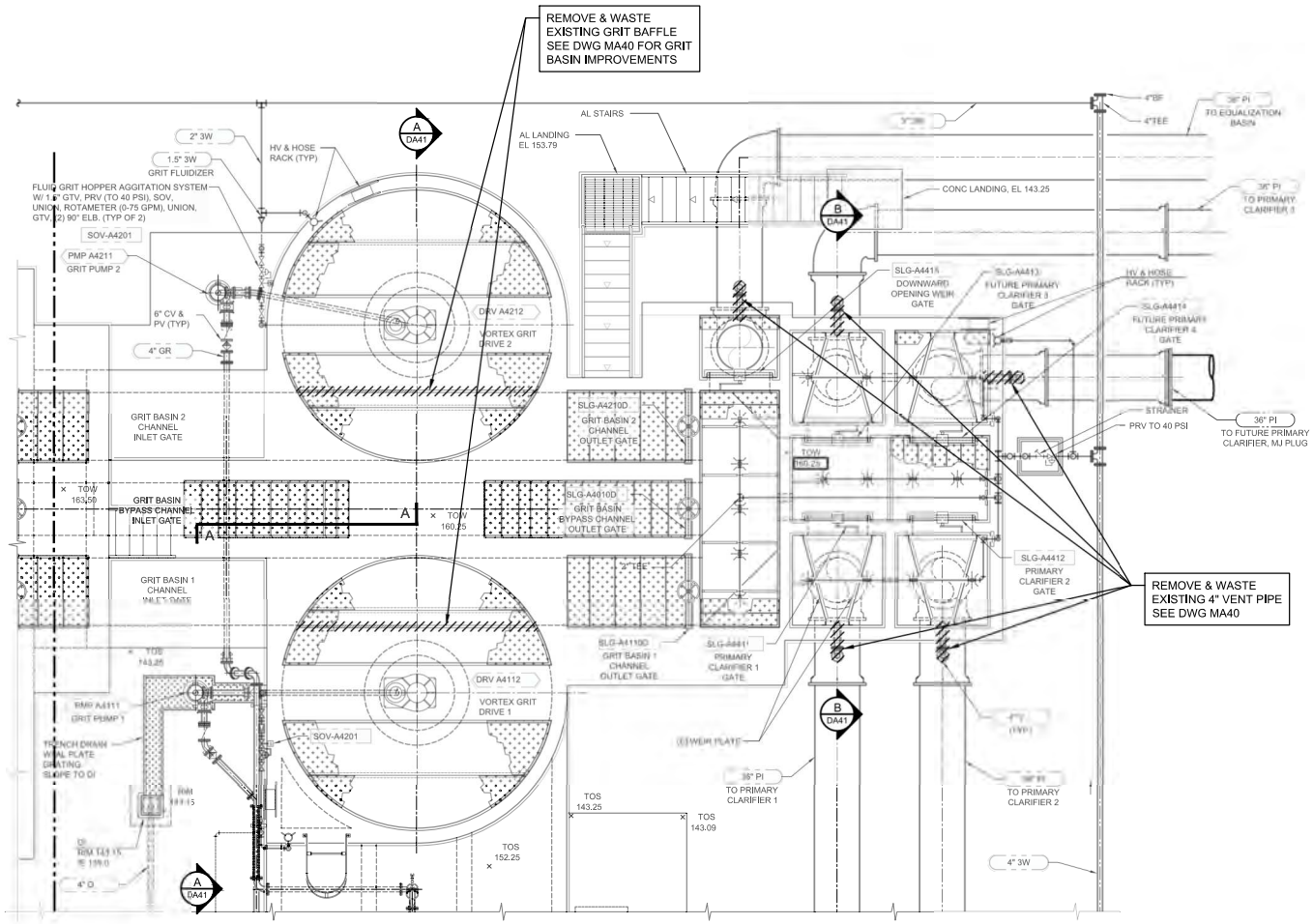
Drawing No.
DA30

ORIGINAL SHEET - ANSI D



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

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File Name: 313298-DA40	ASB	BPC	SLB	2023.03.14
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Title

EXISTING HEADWORKS
GRIT BASINS
DEMOLITION PLAN

Project No.	Scale
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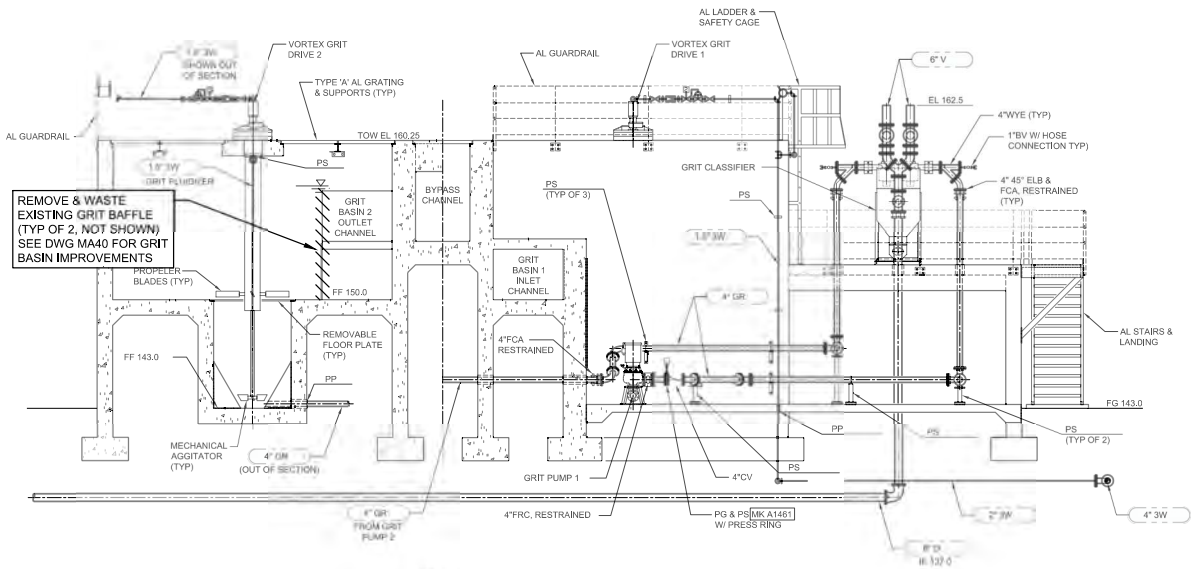
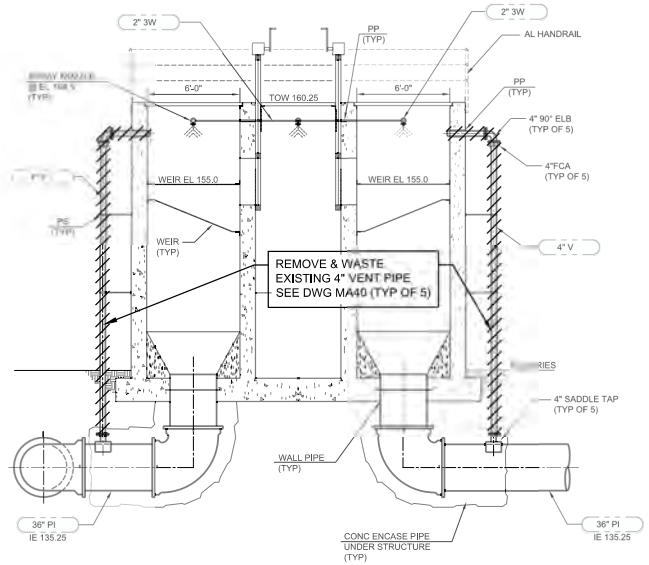
DA40	



SECTION A DA40
SCALE: 1/4"=1'-0"



SECTION B DA40
SCALE: 1/4"=1'-0"

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Title
EXISTING HEADWORKS GRIT BASINS DEMOLITION SECTIONS

Project No.	Scale
184031329	1/4" = 1'-0"
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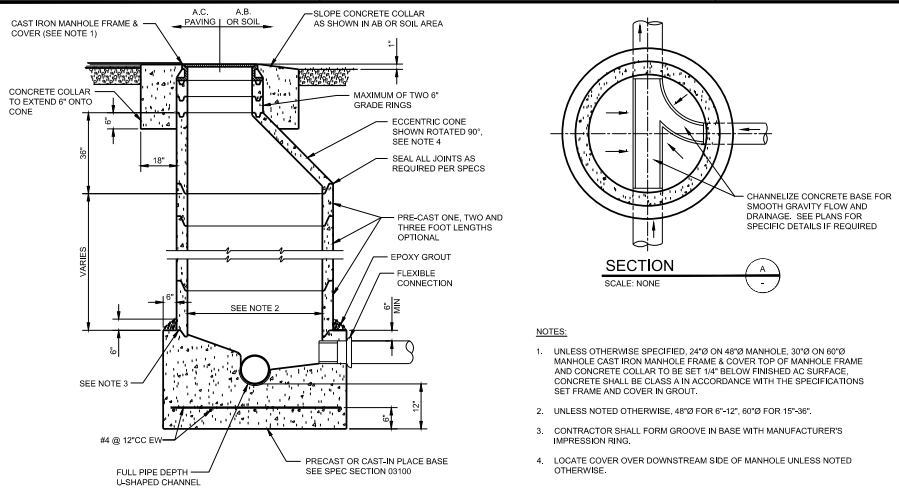
ORIGINAL SHEET - ANSI D

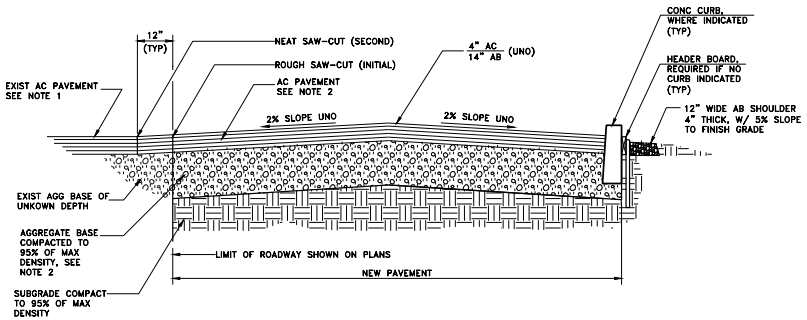


SECTION
SCALE: NONE
A
-

NOTES:

1. UNLESS OTHERWISE SPECIFIED, 24"Ø ON 48"Ø MANHOLE, 30"Ø ON 60"Ø MANHOLE CAST IRON MANHOLE FRAME & COVER TOP OF MANHOLE FRAME AND CONCRETE COLLAR TO BE SET 1/4" BELOW FINISHED AC SURFACE. CONCRETE SHALL BE CLASS A IN ACCORDANCE WITH THE SPECIFICATIONS SET FRAME AND COVER IN GROUT.
2. UNLESS NOTED OTHERWISE, 48"Ø FOR 6'-12", 60"Ø FOR 15'-36".
3. CONTRACTOR SHALL FORM GROOVE IN BASE WITH MANUFACTURER'S IMPRESSION RING.
4. LOCATE COVER OVER DOWNSTREAM SIDE OF MANHOLE UNLESS NOTED OTHERWISE.

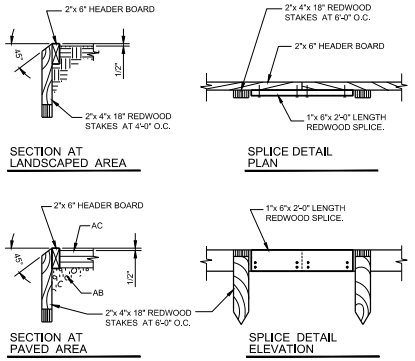
MANHOLE
SCALE: NONE
C101
TYP



NOTES:

1. FOG SEAL SHALL EXTEND 2'-0" ONTO EXISTING PAVEMENT.
2. AC PAVEMENT AND AGG BASE SHALL BE PLACED TO THE MIN DEPTHS INDICATED (SEE LEGEND, DWG G005, 4"/14", 4"/8").

ASPHALT CONCRETE ROADWAY
SCALE: NONE
C600
TYP



SECTION AT LANDSCAPED AREA

SPLICE DETAIL PLAN

SECTION AT PAVED AREA

SPLICE DETAIL ELEVATION

HEADER BOARD NOTES:

1. INSTALL ALL STAKES AND SPLICES ON PLANTING SIDE OF HEADER BOARD.
2. ALL FASTENERS SHALL BE GALVANIZED WOODSCREWS.
3. ALL HEADER BOARD LUMBER SHALL BE COMMINGLED RECYCLED PLASTIC LUMBER. ALL STAKE AND SPLICE LUMBER SHALL BE REDWOOD, ROUGH CONSTRUCTION HEART GRADE IN ACCORDANCE TO CALIFORNIA REDWOOD ASSOCIATION GRADING RULES.

HEADER BOARD - RECYCLED PLASTIC
SCALE: NONE
C621
TYP

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WWTF PHASE VI PROJECT
HEADWORKS IMPROVEMENTS

City of Merced, California

File Name: 313298-C001

ASB	BPC	SLB	2023.03.14
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Title
TYPICAL CIVIL DETAILS

Project No.
184031329

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AS SHOWN

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0

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C001

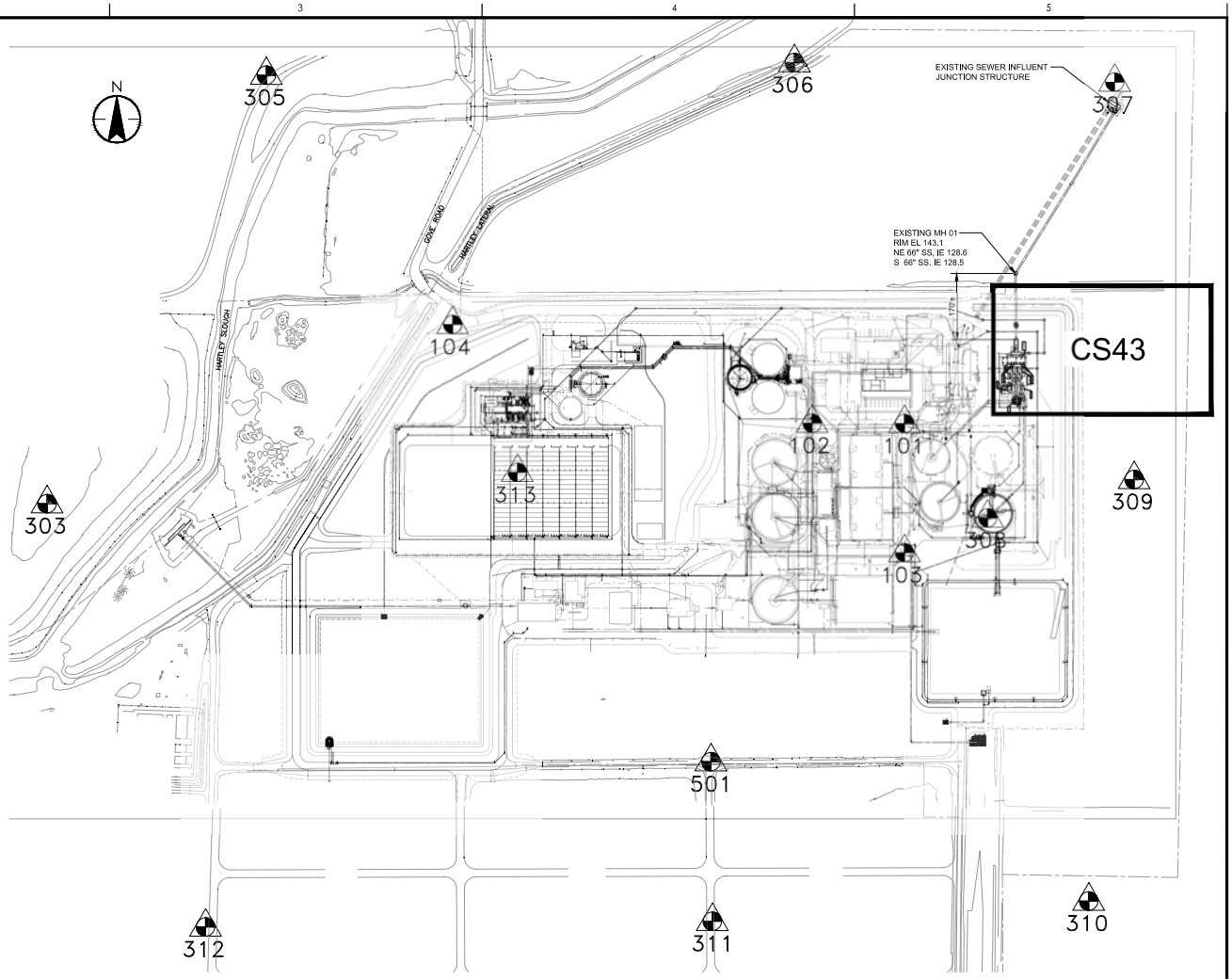
GENERAL CIVIL NOTES:

1. THE CONTRACTOR SHALL REPAIR AND REPLACE IN KIND ALL DAMAGED ROADS, FROM WEAR DURING CONSTRUCTION ACTIVITIES, SEE SPECIFICATIONS FOR DETAILS.
2. THE CONTRACTOR SHALL INSURE THAT ALL CONSTRUCTION EQUIPMENT AND ACTIVITIES ARE CONFINED TO THE DESIGNATED WORK AREA.
3. THE CONTRACTOR SHALL EXAMINE THE PROJECT WORK AREAS PRIOR TO BIDDING TO SATISFY HIMSELF AS TO THE NATURE AND EXTENT OF THE EXISTING SITE CONDITIONS THAT WILL BE ENCOUNTERED.
4. THE CONTRACTOR SHALL ASSUME SOLE AND COMPLETE RESPONSIBILITY FOR JOB SITE CONDITIONS DURING CONSTRUCTION OF THIS PROJECT, INCLUDING SAFETY OF ALL PERSONS AND PROPERTY. THIS REQUIREMENT SHALL APPLY CONTINUOUSLY, AND NOT BE LIMITED TO NORMAL WORKING HOURS.
5. THE CONTRACTOR SHALL BE RESPONSIBLE FOR ALL EXCAVATING AND SHORING PROCEDURES AND CONFORM TO THE LATEST O.S.H.A. REQUIREMENTS.
6. THE CONTRACTOR SHALL NOTIFY THE OWNER 48 HOURS PRIOR TO BEGINNING CONSTRUCTION, AND 24 HOURS NOTICE FOR ALL INSPECTIONS DURING CONSTRUCTIONS, UNLESS OTHERWISE NOTED.
7. THE CONTRACTOR SHALL PROVIDE AND MAINTAIN AT ALL TIMES EMERGENCY ACCESS TO THE PROJECT SITE TO THE SATISFACTION OF THE FIRE DEPARTMENT. CONTRACTOR MAINTAIN AT ALL TIMES ACCESS TO THE CHEMICAL BUILDING BY CHEMICAL DELIVERY TRUCKS.
8. IF AT ANY TIME DURING CONSTRUCTION, EVIDENCE OF SOIL AND/OR GROUNDWATER CONTAMINATION FROM HAZARDOUS MATERIAL IS ENCOUNTERED, THE CONTRACTOR SHALL IMMEDIATELY STOP WORK IN THE AREA WHERE HAZARDOUS MATERIAL IS ENCOUNTERED AND CONTACT THE OWNER. WORK WITHIN THE CONTAMINATED AREA SHALL REMAIN STOPPED UNTIL THERE IS RESOLUTION OF THE CONTAMINATION PROBLEM TO THE SATISFACTION OF THE OWNER.
9. THE CONTRACTOR SHALL VERIFY IN THE FIELD ALL ELEVATIONS, FLOW LINES, AND POINTS OF CONNECTION TO EXISTING IMPROVEMENTS. ANY DISCREPANCIES SHALL BE BROUGHT TO THE ATTENTION OF THE ENGINEER PRIOR TO PROCEEDING.
10. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE PROTECTION OF ALL EXISTING SURVEY MONUMENTS OR MARKERS DURING CONSTRUCTION. ALL SUCH MONUMENTS OR MARKERS DESTROYED OR DISTURBED DURING CONSTRUCTION SHALL BE REPLACED IN ACCORDANCE WITH CITY STANDARDS BY LICENSED CA LAND SURVEYOR AT THE CONTRACTORS EXPENSE.
11. UNLESS OTHERWISE NOTED ALL PIPELINES SHALL HAVE A MINIMUM COVER OF 3 FEET.
12. ANY EXISTING CONCRETE SURFACE TO BE REMOVED SHALL BE SAW CUT TO A NEAT STRAIGHT LINE.
13. THE CONTRACTOR SHALL MAINTAIN ALL EXISTING DRAINAGE FACILITIES WITHIN THE CONSTRUCTION AREA UNTIL IMPROVEMENTS ARE COMPLETED.
14. THE CONTRACTOR SHALL POTHOLE TO DETERMINE THE EXACT LOCATION AND DEPTH OF ALL BURIED PIPING AND UTILITIES SHOWN ON THE DRAWINGS WITHIN THE CONSTRUCTION AREA AT NO ADDITIONAL COST TO THE OWNER. ADJUSTMENTS REQUIRED BASED ON DIFFERENCES FOUND COMPARED TO WHAT IS SHOWN OR LABELED SHALL BE APPROVED BY THE ENGINEER.
15. DEWATERING WILL BE REQUIRED IN PORTION OF THE PROJECT. THE CONTRACTOR SHALL PROVIDE ALL EQUIPMENT AS NEEDED TO DEWATER EXCAVATIONS IN ACCORDANCE WITH THE SPECIFICATIONS.
16. FOR SEQUENCE OF CONSTRUCTION, BYPASS PUMPING REQUIREMENTS, AND OPERATIONAL SHUTDOWNS. SEE SPECIFICATION SECTION 01020.
17. CONTRACTOR SHALL INSTALL CLAY CUTOFF COLLARS ON PIPING AT ALL EMBANKMENT PENETRATIONS.
18. HYDROSEED DISTURBED AREAS SEE SPECIFICATIONS.

POINT NUMBER	NORTHING	EASTING	ELEVATION	DESCRIPTION
1	1850421.29	6558627.26	122.16	NGS F 982 (PID HS 1435)
2	1906182.79	6501782.06	94.22	NGS CRANE (PID AA4254)
3	1963365.86	6497437.22	134.27	NGS LIVINGSTON RESET (PID HS5446)
4	1927396.56	6568471.27	167.28	NGS E 1420 (PID HS4523)
101	1915033.60	6554402.65	144.92	PK NAIL
102	1915034.36	6554165.36	144.90	PK NAIL
103	1914702.19	6554402.52	148.67	PK NAIL
104	1915287.57	6553243.29	147.38	PHOTO X
106	1921929.85	6553361.96	147.06	ALUMINUM DISK RCE 15310
107	1922034.60	6559908.40	154.35	ALUMINUM DISK RCE 15310
108	1922119.34	6565243.70	159.86	NGS R 938 (PID HS1299)
109	1932735.66	6554897.35	163.47	NGS S 939 RESET (NO DATASHEET)
110	1932710.99	6550711.92	155.65	NGS T 939 (PID HS1795)
111	1931979.92	6565338.58	168.18	NGS X 84 (PID HS1148)
301	1913839.83	6551708.97	140.48	HUB AND TACK AT CLOTH PX
302	1914704.84	6551880.69	140.02	HUB AND TACK AT CLOTH PX
303	1914828.63	6552204.34	162.14	RBRC AT CLOTH PX
304	1916006.02	6551660.24	140.21	HUB AND TACK AT CLOTH PX
305	1915927.53	6552766.96	142.18	REBAR AND CAP AT CLOTH PX
306	1915959.83	6554121.56	145.19	REBAR AND CAP AT CLOTH PX
307	1915909.30	6554942.45	143.36	HUB AND TACK AT CLOTH PX
308	1914791.36	6554615.70	148.77	REBAR AND CAP AT CLOTH PX
309	1914890.50	6554993.34	142.24	HUB AND TACK AT CLOTH PX
310	1913809.16	6554876.87	141.56	HUB AND TACK AT CLOTH PX
311	1913757.21	6553911.29	145.34	REBAR AND CAP AT CLOTH PX
312	1913742.54	6552610.89	146.37	REBAR AND CAP AT CLOTH PX
313	1914908.32	6553409.73	144.35	REBAR AND CAP AT CLOTH PX
501	1914166.77	6553907.72	145.40	REBAR BASE

BASIS OF CONTROL (NAD83, NAVD88, SFT): BEARINGS AND DISTANCES SHOWN ARE BASED ON THE NORTH AMERICAN DATUM OF 1983 (NAD83) CONVERTED TO THE CALIFORNIA COORDINATE SYSTEM OF 1983, ZONE 3 (CCS83-III) AS REFERENCED BY AVAILABLE NGS PUBLISHED CONTROL MONUMENTS. GRID DISTANCES SHOWN MUST BE MULTIPLIED BY 1.00003501 TO OBTAIN GROUND DISTANCES. THE COMBINED SCALE FACTOR WAS SELECTED AT POINT 501. ELEVATIONS SHOWN ARE BASED ON AVAILABLE NGS PUBLISHED NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88) AS REFERENCED BY AVAILABLE NGS PUBLISHED BENCHMARKS. UNITS SHOWN ARE SURVEY FEET, EPOCH DATE 1991.35 ADJUSTMENT.

SURVEY CONTROL POINTS



KEY MAP
SCALE: NONE

Revision	By	Appd	YYYY.MM.DD

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Permit/Seal

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WWTF PHASE VI PROJECT
HEADWORKS IMPROVEMENTS

City of Merced, California

File Name: 313298-C010	ASB	SLB	BPC	2023.03.14
	Dwn.	Dsgn.	Chkd.	YYYY.MM.DD

Title
GENERAL CIVIL NOTES, SURVEY CONTROL POINTS AND KEY MAP

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184031329	NONE
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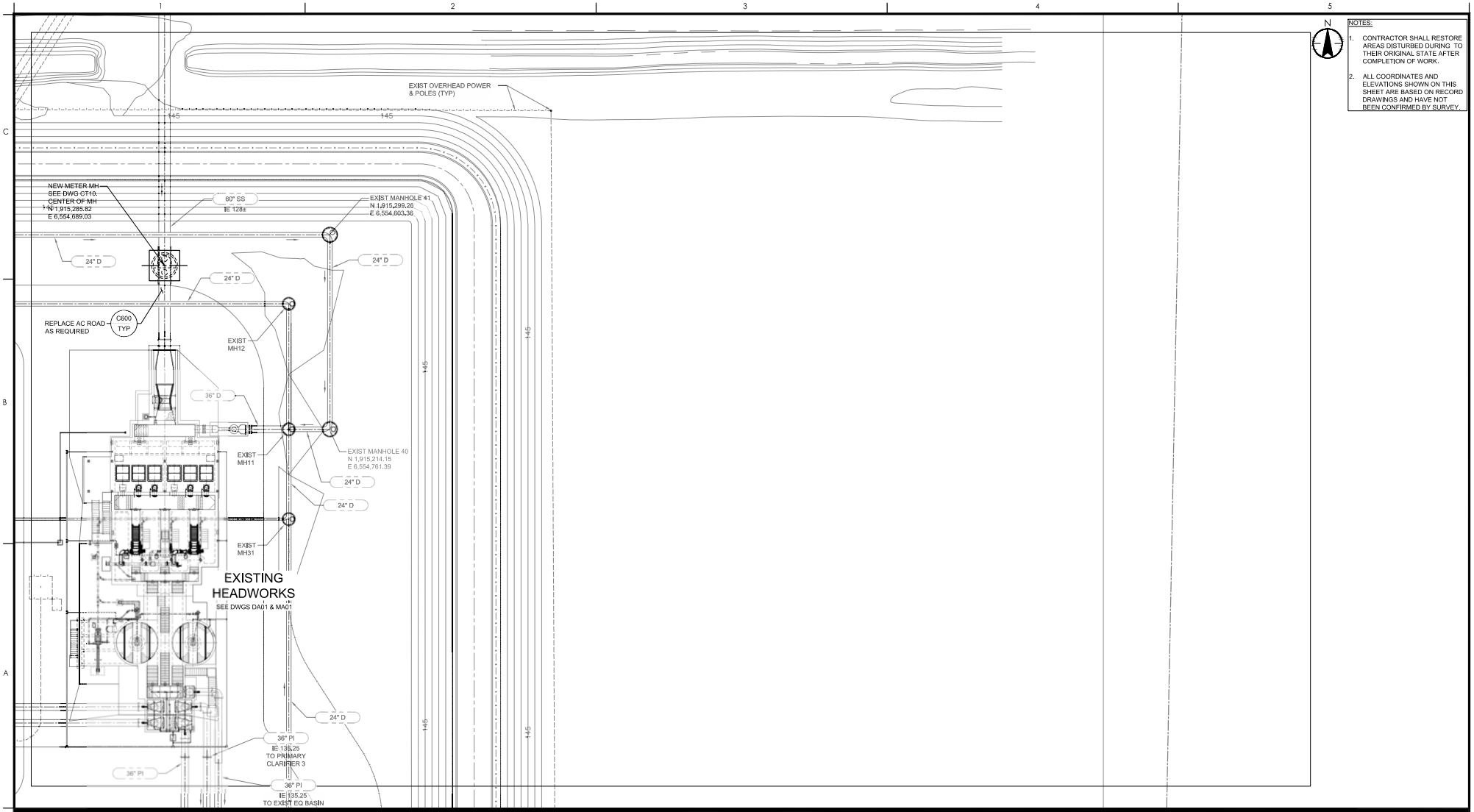
C010	



N

NOTES:

1. CONTRACTOR SHALL RESTORE AREAS DISTURBED DURING TO THEIR ORIGINAL STATE AFTER COMPLETION OF WORK.
2. ALL COORDINATES AND ELEVATIONS SHOWN ON THIS SHEET ARE BASED ON RECORD DRAWINGS AND HAVE NOT BEEN CONFIRMED BY SURVEY.

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WWTF PHASE VI PROJECT
HEADWORKS IMPROVEMENTS

City of Merced, California

File Name: 313298-CS43

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Title

YARD PIPING PLAN
NEW FLOW METERING MANHOLE
AND HEADWORKS AREA

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184031329	1" = 20'
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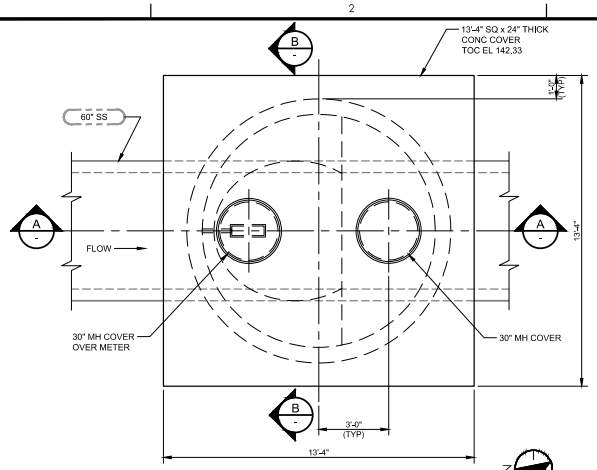
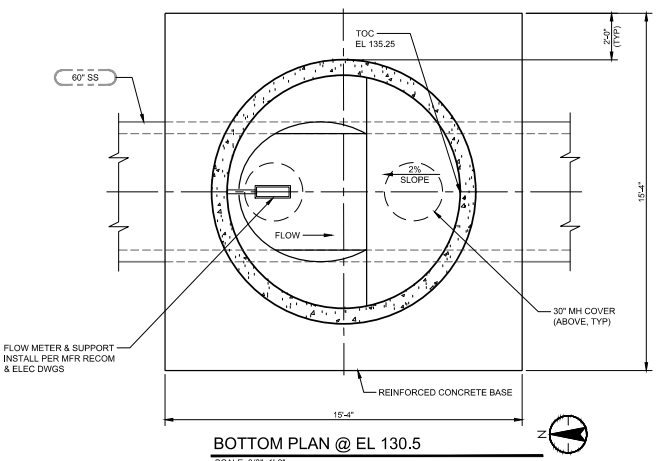
CS43



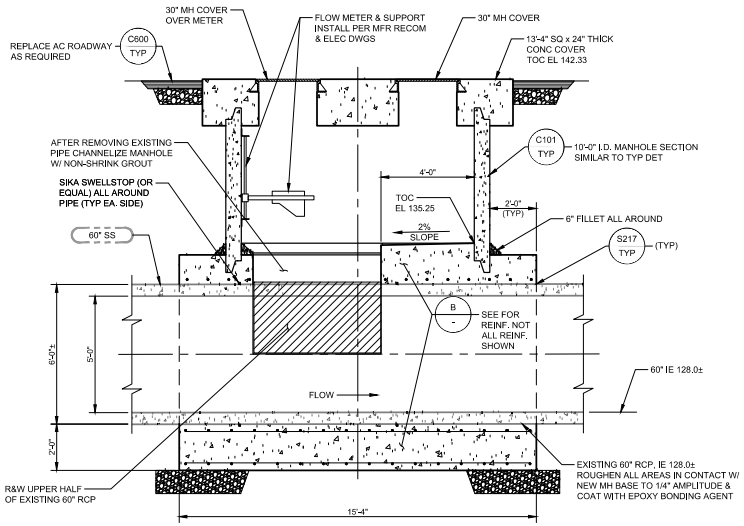
TOP PLAN

SCALE: 3/8"=1'-0"



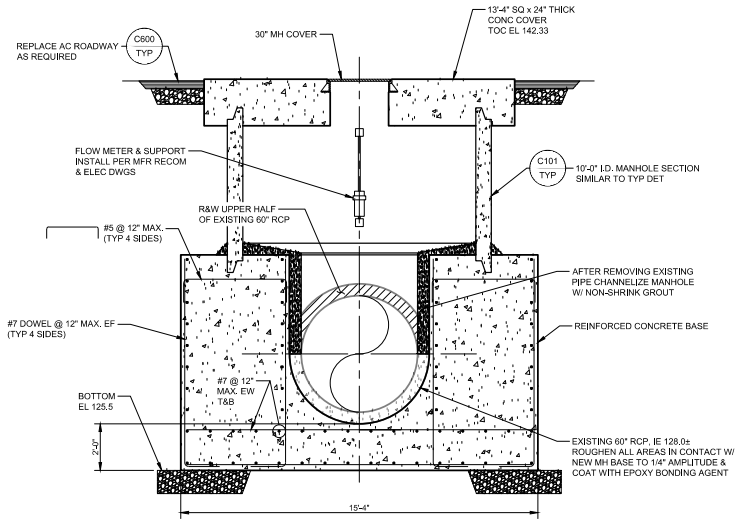
BOTTOM PLAN @ EL 130.5

SCALE: 3/8"=1'-0"



SECTION A

SCALE: 3/8"=1'-0"



SECTION B

SCALE: 3/8"=1'-0"

Revision	By	Appd	YYYY.MM.DD
0			

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WWTF PHASE VI PROJECT
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City of Merced, California

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Title

NEW FLOW METERING MANHOLE
PLANS AND SECTIONS

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CT10

ABBREVIATIONS:

ADDL	ADDITIONAL
AB	AGGREGATE BASE, ANCHOR BOLT
AC	ASPHALT CONCRETE
ACP	ASBESTOS CEMENT PIPE
AL	ALUMINUM
ALT	ALTERNATE
APPROX	APPROXIMATE (LY)
ARCH	ARCHITECTURAL
@	AT
BETW	BETWEEN
BEV	BEVELED
BLKG	WOOD BLOCKING
BOT	BOTTOM
BRG	BEARING
BLDG	BUILDING
BF	BOTTOM OF FOOTING
B/W	BACK OF WALL
BIT CTD	BITUMINOUS COATED
CHK PL	CHECKERED PLATE
CLR	CLEAR
CL	CENTER LINE
CLSM	CONTROLLED LOW STRENGTH MATERIAL
CC	CENTER TO CENTER
CMU	CONCRETE MASONRY UNIT
COL	COLUMN
CONC	CONCRETE
CJ	CONSTRUCTION JOINT
CONT	CONTINOUS
CT J	CONTROL JOINT
CR J	CONTRACTION JOINT
CIP	CAST-IN-PLACE
CIDH	CAST-IN-DRILLED-HOLE
CTR	CENTER (ED)
CG	CENTER OF GRAVITY
CONST	CONSTRUCTION
COORD	COORDINATE
CSK	COUNTER SINK
CAB	CRUSHED AGGREGATE BASE
CAP	CORRUGATED ALUMINUM PIPE
D	DEPTH
db	BAR DIAMETER
DF	DOUGLAS FIR
DEMO	DEMOLITION
DIA	DIAMETER
DIM	DIMENSION
DN	DOWN
DWG	DRAWING
DL	DEAD LOAD
DIST	DISTANCE
DD	DOWN DRAIN
DIAPH	DIAPHRAGM
DSA	DIVISION OF STATE ARCHITECT
EXIST, (E)	EXISTING
EA	EACH
EF	EACH FACE
EJ	EXPANSION JOINT
EL, ELEV	ELEVATION
EQ	EQUAL
EQUIP	EQUIPMENT
EXT	EXTERIOR
EMBED	EMBEDMENT
EN	EDGE NAILING
ES	EACH SIDE
EW	EACH WAY
ENGR	ENGINEER, ENGINEERING
EXC	EXCAVATION
EXP	EXPANSION
FAB	FABRICATE
F & I	FURNISH AND INSTALL
FB	FACE OF BLOCK
FC	FACE OF CONCRETE
FD	FLOOR DRAIN
FF	FINISHED FLOOR, FACE OF FRAMING
FDN	FOUNDATION
FG	FINISHED GRADE
FS	FINISHED SURFACE, FACE OF STUD
F/S	FAR SIDE
FLG	FLANGE
FN	FIELD NAILING
FTG	FOOTING
FW	FACE OF WALL
FT	FEET (FOOT)
GA	GAGE
GAF	GALVANIZE AFTER FABRICATION
GALV	GALVANIZED
GS	GALVANIZED STEEL
GR	GUARD RAILING, GRADE
GTR	GUTTER
GRTG	GRATING
GSP	GALVANIZED STEEL PIPE
H	HIGH OR HEIGHT
HA	HEADED ANCHOR
HR	HANDRAIL
HSB	HIGH STRENGTH BOLT
HORIZ	HORIZONTAL
HW	HEAD WALL
HS	HIGH STRENGTH

ABBREVIATIONS (Continued):

ID	INSIDE DIAMETER
INCL	INCLUDING
INSP	INSPECTION
INV	INVERT
IE	INVERT ELEVATION
IF	INSIDE FACE
IN	INCH
JT	JOINT
JCT	JUNCTION
KP	KICK PLATE
KIPS	KILO POUNDS
L	LENGTH
LS	LAG SCREW
LAT	LATERAL
LB	POUND
LF	LINEAR FOOT
LL	LIVE LOAD
LT	LEFT
LONG	LONGITUDE
LONGIT	LONGITUDINAL
LTS	LIME TREATED SOIL
MANUF	MANUFACTURER
MAX	MAXIMUM
MB	MACHINE BOLT
MECH	MECHANICAL
MIN	MINIMUM
MPH	MILES PER HOUR
MISC	MISCELLANEOUS
(N)	NEW
NS	NON-SHRINK
N/S	NEAR SIDE
NTS	NOT TO SCALE
NO., NOS	NUMBER, NUMBERS
OC	ON CENTER
OD	OUTSIDE DIAMETER
OF	OUTSIDE FACE
OG	ORIGINAL GROUND
OE	OUTER EDGE
OH	OVERHEAD, OPPOSITE HAND
OPNG	OPENING
OPP	OPPOSITE
O-O	OUT TO OUT
PVMT	PAVEMENT
PL	PLATE
PREFAB	PREFABRICATED
PSI	POUNDS PER SQUARE INCH
P/S	PRESTRESSED
R	RADIUS
REINF	REINFORCEMENT
RC	REINFORCED CONCRETE
RCB	REINFORCED CONCRETE BOX
RCE	REGISTERED CIVIL ENGINEER
RET	RETAINING
RT	RIGHT
REQD	REQUIRED
SEC	SECTION
SF	SQUARE FOOT
SIM	SIMILAR
SPEC	SPECIFICATIONS
SHT	SHEET
STR	STRUCTURE/STRUCTURAL
SG	SUBGRADE
STD	STANDARD
SOG	SLAB ON GRADE
SP	STRUCTURAL PLYWOOD
SS	STAINLESS STEEL
SSB	STAINLESS STEEL BOLT
ST	STEEL
STIFF	STIFFENER
STAG	STAGGERED
STIR	STIRRUPS
SQ	SQUARE
SYMM	SYMMETRICAL
T & B	TOP AND BOTTOM
TF	TOP OF FOOTING
TOB	TOP OF BLOCK
TOC	TOP OF CONCRETE
TOG	TOP OF GRATING
TOS	TOP OF STEEL
TS	TUBE STEEL
TOW	TOP OF WALL
TYP	TYPICAL
TEMP	TEMPORARY
UG	UNDER GROUND
UNO (UON)	UNLESS NOTED OTHERWISE
VERT	VERTICAL
VOL	VOLUME
W	WIDTH
WS	WATERSTOP
WP	WORKING POINT
WH	WEEP HOLE
WM	WIRE MESH
WSP	WELDED STEEL PIPE
WWF	WELDED WIRE FABRIC
W/	WITH
W/O	WITHOUT

INSPECTION / OBSERVATION NOTES:

A. SPECIAL INSPECTIONS:

GENERAL: IN ADDITION TO THE INSPECTIONS REQUIRED BY 108 OF THE CURRENT CBC, THE OWNER SHALL EMPLOY A SPECIAL INSPECTOR DURING CONSTRUCTION ON THE FOLLOWING TYPES OF WORK. ALL INSPECTIONS SHALL BE PREFORMED IN ACCORDANCE WITH CHAPTER 17 OF THE CURRENT CBC. REFER TO CHAPTER 17 FOR ADDITIONAL REQUIREMENTS OF THE SPECIAL INSPECTOR.

- [x] 1. CONCRETE: DURING THE TAKING OF TEST SPECIMENS AND PLACING OF ALL REINFORCED CONCRETE.
- [x] 2. REINFORCING STEEL:
  a. DURING THE PLACING OF REINFORCING STEEL, FOR ALL STRUCTURAL CONCRETE
  b. DURING THE PLACEMENT OF ALL CONCRETE INSERTS.
- [x] 3. WELDING: DURING ALL STRUCTURAL WELDING INCLUDING WELDING OF REINFORCING STEEL. SUBMIT FIELD WELDERS CERTIFICATE TO THE DSA APPROVED WELDING INSPECTOR FOR APPROVAL PRIOR TO THE START OF WELDING.
- [x] 4. HIGH STRENGTH BOLTING: IN ACCORDANCE WITH CBC REQUIREMENTS.
- [ ] 5. STRUCTURAL MASONRY: IN ACCORDANCE WITH CBC REQUIREMENTS.
- [ ] 6. PILING, DRILLED PIERS AND CAISSIONS: DURING DRIVING AND TESTING OF PILES AND CONSTRUCTION OF CAST-IN-PLACE DRILLED PILES AND CAISSIONS.
- [ ] 7. SHOTCRETE: DURING THE TAKING OF TEST SPECIMENS AND PLACING OF SHOTCRETE PER CBC REQUIREMENTS.
- [ ] 8. GLULAM FABRICATION INSPECTION PER 2337A.1.
- [x] 9. A REPRESENTATIVE OF THE CIVIL ENGINEER OF RECORD SHALL BE PRESENT DURING THE GRADING, EXCAVATION AND FOUNDATION CONSTRUCTION.
- [x] 10. ADHESIVE ANCHOR INSTALLATION: PERFORM SPECIAL INSPECTION IN ACCORDANCE WITH THE REQUIREMENTS OF THE CBC. THE SPECIAL INSPECTOR MUST RECORD PRODUCT DESCRIPTION (INCLUDING PRODUCT NAME), ADHESIVE EXPIRATION DATE, CONCRETE TYPE AND STRENGTH, ANCHOR DIAMETER AND STEEL GRADE, COMPLIANCE OF DRILL BIT WITH THE ICC-ES REPORT, HOLE DIAMETER AND LOCATION, CLEANLINESS OF HOLE AND ANCHOR, ADHESIVE APPLICATION, AND ANCHOR EMBEDMENT. PERSONNEL USED FOR INSTALLATION SHALL BE CERTIFIED BY AN APPLICALBE CERTIFICATION PROGRAM PER ACI 318-14 SECTION 17.8.2.2.

B. STRUCTURAL OBSERVATIONS:

THE STRUCTURAL ENGINEER SHALL MAKE VISITS TO THE SITE TO OBSERVE GENERAL COMPLIANCE WITH THE APPROVED STRUCTURAL PLANS, SPECIFICATIONS AND CHANGE ORDERS. THE ENGINEER SHALL SUBMIT A STATEMENT IN WRITING TO THE BUILDING OFFICIAL STATING THE SITE VISITS HAVE BEEN MADE AND THAT ANY DEFICIENCIES NOTED HAVE BEEN CORRECTED.

- [x] 1. OBSERVE FOUNDATION EXCAVATIONS AND REINFORCEMENT PLACEMENT PRIOR TO THE PLACING OF CONCRETE. PROVIDE 48 HR. NOTICE.
- [ ] 2. OBSERVE EDGE NAILING ON PLYWOOD SHEAR WALLS AND ROOFS.
- [ ] 3. OBSERVE THE CONNECTION OF SEISMIC TIES, STRAPS AND CONNECTORS.
- [x] 4. PERFORM ADDITIONAL OBSERVATIONS, IF REQUIRED IN THE OPINION OF THE STRUCTURAL ENGINEER.

GENERAL NOTES:

1. TYPICAL STRUCTURAL DETAILS AND NOTES SHALL APPLY TO ALL "S" SHEETS UNLESS OTHERWISE SHOWN OR NOTED ON PLANS.
2. DETAILS OF CONSTRUCTION NOT FULLY SHOWN SHALL BE OF THE SAME NATURE AS SHOWN FOR SIMILAR CONDITION.
3. CONSTRUCTION SHALL CONFORM TO ALL APPLICABLE CODES AND REGULATIONS.
4. PRIOR TO FABRICATION, SHOP DRAWINGS SHALL BE SUBMITTED FOR REVIEW BY THE ENGINEER ON ALL STRUCTURAL STEEL, METAL DECK, STRUCTURAL ALUMINUM, REINFORCING STEEL, CONST. JT. LAYOUT AND CONCRETE MIX DESIGN. SHOP DRAWINGS: CONTRACTOR AGREES THAT SHOP DRAWING SUBMITTALS PROCESSED BY THE ENGINEER ARE NOT CHANGE ORDERS AND THAT THE PURPOSE OF SHOP DRAWING SUBMITTALS BY THE CONTRACTOR IS TO DEMONSTRATE TO THE ENGINEER THAT THE CONTRACTOR UNDERSTANDS THE DESIGN CONCEPT BY INDICATING WHICH MATERIAL HE INTENDS TO FURNISH AND INSTALL AND BY DETAILING THE FABRICATION AND INSTALLATION METHODS HE INTENDS TO USE.
5. SAFETY NOTE: IT IS THE CONTRACTOR'S RESPONSIBILITY TO COMPLY WITH THE PERTINENT SECTIONS OF THE A) "CONSTRUCTION SAFETY ORDERS" ISSUED BY THE STATE OF CALIFORNIA, LATEST EDITION, AND ALL OSHA REQUIREMENTS AS THEY APPLY TO THIS PROJECT. THE ENGINEER AND THE OWNER DO NOT ACCEPT ANY RESPONSIBILITY FOR THE CONTRACTOR'S B) FAILURE TO COMPLY WITH THESE REQUIREMENTS. THE CONTRACTOR SHALL BE RESPONSIBLE FOR ADEQUATE DESIGN AND CONSTRUCTION OF ALL C) FORMS AND SHORING REQUIRED.
6. CONTRACTOR SHALL VERIFY ALL DIMENSIONS, ELEVATIONS, PROPERTY LINES, ETC. ON THE JOB.
7. CONTRACTOR SHALL NOTIFY THE ENGINEER WHERE A CONFLICT OCCURS ON ANY OF THE CONTRACT DRAWINGS OR DOCUMENTS. CONTRACTOR IS NOT TO ORDER MATERIAL OR CONSTRUCT ANY PORTION OF STRUCTURES THAT IS IN CONFLICT UNTIL CONFLICT IS RESOLVED WITH THE AFFECTED PARTIES.
8. MECHANICAL AND ELECTRICAL EQUIPMENT SUPPORTS, ANCHORAGES, OPENINGS, RECESSES AND REVEALS NOT SHOWN ON THE STRUCTRUAL DRAWINGS, BUT REQUIRED BY OTHER CONTRACT DRAWINGS SHALL BE PROVIDED. OPENINGS THROUGH NEW AND EXISTING WALLS AND SLABS FOR PIPES, DUCTS CONDUITS, ETC. ARE NOT ALL SHOWN ON THE STRUCTURAL DRAWINGS. CONTRACTOR SHALL PROVIDE THESE OPENINGS IN ACCORDANCE WITH THE CONTRACT DOCUMENTS. REINFORCEMENT AROUND OPENINGS IN NEW WALLS AND SLABS SHALL BE AS SHOWN IN THE TYPICAL DETAILS UNLESS OTHERWISE SHOWN.
9. CONTRACTOR SHALL VERIFY MECHANICAL AND ELECTRICAL PLANS FOR THE LOCATION OF EQUIPMENT.

CONSTRUCTION LOADS:

STRUCTURES HAVE BEEN DESIGNED FOR OWNER'S OPERATIONAL LOADS ON THE FINISHED STRUCTURES. DURING CONSTRUCTION, THE CONTRACTOR IS RESPONSIBLE FOR PROTECTING AND BRACING THE STRUCTURES AND BALANCING WHEREVER EXCESSIVE CONSTRUCTION LOADS MAY OCCUR. BACKFILL SHALL BE PLACED AROUND STRUCTURES SYMMETRICALLY AND UNIFORMLY SO THAT LOADS AGAINST STRUCTURES ARE INTRODUCED IN BALANCE. LIQUID-CONTAINING STRUCTURES SHALL BE TESTED FOR WATER-TIGHTNESS BEFORE BACKFILLING - SEE SPECS.

CONCRETE AND REINFORCING STEEL:

1. CONCRETE CONSTRUCTION SHALL CONFORM TO ACI 350-06, ACI 318-14 AND ACI CODE OF STANDARD PRACTICE.
2. SEE SPECIFICATIONS FOR REQUIREMENTS.
3. CEMENT SHALL CONFORM TO ASTM C-150, TYPE II, MODIFIED/TYPE V.
4. CONCRETE AGGREGATES: NATURAL SAND AND ROCK AGGREGATES CONFORMING TO ASTM C-33.
5. REINFORCING SHALL CONFORM TO ASTM A706 GRADE 60 OR 70, EXCEPT #3 & #4 STIRRUPS AND TIES MAY BE GRADE40.
6. WELDING OF REINFORCING STEEL SHALL CONFORM TO AWS D1.4 USING PROPER LOW HYDROGEN ELECTRODES. TACK WELDING TO REBAR IS STRICTLY PROHIBITED. SEE "REBAR WELDING".
7. REINFORCING STEEL SHALL BE DETAILED, FABRICATED, AND INSTALLED ACCORDING TO "MANUAL OF STANDARD PRACTICE FOR REINFORCED CONCRETE CONSTRUCTION" BY CRSI.
8. WIRE FABRIC SHALL CONFORM TO ASTM A-185.
9. DIMENSIONS SHOWN FOR LOCATION OF REINFORCING ARE TO THE FACE OF MAIN BARS AND DENOTE CLEAR COVERAGE. UNLESS OTHERWISE NOTED, CLEAR COVERAGE SHALL BE AS FOLLOWS:
   CONCRETE DEPOSITED DIRECTLY AGAINST GROUND (EXCEPT SLABS) . . . . 3"
   FORMED CONCRETE EXPOSED TO WEATHER OR GROUND OR LIQUID
   #6 AND LARGER . . . . .2"
   #5 AND SMALLER . . . . 2"
   BEAMS (TOP BARS) . . . .$1\frac{1}{2}$"
   BEAMS (ALL OTHER MAIN REINFORCING) . . . . 2"
   COLUMN MAIN REINFORCING . . . . .2"
   SLABS ON GROUND WITH ONE LAYER OF REINFORCEMENT . . . . . POSITION IN CENTER OF SLAB
10. A) UNLESS OTHERWISE NOTED ALL BARS SHOWN WITH LAPS OR SPLICES SHALL HAVE CLASS 'B' LAP LENGTH. SEE TABLE BELOW .

CLASS 'B' LAP LENGTH

BAR SIZE	OTHER	TOP *
#3	1'-7"	2'-0"
#4	2'-1"	2'-8"
#5	2'-7"	3'-4"
#6	3'-1"	4'-0"
#7	4'-6"	5'-11"
#8	5'-2"	6'-9"
#9	5'-10"	7'-7"
#10	6'-7"	8'-6"
#11	7'-3"	9'-6"

* TOP REINFORCING IS HORIZONTAL REINFORCEMENT THAT HAS MORE THAN 12" OF CONCRETE PLACED BELOW IT.

B) DOWEL ALL VERTICAL REBARS IN WALLS AND COLUMNS FROM FOUNDATION WITH SAME SIZE AND SPACING AS WALL VERTICAL BAR U.N.O.
C) SPLICES IN ADJACENT HORIZ. BARS SHALL BE STAGGERED NOT LESS THAN 5'-0" APART.
D) SPLICE CONTINUOUS BARS IN SOIL-BEARING GRADE BEAMS AS FOLLOWS: BOTTOM BARS AT MID-SPAN, TOP BARS AT CENTERLINE OF SUPPORT, UNLESS NOTED OTHERWISE.
E) SPLICE CONTINUOUS BARS IN BEAMS, SPANDRELS, WALL BEAMS ETC. AS FOLLOWS: BOTTOM BARS AT CENTERLINE OF SUPPORT, TOP BARS AT MIDSPAN, UNLESS NOTED OTHERWISE.
F) REINFORCING BARS SHALL BE RUN IN A MANNER THAT FORMS A CONTINUOUS SYSTEM OF BARS TYING ALL PARTS OF THE STRUCTURE TOGETHER. EXTEND ALL REINFORCING BARS AS FAR AS POSSIBLE IN EACH CONCRETE MEMBER AND TERMINATE BAR W/ 90° STD. HOOK TO 2" OF CONCRETE COVER OVER END OF HOOK. FACE OR BEND.
G) BEAM STIRRUPS AND COLUMN TIES SHALL HOOK 135 DEGREES AROUND A CORNER BAR UNLESS NOTED OTHERWISE.

11. GENERAL:
    A) NO PIPES OR DUCTS SHALL BE PLACED IN CONCRETE SLABS, BEAMS, WALLS OR GRADE BEAMS UNLESS SPECIFICALLY DETAILED.
    B) REFER TO ARCHITECTURAL, STRUCTURAL, ELECTRICAL AND MECHANICAL DRAWINGS FOR ALL OPENINGS, FLANGES, MOULDS, GROOVES, CLIPS AND GROUNDS TO BE CAST IN CONCRETE.
12. CONSTRUCTION JOINTS SHALL BE MADE ROUGH AND ALL LAITANCE REMOVED FROM THE SURFACE. CONCRETE MAY BE ROUGHENED BY CHIPPING THE ENTIRE SURFACE, SANDBLASTING, OR HOSING THE SURFACE 4 TO 6 HOURS AFTER THE POUR WITH A FINE SPRAY.
13. REMOVE ALL DEBRIS FROM THE FORMS BEFORE PLACING ANY CONCRETE.
14. REINFORCING, DOWELS, BOLTS, ANCHORS, SLEEVES, ETC. TO BE EMBEDDED IN CONCRETE SHALL BE SECURELY POSITIONED BEFORE PLACING CONCRETE. OBTAIN APPROVAL OF ALL AFFECTED TRADES PRIOR TO PLACING CONCRETE.
15. MAXIMUM FREE FALL OF CONCRETE SHALL BE 4'-0".
16. CONCRETE FOR WALLS SHALL BE PLACED SO THAT NO PART OF THE LIFT IS MORE THAN 2 FT. HIGHER THAN ANY OTHER PART.
17. CONCRETE IN WALLS, PIERS, OR COLUMNS SHALL SET AT LEAST 2 HOURS BEFORE PLACING CONCRETE IN BEAMS, SPANDRELS, OR SLABS SUPPORTED THEREON.
18. REINFORCE ALL SLABS ON GRADE AS SHOWN ON DRAWINGS.
19. USE #2 SPREADERS APPROXIMATELY EVERY THIRD INTERSECTION EACH DIRECTION FOR ALL DOUBLE LAYER WALLS. PLACE SPREADERS IN VERTICAL LINES WITH FORM TIES.
20. NO WOOD SPREADERS ARE ALLOWED. NO WOOD STAKES ARE ALLOWED IN AREAS TO BE CONCRETED.
21. CONCRETE MIX DESIGN SHALL BE SUBMITTED FOR ENGINEER'S REVIEW PRIOR TO PLACING CONCRETE.
22. NOTIFY THE ENGINEER 48 HOURS PRIOR TO PLACING CONCRETE.
23. SPACING OF CONST. JOINTS IN WALLS AND SLABS IS 30 FT. MAXIMUM EA. WAY; LENGTH OF WALL POUR FROM CORNER IS 20 FT. MAXIMUM; MAXIMUM AREA OF ONE POUR IS 900 SF. U.N.O. SUBMIT SHOP DRAWINGS FOR APPROVAL.
24. EXCEPT AS OTHERWISE REQUIRED, EXPOSED CONCRETE CORNERS AND EDGES SHALL HAVE 3/4" CHAMFERS. RE ENTRANT CORNERS SHALL NOT HAVE FILLETS.
25. POST INSTALLED ANCHORS AS APPROVED BY ICC-ES FOR THE USE IN CRACKED CONCRETE SHALL BE USED. THE DESIGN SHALL BE IN ACCORDANCE WITH CHAPTER-17 OF ACI 318-14. PROVIDE ICC-ES REPORT FOR ENGINEERS APPROVAL.
26. IF EXPANSION JOINTS ARE GOING TO BE USED, THEY WILL BE SHOWN ON CONSTRUCTION DRAWINGS.

Revision | By | Appd | YYYY.MM.DD

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City of Merced

WWTF PHASE VI PROJECT
HEADWORKS IMPROVEMENTS

City of Merced, California

File Name: 31329B-S001 & S002 | SDS Dwn. | SDS Dsgn. | KKC Chkd. | 2023.03.14 YYYY.MM.DD

Title

TYPICAL STRUCTURAL NOTES

Project No. 184031329 | Scale AS SHOWN

Revision 0 | Sheet 16 of 39 | Drawing No. S001

WATER STOPS FOR CONCRETE CONSTRUCTION:

1. ALL WATER STOPS SHALL BE INSTALLED ACCORDING TO THE MANUFACTURER'S SPECIFICATIONS TO GIVE A WATERTIGHT JOINT.
2. WATER STOPS SHALL BE CAREFULLY POSITIONED IN PLACE AND SUPPORTED AS REQUIRED TO REMAIN IN PLACE DURING OPERATIONS.
3. WATERSTOPS MUST BE USED AT ALL CONSTRUCTION JOINTS IN LIQUID CONTAINING STRUCTURES.

REBAR WELDING:

ALL REBAR TO BE WELDED SHALL BE CONTINUOUSLY INSPECTED BY A QUALIFIED LABORATORY APPROVED BY THE BUILDING OFFICIAL OF LOCAL JURISDICTION. CONTRACTOR MUST FURNISH TO THE LABORATORY MILL CERTIFICATES SHOWING CHEMICAL ANALYSIS. ALL PREHEATING AND WELDING SHALL BE DONE IN ACCORDANCE WITH AWS D1.4 STANDARDS (LATEST EDITION).

STRUCTURAL STEEL:

1. FABRICATION, ERECTION AND MATERIALS SHALL CONFORM WITH THE CURRENT AISC SPECIFICATION FOR THE DESIGN, FABRICATION AND ERECTION OF STRUCTURAL STEEL FOR BUILDINGS AND 2010 CALIFORNIA BUILDING CODE.
2. W, WT STRUCTURAL SECTIONS SHALL CONFORM TO A992 GRADE 50. CHANNELS, ANGLES AND MISCELLANEOUS STRUCTURAL STEEL SHALL CONFORM TO ASTM A-36 UNO.
3. PIPE COLUMNS SHALL CONFORM TO ASTM A53, TYPE E OR S, GRADE B.
4. TUBE COLUMNS SHALL CONFORM TO ASTM A500, GRADE B.
5. WELDING SHALL BE DONE BY THE ELECTRIC ARC PROCESS IN ACCORDANCE WITH "AWS" STANDARDS, USING ONLY CERTIFIED WELDERS. ALL BUTT WELDS SHALL HAVE COMPLETE PENETRATION. ALL EXPOSED BUTT WELDS SHALL BE GROUND.
6. PLACE NON-SHRINK GROUT UNDER ALL BEARINGS ON CONCRETE OR MASONRY BEFORE ADDING VERTICAL LOAD.
7. ALL STRUCTURAL STEEL SHALL BE ERECTED PLUMB AND TRUE TO LINE. TEMPORARY BRACING SHALL BE INSTALLED AND SHALL BE LEFT IN PLACE UNTIL OTHER MEANS ARE PROVIDED TO ADEQUATELY BRACE THE STRUCTURE.
8. HOLES FOR BOLTS SHALL BE OF THE SAME NOMINAL DIAMETER AS THE BOLT PLUS 1/16".
9. USE STANDARD AISC GAGE AND PITCH FOR BOLTS EXCEPT AS NOTED OTHERWISE.
10. HIGH STRENGTH BOLTS SHALL BE 3/4" DIAMETER ASTM A-325N UNO-SEE SPECIFICATIONS.

FOUNDATIONS:

1. BEARING SOIL IS CLASSIFIED AS: SEE GEOTECHNICAL ENGINEERING REPORT.
2. THE FOOTINGS SHALL BEAR ON FIRM, DRY NATIVE MATERIAL OR ENGINEERED FILL WITH A MINIMUM PENETRATION OF 18 INCHES.
3. EXCAVATIONS SHALL BE CLEANED OF ALL DEBRIS. STANDING WATER SHALL BE REMOVED.
4. ALL FOOTINGS SHALL BE FORMED. FOUNDATIONS MAY BE PLACED IN NEAT EXCAVATIONS PROVIDED WRITTEN PERMISSION IS OBTAINED FROM THE ENGINEER AND FOOTINGS ARE INCREASED 2" IN WIDTH. SEE TYPICAL DETAIL.
5. NOTIFY THE ENGINEER 48 HOURS BEFORE PLACING FOUNDATIONS.
6. ALL EARTHWORK AND FOUNDATION SUBGRADES SHALL BE INSPECTED AND APPROVED BY THE PROJECT GEOTECHNICAL ENGINEER.

STRUCTURAL ALUMINUM:

1. ALUMINUM CONSTRUCTION SHALL CONFORM TO THE LATEST EDITION OF THE ALUMINUM CONSTRUCTION MANUAL OF THE ALUMINUM ASSOCIATION.
2. UNLESS OTHERWISE INDICATED, STRUCTURAL ALUMINUM SHALL BE ALLOY 6061-T6 AS SPECIFIED IN ASTM B308.
3. WHERE ALUMINUM IS IN CONTACT WITH CONCRETE OR MASONRY SURFACES, CONTACT SURFACES SHALL BE COATED WITH HEAVY ALKALI-RESISTANT BITUMINOUS PAINT.

EXPANSION ANCHOR AND ADHESIVE ANCHOR NOTES:

1. ANCHORS SHALL BE INSTALLED IN ACCORDANCE WITH THE RECOMMENDATIONS GIVEN IN THE ICC-ES REPORT.
2. SPECIAL INSPECTION IS REQUIRED FOR ICC ALLOWABLE TENSION VALUES LISTED IN THE INSPECTION NOTES. UNLESS NOTED OTHERWISE ANCHORS HAVE BEEN DESIGNED FOR SPECIAL INSPECTION.
3. DESIGN LOADS ON ANCHORS ARE NOT TO EXCEED 80% OF THE TENSION AND SHEAR VALUES AS RECOMMENDED BY THE MANUFACTURER.
4. TENSION TEST LOAD VALUES ARE BASED ON 80% OF TWICE THE TENSION VALUES LISTED.
5. ALLOWABLE LOADS MAY NOT BE INCREASED FOR DURATION OF LOADS SUCH AS WIND OR SEISMIC FORCES.
6. WHEN INSTALLING DRILLED IN ANCHORS IN EXISTING CONCRETE OR MASONRY, USE CARE AND CAUTION TO AVOID CUTTING OR DAMAGING EXISTING REINFORCING BARS.
7. THE TESTING OF THE ANCHORS SHALL BE DONE BY THE TESTING LABORATORY AND A REPORT OF THE TEST RESULTS SHALL BE SUBMITTED TO THE GOVERNING AGENCY AND ARCHITECT/STRUCTURAL ENGINEER. TESTING SHALL OCCUR 24 HOURS MINIMUM AFTER THE INSTALLATION OF THE ANCHORS.
8. ANCHORS INSTALLED IN METAL DECK WITH CONCRETE SHALL BE INSTALLED IN THE CENTER OF THE LOW FLUTE OF THE DECKING. THE DECKING SHALL HAVE A MINIMUM THICKNESS OF 20 GAUGE. THE MINIMUM DEPTH OF EMBEDMENT ABOVE THE TOP OF THE DECK SHALL BE 1-1/2". THE EFFECTIVE DEPTH OF EMBEDMENT IS CONSIDERED TO BE 1/3 OF THE METAL DECK HEIGHT PLUS THE DEPTH OF EMBEDMENT ABOVE THE TOP OF THE DECK.
9. ANCHORS SHALL NOT BE INSTALLED IN CONCRETE LESS THAN 21 DAYS OLD.
10. WHERE ADHESIVE ANCHORS ARE ALLOWED, PERSONNEL USED FOR INSTALLATION SHALL BE CERTIFIED BY AN APPLICABLE CERTIFICATION PROGRAM PER ACE 318-14 SECTION 17.8.2.2.

MASONRY:

1. F'm=2000 PSI.
2. MORTAR SEE SPECIFICATIONS.
3. GROUT SEE SPECIFICATIONS.
4. REINFORCING STEEL SHALL BE THE SAME AS NOTE 5 UNDER "CONCRETE AND REINFORCING STEEL" NOTES.
5. LAP ALL BARS 48 BAR DIAMETERS (UNLESS NOTED OTHERWISE).
6. BEFORE BLOCK IS PLACED ON CONCRETE, THOROUGHLY CLEAN CONCRETE OF ALL LAITANCE AND ALL LOOSE MATERIAL. ROUGHEN AS DIRECTED IN "CONCRETE AND REINFORCING STEEL" NOTES.
7. CONCRETE BLOCK MASONRY SHALL BE BUILT TO PRESERVE THE UNOBSTRUCTED CONTINUITY OF THE VERTICAL CELLS. WALLS AND CROSS WEBS FORMING SUCH CELLS SHALL BE FULLY BEDDED IN MORTAR. ALL HEAD OR END JOINTS SHALL BE SOLIDLY FILLED WITH MORTAR FOR A DISTANCE IN FROM THE FACE OF THE WALL OR UNITS NOT LESS THAN THE THICKNESS OF THE LONGITUDINAL FACE SHELLS.
8. VERTICAL CELLS SHALL HAVE VERTICAL ALIGNMENT SUFFICIENT TO MAINTAIN A CLEAR UNOBSTRUCTED CONTINUOUS VERTICAL CELL MEASURING NOT LESS THAN 3" x 3".
9. CLEAN OUT OPENINGS SHALL BE PROVIDED AT THE BOTTOMS OF ALL CELLS TO BE FILLED AT EACH LIFT OR POUR OF GROUT WHERE SUCH LIFT OR POUR OF GROUT IS IN EXCESS OF 2'-0" IN HEIGHT. ANY OVERHANGING MORTAR OR OTHER OBSTRUCTION OR DEBRIS SHALL BE REMOVED FROM INSIDE OF SUCH CELLS. THE CLEANOUTS SHALL BE SEALED AFTER INSPECTION AND BEFORE GROUTING.
10. VERTICAL REINFORCING SHALL BE HELD IN POSITION AT TOP AND BOTTOM AND AT INTERVALS NOT EXCEEDING 192 BAR DIAMETERS.
11. WHEN GROUTING IS STOPPED FOR ONE HOUR OR LONGER, HORIZONTAL CONSTRUCTION JOINTS SHALL BE FORMED STOPPING THE POUR 1-1/2 INCHES BELOW THE TOP OF THE UPPERMOST UNIT.
12. PLACE ALL HORIZONTAL BARS IN BOND BEAM UNITS. WHEN 2 BARS ARE USE, STAGGER LAPS 6'-0" MIN.
13. PROVIDE DOWEL TO FOUNDATION OF EQUAL DIAMETER AND 48 BAR DIAMETER LAP AT EACH VERTICAL BAR IN WALLS. DOWELS TO BE STRAIGHT AND PLUMB UNLESS OTHERWISE NOTED.
14. ALL WALLS SHALL HAVE ALL CELLS FILLED WITH GROUT.
15. ALL CONCRETE BLOCK UNITS SHALL BE OPEN END BOND BEAM UNITS AND CONSTRUCTED IN RUNNING BOND UNLESS NOTED OTHERWISE.

METAL DECK NOTES:

1. PROVIDE METAL DECKING OF TYPE AND GAUGE AS SHOWN ON PLANS
2. METAL FLOOR DECK SHALL BE COMPOSITE TYPE, CONFORMING TO ASTM A653, STRUCTURAL QUALITY, WITH MINIMUM YIELD STRENGTH OF 38 KSI AND SHALL BE ZINC COATED PER ASTM A653, G60 COATING DESIGNATION.
3. PRIOR TO FABRICATION, THE CONTRACTOR SHALL SUBMIT SHOP DRAWINGS FOR THE METAL DECKING, SHOWING DECK GAUGE, SIZE AND LAYOUT AS WELL AS CLOSURE CONDITIONS, WELDS TO SUPPORTS AND SIDE LAP DETAILS.
4. CONNECTION AND WELDING OF DECKING TO STRUCTURAL SUPPORTS AND DECK SIDE SEAMS SHALL BE AS SPECIFIED IN THE STRUCTURAL DRAWINGS. ALL ELECTRODES FOR WELDING SHALL COMPLY WITH AWS CODE, E60 SERIES MINIMUM.
5. THE GENERAL CONTRACTOR SHALL COORDINATE THE LOAD REQUIREMENTS FROM ALL SUBCONTRACTORS SO THAT NO COMBINATION OF LOADS EXCEEDS THE LIMITATIONS GIVEN IN DESIGN CRITERIA.
6. ALL REINFORCED OPENINGS IN METAL DECK SHALL BE INSTALLED BY METAL DECK SUBCONTRACTOR.
7. AT METAL DECKS WITHOUT CONCRETE, HANG NO MORE THAN 50 LBS. AT 1½" DECK (20 GAUGE MIN.) AND 100 LBS. AT 3" DECK (20 GAUGE MIN.) PER METAL DECK RIB IN ANY SPAN; SPACE HANGERS NO CLOSER THAN 2'-0"CC PERPENDICULAR TO SPAN.
8. WHERE SUSPENSION OR HANGER WIRES ARE REQUIRED BY OTHERS, VERIFY AND COORDINATE LOCATIONS, PATTERNS, SPACINGS, ETC. WITH THE APPROPRIATE TRADE. DRILL OR PUNCH HOLES AT BOTTOM OF DECK FLUTES OF SUFFICIENT SIZE TO PASS SUPPORT WIRES. WIRE SUPPORTS SHALL BE LOOPED AND SECURED WITH A MINIMUM OF THREE (3) TIGHT TURNS AROUND A MINIMUM 1-1/2x8" LONG FURRING CHANNEL OR NO. 3 x 8" LONG REINFORCING BAR CENTERED ABOVE THE HOLE AND LAID IN THE DECK FLUTES.
9. METAL DECK SHALL BE PROVIDED AS SHOWN ON THE DRAWINGS.
10. INSTALL METAL DECK IN ACCORDANCE WITH THE REQUIREMENTS OF THE MANUFACTURER.
11. METAL DECK SHALL BE GALVANIZED.
12. WELD ATTACHMENT OF METAL DECK TO STRUCTURAL STEEL SHALL CONFORM WITH AWS D1.1 AND D1.3. WELDERS SHALL BE CERTIFIED PRIOR TO COMENCING THE WORK.

CODE:

1. 2019 CALIFORNIA BUILDING CODE (CBC).
2. CODE REQUIREMENTS FOR ENVIRONMENTAL ENGINEERING CONCRETE STRUCTURES (ACI 350-06) AND COMMENTARY (ACI 350R-06).
3. BUILDING CODE REQUIREMENTS FOR STRUCTURAL CONCRETE (ACI 318-14).
4. MINIMUM DESIGN LOADS FOR BUILDINGS AND OTHER STRUCTURES (ASCE 7-10).

SEISMIC DESIGN REQUIREMENTS:

SEISMIC COEFFICIENTS	Ss = 0.605g	Sms = 0.796g
	S1 = 0.246g	Sm1 = 0.519g
	Fa = 1.316	SDS = 0.531g
	Fv = 2.108	SD1 = 0.346g
SITE CLASS	D	
RISK CATEGORY	III	
SEISMIC DESIGN CATEGORY	D	
IMPORTANCE FACTOR	I =1.25	
NON-BUILDING STRUCTURE		PER ASCE 7-05 CHAPTER 15 SECTION 15.4.1.1 & TABLES 15.4-1 & 15.4-2
RESPONSE MODIFICATION FACTOR	R =	
IMPORTANCE FACTOR	I =	

SEE SPECIFICATION SECTION - 01610 FOR OTHER REQUIREMENTS.

WIND DESIGN REQUIREMENTS:

BASIC WIND SPEED	100 MPH
EXPOSURE CATEGORY	C
RISK CATEGORY	III

SEE SPECIFICATION SECTION - 01615 FOR OTHER REQUIREMENTS.

GEOTECHNICAL REPORT:

FOR GEOTECHNICAL DATA, REFER TO GEOTECHNICAL DESIGN ADDENDUM No. 7-CBC 2019 UPDATE, MERCED WWTF PHASE VI EXPANSION PROJECT {AND ALL REFERENCES}, MERCED, CALIFORNIA BY BSK ASSOCIATES , PROJECT G22-001-10-F DATED JUNE 21, 2022.

FLOOR LIVE LOAD:

SLAB ON GRADE= 250 PSF

FLOOD DESIGN DATA:

FLOOD ZONE X

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Permit/Seal

REGISTERED PROFESSIONAL ENGINEER
No. S6431
Exp.6-30-24
STRUCTURAL
STATE OF CALIFORNIA

2023/03/14

Consultant

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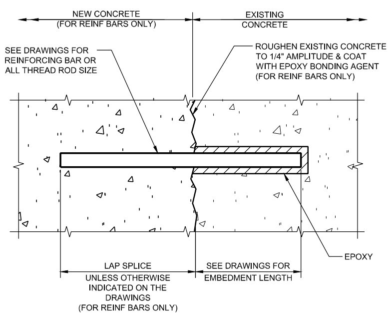
City of Merced
WWTF PHASE VI PROJECT
HEADWORKS IMPROVEMENTS

City of Merced, California
File Name: 31329B-S001 & S002 | SDS Dwn. | SDS Dsgn. | KKC Chkd. | 2023.03.14 YYYY.MM.DD

Title
TYPICAL STRUCTURAL NOTES

Project No. 184031329
Scale AS SHOWN
Revision 0
Sheet 17 of 39
Drawing No. S002



NOTES:

1. INSTALLATION OF REINFORCING BARS AND ALL THREAD RODS AS INDICATED IN THE SPECIFICATIONS.

EPOXY BONDED REINFORCING BARS

SCALE: NONE

S206 TYP

BAR SIZE	GRADE 60 A	GRADE 60 B
#3	17"	22"
#4	22"	29"
#5	28"	36"
#6	33"	43"
#7	48"	63"
#8	55"	72"
#9	62"	81"
#10	70"	91"

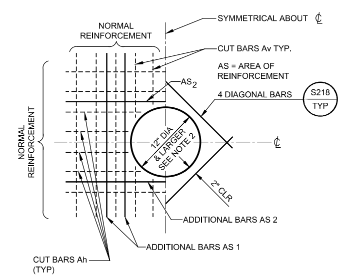
NOTES FOR DETAILS: S216, S217

1. THIS DETAIL TO BE USED EXCEPT WHEN NOTED OTHERWISE ON STRUCTURAL DRAWINGS.
2. NORMAL REINFORCEMENT CUT AT OPENING:
   AS_1 = 1/2 TOTAL Av CUT BARS
   AS_2 = 1/2 TOTAL Ah CUT BARS
   TO BE ADDED ON EACH SIDE OF OPENING.
3. DIAGONAL BARS TO BE PLACED:
   a) AT CENTER LINE OF WALL OR SLAB WHERE ONE LAYER OF REINFORCEMENT IS PROVIDED.
   b) AT EACH FACE OF WALLS OR SLABS WHERE TWO LAYERS OF REINFORCEMENT ARE PROVIDED.
4. PROVIDE DIAGONAL DOWEL FOR EACH LAYER OF REINFORCEMENT (#4 x 3'-0") U.N.O.
5. LOCATE ADDITIONAL BARS AT MID SPACING BETWEEN CONTINUOUS BARS THAT ARE NOT CUT.

NOTES FOR ADDITIONAL REINFORCEMENT AT OPENINGS

SCALE: NONE

S215 TYP



ELEVATION

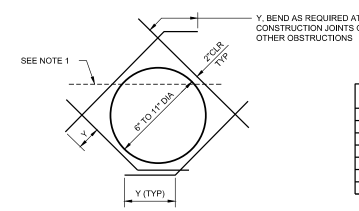
NOTES:

1. FOR ADDITIONAL REINFORCEMENT SIZES & LENGTHS SEE S215 TYP
2. FOR CIRCULAR OPENINGS LESS THAN 12"Ø, SEE S218 TYP

ADDITIONAL REINFORCEMENT AT CIRCULAR OPENINGS

SCALE: NONE

S217 TYP



BAR SIZE	"Y" GRADE 60
#4	22"
#5	28"
#6	33"
#7	48"
#8	55"
#9	62"
#10	70"

NOTES:

1. CUT TYPICAL REINFORCEMENT AT OPENING.
2. DIAGONAL BARS TO BE PLACED: a) AT CENTERLINE OF WALL OR SLAB WHERE ONE LAYER OF REINFORCEMENT IS PROVIDED. b) AT EACH FACE OF WALLS OR SLABS WHERE TWO LAYERS OF REINFORCEMENT ARE PROVIDED.
3. UNLESS OTHERWISE NOTED, SIZE OF DIAGONAL BARS SHALL BE THE SIZE OF THE LARGEST REINFORCEMENT CUT.
4. USE THIS DETAIL FOR ALL CIRCULAR OPENINGS 6" THROUGH 11" UNLESS OTHERWISE NOTED ON THE STRUCTAL DRAWINGS.

DIAGONAL REINFORCEMENT AT CIRCULAR OPENINGS

SCALE: NONE

S218 TYP

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No. S4431
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WWTF PHASE VI PROJECT
HEADWORKS IMPROVEMENTS

City of Merced, California

File Name: 31329B-S003

SDS	KKC	SDS	2023.03.14
Dwn.	Dsgn.	Chkd.	YYYY.MM.DD

Title

TYPICAL STRUCTURAL DETAILS

Project No. 184031329
Scale AS SHOWN

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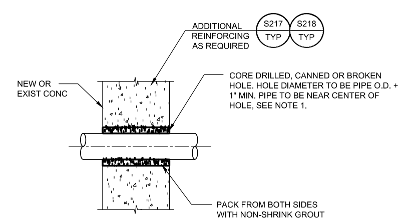
Drawing No. S003



NOTES:

1. FOR ELEVATED FLOOR PENETRATIONS, WRAP WITH 3/8" THICK, 60 DUROMETER RUBBER SHEETING BEFORE POURING CONCRETE. SECURE TO PIPE WITH (2) STEEL BANDS.

GROUTED PIPE PENETRATION

SCALE: NONE

M301 TYP

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0			

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REGISTERED PROFESSIONAL ENGINEER BETH P. COHEN No. C70184 Exp.9/30/2024 CIVIL STATE OF CALIFORNIA

2023/03/14

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WWTF PHASE VI PROJECT
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City of Merced, California

File Name: 313298-M001

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Title

TYPICAL MECHANICAL DETAILS

Project No. 184031329

Scale AS SHOWN

Revision 0

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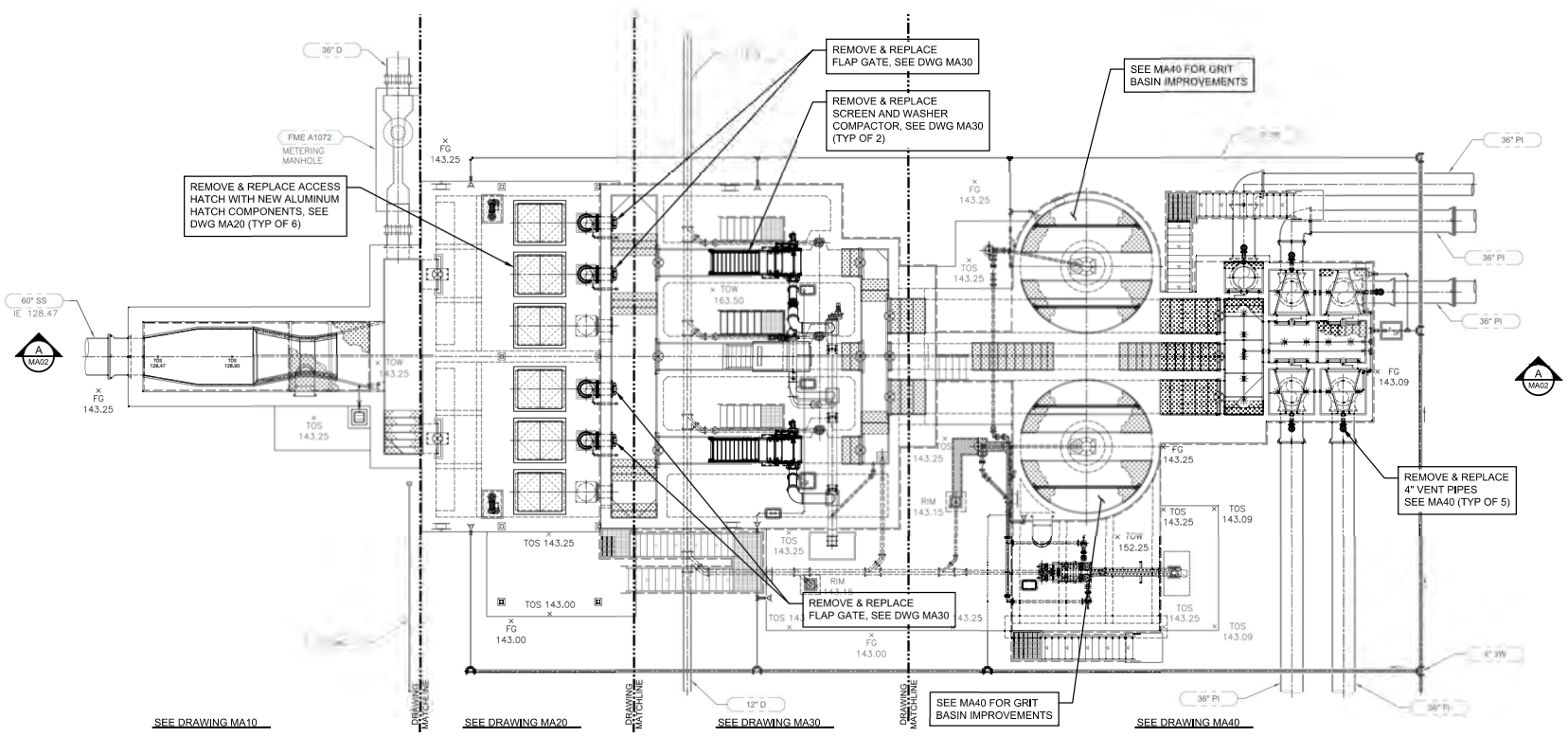
Drawing No. M001



PLAN

SCALE: 1/8" = 1'-0"

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Issued	ASB	SLB	2023.03.14

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City of Merced, California

File Name: 313295-MA01

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Title

HEADWORKS
OVERALL PLAN

Project No.	Scale
184031329	1/8" = 1'-0"
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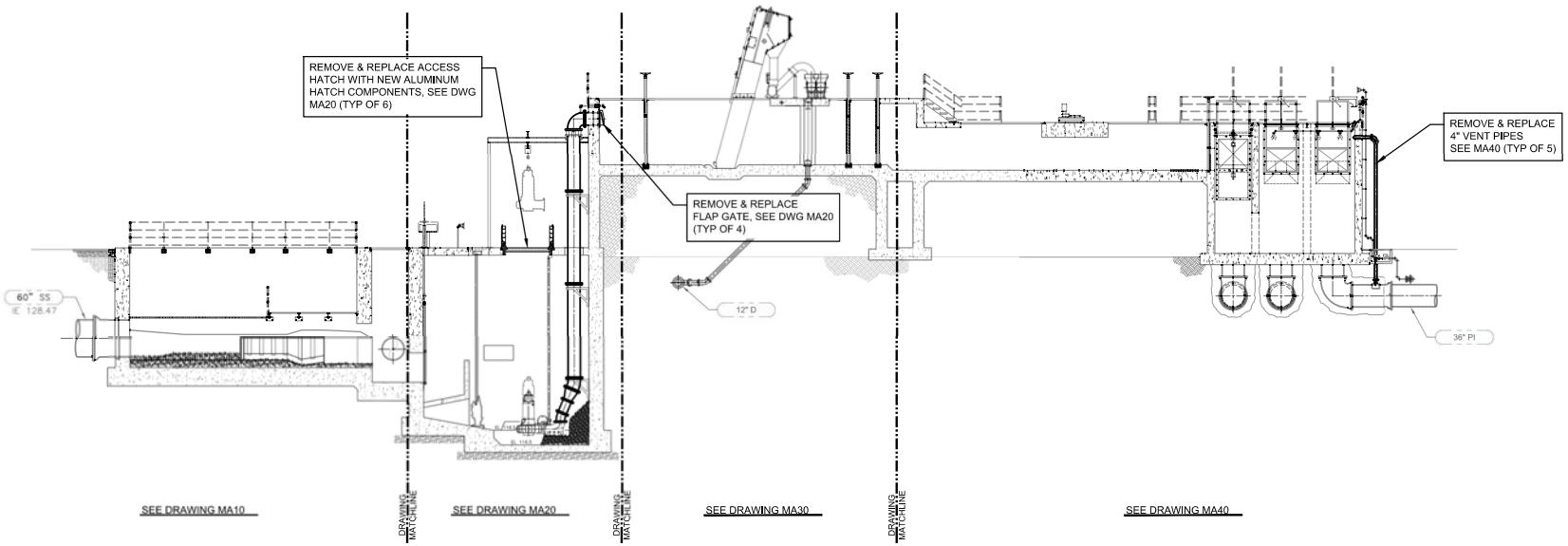
ORIGINAL SHEET - ANSI D



SECTION

SCALE: 1/8" = 1'-0"

Revision	By	Appd	YYYY.MM.DD

Issued	By	Appd	YYYY.MM.DD
FINAL	ASB	SLB	2023.03.14

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City of Merced, California

File Name: 313298-MA01

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ASB	BPC	SLB	2023.03.14

Title

EXISTING HEADWORKS SECTION

Project No.	Scale
184031329	1/8" = 1'-0"
Revision	**Sheet**
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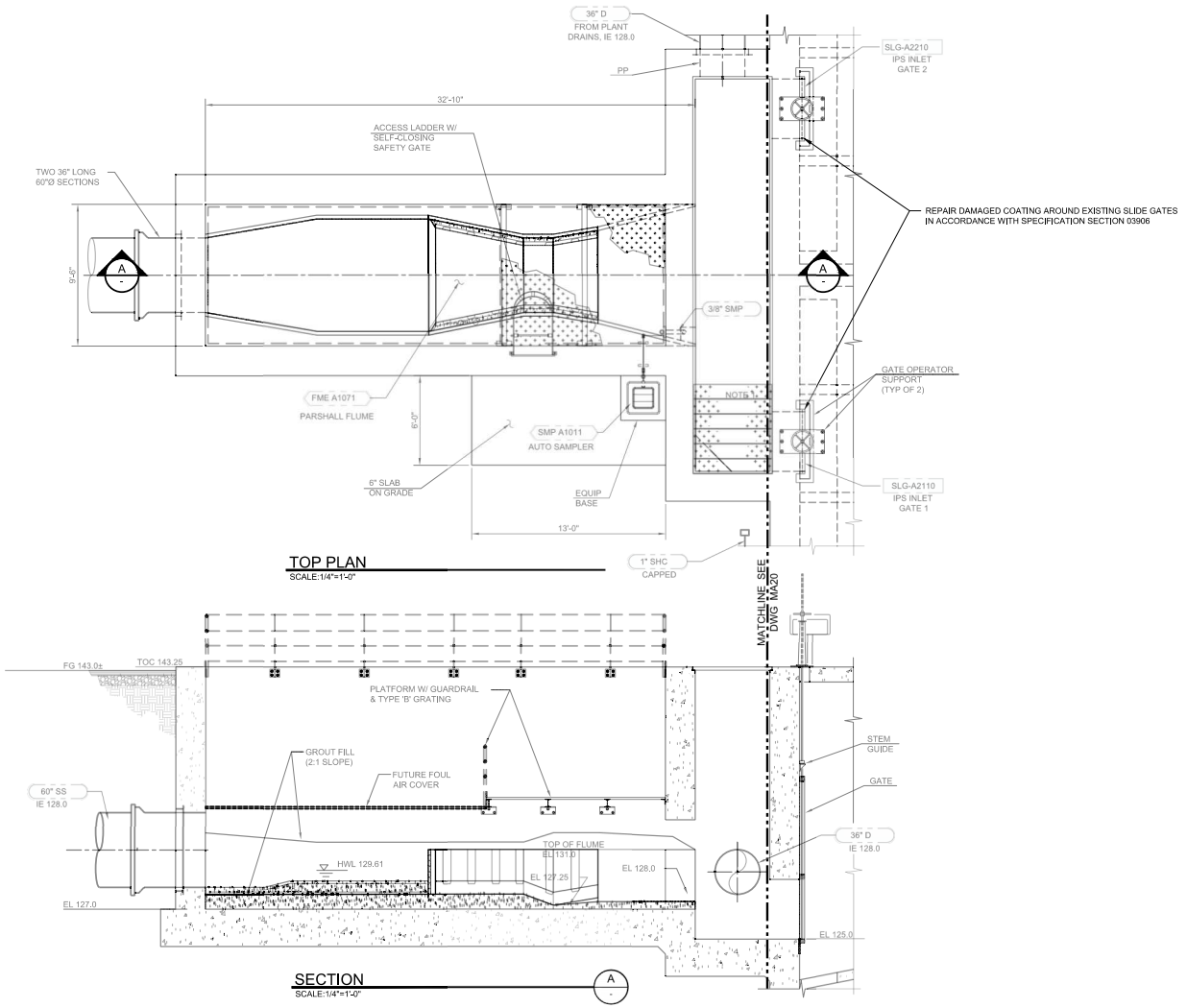
Drawing No.	
MA02	



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FINAL	ASB	SLB	2023.03.14

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City of Merced, California

File Name: 313295-MA10

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ASB	BPC	SLB	2023.03.14

Title

HEADWORKS METERING AND SAMPLING VAULT PLANS, SECTIONS AND DETAILS

Project No.	Scale
184031329	1/4" = 1'-0"

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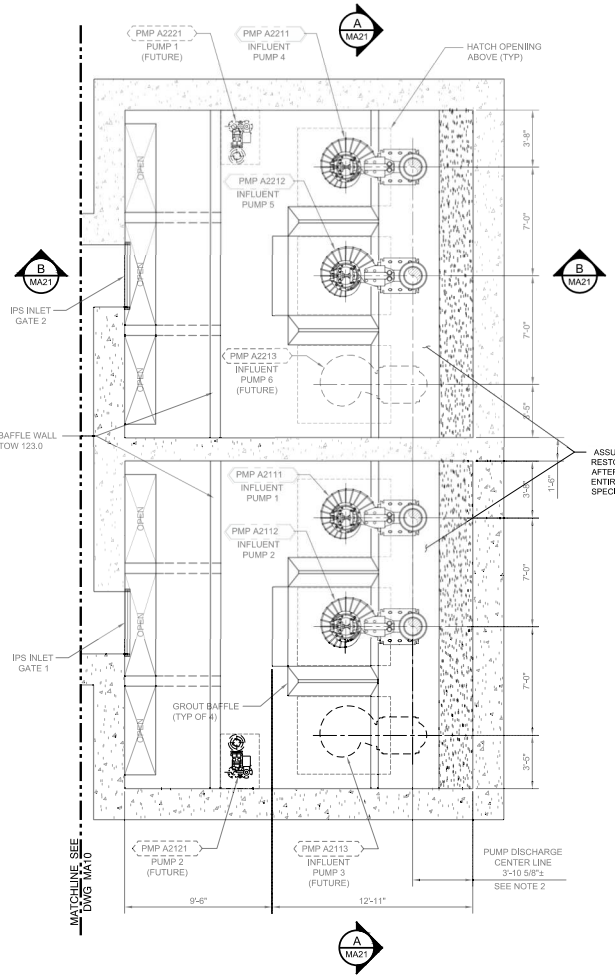

LOWER PLAN
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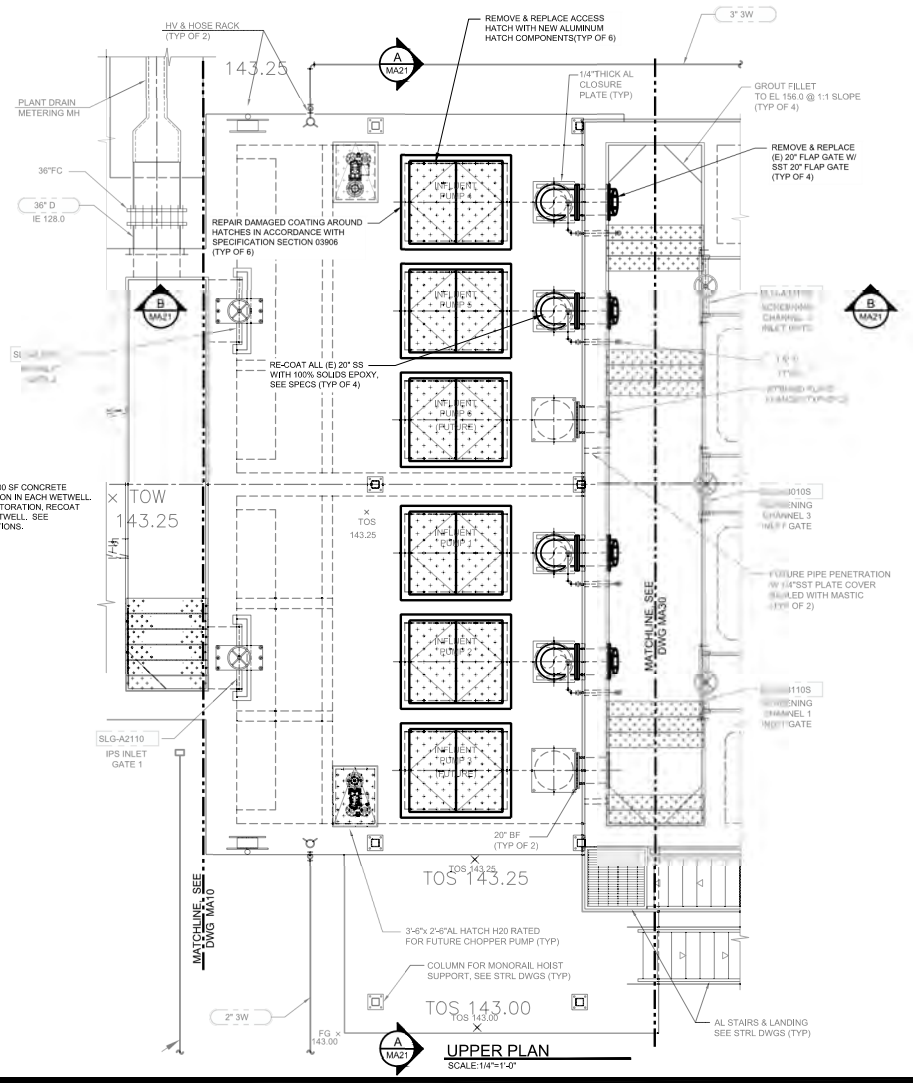

UPPER PLAN
SCALE:1/4"=1'-0"

Revision	By	Appd	YYYY.MM.DD

Issued	By	Appd	YYYY.MM.DD
FINAL	ASB	SLB	2023.03.14

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REGISTERED PROFESSIONAL ENGINEER
BETH P. COHEN
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Exp.6/30/2024
CIVIL
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2023/03/14

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WWTF PHASE VI PROJECT
HEADWORKS IMPROVEMENTS

City of Merced, California

File Name: 313298-MA20	ASB	BPC	SLB	2023.03.14
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Title

HEADWORKS INFLUENT PUMP STATION PLANS

Project No.	Scale
184031329	1/4" = 1'-0"
Revision	**Sheet**
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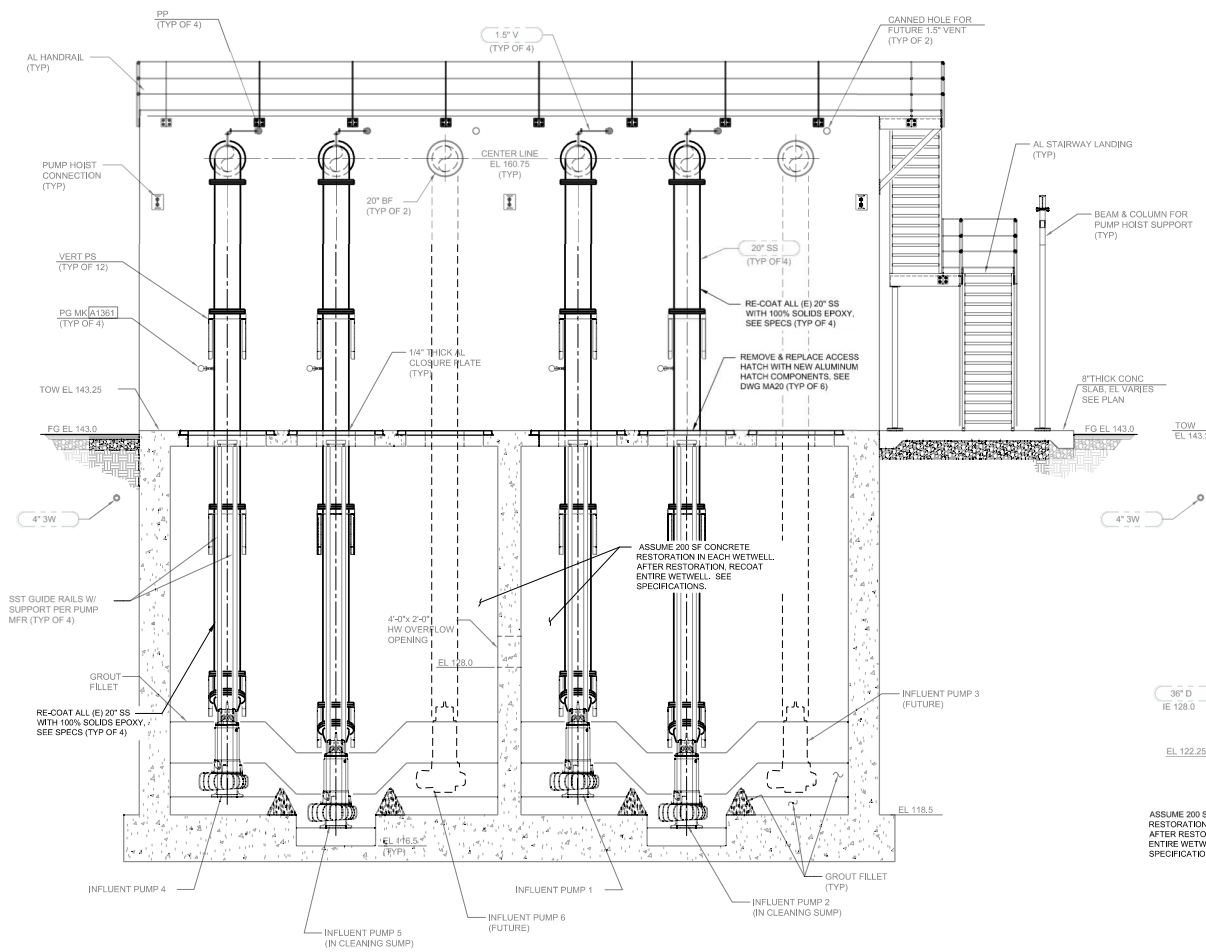
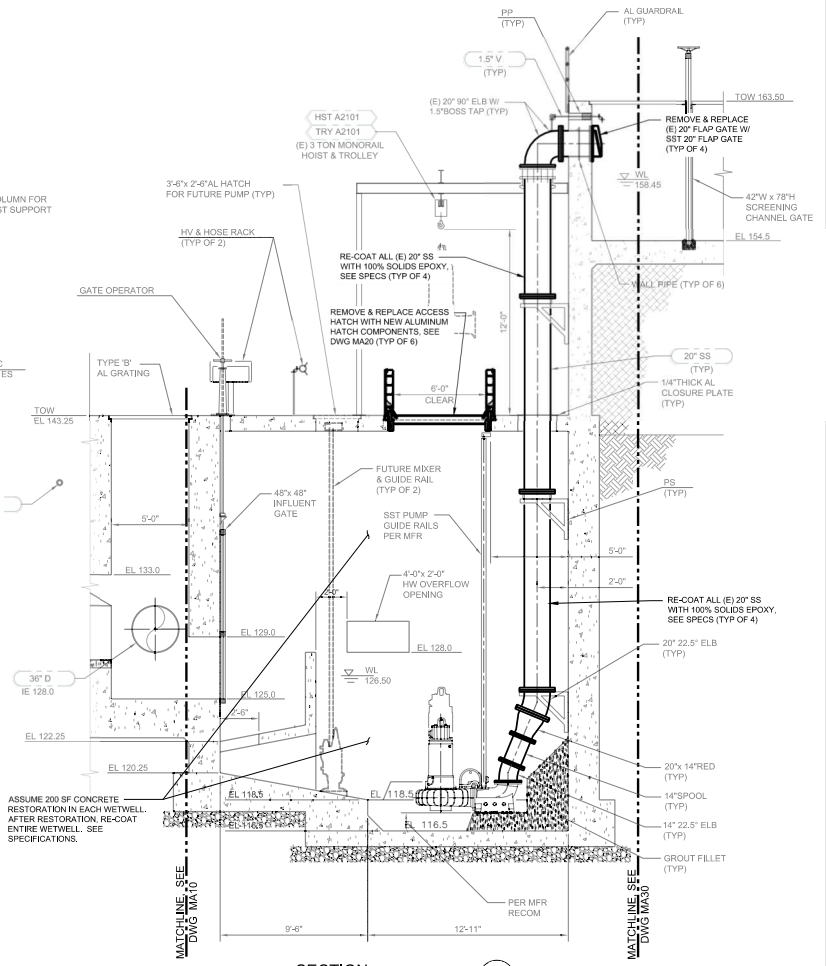
	Drawing No. MA20



SECTION
SCALE:1/4"=1'-0"
A
MA20



SECTION
SCALE:1/4"=1'-0"
B
MA20

Revision	By	Appd	YYYY.MM.DD
Issued	ASB	SLB	2023.03.14
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Permit/Seal

REGISTERED PROFESSIONAL ENGINEER
BETH P. COHEN
No. C70184
EXP. 9/30/2024
CIVIL
STATE OF CALIFORNIA

2023/03/14

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City of Merced

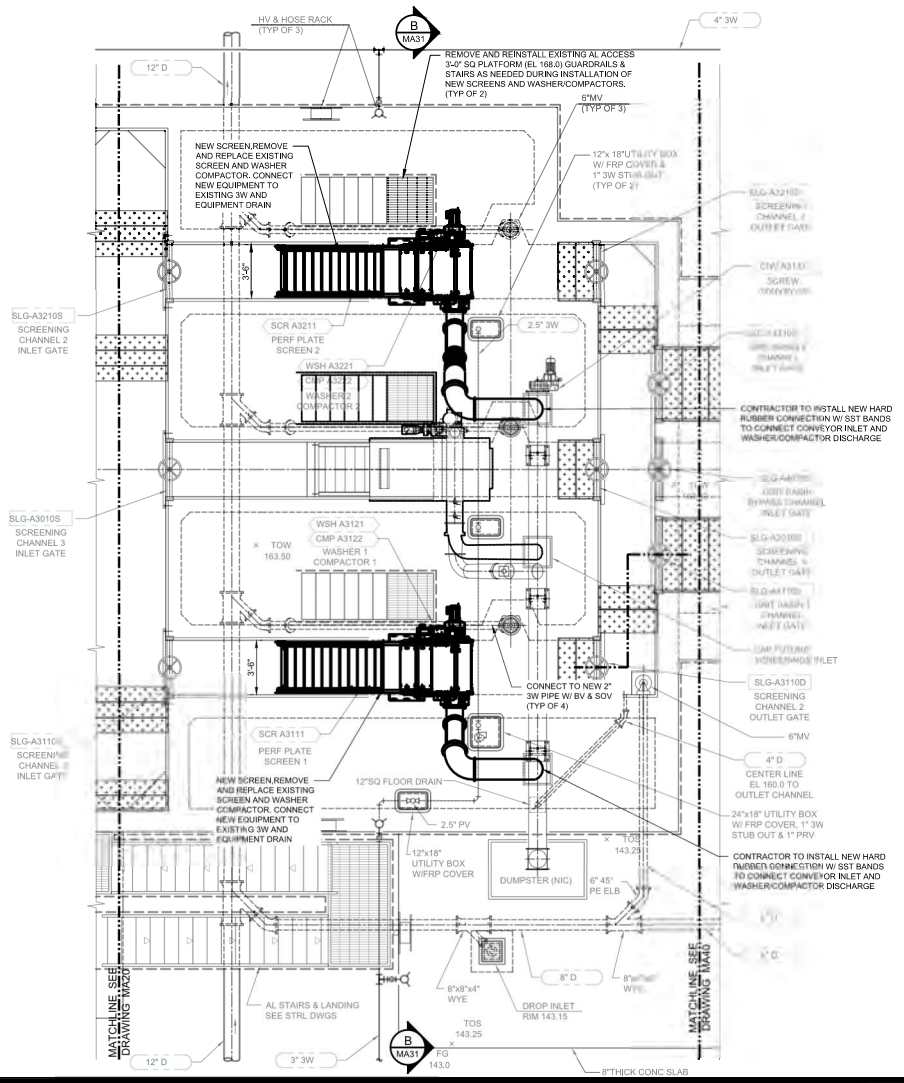
WWTF PHASE VI PROJECT
HEADWORKS IMPROVEMENTS

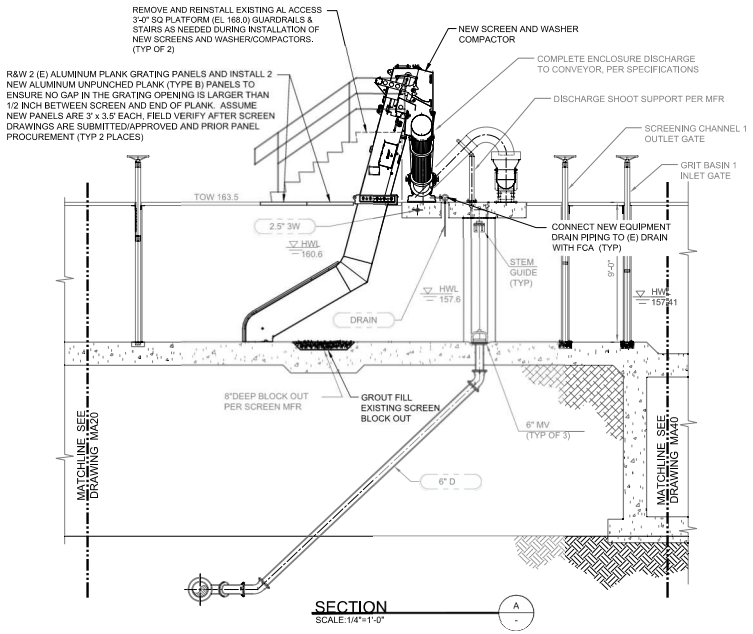
City of Merced, California

File Name: 313298-MA20	ASB	BPC	SLB	2023.03.14
	Dwn.	Dsgn.	Chkd.	YYYY.MM.DD

Title
HEADWORKS INFLUENT PUMP STATION SECTIONS

Project No.	Scale
184031329	1/4" = 1'-0"
Revision	Sheet
0	24 of 39
	Drawing No. MA21





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City of Merced, California

File Name: 313298-MA30

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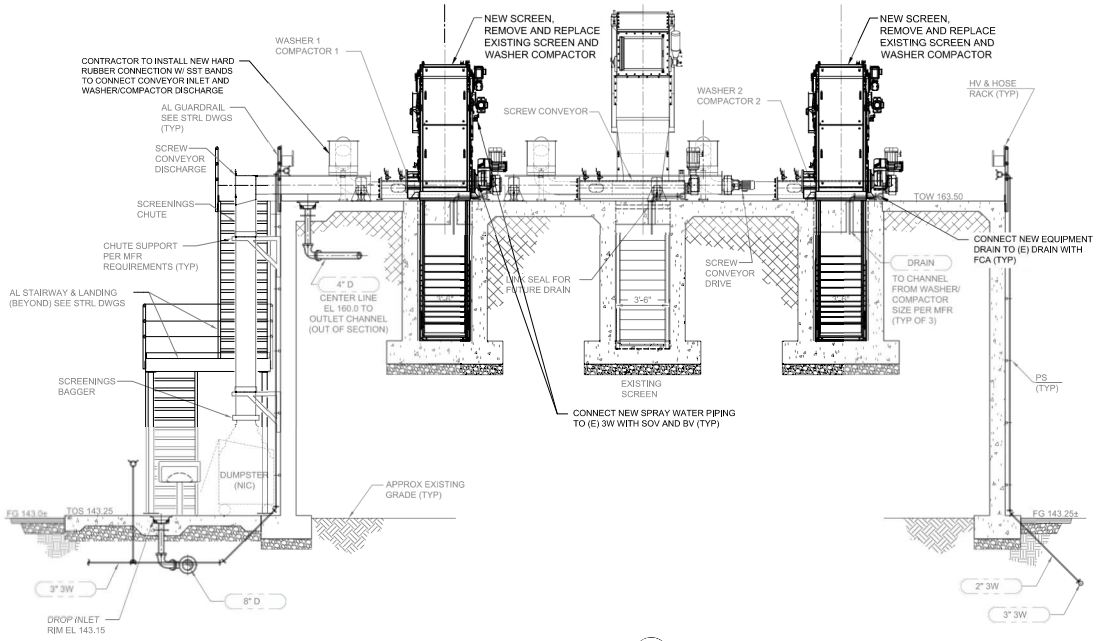
ASB	BPC	SLB	2023.03.14

Title

HEADWORKS
SCREENING CHANNELS
PLAN AND SECTIONS

Project No.	Scale
184031329	1/4" = 1'-0"
Revision	Sheet
0	25 of 39
	Drawing No. MA30



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

B
MA31

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REGISTERED PROFESSIONAL ENGINEER
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WWTF PHASE VI PROJECT
HEADWORKS IMPROVEMENTS

City of Merced, California

File Name: 313295-MA30

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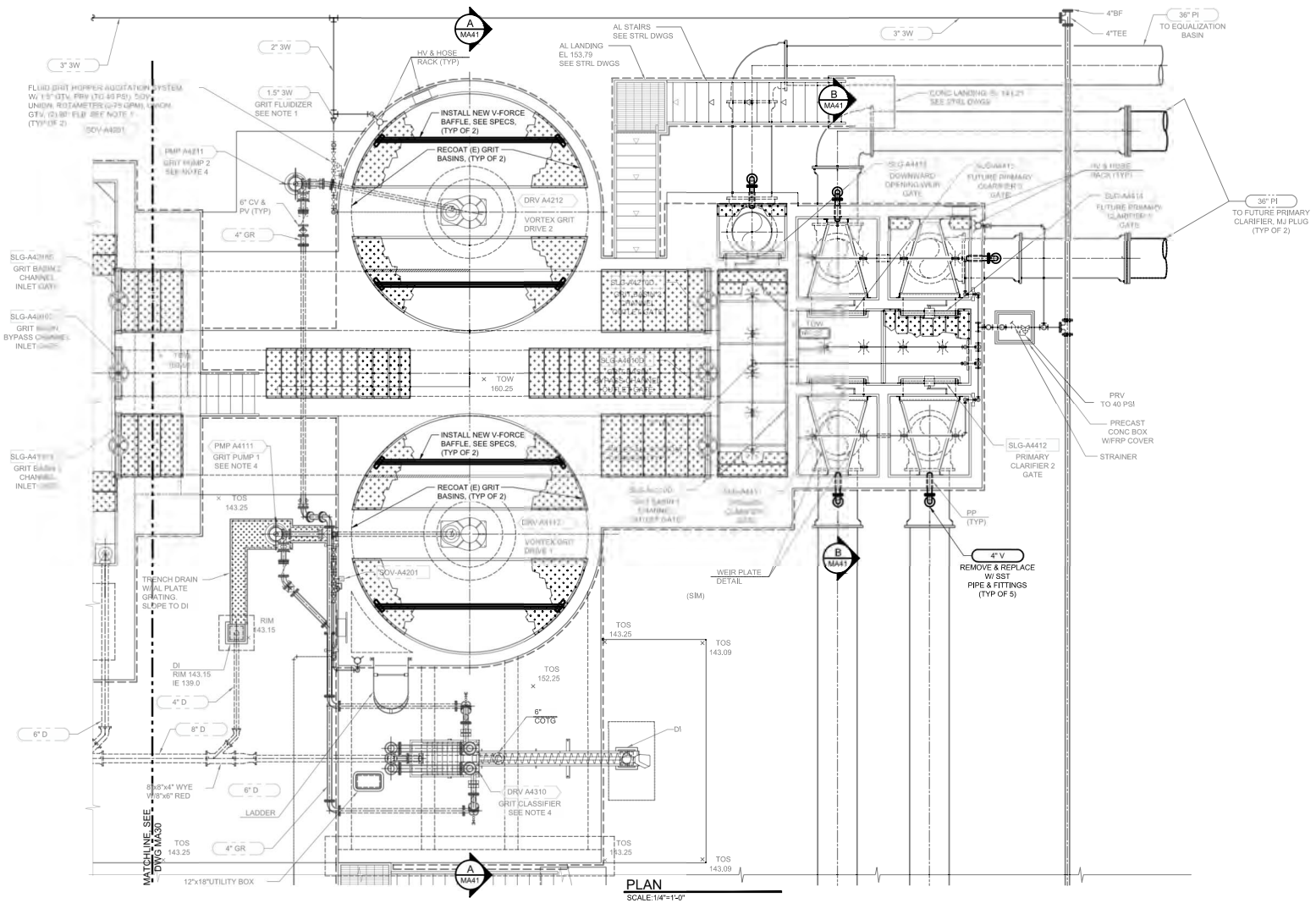
Title

HEADWORKS
SCREENING CHANNELS
SECTIONS AND DETAILS

Project No.	Scale
184031329	1/8" = 1'-0"
Revision	Sheet
0	26 of 39
Drawing No.	MA31



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

Revision	By	Appd	YYYY.MM.DD

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REGISTERED PROFESSIONAL ENGINEER BRETT P. COHEN No. C70184 Exp.6/30/2024 CIVIL STATE OF CALIFORNIA

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WWTF PHASE VI PROJECT
HEADWORKS IMPROVEMENTS

City of Merced, California

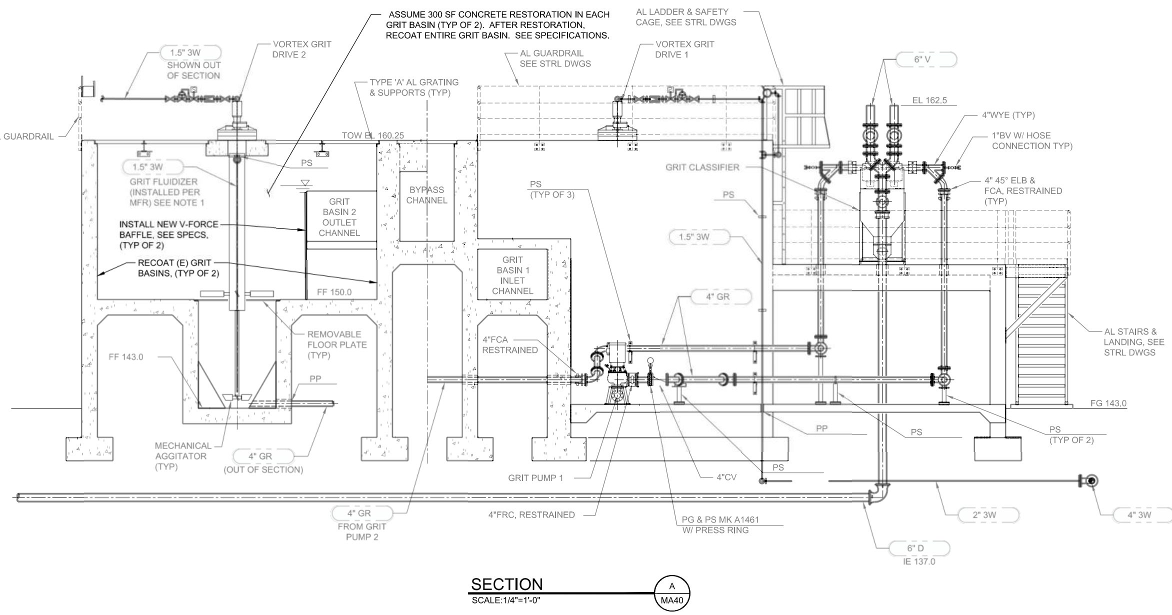
File Name: 313295-MA40	ASB Dwn.	BPC Dsgn.	SLB Chkd.	2023.03.14 YYYY.MM.DD

Title

HEADWORKS GRIT BASINS PLAN

Project No.	Scale
184031329	1/4" = 1'-0"
Revision: 0	Sheet: 27 of 39
	Drawing No.: MA40

ORIGINAL SHEET - ANSI D



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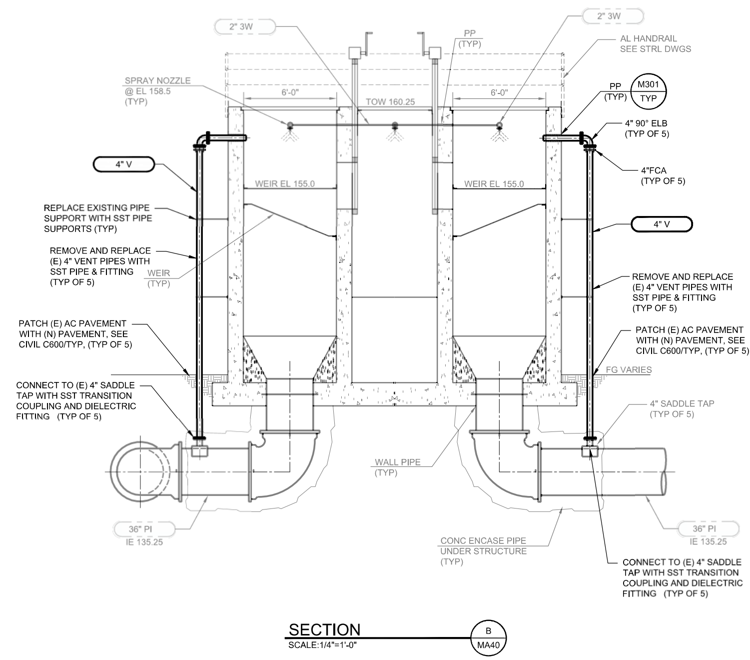

SECTION B/MA40
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HEADWORKS GRIT BASINS
SECTIONS

Project No. 184031329
Scale 1/4" = 1'-0"
Revision 0
Sheet 28 of 39
Drawing No. MA41

MISCELLANEOUS ELECTRICAL & INSTRUMENTATION ABBREVIATIONS

&	AND	HOR	HAND-OFF-REMOTE	PRESS	PRESSURE
@	AT	HP	HORSEPOWER	PRI	PRIMARY
A	AMBER, AMPERES	HPS	HIGH PRESSURE SODIUM	PROVIDE	FURNISH, INSTALL & CONNECT
AC	ALTERNATING CURRENT	HS	HAND SWITCH	PRR	POWER RELAY
AF	AMP FRAME	HTR	HEATER	PS	PRESSURE SWITCH, POWER SUPPLY
AFF	ABOVE FINISHED FLOOR	HZ	HERTZ (CYCLES PER SECOND)	PT	POTENTIAL TRANSFORMER
AI	ANALOG INPUT	HZD	HAZARDOUS AREA, EXPLOSION PROOF	PTT	PUSH TO TEST
AIC	AMP INTERRUPTING CAPACITY SYMMETRICAL	I	INTERLOCK	PV	PROCESS VARIABLE
AL	RIGID ALUMINUM CONDUIT	I/O	INPUT/OUTPUT	PVC	POLY VINYL CHLORIDE
ALT	ALTERNATOR	ICR	INSTRUMENTATION CONTROL RELAY	PWR	POWER
AM	AMMETER	INST	INSTANTANEOUS	R	RED
ARMS	ARC FLASH REDUCTION MAINTENANCE SYS	ISC	SHORT CKT INTERRUPTING CURRENT (SYMM)	RCT	REPEAT CYCLE TIMER
AO	ANALOG OUTPUT	ISR	INTRINSICALLY SAFE RELAY	REF	REFERENCE
AT	AMP TRIP	J	JUNCTION BOX	RIO	REMOTE I/O
ATS	AUTOMATIC TRANSFER SWITCH	K	KILO, PREFIX	RTD	RESISTANCE TEMPERATURE DETECTOR
AWG	AMERICAN WIRE GUAGE	KAIC	KILO-AMPERE INTERRUPTING CAPACITY	RTM	RUN TIME METER
B	BLUE	L	LINE	RTU	REMOTE TELEMETRY UNIT
BC	BARE COPPER	LA	LIGHTNING ARRESTOR	RVNR	REDUCED VOLTAGE NON-REVERSING
BFC	BELOW FINISHED CEILING	LC	LIGHTING CONTACTOR	(R)	REWIRE, RELOCATE, REVISE, REUSE, REPLACE
BOD	BIOCHEMICAL OXYGEN DEMAND	LCD	LIQUID CRYSTAL DISPLAY	SC	SHORTING CONTACTOR
BLK	BLANK	LED	LIGHT EMITTING DIODE	SCH	SCHEDULE
BKR	BREAKER	LEL	LOWER EXPLOSIVE LIMIT	SEC	SECONDARY
C	CONDUIT	LGT	LIGHT	SECS	SECONDS
CAP	CAPACITOR	LO	LOW	SEL	SELECTOR
CB	CIRCUIT BREAKER	LOR	LOCAL-OFF-REMOTE	SFA	SERVICE FACTOR AMPS
CBL	CABLE	LOS	LOCK-OUT STOP SWITCH	SP	SETPOINT
CH	CHANNEL	LP	LIGHTING PANELBOARD	SPD	SURGE PROTECTIVE DEVICE
CKT	CIRCUIT	LPU	LINE PROTECTION UNIT	SPEC	SPECIFICATION
COAX	COAXIAL CABLE	LS	LEVEL SWITCH	SS	STAINLESS STEEL
COMM	COMMUNICATION PORT	LSI	LONG, SHORT, INSTANTANOUS	SSS	SOLID STATE SOFT STARTER
CP	CONTROL PANEL	M	MOTOR CONTRACTOR	STT	START
CPT	CONTROL POWER TRANSFORMER	MAX	MAXIMUM	STP	STOP
CR	CONTROL RELAY	MCC	MOTOR CONTROL CENTER	SV	SOLENOID VALVE
CT	CURRENT TRANSFORMER	MCM	THOUSAND CIRCULAR MILS	SW	SWITCH
CTQ	CONSTANT TORQUE	MCP	MOTOR CIRCUIT PROTECTOR	SWBD	SWITCHBOARD
CU	COPPER	MH	MANHOLE	SWGR	SWITCHGEAR
DC	DIRECT CURRENT	MHD	METAL HALIDE	SYMM	SYMMETRICAL
DET	DETAIL	MIN	MINIMUM	T	TRIP
DI	DIGITAL INPUT	MINS	MINUTES	TB	TERMINAL BLOCK
DIA	DIAGRAM	MISC	MISCELLANEOUS	TC	TIME CLOCK
DISC	DISCONNECT	MNFR	MANUFACTURER	TDOD	TIME DELAY ON DE-ENERGIZATION
DIV	DIVISION	MOV	MOTOR OPERATED VALVE	TDOE	TIME DELAY ON ENERGIZATION
DO	DIGITAL OUTPUT	MPS	MOTOR PROTECTION SYSTEM	TEL	TELEMETRY
DPDT	DOUBLE POLE DOUBLE THROW	MS	MOISTURE SENSOR/SWITCH	TELCO	TELEPHONE COMPANY
DWG	DRAWING	MTR	MOTOR	TEMP	TEMPERATURE
ELEV	ELEVATION	MTS	MANUAL TRANSFER SWITCH	TM	THERMAL MAGNETIC
EMT	ELECTRICAL METALLIC TUBING	MV	MEDIUM VOLTAGE	TOC	TOTAL ORGANIC CARBON
ETM	ELAPSED TIME METER	N	NEUTRAL	TR	TIME DELAY RELAY
(E)	EXISTING	NC	NORMALLY CLOSED	TRIAD	TWISTED & SHIELDED 3 CONDUCTOR
F	FRAME	NEC	NATIONAL ELECTRICAL CODE	TS	TEMPERATURE SWITCH
FC	FAIL CLOSED	NEMA	NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION	TSPR	TWISTED & SHIELDED PAIR
FCS	FIELD CONTROL STATION	NIC	NOT IN CONTRACT	TYP	TYPICAL
FLA	FULL LOAD AMPS	NO	NORMALLY OPEN	UG	UNDERGROUND
FO	FAIL OPEN	NP	NAMEPLATE	UL	UNDERWRITERS LABORATORIES
FLEX	FLEXIBLE, METAL LIQUID TIGHT CONDUIT	NTS	NOT TO SCALE	UON	UNLESS OTHERWISE NOTED
FROA	FORWARD-REVERSE-OFF-AUTO	(N)	NEW	UPS	UNINTERRUPTIBLE POWER SUPPLIES
FS	FLOW SWITCH OR FULL SPEED	OC	ON CENTER	V	VOLTAGE
FV, FVNR	FULL VOLTAGE NON-REVERSING	OI	OPERATOR INTERFACE	VA	VOLT AMPS
FVR	FULL VOLTAGE REVERSING	OL	OVERLOAD	VAR	VOLT AMP REACTIVE
FWD	FORWARD	ORP	OXIDATION REDUCTION POTENTIAL	VFD	VARIABLE FREQUENCY DRIVE
(F)	FUTURE	P	PHASE, POLE	VLV	VALVE
G	GREEN	PB	PULL BOX	VM	VOLTMETER
GALV	GALVANIZED	PBI	PULL BOX INSTRUMENT	VTQ	VARIABLE TORQUE
GEN	GENERATOR	PBP	PULL BOX POWER	W	WHITE, WATTS
GFI	GROUND FAULT CIRCUIT INTERRUPTER	PE	PHOTOCELL	WHM	WATT-HOUR METER
GND	GROUND	PF	POWER FAIL	WM	WATTMETER
GRS	GALVANIZED RIGID STEEL CONDUIT	PFR	POWER (PHASE) FAIL RELAY	WP	WATERPROOF, WEATHER PROOF
GRS-PVC	PVC COATED GRS CONDUIT	PH	HYDROGEN ION CONCENTRATION	WS	TORQUE SWITCH, WATER SURFACE
HC	PUSHBUTTON	PLC	PROGRAMMABLE LOGIC CONTROLLER	XFMR	TRANSFORMER
HI	HIGH	PM	POWER MONITOR	XS	MISCELLANEOUS SWITCH
HID	HIGH INTENSITY DISCHARGE	PMP	PUMP	Y	YELLOW
HMI	HUMAN MACHINE INTERFACE	PNL	PANEL	Z	IMPEDANCE
HOA	HAND-OFF-AUTO	PR	PAIR, TWISTED & SHIELDED CABLE	ZS	LIMIT SWITCH

SWITCHES – PROCESS

SYMBOL	DESCRIPTION
FS	FLOW SWITCH – CLOSES UPON INCREASING FLOW
FS	FLOW SWITCH – OPENS UPON INCREASING FLOW
LS	LEVEL SWITCH – CLOSES UPON INCREASING LEVEL
LS	LEVEL SWITCH – OPENS UPON INCREASING LEVEL
PS	PRESSURE SWITCH – CLOSES UPON INCREASING PRESSURE (INCREASING VACUUM)
PS	PRESSURE SWITCH – OPENS UPON INCREASING PRESSURE (INCREASING VACUUM)
TS	TEMPERATURE SWITCH – CLOSES UPON INCREASING TEMPERATURE
TS	TEMPERATURE SWITCH – OPENS UPON INCREASING TEMPERATURE
ZS	LIMIT SWITCH – CLOSES AT SET LIMIT
ZS	LIMIT SWITCH – OPENS AT SET LIMIT
ZS	PROXIMITY SWITCH – CLOSES UPON DECREASING DISTANCE
ZS	PROXIMITY SWITCH – OPENS UPON DECREASING DISTANCE
WS	TORQUE SWITCH – CLOSES UPON INCREASING TORQUE
WS	TORQUE SWITCH – OPENS UPON INCREASING TORQUE

DEVICES – RELAY

SYMBOL	DESCRIPTION
CR 1 / 28, 111	CONTROL RELAY CR1 WITH NORMALLY OPEN CONTACT ON LINE 28 & NORMALLY CLOSED CONTACT ON LINE 111
TR 1	TIME DELAY RELAY TR2 – ADJUSTABLE TIME DELAY RANGE & SETTING AS SHOWN
TDOE / TDOD	TIME DELAY ON ENERGIZATION / TIME DELAY ON DE–ENERGIZATION
M1	CONTACTOR OR STARTER M1
SV	SOLENOID
CR1 (105)	NORMALLY OPEN, RELAY CONTACT – ACTUATED BY RELAY CR1 COIL LOCATED ON LINE 105
CR1	NORMALLY CLOSED, RELAY CONTACT – ACTUATED BY RELAY CR1
TR2	NORMALLY OPEN, TIME DELAY RELAY CONTACT – CONTACT CLOSES AFTER TR2 IS ENERGIZED
TR2	NORMALLY CLOSED, TIME DELAY RELAY CONTACT – CONTACT OPENS AFTER TR2 IS ENERGIZED
TR2	NORMALLY OPEN, TIME DELAY RELAY CONTACT – CONTACT OPENS AFTER TR2 IS DE–ENERGIZED
TR2	NORMALLY CLOSED, TIME DELAY RELAY CONTACT – CONTACT CLOSES AFTER TR2 IS DE–ENERGIZED
TR2	CONTACT OPENS AND CLOSES IN A TIMED REPEAT CYCLE

COMPONENTS

SYMBOL	DESCRIPTION
RES	RESISTOR
	POTENTIOMETER
	CAPACITOR, FIXED
	CAPACITOR, ADJUSTABLE
	DIODE
	DIODE, ZENER
	VARISTOR TRANSIENT VOLTAGE SUPPRESSOR
	VOLTAGE SURGE SUPPRESSOR, AC
	RESISTANCE TEMPERATURE DETECTOR (RTD)
	THERMOCOUPLE (T/C)

DEVICES – MISCELLANEOUS

SYMBOL	DESCRIPTION
	AUDIBLE ALARM
+	BATTERY
HTR	HEATER
	3 PHASE HEATER
G	GENERATOR
HP	3 PHASE MOTOR # = MOTOR HP
HP	SINGLE PHASE MOTOR
	TRANSFORMER
	LINE REACTOR

WIRING – CONNECTIONS

SYMBOL	DESCRIPTION
	PANEL OR EQUIPMENT WIRING
	FIELD WIRING
	CONDUCTORS – NOT CONNECTED
	CONDUCTORS – CONNECTED
	GROUND
	CHASSIS OR FRAME GROUND
	PLUG AND RECEPTACLE
	INCOMING LINE
	TERMINAL BLOCKS
	TERMINALS
SHIELD / CONDUCTOR	SHIELDED CABLE

SWITCHES – OPERATOR

SYMBOL	DESCRIPTION
SW	TOGGLE OR DISCONNECT SWITCH
PB	PUSHBUTTON – NORMALLY OPEN, MOMENTARY ACTION
PB	PUSHBUTTON – NORMALLY CLOSED, MOMENTARY ACTION
PB	PUSHBUTTON, MECHANICALLY INTERLOCKED, DOUBLE CIRCUIT – NORMALLY CLOSED AND NORMALLY OPEN, MAINTAINED ACTION
H O A / 2 1 1 2	SELECTOR SWITCH, 3 POSITION – CONTACT STATUS SHOWN EXISTS AT POSITION OF H–HAND, O–OFF, OR A–AUTO
2 1 1 2	SELECTOR SWITCH, 2 POSITION – CONTACT STATUS SHOWN EXISTS AT POSITION AS SHOWN

DEVICES – FRONT PANEL

SYMBOL	DESCRIPTION
X	INDICATING LIGHT, LETTER "X" INDICATES COLOR: R=RED G=GREEN, A=AMBER, W=WHITE Y=YELLOW, B=BLUE
PTT X	INDICATING LIGHT, PUSH TO TEST
AM	AMP METER
VM	VOLT METER
ETM	ELAPSED TIME METER
RTM	RUN TIME METER
XS	MULTI–POSITION SWITCH WHERE LETTER "X" IS FUNCTION: A=AMP, V=VOLT

DEVICES – PROTECTIVE

SYMBOL	DESCRIPTION
	DISCONNECT, 3 POLE
	CIRCUIT BREAKER, 3 POLE THERMAL MAGNETIC (TM) OR MOTOR CIRCUIT PROTECT (MCP)
OL	THERMAL OVERLOAD CONTACT
	THERMAL OVERLOAD ELEMENT
	FUSE WITH BLOWN FUSE INDICATING LIGHT
	FUSE
52	MEDIUM VOLTAGE DRAWOUT CIRCUIT BREAKER
	LOW VOLTAGE DRAWOUT CIRCUIT BREAKER

PLAN – SYMBOLS

SYMBOL	DESCRIPTION
	CONDUIT, EXPOSED
	CONDUIT, IN SLAB OR BELOW GRADE
	CONDUIT STUBBED OUT & CAPPED
	CONDUIT BENDS TOWARD OBSERVER
	CONDUIT BENDS AWAY FROM OBSERVER
	CONDUIT ENDS
	CONDUIT CHANGE IN ELEVATION
G	BARE COPPER GROUND WIRE
	GROUND CONNECTION BOLTED TYPE
	GROUND CONNECTION EXOTHERMIC WELD TYPE
	PULL BOX
	DISCONNECT SWITCH
#A	FIELD CONTROL STATION WITH JUNCTION BOX
#A	FIELD CONTROL STATION WITH #AMP DISCONNECT SWITCH
	SPECIAL RECEPTACLE
J	JUNCTION BOX
T	THERMOSTAT
# A a	LIGHTING, FANS, HEATERS # – CIRCUIT BREAKER NUMBER A – FIXTURE SCHEDULE REF. a – CONTROL SWITCH REFERENCE
#	DUPLEX RECEPTACLE # – CIRCUIT BREAKER NUMBER
# $ 2 a	TOGGLE SWITCH # – CIRCUIT BREAKER NUMBER SUBSCRIPT – CIRCUIT CONTROLLED SUPERSCRIPT – BLANK = 1 POLE 2 = 2 POLE 3 = 3 WAY
#	CONDUIT #
##	EQUIPMENT NUMBER

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Permit/Seal

REGISTERED PROFESSIONAL ENGINEER – STEPHEN M. KINNEY – No. 15636 – Exp. 6-30-2024 – ELECTRICAL – STATE OF CALIFORNIA

2023/3/14

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WWTF PHASE VI PROJECT HEADWORKS IMPROVEMENTS

City of Merced, California

File Name: 2112C8001	Dwn. ZKV	Dsgn. SMK	Chkd. XML	YYYY.MM.DD 2023.03.14

Title

ELECTRICAL SYMBOLS & ABBREVIATIONS

Project No.	Scale
184031329	SCALE
Revision: 0	Sheet: 29 of 39
Drawing No.	E01

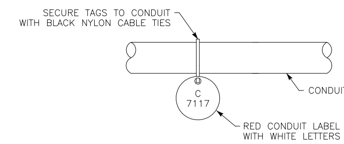
NOTES:

1. CONDUIT SIZE & TYPE; WIRE FILL FOR CONDUITS TO BE DESIGNATED NEXT TO CONDUIT NUMBER ELLIPSE.
2. THESE ARE THE CONTRACTOR DESIGNATED DRAWING NUMBERS.
3. NOT MORE THAN TWO WIRES PER TERMINAL BLOCK.
4. ALL TERMINAL BLOCKS TO BE PLACED IN NUMERICAL ORDER.
5. ALL NEUTRALS SHALL BE WHITE WIRE COLOR.
6. #12 GND TO DEVICES SHALL BE BONDED TO #8 GND LUG.

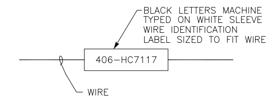
REFERENCE DOCUMENTS

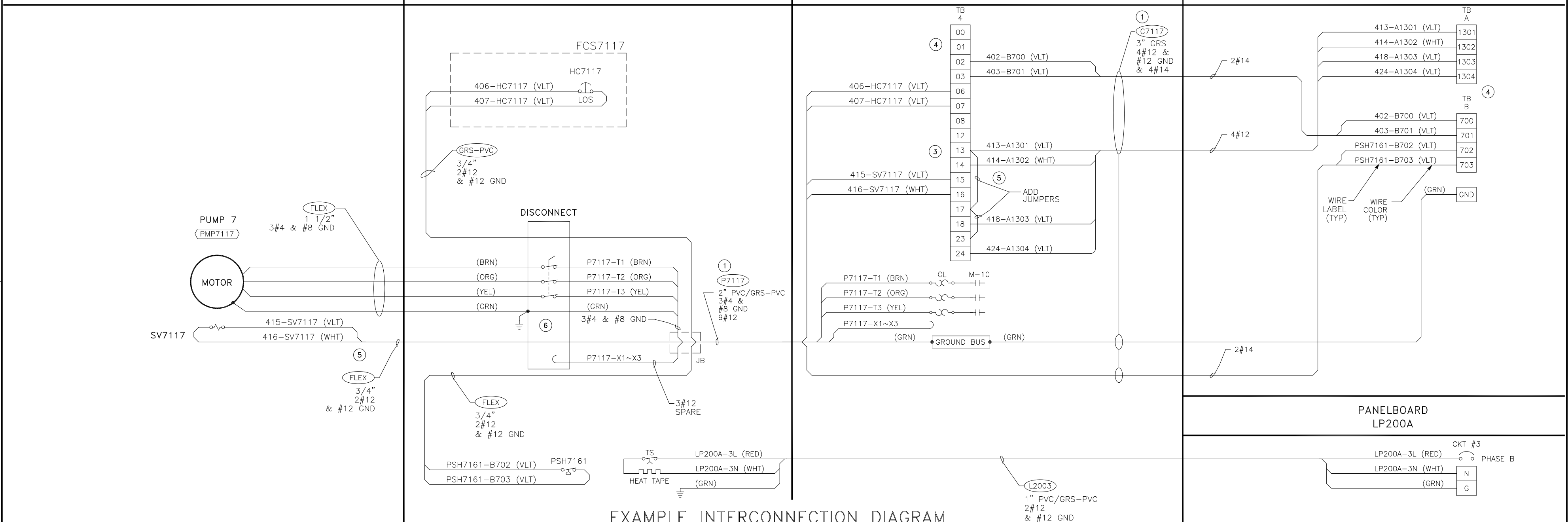
DRAWING #	DESCRIPTION	MANUFACTURER
P712	P&ID DIAGRAM	DESIGN
E717	ELECTRICAL SITE PLAN	DESIGN
PAGE 32, 36	CONDUIT AND CABLE SCHEDULE	DESIGN
(2) 1354-11	LOOP DIAGRAM	CONTRACTOR
(2) 1354-68	ELEMENTARY DIAGRAM	CONTRACTOR

TYPICAL CONDUIT MARKING SYSTEM



TYPICAL WIRE LABEL





EXAMPLE INTERCONNECTION DIAGRAM

(THIS DRAWING ILLUSTRATES THE FORMAT THAT SHALL BE FOLLOWED IN PREPARATION OF ALL INTERCONNECT DWGS)

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REGISTERED PROFESSIONAL ENGINEER — N M. KIM — NO. 15698 — Exp.6-30-2024 — ELECTRICAL — STATE OF CALIFORNIA

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City of Merced

WWTF PHASE VI PROJECT
HEADWORKS IMPROVEMENTS

City of Merced, California

File Name: 2112CE010

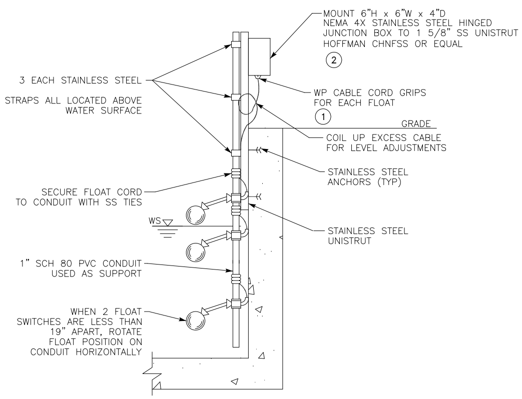
Dwn.	Dsgn.	Chkd.	YYYY.MM.DD
ZKV	SMK	XML	2023.03.14

Title

EXAMPLE INTERCONNECT DIAGRAM

Project No. 184031329 — Scale NONE

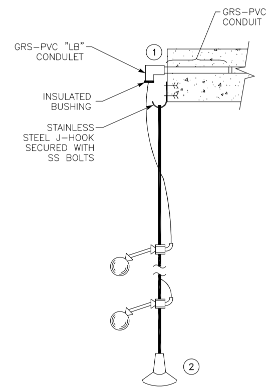
Revision 0 — Sheet 30 of 39 — Drawing No. E10



FLOAT SWITCH ROD DETAIL (A / E41)
NOT TO SCALE

NOTES: (1) ATTACH CABLE TO JUNCTION BOX WITH NYLON FITTING, STAINLESS STEEL CORD GRIP: HUBBELL/ KELLEMS SERIES 74 OR EQUAL.

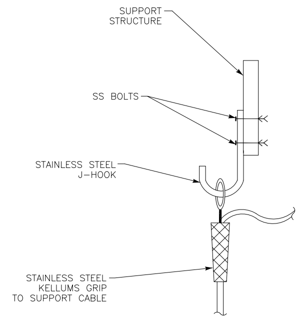
NOTES: (2) WHEN WETWELL TOP IS COVERED MOUNT BOX INSIDE WETWELL AT TOP ACCESSABLE THROUGH HATCH OPENING.



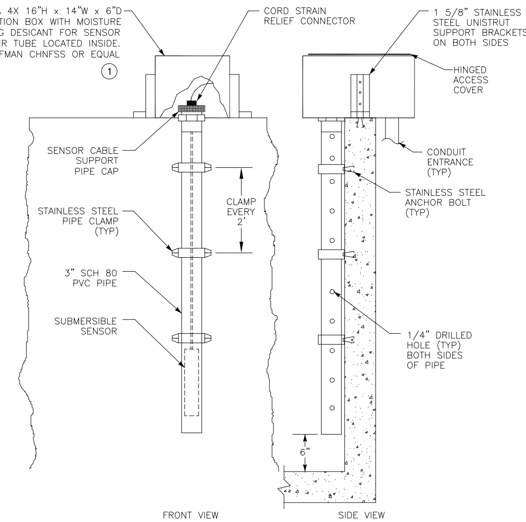
FLOAT SWITCH CABLE DETAIL (B / E41)
NOT TO SCALE

NOTE: (1) CONDUIT TO ENTER THROUGH SIDE OF WETWELL ACCESS OPENNING.

(2) LEVEL SWITCHES TO BE SUSPENDED WITH STAINLESS STEEL CABLE/WEIGHT MOUNTING KIT. CONSOLIDATED ELECTRIC OR APPROVED EQUAL.

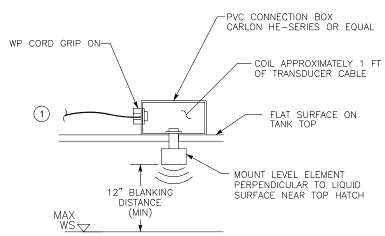


CABLE SUPPORT DETAIL (C / E41)
NOT TO SCALE



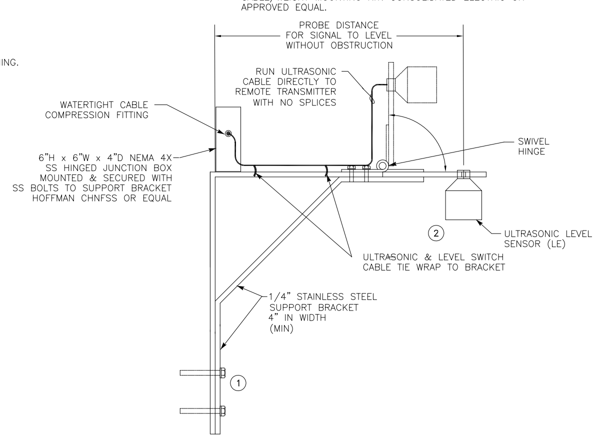
SUBMERSIBLE LEVEL TRANSMITTER DETAIL (D / E41)
NOT TO SCALE

NOTES: (1) WHEN WETWELL TOP IS COVERED MOUNT BOX INSIDE WETWELL AT TOP ACCESSABLE THROUGH HATCH OPENING.



TANK LEVEL SENSOR DETAIL (E / E41)
NOT TO SCALE

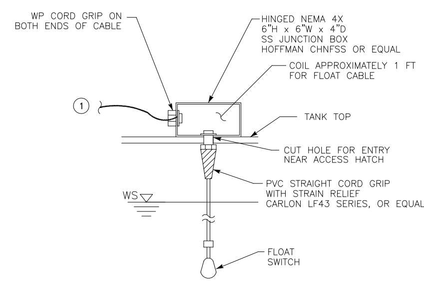
NOTE: (1) OUTDOOR TRAY RATED CABLE TO JUNCTION BOX.



WETWELL LEVEL SENSOR DETAIL (F / E41)
NOT TO SCALE

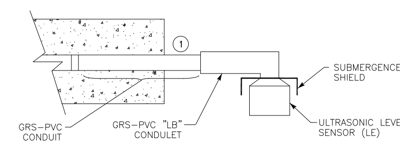
NOTES: (1) SECURE SUPPORT BRACKET TO STRUCTURE WITH 4 EACH 1/2" SS BOLTS SEPERATED 1' APART (MIN).

(2) LEVEL ELEMENT SHALL BE MOUNTED 1 1/2' (MIN) ABOVE THE HIGHEST WATER ELEVATION.



LEVEL SWITCH DETAIL (G / E41)
NOT TO SCALE

NOTE: (1) OUTDOOR TRAY RATED CABLE TO JUNCTION BOX.



ULTRASONIC SENSOR DETAIL (H / E41)
NOT TO SCALE

NOTES: (1) CONDUIT TO ENTER THROUGH SIDE OF WETWELL ACCESS OPENNING.

Revision	By	Appd	YYYY.MM.DD

Issued	By	Appd	YYYY.MM.DD
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2023/3/14

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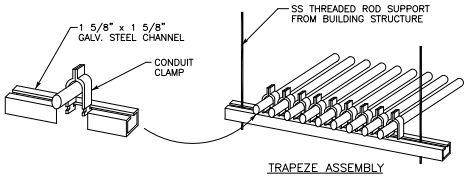
City of Merced
WWTF PHASE VI PROJECT
HEADWORKS IMPROVEMENTS
City of Merced, California
File Name: 2112CE041

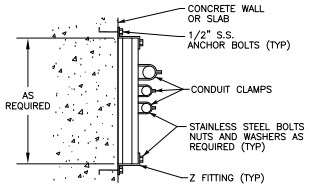
ZKV	SMK	XML	2023.03.14
Dwn.	Dsgn.	Chkd.	YYYY.MM.DD

Title
TYPICAL ELECTRICAL DETAILS 1

Project No. 184031329 — Scale NONE
Revision 0 — Sheet 31 of 39 — Drawing No. E41



TRAPEZE ASSEMBLY

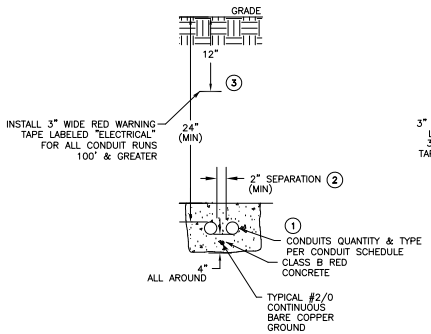


CONDUIT SUPPORT

CONDUIT PIPE STRAP MOUNTING DETAIL

NOT TO SCALE — A / E44

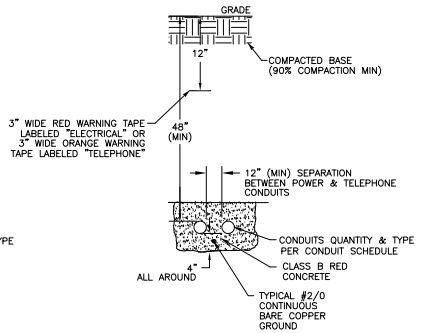
NOTES:
1. THIS DETAIL TYPICAL FOR BOTH VERTICAL AND HORIZONTAL MOUNTING.
2. CHANNEL AND ALL SUPPORT DEVICES TO BE NEMA RATED PER AREA CLASSIFICATION. FIELD COAT ALL CUTS, ETC. TO MATCH.
3. CHANNELS TO BE SPACED 5' MAXIMUM.



ENCASED CONDUITS DETAIL

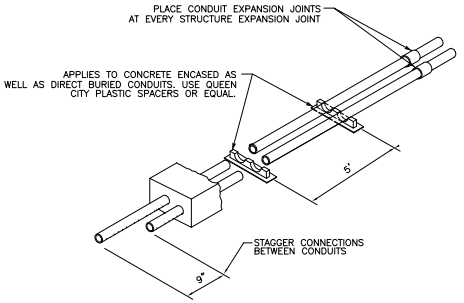
NOT TO SCALE — B / E44

NOTES:
1. PLACE CONDUIT RUNS OF 4 CONDUITS OR GREATER IN PLASTIC SPACERS (RATED FOR DIRECT BURIAL) EVERY 5' ALONG LENGTH OF RUN.
2. PROVIDE 12" (MIN) SEPARATION BETWEEN "A, C, D & M" TYPE GROUP AND "E, L & P" TYPE GROUP CONDUITS.
3. TRENCHING & COMPACTED BACKFILL PER SPECIFICATIONS.



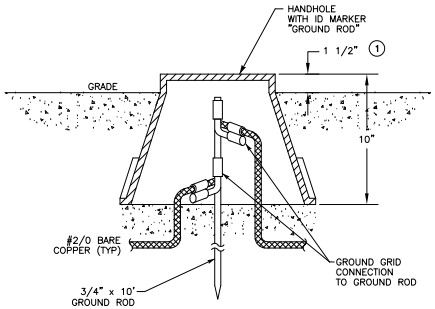
UTILITY CONDUITS DETAIL

NOT TO SCALE — C / E44



SPACERS AND JOINTS INSTALLATION DETAIL

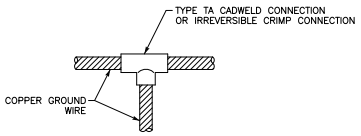
NOT TO SCALE — D / E44



HANDHOLE GROUNDING DETAIL

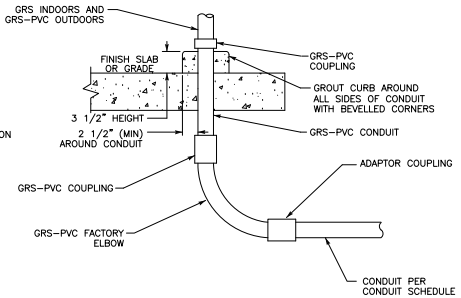
NOT TO SCALE — E / E44

NOTES:
1. FLUSH IN PAVED AREAS.



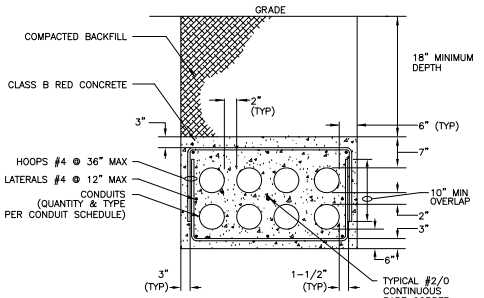
GROUND CABLE CONNECTION DETAIL

NOT TO SCALE — F / E44



EXPOSED CONDUIT TRANSITION DETAIL

NOT TO SCALE — G / E44



DUCT BANK DETAIL

NOT TO SCALE — H / E44

NOTES:
1. PLACE CONDUIT RUNS OF 4 CONDUITS OR GREATER IN PLASTIC SPACERS (RATED FOR DIRECT BURIAL) EVERY 5' ALONG LENGTH OF RUN.
2. PROVIDE 12" (MIN) SEPARATION BETWEEN "A, C, D & M" TYPE GROUP AND "E, L & P" TYPE GROUP CONDUITS.
3. TRENCHING & COMPACTED BACKFILL PER SPECIFICATIONS.

Revision	By	Appd	YYYY.MM.DD

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REGISTERED PROFESSIONAL ENGINEER
SHARON M. KINKADE
No. 15696
Exp. 6-30-2024
ELECTRICAL
STATE OF CALIFORNIA

2023/3/14

Consultant

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City of Merced

WWTF PHASE VI PROJECT
HEADWORKS IMPROVEMENTS

City of Merced, California

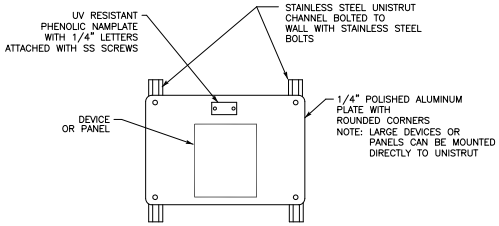
File Name: 2112C8044	ZKV	SMK	XML	2023.03.14
	Dsn.	Dsgn.	Chkd.	YYYY.MM.DD

Title

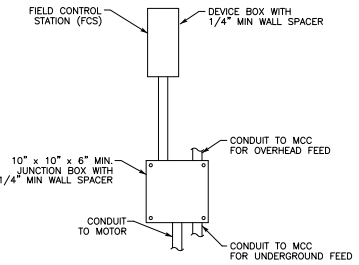
TYPICAL ELECTRICAL
DETAILS 4

Project No.	Scale
184031329	NONE
Revision	**Sheet**
0	32 of 39
Drawing No.	
E44	

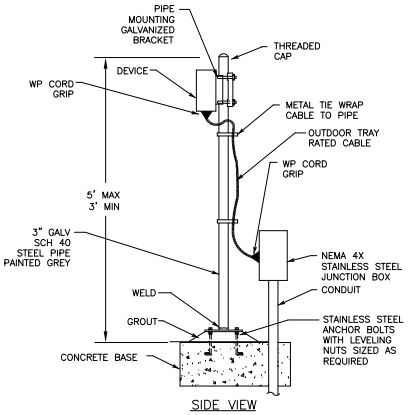
ORIGINAL SHEET - ANSI D



WALL PLATE SUPPORT — NOT TO SCALE DETAIL A E49

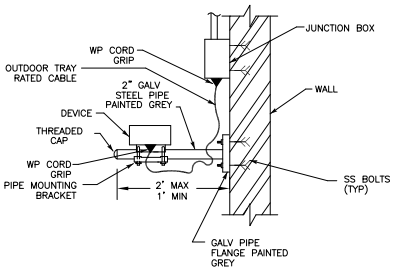


FCS WALL SUPPORT — NOT TO SCALE DETAIL B E49



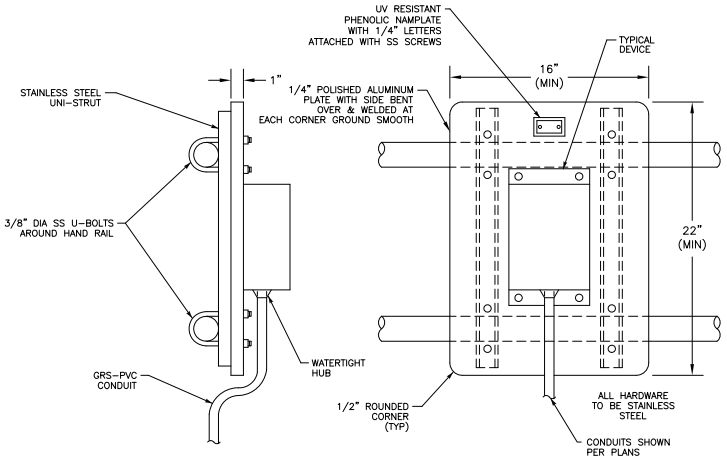
SIDE VIEW

FLOOR PIPE SUPPORT — NOT TO SCALE DETAIL C E49

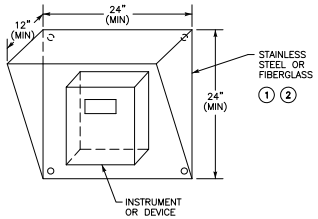


WALL PIPE SUPPORT — NOT TO SCALE DETAIL D E49

NOTES:
1. ALL MOUNTING HARDWARE SHALL BE STAINLESS STEEL.
2. GALV => HOT DIP GALVANIZED.

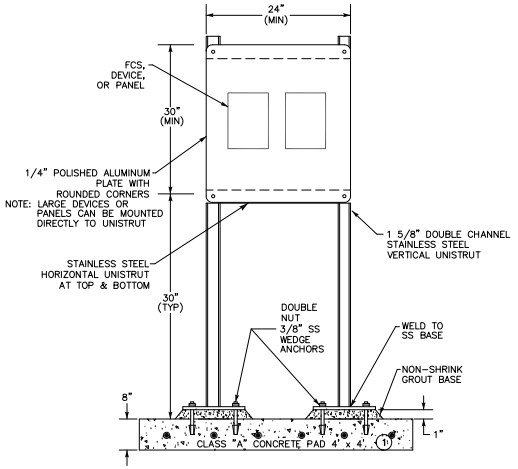


HANDRAIL SUPPORT PLATE — NOT TO SCALE DETAIL E E49



SUNSHIELD — NOT TO SCALE DETAIL F E49

NOTES: (1) USA BLUEBOOK SUNSHIELD OR EQUAL.
(1) SUPPORT WITH STAINLESS STEEL UNISTRUT.



PANEL SUPPORT — NOT TO SCALE DETAIL G E49

NOTES: (1) #3 REBAR CROSSWAYS AT 12" INTERVALS INSIDE PAD.

Revision	By	Appd	YYYY.MM.DD

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Consultant

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WWTF PHASE VI PROJECT
HEADWORKS IMPROVEMENTS

City of Merced, California

File Name: 211230049

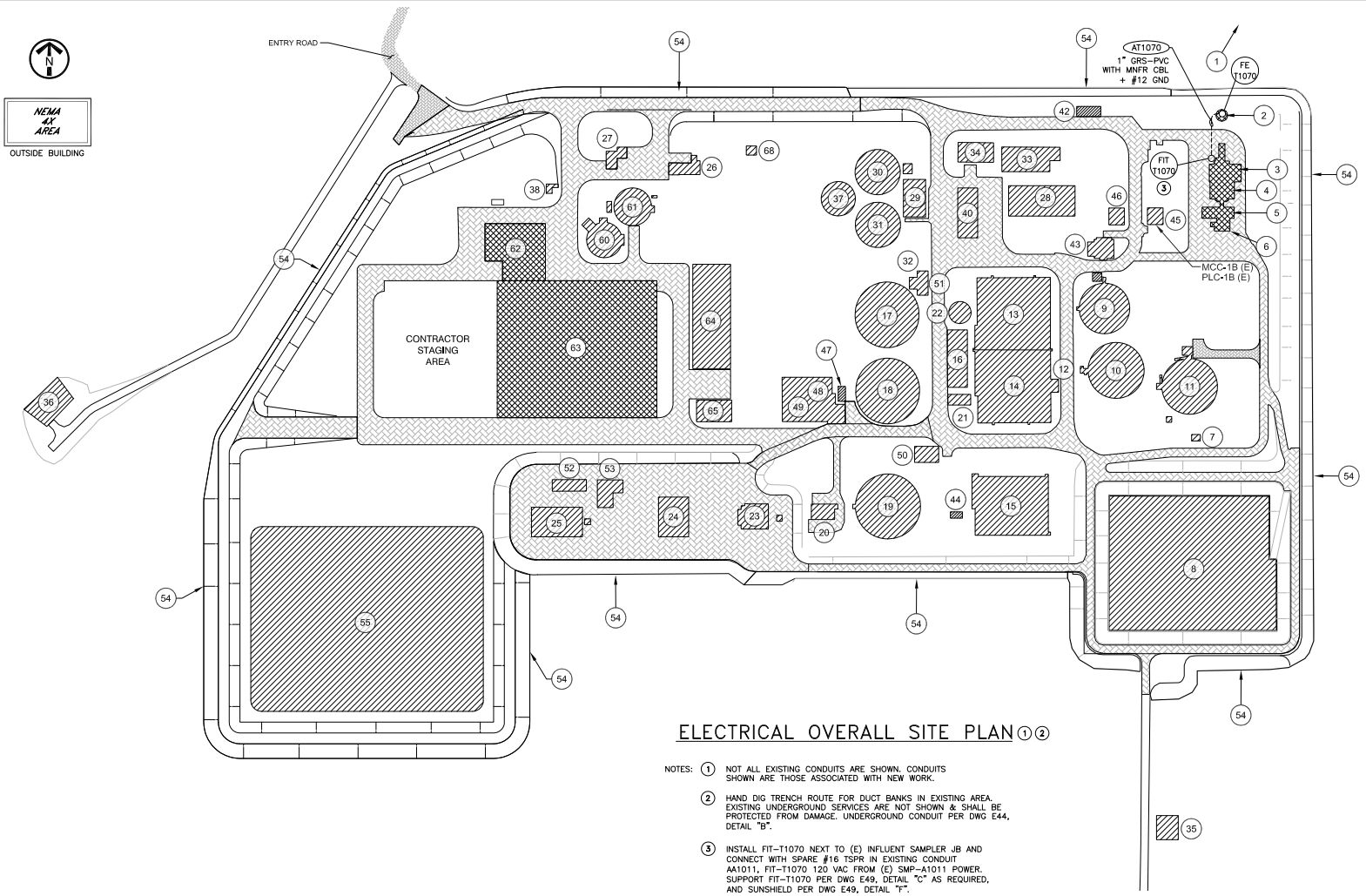
Dwn.	Dsgn.	Chkd.	YYYY.MM.DD
ZKV	SMK	XML	2023.03.14

Title

TYPICAL ELECTRICAL DETAILS 9

Project No.	Scale
184031329	NONE
Revision	**Sheet**
0	33 of 39
Drawing No.	
E49	

ORIGINAL SHEET - ANSI D



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2 NEW METER MANHOLE
3 HEADWORKS - INFLUENT PUMP STATION
4 HEADWORKS - SCREENING CHANNELS - **DWG EA30**
5 HEADWORKS - GRIT BASINS
6 HEADWORKS - PRIMARY CLARIFIER SPLITTER BOXES
7 EQUALIZATION BASIN INLET-OUTLET BOX
8 EQUALIZATION BASIN 1
9 PRIMARY CLARIFIER 1
10 PRIMARY CLARIFIER 2
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62 SOLIDS DEWATERING BUILDING
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65 SOILDS STORAGE 2
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67
68 CONDENSATE TRAP

ELECTRICAL OVERALL SITE PLAN ① ②

NOTES:
① NOT ALL EXISTING CONDUITS ARE SHOWN. CONDUITS SHOWN ARE THOSE ASSOCIATED WITH NEW WORK.
② HAND DIG TRENCH ROUTE FOR DUCT BANKS IN EXISTING AREA. EXISTING UNDERGROUND SERVICES ARE NOT SHOWN & SHALL BE PROTECTED FROM DAMAGE. UNDERGROUND CONDUIT PER DWG E44, DETAIL "B".
③ INSTALL FIT-T1070 NEXT TO (E) INFLUENT SAMPLER JB AND CONNECT WITH SPARE #16 TSPR IN EXISTING CONDUIT AA1011, FIT-T1070 120 VAC FROM (E) SMP-A1011 POWER. SUPPORT FIT-T1070 PER DWG E49, DETAIL "C" AS REQUIRED, AND SUNSHIELD PER DWG E49, DETAIL "F".

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FINAL Issued	ASB By	SLB Appd	2023.3.14 YYYY.MM.DD

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2023/3/14

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HEADWORKS IMPROVEMENTS
City of Merced, California
File Name: 211ZC805I

ZKV	SMK	XML	2023.03.14
Dwn.	Dsgn.	Chkd.	YYYY.MM.DD

Title
ELECTRICAL OVERALL SITE PLAN

Project No.	Scale
184031329	1" = 100'
Revision	Sheet
0	34 of 39
Drawing No.	E51

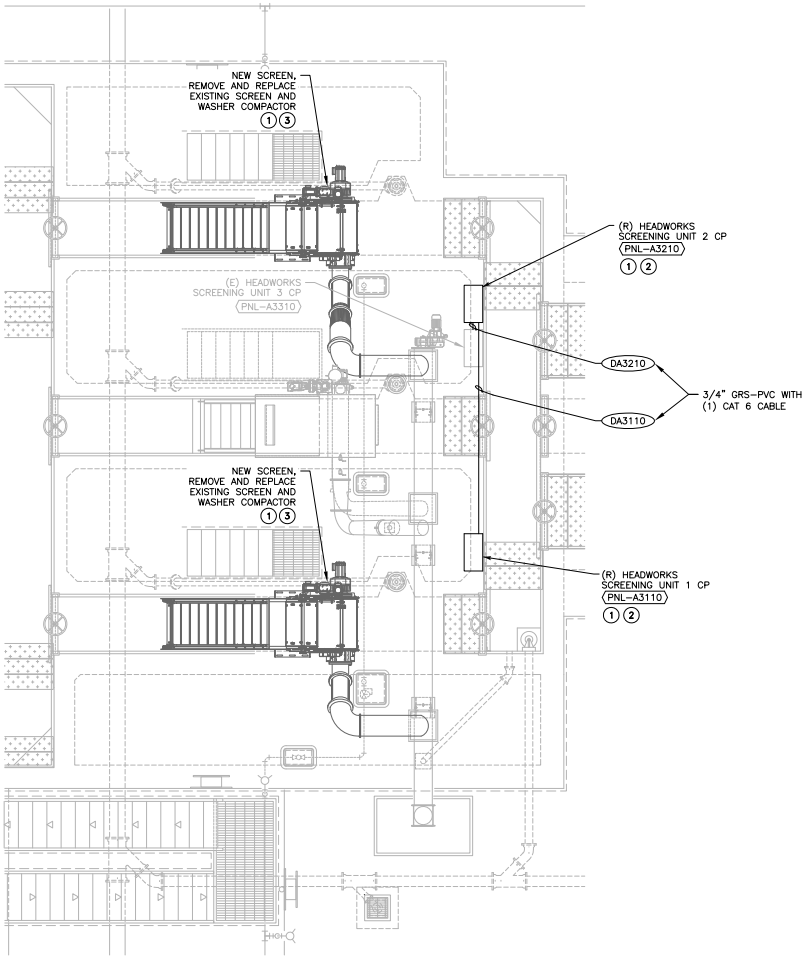
ORIGINAL SHEET - ANSI D

NEMA 4X AREA

OUTSIDE CLASS 1, DIV 2 AREA

CLASS 1 DIV 2 AREA

10 FT AROUND OPEN CHANNELS & EQUIPMENT TO A HEIGHT OF 18"



HEADWORKS SCREENING CHANNELS ELECTRICAL PLAN

NOTES:

1. CONTRACTOR TO FIELD VERIFY EXISTING CONDITIONS, DISCONNECT ALL EXISTING WIRES AND REPLACE EXISTING CONTROL PANELS IN PLACE. REUSE EXISTING CONDUITS/WIRES TO RECONNECT REPLACED SCREEN AND WASHER COMPACTOR, SEE SPEC SECTION 11344 AND CIVIL DRAWINGS FOR DETAILS.
2. INSTALL NEW CONDUITS AS SHOWN TO CONNECT TO ETHERNET SWITCH IN (E) PNL-A3310 (FROM PLC-1B), MODIFY PLC-1B & SCADA PER CITY'S INSTRUCTIONS AND DETAILS IN SPEC SECTION 11344, SAFETY NOT USED WIRES IN PLACE FOR SPARES PER CITY'S INSTRUCTIONS.
3. EXTEND EXISTING CONDUITS & WIRE AND INSTALL NEW GRS-PVC CONDUITS AND WIRE TO NEW INSTRUMENTS AS REQUIRED FOR A COMPLETE & OPERABLE SYSTEM. PLACE EYS ON CONDUITS ENTERING NEW CONTROL PANELS.

Revision	By	Appd	YYYY.MM.DD

Issued	By	Appd	YYYY.MM.DD
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2023/3/14

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WWTF PHASE VI PROJECT
HEADWORKS IMPROVEMENTS

City of Merced, California

File Name: 2112CEA30	Dwn. ZKV	Dsgn. SMK	Chkd. XML	YYYY.MM.DD 2023.03.14

Title

HEADWORKS SCREENING CHANNELS ELECTRICAL PLAN

Project No.	Scale
184031329	3/8" = 1'
Revision: 0	Sheet: 35 of 39
	Drawing No.: EA30

P & I DIAGRAM SYMBOLS

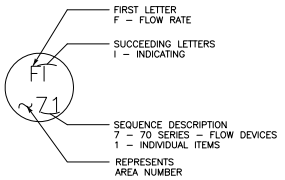
SYMBOL	DESCRIPTION
XXX / XXX	FIELD MOUNTED INSTRUMENT
XXX / XXX	FACE MOUNTED INSTUMENT ON LOCAL PANEL, OPERATOR ACCESSIBLE
XXX / XXX	FACE MOUNTED INSTRUMENT ON FIELD PANEL, OPERATOR ACCESSIBLE
XXX / XXX	INSTRUMENT MOUNTED IN LOCAL PANEL, OPERATOR INACCESSIBLE
XXX / XXX	INSTRUMENT MOUNTED IN FIELD PANEL, OPERATOR INACCESSIBLE
I	OPERATION PERFORMED WITH LOGIC OR HARDWIRED DEVICES
DWG #	– REFERENCE ELEMENTARY DWG. #
XXX / XXX	PLC OR COMPUTER FUNCTION PERFORMING OPERATION WITH VISUAL INDICATION
XXX / XXX	PLC OR COMPUTER FUNCTION PERFORMING OPERATION WITH VISUAL ALARM INDICATION
XXX / XXX	PLC OR COMPUTER PERFORMING INTERNAL OPERATION
XXX / XXX	PLC OR COMPUTER PERFORMING INTERNAL ALARM OPERATION
$\propto \int \frac{d}{dt}$	PROPORTIONAL, INTEGRAL, AND DIFFERENTIAL PARAMETERS
% +/–	RATIO AND BIAS PARAMETERS
	AUDIBLE ALARM (BUZZER OR HORN)
R#–C#	ANNUNCIATOR WINDOW R – ROW # C – COLUMN #
X	LAMP INDICATION (STATUS OR ALARM)
XXXXX	DISCRETE INPUT
	DISCRETE OUTPUT
	ANALOG INPUT
	ANALOG OUTPUT
a XXXX / XXXX a	JUMP TAG FROM ONE AREA TO ANOTHER AREA OF DRAWING "a" TAG CONNECT POINT ON EACH DRAWING
P–X / P–X	CONTINUED ON DWG P–X
#	AUTODIALER PRIORITY # PC BASED SOFTWARE

P & I DIAGRAM SYMBOLS

OPEN	CLOSED	DESCRIPTION
		VALVE (GENERAL)
		GATE (GENERAL)
		CHECK VALVE (GENERAL)
		PUMP (GENERAL)
		BLOWER (GENERAL)
	XXXX	VALVE/GATE NUMBER
	XXXXX	EQUIPMENT NUMBER
		ELECTRIC SIGNAL
		LOGIC OR DATA SIGNAL
		PNEUMATIC SIGNAL
		CAPILLARY TUBING (FILLED SYSTEM)
		HYDRAULIC SIGNAL
ES / AS		SONIC OR ELECTROMAGNETIC SIGNAL
E		ELECTRIC SUPPLY
SA		SERVICE AIR
IA		INSTRUMENT AIR
		DISCONNECT SWITCH

INSTRUMENT IDENTIFICATION LETTERS

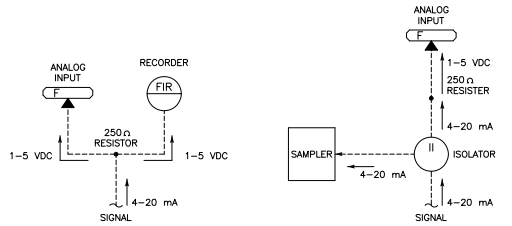
	FIRST – LETTER	SUCCEEDING – LETTER			
	MEASURED OF INITIATING VARIABLE	MODIFIER	READOUT PASSIVE FUNCTION	OUTPUT FUNCTION	MODIFIER
A	ANALYSIS		ALARM		
B	BURNER, COMBUSTION		USER'S CHOICE	USER'S CHOICE	USER'S CHOICE
C	CONDUCTIVITY			CONTROLLER	
D	DENSITY	DIFFERENTIAL			
E	VOLTAGE		SENSOR, PRIMARY ELEMENT		
F	FLOW RATE	RATIO (FRACTION)			
G	GENERAL		GLASS VIEWING DEVICE		
H	HAND				HIGH, OPENED
I	CURRENT (ELEC.)		INDICATING, INDICATOR		
J	POWER	SCAN			
K	TIME, TIME SCHEDULE	TIME RATE OF CHANGE		CONTROL STATION	
L	LEVEL		LIGHT		LOW, CLOSED
M	MOISTURE	MOMENTARY			MIDDLE
N	STATUS		STATUS	USER'S CHOICE	USER'S CHOICE
O	OPERATOR		ORIFICE, RESTRICTION		
P	PRESSURE, VACUUM		POINT (TEST) CONNECTION		
Q	QUANTITY	INTEGRATE, TOTALIZE			
R	RESET		RECORD		
S	SPEED, FREQUENCY	SAFETY		SWITCH	
T	TEMPERATURE			TRANSMITTER	TEST
U	MULTIVARIABLE		MULTIFUNCTION	MULTIFUNCTION	MULTIFUNCTION
V	VIBRATION, MECH. ANALYSIS			VALVE, DAMPER LOUVER	
W	WEIGHT, FORCE		WELL		
X	SWITCH	X AXIS	UNCLASSIFIED	UNCLASSIFIED	UNCLASSIFIED
Y	EVENT, STATE OR PRESENCE	Y AXIS		RELAY, COMPUTER, CONVERTOR	
Z	POSITION DIMENSION	Z AXIS		DRIVER, ACTUATOR, UNCLASSIFIED FINAL CONTROL ELEMENT	



NUMBERING SEQUENCE

SEQUENCE NUMBER	DESCRIPTION
00	COMMON ALARM
01–09	INDIVIDUAL ITEMS
10	MECHANICAL
20	MECHANICAL
30	MECHANICAL
40	MECHANICAL
50	LEVEL DEVICES
60	PRESSURE DEVICES
70	FLOW DEVICES
80	ANALYTICAL DEVICES
90	SAFETY & SECURITY DEVICES

P&ID INSTRUMENT IDENTIFICATION EXAMPLE



TYPICAL SIGNAL FLOWS

Revision | By | Appd | YYYY.MM.DD

Issued | FINAL | ASB | SLB | 2023.3.14 | By | Appd | YYYY.MM.DD

Permit/Seal

REGISTERED PROFESSIONAL ENGINEER
SHARON M. KINKADE
No. 15696
Exp. 6-30-2024
ELECTRICAL
STATE OF CALIFORNIA
2023/3/14

Consultant

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Client/Project Logo

Client/Project

City of Merced

WWTF PHASE VI PROJECT
HEADWORKS IMPROVEMENTS

City of Merced, California

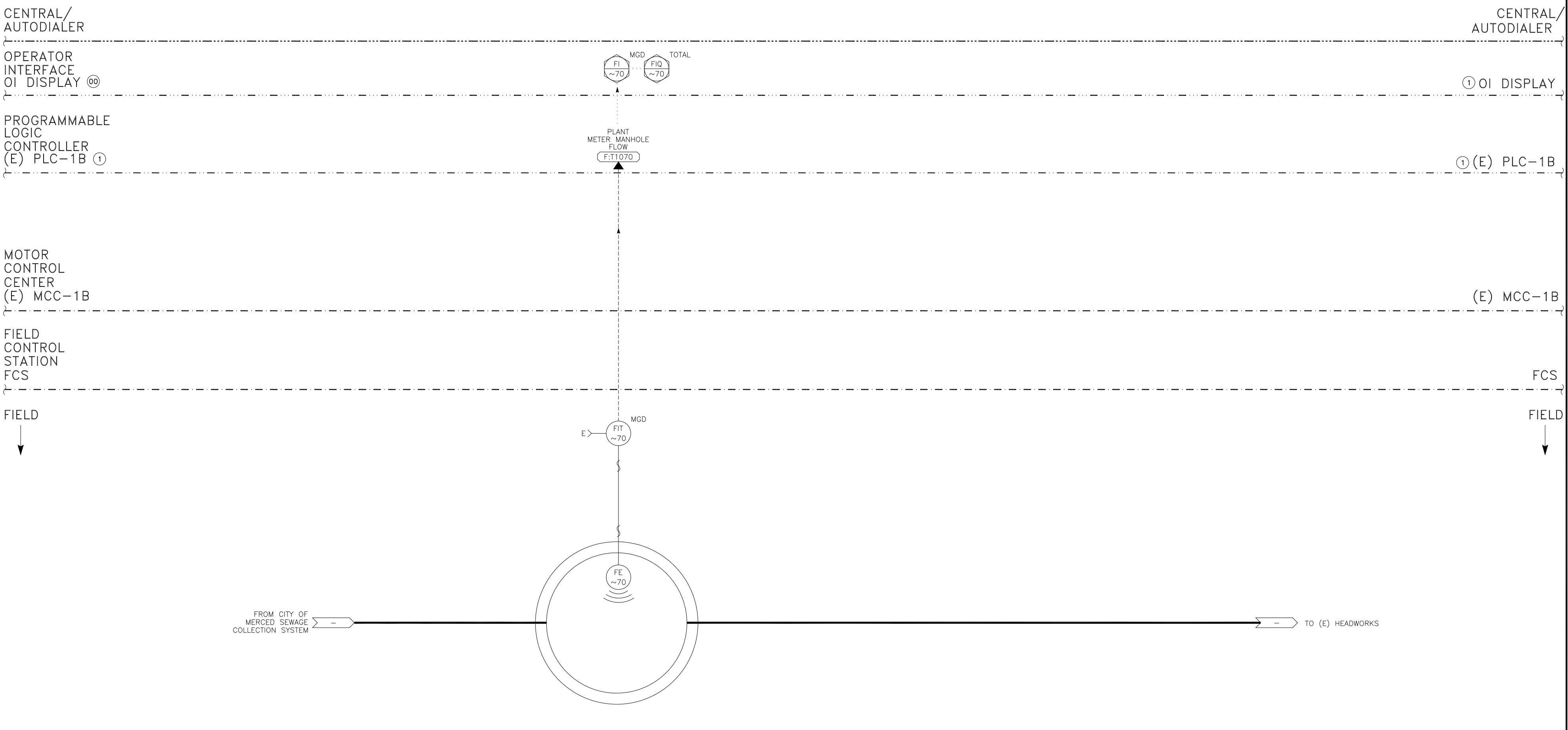
File Name: 211CP001 | ZKV Dwn. | SMK Dsgn. | XML Chkd. | 2023.03.14 YYYY.MM.DD

Title

ELECTRICAL SYMBOLS & ABBREVIATIONS

Project No. 184031329 | Scale SCALE

Revision 0 | Sheet 36 of 39 | Drawing No. P01



FLOW METERING MANHOLE

NOTES: 1 MODIFY (E) PLC & SCADA.

AREA PREFIX T10~

Revision	By	Appd	YYYY.MM.DD

Issued	By	Appd	YYYY.MM.DD
FINAL	ASB	SLB	2023.3.14

Permit/Seal

NO. 15698 Exp.6-30-2024 ELECTRICAL STATE OF CALIFORNIA

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City of Merced

WWTF PHASE VI PROJECT
HEADWORKS IMPROVEMENTS

City of Merced, California

File Name: 2112CPT010

ZKV	SMK	XML	2023.03.14
Dwn.	Dsgn.	Chkd.	YYYY.MM.DD

Title

FLOW METERING MANHOLE P&ID

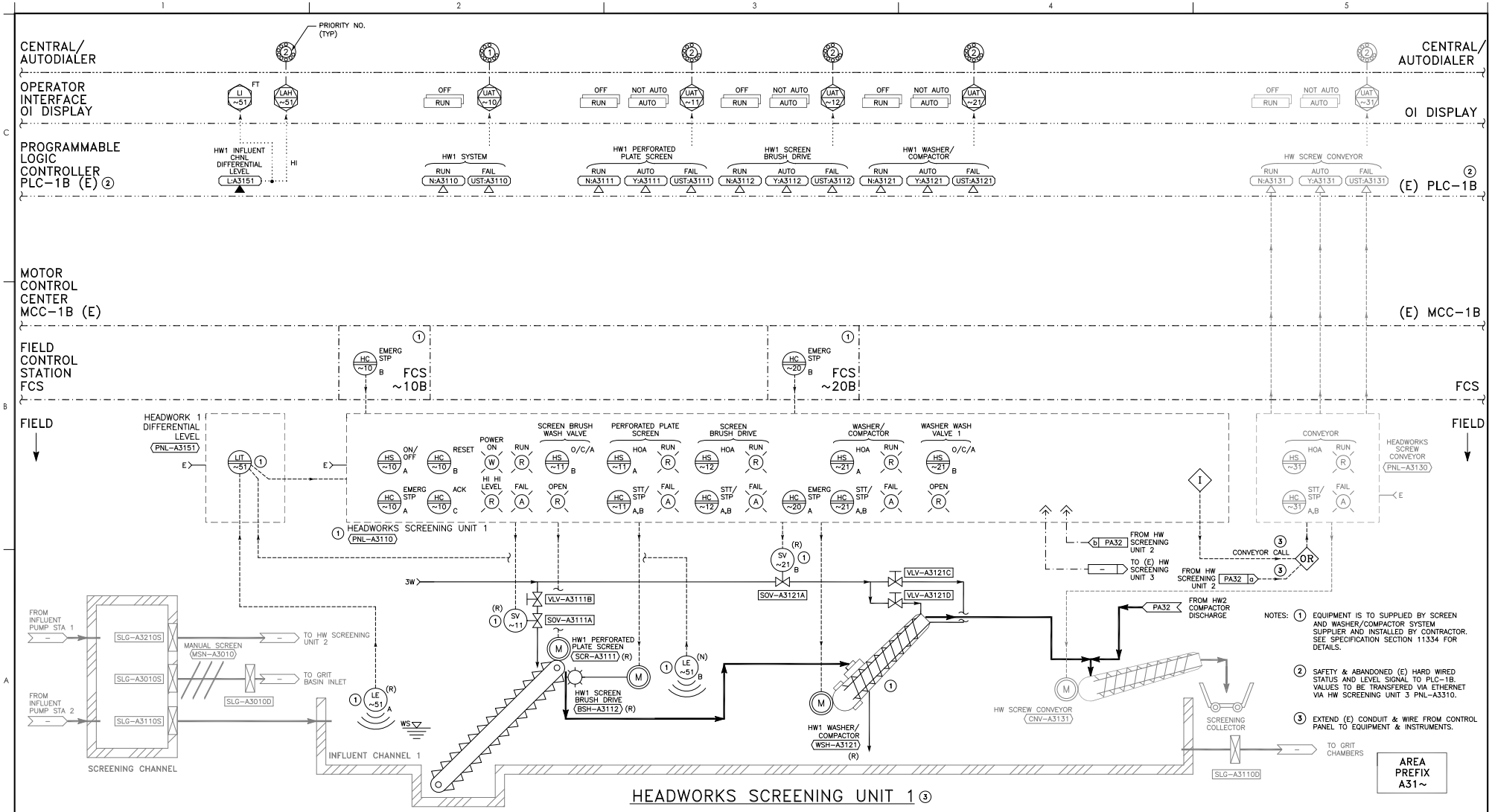
Project No. 184031329

Scale NONE

Revision 0

Sheet 37 of 39

Drawing No. PT10



Revision	By	Appd	YYYY.MM.DD
0	ASB	SLB	2023.3.14

Issued: FINAL

Permit/Seal

REGISTERED PROFESSIONAL ENGINEER — SHARON M. KINKLADE — No. 15696 — Exp. 6-30-2024 — ELECTRICAL — STATE OF CALIFORNIA

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City of Merced

WWTF PHASE VI PROJECT
HEADWORKS IMPROVEMENTS

City of Merced, California

File Name: 2112CPA031

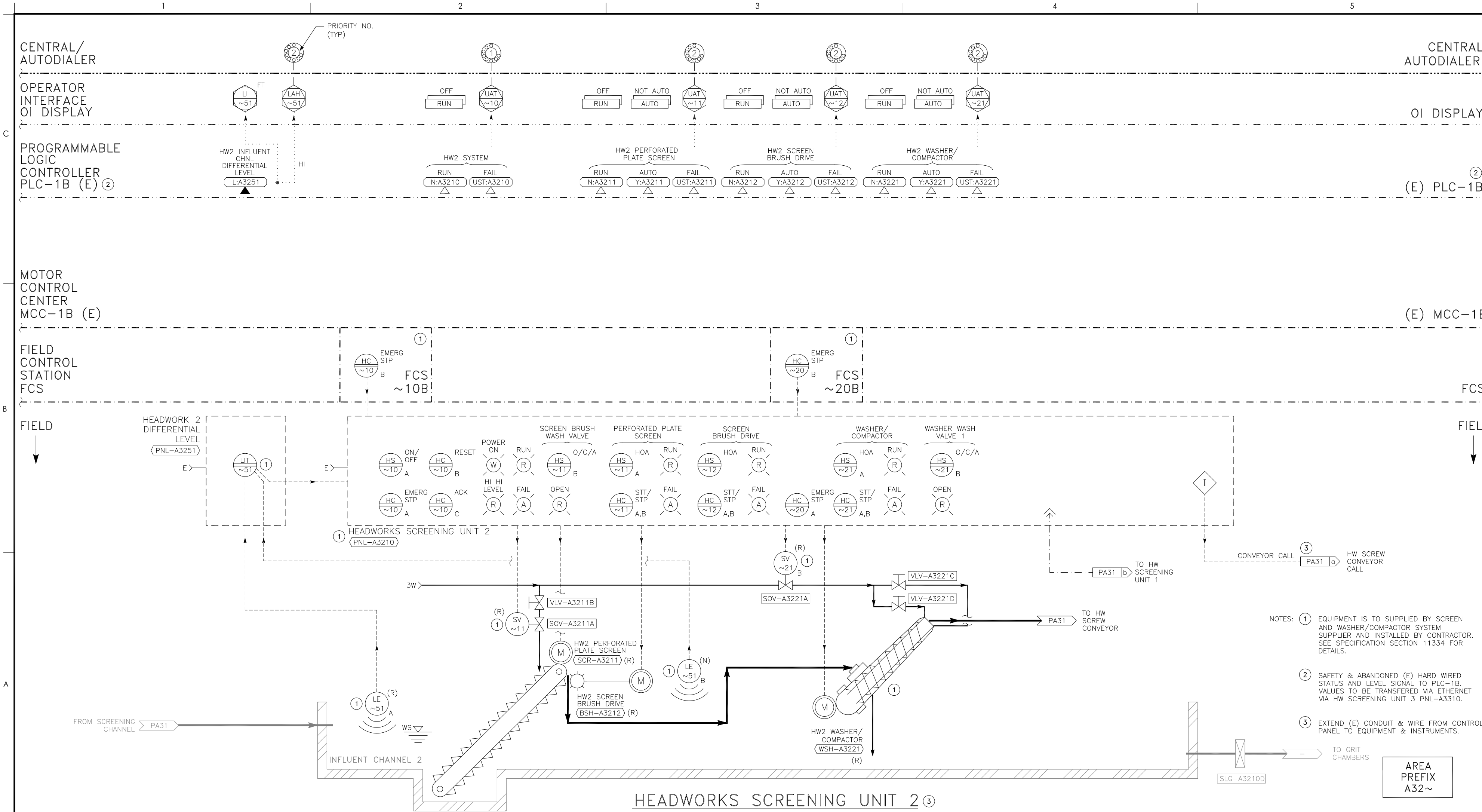
Dwn.	Dsgn.	Chkd.	YYYY.MM.DD
ZKV	SMK	XML	2023.03.14

Title

HEADWORKS SCREENING UNIT 1 P&ID

Project No.	Scale
184031329	NONE
Revision	**Sheet**
0	38 of 39

Drawing No. PA31



NOTES:
1. EQUIPMENT IS TO SUPPLIED BY SCREEN AND WASHER/COMPACTOR SYSTEM SUPPLIER AND INSTALLED BY CONTRACTOR. SEE SPECIFICATION SECTION 11334 FOR DETAILS.
2. SAFETY & ABANDONED (E) HARD WIRED STATUS AND LEVEL SIGNAL TO PLC-1B. VALUES TO BE TRANSFERED VIA ETHERNET VIA HW SCREENING UNIT 3 PNL-A3310.
3. EXTEND (E) CONDUIT & WIRE FROM CONTROL PANEL TO EQUIPMENT & INSTRUMENTS.

AREA PREFIX A32~

Revision	By	Appd	YYYY.MM.DD

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Permit/Seal

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City of Merced

WWTF PHASE VI PROJECT
HEADWORKS IMPROVEMENTS

City of Merced, California

File Name: 2112CPA032

ZKV	SMK	XML	2023.03.14
Dwn.	Dsgn.	Chkd.	YYYY.MM.DD

Title

HEADWORKS SCREENING
UNIT 2 P&ID

Project No. 184031329
Scale NONE
Revision 0
Sheet 39 of 39
Drawing No. PA32

Contract Documents and Specifications for

CITY OF MERCED
DEPARTMENT OF PUBLIC WORKS
PROJECT NUMBER 230035
MERCED WWTF PHASE VI PROJECT – HEADWORKS IMPROVEMENTS

Volume 1A

March 2023

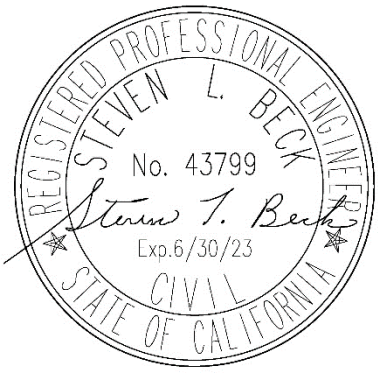
Stantec

PROJECT NUMBER 230035

CITY OF MERCED WWTF PHASE VI PROJECT – HEADWORKS IMPROVEMENTS

LICENSEE RESPONSIBLE FOR TECHNICAL SPECIFICATIONS

Technical Specifications prepared by or under the direction of the following registered persons:



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03/14/2023

EXHIBIT B

CITY OF MERCED
DEPARTMENT OF PUBLIC WORKS

PROJECT NUMBER 230035

MERCED WWTF PHASE VI PROJECT – HEADWORKS IMPROVEMENTS

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Division 12: Furnishings

Not Used

Division 13: Special Construction

Not Used

Division 14: Conveying System

Not Used

SECTION 01010

GENERAL CONSTRUCTION INFORMATION AND REQUIREMENTS

PART 1 GENERAL

1.1 DESCRIPTION

This section covers the general requirements for the Contractor's temporary facilities at the job site and for the prosecution of the work.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Section 01020 - Modification of Existing Facilities and Order of Work

B. Section 01300 - Submittals

C. Section 01330 - Safety Plan

D. Section 01700 - Contract Closeout

E. Section 02270 - Stormwater Runoff Control Program

F. Section 02513 - Asphalt Concrete Paving

G. Section 11010 - General Mechanical Equipment Provisions

H. Division 16 – Electrical

1.3 GENERAL NATURE OF THE WORK

The work generally involves furnishing of labor, equipment, and materials necessary to demolish existing screens and washer/compactors and miscellaneous headworks appurtenances, install new mechanical screens, new washer/compactors, new grit removal baffles, miscellaneous headworks appurtenances, construct a new influent flow meter manhole, site grading and paving, site piping, and electrical and instrumentation.

1.4 LOCATION OF THE PROJECT SITE

The project site is located at 1961 Gove Road, Merced, CA 95341.

1.5 ACCESS TO THE SITE

Access to the project site shall be as shown on the Drawings or as directed by the Engineer.

PART 2 MATERIALS

2.1 MATERIALS

See Divisions 2 through 16 for materials and methods of installation.

PART 3 EXECUTION

3.1 CONTRACTOR'S OFFICE TOOLS AND EQUIPMENT

A. Security: The Contractor shall at all times be responsible for the security of his plant and equipment. The Owner will not take any responsibility for missing or damaged equipment, tools or personal belongings.

B. Contractor’s Field Office: During the performance of the contract, the Contractor shall maintain a suitable office at the work site which shall be the headquarters of the Contractor's representative. The Contractor shall provide furnishings for the Contractor’s field office, including desks, chairs, conference table for 6 persons, and whatever electrical and computing devices needed by the Contractor to complete the project and as described in subsequent sections. The Contractor shall maintain a cleaning service, garbage service, and arrange for utility repairs should repairs be necessary for the operation and maintenance of the services.

C. Workshop and Storage Facilities: Contractor shall provide storage buildings for the protection of equipment, materials, supplies and tools. The building used for the storage of materials which deteriorate when exposed to moisture shall be moisture-proof. Workshops and storage buildings shall be located as designated by the Engineer, and shall be clean and in proper order at all times.

D. Parking Facilities: Contractor shall provide temporary parking areas, at locations on the project site approved by the Engineer, for visitor parking, employee vehicles, and the vehicles used by the Contractor's construction employees.

3.2 CONTRACTOR'S UTILITIES

A. Power: The Contractor shall provide and maintain power to the field offices. The Contractor shall be responsible for obtaining and maintaining power for the purposes of construction, and for any field offices or ancillary structures installed by the Contractor for his use during construction.

B. Water: Potable water used for the purposes of construction or for the Contractor's use shall be furnished by the Contractor at no charge to the Owner. See specification Section 02233 for information on availability of water. Arrangements for the purchase of this water from the City of Merced shall be the responsibility of the Contractor. All equipment and labor for water storage, pumping, and conveyance shall be furnished and paid for by the Contractor.

C. Telephone: The Contractor shall be responsible for connecting and maintaining telephone/DSL service to the field offices.

D. Sanitary Facilities: The Contractor shall provide sanitary facilities for the field offices. The Contractor shall be responsible for obtaining and maintaining sanitary facilities for the purposes of construction, and for any additional field offices or ancillary structures installed by the Contractor for his use during construction. Currently, there are no available sanitary facilities on the site.

E. Temporary Heating: The Contractor shall be responsible for providing temporary heating, covering and enclosures as necessary to protect all work and material against damage by dampness and cold and to facilitate completion of the work. The Contractor shall supply all the fuel, equipment and materials required for temporary heating, in accordance with manufacturer's recommendations.

F. The Contractor's use of the project site and facilities for personnel housing shall be prohibited.

G. Use of the Owner's equipment is prohibited without written approval from the Owner. The Contractor shall obtain written permission from the Owner before using owner's equipment. The Contractor shall take care to protect Owner's equipment from misuse. Any damage of Owner's equipment or failure of the equipment as a result of abuse or overloading shall be Contractor's responsibility.

3.3 LANDS PROVIDED BY OWNER

The Owner will provide all lands required for the Work under the contract, together with the right of access to such lands, as indicated. The Contractor shall not unreasonably encumber the premises with his equipment or materials. Periodic clean-up and debris removal may be requested by the Engineer as site maintenance at no extra cost to the Owner. Unless otherwise indicated, Owner's facilities on the site must remain in operation throughout the duration of project construction.

3.4 LANDS PROVIDED BY CONTRACTOR

A. The Contractor shall provide, with no liability or additional cost to the Owner, any additional land and access thereto not shown or described that may be required for temporary construction facilities or storage of materials. He shall construct all access roads, detour roads or other temporary works as required by his operations.

B. The Contractor shall confine his equipment, storage of materials and operation of his workmen to those areas shown and described and such additional areas as he may provide.

3.5 PRECONSTRUCTION PRINTS

The Contractor shall, before mobilization begins, submit two binders of hard copy printouts, and electronic files of digital preconstruction photos of the work area. Each photo shall include a date stamp as part of the image. The electronic photo files shall be provided in JPEG format at the highest quality compression setting with a camera resolution of 3.3 megapixels minimum on a USB flash drive shall be provided with each binder. The hard copy image printouts shall be full color, a maximum of two prints to a page, each print a minimum size of 5 inches by 7 inches, with a printed image quality of at least 300dpi and shall be printed on photo glossy white photo paper. Each printed image shall be labeled with the electronic image file name, the location and direction it was taken, and a short description of the subject. The Engineer may designate the locations and subject of up to 50 photos, but the Contractor may wish to take more images to fully document the existing conditions of the site or facilities before work begins. All such photos shall be included in the aforementioned submittal.

3.6 PRECONSTRUCTION VIDEO

The Contractor shall provide a video, on a USB flash drive, to the Owner. The video shall clearly show the pre-construction condition of the project site and roadways to be utilized for access to the project site during construction, a minimum distance of one mile from the project site. The video shall clearly display the date and time it was taken. Two copies of the video shall be transmitted to the Owner prior to mobilization.

3.7 CONSTRUCTION PRINTS

The Contractor shall submit, each month during the construction, two binders of hard copy printouts, and two copies of electronic files of digital construction photos documenting the progress of the Work. Each photo shall include a date stamp as part of the image. The electronic photo files shall be provided in JPEG format at the highest quality compression setting with a camera resolution of 3.3 megapixels minimum on a USB flash drive to be provided with each binder. The hard copy image printouts shall be full color, a maximum of two prints to a page, each print a minimum size of 5 inches by 7 inches, with a printed image quality of at least 300dpi, and shall be printed on photo glossy white photo paper. Each printed image shall be labeled with the electronic image file name, the location and direction it was taken, and a short description of the subject. The Engineer may designate the locations and subject of up to 50 photos each monthly submittal. Upon completion of the Work, additional photos shall be taken of the subjects and locations depicted in the preconstruction photographs and submitted as described above.

3.8 SHIPPING AND PROTECTION OF EQUIPMENT

A. Provide product handling and protection of the equipment and materials in accordance with Section 01640 – Product Handling

3.9 TESTS AND INSPECTION

A. General Requirements: All materials, equipment, installation and workmanship included in this contract, if so required by the Engineer, shall be tested and inspected to prove compliance with the contract requirements. No tests specified herein shall be applied until the item to be tested has been inspected and approval given for the application of such test.

B. Tests and inspections shall include:

1. The delivery acceptance test and inspections.

2. The installed tests and inspections of items as installed.

C. Tests and inspections, unless otherwise specified or accepted, shall be in accordance with the recognized standards of the industry.

D. The form of evidence of satisfactory fulfillment of delivery acceptance test and of installed test and inspection requirements shall be, at the discretion of the Engineer, either by tests and inspections carried out in his presence or by certificates or reports of tests and inspections carried out by approved persons or organizations.

E. Delivery Acceptance Tests and Inspections: The delivery acceptance tests and inspections shall be at the Contractor's expense for any materials or equipment specified and shall include the following:

1. Test of items during the process of manufacture and/or on completion of manufacture, comprising material tests, hydraulic pressure tests, electric tests, performance and operating tests and inspections in accordance with the relevant standards of the industry and more particularly as detailed in individual sections of these specifications, or as may be required by the Engineer to satisfy himself that the items tested and inspected comply with the requirements of this contract.

2. Inspection of all items delivered at the site in order to satisfy the Engineer that such items are of the specified quality and workmanship and are in good order and condition at the time of delivery.

F. Installed Tests and Inspection:

1. All mechanical and electrical equipment shall be tested by the Contractor to the satisfaction of the Engineer before any facility is put into operation. Tests shall be specified herein and shall be made to determine whether the equipment has been properly assembled, aligned, adjusted and connected. Any changes, adjustments or replacements required to make the equipment operate as specified shall be carried out by the Contractor as part of the work and be pre-approved by the manufacturer.

2. At least 30 days before the time allowed in his construction schedule for commencing testing and start-up procedures, the Contractor shall submit to the Engineer, in duplicate, details of the procedures he proposes to adopt for testing and start-up of all mechanical and electrical equipment to be operated singly and together.

3. During the testing of equipment, the Contractor shall make available experienced factory trained representatives of the manufacturers of all the various pieces of equipment, or other qualified persons who shall instruct the Owner's personnel in the operation and care thereof. Instruction shall include step-by-step troubleshooting procedures with all necessary test equipment. All manufacturer's instructions shall be provided in writing.

4. During the performance tests, data shall be taken and recorded to demonstrate that all equipment and systems comply with manufacturer's submitted data and other requirements of the contract.

5. If under test, any portion of the work should fail to fulfill the contract requirements and is altered, renewed or replaced, tests on that portion when so altered, removed or replaced, together with all other portions of the work as are affected thereby, shall, if so required by the Engineer, be repeated within reasonable time and in accordance with the specified conditions, and the Contractor shall pay to the Owner all reasonable expenses incurred by the Owner as a result of the carrying out of such tests.

6. If any doubt, dispute or difference should arise between the Engineer and the Contractor regarding the test results or the methods or equipment used in the carrying out of a test, the Engineer may order the test to be repeated using modified methods or equipment. If the repeat test substantially confirms the Engineer’s position on the previous test, all costs in connection with the repeat test will be paid by the Contractor, otherwise the costs shall be borne by the Owner. Where the results of

any installed test fail to meet the contract requirements, repeat tests to achieve the contract requirements shall be made at the Contractor's expense.

G. Plant Operational and Performance Tests

1. After all individual equipment is tested and certified by the factory-trained representatives, the Contractor shall perform a 5-day plant operational test of the entire treatment process train. Contractor shall be responsible for any recirculation pumping required during this test as specified in Section 01020. The 5-day operational test shall be conducted using clean water and shall include all operational facilities. The testing shall be completed under the supervision of plant operations staff. Operational testing shall include automatic control and instrumentation systems. Any equipment or control systems that fail to perform properly shall be corrected and retested by the Contractor. Successful completion of the 5-day plant operational test is required prior to substantial completion.

2. In addition to the 5-day plant operational test, certain mechanical equipment and pumps, when required in the specifications, shall be given a field performance test in accordance with Section 11010 and 01670.

3.10 OPERATION AND MAINTENANCE MANUALS

A. Before receiving payment for more than 85 percent of the work or prior to the start-up of individual equipment, the Contractor shall deliver to the Engineer five sets of acceptable manufacturer's operating and maintenance instructions, as detailed below.

B. Operating and maintenance information shall be provided for each maintainable piece of equipment, equipment assembly or subassembly, and material provided or modified under this Contract in accordance with Section 01680 – Operation and Maintenance Manuals.

3.11 TRAINING

The Contractor shall provide training of the Owner’s personnel in the proper operation and maintenance of the equipment and systems installed under this Contract in accordance with Section 01675 – Training.

3.12 RESTORATION OF STRUCTURES AND SURFACES

A. Structures, Equipment and Pipework: The Contractor shall remove such existing structures, equipment, and pipework as may be necessary for the performance of the work and shall rebuild or replace the items thus removed to original or better condition. He shall repair any existing structures which may be damaged as a result of his work.

B. Roads and Streets: All roads and streets in which the surface is removed, broken or damaged, or in which the ground has caved or settled due to work under this contract, shall

be completely restored and brought to the original grade and crown section unless otherwise indicated. Before resurfacing material is placed, edges of pavements shall be trimmed back far enough to provide clean, solid, vertical faces, and shall be free of any loose material. Roadways used by the Contractor for hauling materials, equipment, supplies, etc., shall be cleaned and repaired if the condition of the roadway is damaged or otherwise affected due to the Contractor's operations. Repaving and repairs shall be done in accordance with Section 02513 – Asphalt Concrete Paving.

C. Cultivated Areas and Other Surface Improvements: All cultivated and natural areas, either agricultural or lawns, and other surface improvements which are damaged by actions of the Contractor shall be restored, including roadside drainage ditches, as nearly as possible to their original condition or better.

3.13 SAFETY

A. The Contractor shall execute and maintain his work so as to avoid injury or damage to any person or property. All work shall be done in conformance with the State of California Division of Industrial Relations and OSHA Standards.

B. Safety precautions as applicable shall include, but not be limited to, adequate life protection, and life saving equipment; adequate illumination for underground and night operations; instructions in accident prevention for all employees; such machinery guards, walkways, scaffolds, ladders, bridges, and other safety devices, equipment and wearing apparel as are necessary or lawfully required to prevent accidents or injuries, and the proper inspection and maintenance of all safety measures.

C. The names and telephone numbers of at least two medical doctors practicing in the vicinity and the telephone number of the local ambulance shall be prominently displayed adjacent to all telephones.

D. The Contractor shall develop and maintain a Construction Safety Plan as stipulated in Section 01330.

E. Nothing in this Section shall dilute the Contractor’s complete and continuous responsibility for Site health, safety, and security as set forth in the General Conditions.

3.14 CONTRACTOR'S PERSONNEL PROTECTION

A. The Contractor is warned that sewage may contain infectious bacteria, viruses and other disease-bearing organisms. It is the Contractor's responsibility to urge his personnel to observe a strict regimen of proper hygienic precautions, including any inoculations recommended by the public health officer.

B. Because of the danger of solvents, gasoline and other hazardous materials being carried in raw sewage, sewer lines and manholes, certain areas around the treatment plant are considered hazardous to open flame, sparks or unventilated occupancy. The Contractor shall be aware of these dangers and shall take the necessary measures to assure his personnel observe proper safety precautions when working in these areas.

3.15 TRENCH SAFETY

A. Attention is directed to the provisions of Section 6705 of the Labor Code of the State of California.

B. Excavation for any trench 5 feet or more in depth shall not begin until the Contractor has submitted to the Engineer, with the resolution of "No exceptions taken" of the Contractor's detailed plan for worker protection from the hazards of caving ground during the excavation of such trench. Such plan shall be submitted in accordance with Section 01300 and shall show the details of the design of shoring, bracing, sloping, or other provisions to be made for worker protection during such excavation. No such plans shall allow the use of shoring, sloping or a protective system less effective than that required by the Construction Safety Orders of the Division of Industrial Safety and if such plan varies from the shoring system standards established by the Construction Safety Orders, the plan shall be prepared and signed by an Engineer who is registered as a Civil or Structural Engineer in the State of California.

C. In addition, the Contractor shall obtain, pay for, and comply with all provisions of the permit required by Section 6500 of the California Occupational Safety and Health Act of 1973. A copy of permit must be submitted per Section 01300.

D. In accordance with the provisions of Section 6707 of the State Labor Code, each bidder shall list, in the Bid Items indicated, the amount contained in his proposal for adequate trench and excavation, sheeting, shoring, and bracing or equivalent method for the protection of life and limb which shall conform to applicable Safety Orders. By listing this sum in his proposal, the bidder warrants that his action does not convey tort liability to the Owner, the Owner's employees, or the Engineer.

END OF SECTION

Name of Bidder: _____

SECTION 01011

LIST OF EQUIPMENT MANUFACTURERS

Bidder shall list the manufacturer or supplier that will furnish the respective item of equipment. Bidder shall list only one manufacturer or supplier for each piece of equipment listed. Failure by Bidder to list names of manufacturers or suppliers for every item of equipment listed may be cause for rejection of the Bid. The manufacturers or suppliers listed by the Bidder shall not be changed after submitting list unless approved in writing by the Owner.

1.1 LUMP SUM BASE BID

A. The Bidder shall base the Lump Sum Base Bid and Deductive Bid Item Schedule upon the specified and named Alternate A, B, or C major equipment items as listed in the following Major Product or System Schedule.

1.2 MAJOR PRODUCT OR SYSTEMS SCHEDULE

A. This section includes a schedule listing alternate equipment acceptable to Owner. The Bidder shall indicate (circle proposed manufacturer) which named alternate equipment it intends to provide. Bidders may also propose "or-equal" equipment for those items where a blank space is provided by writing in the manufacturer's name.

B. If an "or equal" manufacturer is proposed by the Bidder, the cost of any required engineering redesign, and the cost of any electrical, mechanical or structural modifications to adjacent and interfacing equipment necessary to make the several parts fit together, licensing fees and additional construction and other costs resulting from the proposed "or equal" equipment shall be included in the Bid. If there is a deviation from the drawings, submittal of new contract drawings requires approval prior to installation; all drawings must be stamped by a California certified professional engineer. These deviations shall be at no cost to the owner. If the proposed "or-equal" manufacturer is not accepted by the Owner after the Award of Contract, the Bidder shall furnish and install the named equipment at no additional cost to the Owner.

C. When an "or-equal" manufacturer is offered by Bidder, the Bidder shall list only such equipment that will comply with the requirements of the Specifications. Equipment will generally be deemed "or equal" provided that the equipment is the same or better than the named equipment in function, performance, reliability, quality, and general configuration.

D. In order that Owner may determine if the proposed "or equal" equipment is a satisfactory alternative to the named equipment, Bidder shall submit full descriptive material and a detailed list of the equipment proposed as outlined in the Instructions to Bidder. No evaluation of submittals will be made prior to the Bid opening. It is the responsibility of Contractor to furnish materials and equipment meeting the requirements of the Specifications, and acceptance of the Bid does not constitute or imply approval of equipment proposed. Owner reserves the right to deny approval of any equipment or materials that do not comply with the Specifications, even though listed herein.

Name of Bidder: _____

MAJOR PRODUCT OR SYSTEMS SCHEDULE

Item No.	Spec. Section	Description	Manufacturer/Supplier
1.	11334	Perforated Plate Screening System	A. SaveCo

Notes:
1. Not all major products and systems are included in the table above; only those items related to mechanical equipment. Other products, such as concrete, steel and piping are not included.
2. Items in this table must be circled or completed for the bid.

BIDDER

_____

(Signature)

_____

(Date)

END OF SECTION

SECTION 01012

CERTIFICATION OF ELECTRICAL SUBCONTRACTOR'S EXPERIENCE AND QUALIFICATIONS

This certification and the responses herein shall assist the Owner in determining the lowest responsive responsible bidder. To be eligible for an award of Contract, the Bidder must submit this signed certification from the Electrical Subcontractor listed in the List of Subcontractors within the timeframe identified in the Completion of Bid Forms. If the Bidder does not list an Electrical Subcontractor for the electrical work, then Bidder must submit to the Owner with bidding documents this signed Certification of Bidder's experience and qualifications to self-perform the electrical work with the understanding that all references to Electrical Subcontractor in this certification shall mean Contractor.

The electrical subcontractor represents that it is competent, knowledgeable, and has special skills on the nature, extent, and inherent conditions of the work to be performed. The electrical subcontractor further acknowledges that there are certain peculiar and inherent conditions existent in the construction of the particular facilities which may create, during the construction program, unusual or peculiar unsafe conditions hazardous to persons and property. The electrical subcontractor expressly acknowledges that it is aware of such peculiar risks and that it has the skill and experience to foresee and to adopt protective measures to adequately and safely perform the construction work with respect to such hazards.

None of the requirements herein are to determine pre-qualification to bid on the Project, but are part of the Owner's evaluation of bids received.

A. ESSENTIAL REQUIREMENTS FOR QUALIFICATION

If the answer to any of questions 1 through 4 is "no", or if the answer to any of questions 5 through 8 is "yes", the Bidder shall provide an explanation of its answer, including the reasons why its answer shall not result in it being disqualified from being awarded the Contract. However, an exemption explanation letter does not guarantee acceptance of Bid. In accordance with all applicable public contract laws, the Owner shall retain the right to reject unqualified Bidders, which shall render the Bid non-responsive.

1. Subcontractor will comply with and provide Commercial General Liability and Automobile insurance as defined in Contract Documents, except the amount of coverage per occurrence or accident shall not be less than $1,000,000 with an annual general aggregate limit of $2,000,000.

☐ Yes ☐ No

2. Subcontractor has current Workers' Compensation insurance policy as required by the Labor Code or is legally self-insured pursuant to Labor Code section 3700 et. seq.

☐ Yes ☐ No

3. Does your firm meet the requirements of California Code of Regulations, Title 8, Section §290.1? All journeymen shall hold a California general electrician certification.

☐ Yes ☐ No

4. Subcontractor's three year average Workers' Compensation Insurance Experience Modification Rate (EMR) is less than or equal to 1.10 (110%) or is the RIR and LTIR less than 4.7 and 2.5 respectively. See Safety Qualification Criteria below for EMR, RIR, and LTIR rate calculation.

☐ Yes ☐ No

5. Has your contractor's license been revoked at any time in the last five (5) years?

☐ Yes ☐ No

6. Has a surety firm completed a contract on your behalf, or paid for completion because your firm was default terminated by the project owner within the last five (5) years?

☐ Yes ☐ No

7. At the time of submitting this qualification form, is your firm ineligible to bid on or be awarded a public works contract, or perform as a subcontractor on a public works contract, pursuant to either Labor Code section 1777.1 or Labor Code section 1777.7?

☐ Yes ☐ No

8. At any time during the last five (5) years, has your firm, or any of its owners or officers been convicted of a crime involving the awarding of a contract of a government construction project, or the bidding or performance of a government contract?

☐ Yes ☐ No

B. PROJECT EXPERIENCE - To be to the Owner within the timeframe identified in the Completion of Bid Forms.

The electrical subcontractor shall have performed at least three (3) wastewater or water treatment plant projects with electrical systems of similar or greater complexity in the last five (5) years of similar size that demonstrate the electrical subcontractor's experience and qualification to construct this project; of which, the electrical subcontractor must demonstrate the successful completion of at least two (2) wastewater projects with a dollar value of at least 65% of the value bid for this project or two (2) wastewater projects have 65% of the equivalent cost per construction year [of this project] within the past five years.

If the Electrical Subcontractor fails to have the required experience as set forth above, the Bidder shall provide an explanation as to why its Bid should not be rejected. However, an

exemption explanation letter does not guarantee acceptance of Bid. In accordance with all applicable public contract laws, the Owner shall retain the right to reject unqualified Bidders, which shall render the Bid non-responsive.

Bidders are to complete this certification form and not attach their own form to this document with similar information.

1. Project Name: _____

   Owner: _____

   Electrical Subcontract Cost: _____

   Construction Time: _____ Calendar Days

   Owner's Representative: _____

   Owner's Telephone No.: _____

   Date of Substantial Completion _____

2. Project Name: _____

   Owner: _____

   Electrical Subcontract Cost: _____

   Construction Time: _____ Calendar Days

   Owner's Representative: _____

   Owner's Telephone No.: _____

   Date of Substantial Completion _____

3. Project Name: _____

   Owner: _____

   Electrical Subcontract Cost: _____

   Construction Time: _____ Calendar Days

   Owner's Representative: _____

   Owner's Telephone No.: _____

   Date of Substantial Completion _____

4. Project Name: _____

   Owner: _____

   Electrical Subcontract Cost: _____

   Construction Time: _____ Calendar Days

   Owner's Representative: _____

   Owner's Telephone No.: _____

   Date of Substantial Completion _____

5. Project Name: _____

   Owner: _____

   Electrical Subcontract Cost: _____

   Construction Time: _____ Calendar Days

   Owner's Representative: _____

   Owner's Telephone No.: _____

   Date of Substantial Completion _____

C. SAFETY QUALIFICATION CRITERIA

The following information will be used to determine if the electrical subcontractor meets the minimum safety requirements for this project. To qualify to bid and be awarded the project, the contractor shall have a safety record that meets or exceeds the one of the three following safety criteria:

SAFETY CRITERIA REQUIREMENTS FOR QUALIFICATION

1. If the Contractors three-year average Workers' Compensation Experience Modification (EMR) is equal to or less than 110%, the contractor meets the minimum safety requirements for this project;
2. If the Contractor's three-year average EMR is greater than 110%, the Contractor's three-year average Recordable Incident Rate (RIR) must not be greater than 4.7 and three-year average Lost Time Incident Rate (LTIR) must not be greater than 2.5 to meet the minimum safety requirements for this project;

3. If the Contractor only meets either the three-year average RIR or LTIR value, the Contractor shall be required to hire, at no additional cost to the Owner, a mutually acceptable safety consultant who will prepare a project specific safety plan, conduct random weekly inspections of the Contractor's activities to ensure conformance with the safety plan and prepare and submit a weekly report to the Owner summarizing the results of each inspection. The contractors shall adhere to the safety plan. The contractor's activities shall be adjusted immediately to address any issues resulting from the weekly safety inspection.

Contractors that cannot meet any of the three safety criteria above are not eligible to work for the Owner.

The electrical subcontractor shall list its Experience Modification Rate, Lost time incident Rate, and Recordable Incident Rate for the last three complete years (available from your insurance carrier).

Year	EMR	RIR	LTIR
Three Year Average			

To verify the above information, the Owner will contact the electrical subcontractor's Workers' Compensation Insurance carrier. The electrical subcontractor shall authorize its carrier to release this information. Failure to release this information will result in the bid being non-responsive and result in automatic disqualification of the bid.

Workers' Compensation Insurance Company: _____

Contact Person for Insurance Company: _____

Telephone Number: _____

The Owner may check project references listed to verify information provided along with skills and capacity represented by Subcontractor. It is very important that the Bidder is responsible to verify that all contact information is current for each name listed above and that the Subcontractor has the qualifications and experience required by this certification prior to submission of the certification. The undersigned hereby states that all above representations are correct and true.

Signed this _____ day of _____, 20____

_____
Electrical Subcontractor's Name

_____
Authorized Signature

_____
Title of Signator

_____
Valid CA Contractors License No.

_____
License Classification

_____
Expiration Date

END OF SECTION

SECTION 01013

CERTIFICATION OF SYSTEM INTEGRATOR EXPERIENCE AND QUALIFICATIONS

This certification and the responses herein shall assist the Owner in determining the lowest responsive responsible bidder. To be eligible for an award of Contract, the Bidder must submit to the Owner this signed Certification from the General Contractor's or Electrical Subcontractor's System Integrator of all switchboards, panels, ATSs, MCCs, panelboards, panelboard transformers, and PLC hardware; submit certification within the timeframe identified in the Completion of Bid Forms.

The System Integrator represents that it is competent, knowledgeable, and has special skills on the nature, extent, and inherent conditions of the work to be performed. The System Integrator further acknowledges that he has regularly engaged in similar electrical and instrumentation systems for the municipal water and wastewater industry.

None of the requirements herein are to determine pre-qualification to bid on the Project, but are part of the Owner's evaluation of bids received.

A. ESSENTIAL REQUIREMENTS FOR QUALIFICATION

If the answer to any of questions 1 through 3 is "no", or if the answer to questions 4 is "yes", the Bidder shall provide an explanation of its answer, including the reasons why its answer shall not result in it being disqualified from being awarded the Contract. However, an exemption explanation letter does not guarantee acceptance of Bid. In accordance with all applicable public contract laws, the Owner shall retain the right to reject unqualified Bidders, which shall render the Bid non-responsive.

1. The System Integrator employs personnel on this project who have successfully completed ISA or equal training courses on general-purpose instrumentation.

   ☐ Yes ☐ No

2. The System Integrator has a permanent, fully staffed, and equipped service facility in operation at least six (6) months prior to bid date within 150 miles of project site. Service facility shall be under same company name as System Integrator and same company shall be staffed with personnel and equipment required to maintain, repair and calibrate the instrumentation system. Subletting repair and warranty work to a third party is not acceptable.

   ☐ Yes ☐ No

3. System Integrator has current Workers' Compensation insurance policy as required by the Labor Code or is legally self-insured pursuant to Labor Code section 3700 et. seq.

☐ Yes ☐ No

4. Has a surety firm completed a contract on your behalf, or paid for completion because your firm was default terminated by the project owner within the last five (5) years?

☐ Yes ☐ No

B. PROJECT EXPERIENCE - To be submitted within the timeframe identified in the Completion of Bid Forms.

The system integrator shall have performed at least three (3) wastewater or water treatment plant projects with electrical, instrumentation and automation systems of similar or greater complexity in the last five (5) years of similar size that demonstrate the system integrator's experience and qualification to construct this project; of which, the system integrator must demonstrate the successful completion of at least two (2) wastewater projects with a dollar value of at least 65% of the value bid for this project or two (2) wastewater projects have 65% of the equivalent cost per construction year of this project within the past five years.

If the System Integrator fails to have the required experience as set forth above, the Bidder shall provide an explanation as to why its Bid should not be rejected. However, an exemption explanation letter does not guarantee acceptance of Bid. In accordance with all applicable public contract laws, the Owner shall retain the right to reject unqualified Bidders, which shall render the Bid non-responsive.

Bidders are to complete this certification form and not attach their own form to this document with similar information.

1. Project Name: _____

Owner: _____

System Supply Contract Bid Price: _____

Construction Time: _____ Calendar Days

Owner's Representative: _____

Owner's Telephone No.: _____

Electrical Subcontractor's Name: _____

Date of Substantial Completion _____

2. Project Name: _____

Owner: _____

System Supply Contract Bid Price: _____

Construction Time: _____ Calendar Days

Owner's Representative: _____

Owner's Telephone No.: _____

Electrical Subcontractor's Name: _____

Date of Substantial Completion _____

3. Project Name: _____

Owner: _____

System Supply Contract Bid Price: _____

Construction Time: _____ Calendar Days

Owner's Representative: _____

Owner's Telephone No.: _____

Electrical Subcontractor's Name: _____

Date of Substantial Completion: _____

The Owner may check project references listed to verify information provided along with skills and capacity represented by System Integrator. It is very important that the Bidder is responsible to verify that all contact information is current for each name listed above and that the System Integrator has the qualifications and experience required by this certification prior to submission of the certification.

The undersigned hereby states that all above representations are correct and true.

Signed this _____ day of _____, 20____

_____
System Integrator's Name

_____
Authorized Signature

_____
Title of Signator

END OF SECTION

SECTION 01020

MODIFICATION OF EXISTING FACILITIES AND ORDER OF WORK

PART 1 GENERAL

1.1 SCOPE

A. This section covers the care of and work to be done on existing facilities at the site of the work, the requirements for providing continuous wastewater treatment and disposal operations during construction activities, and other requirements affecting the sequence of construction.

B. Existing facilities at the site consist of preliminary treatment, primary treatment, secondary treatment, tertiary treatment, anaerobic digestion, and solids handling processes, and interconnecting transfer piping and structures. Wastewater processed on the site is tertiary effluent that is discharged to a Hartley Slough outfall, sent to irrigation areas, and/or sent to the Plant reclaimed water system. Facility operations are governed by a waste discharge permit issued to the Central Valley Water Quality Control Board (CVWQCB) by the Regional Water Quality Control Board (RWQCB), upon which requirements of this Section are based. The Order of Work contained herein specifies required sequencing and/or timing of construction activities.

PART 2 MATERIALS

2.1 MATERIALS

See Divisions 2 through 16 for materials required.

PART 3 EXECUTION

3.1 GENERAL

A. The existing treatment facilities will be maintained in continuous operation during construction of the project, except for limited shut-downs as described herein. To this end, the Contractor shall establish a schedule of activities in cooperation with the Engineer and City operating staff, which shall be updated from time to time, shall meet the requirements of this section, and shall be approved by the Engineer.

B. Plans and specifications from which most of the existing facilities were constructed are available from the Engineer.

C. Work Sequence and Constraints described hereinafter are critical events in work sequence which are presented to underscore the importance of proper sequencing, scheduling and coordination so that it is integrated with the required wastewater treatment. The work sequence and constraints presented do not describe all items affecting the completion of the work, but are intended to describe important events necessary to minimize disruption of the existing facilities and to ensure compliance with wastewater discharge permit requirements.

D. The existing facility where Contractor's work is to be done will be occupied by the Owner throughout the construction period. The Contractor shall provide all necessary access to the Owner's personnel as required to safely and efficiently operate/maintain the facilities. At all times during the Contract duration, the Contractor is to provide the Owner's personnel and representatives safe and immediate access to all process control equipment. Additionally, the Contractor is to provide for unimpeded access for all delivery vehicles transporting materials, chemicals and equipment to the facility for the Owner's operations.

E. Existing systems or individual equipment items shall be isolated, decommissioned, de-energized, or depressurized only as allowed by the Engineer and the City's plant personnel. This work will be done in accordance with the detailed outage plan and schedule to be submitted by the Contractor and the conditions specified in this section.

F. The Contractor shall design and provide all necessary bulkheads, cofferdams, and support structures to allow isolation of work areas from tanks, pipes, and/or channels which are in service. Bulkheads, cofferdams, and support structures shall conform to applicable CAL/OSHA requirements.

G. The Contractor shall provide all necessary temporary pumps, piping, power, electrical wiring, controls, and labor during and subsequent to all shutdown activities as required. The Contractor shall maintain adequate access to the plant facilities, utilities, and equipment during construction to allow continued operation and maintenance by plant personnel to take place.

H. If valves need to be opened or closed, or pumps turned off or on, or similar operations performed, this is to be performed by the Owner's treatment plant operations staff working in coordination with Contractor personnel.

I. The Contractor shall minimize shutdown times thorough advanced planning. Work shall not proceed prior to the approval of associated submittals, for example excavation plans shall be approved prior to the initiation of excavation, piping installation drawings shall be approved prior to the initiation of piping installation, etc. Contractor shall have all equipment, materials, and labor on hand at time of shutdown.

J. By following the suggested sequence for any procedure described in this section, the Contractor assumes full responsibility for its use.

K. Protect all existing utilities, including but not limited to, electrical, water, sanitary, gas, data and telephone. Existing utilities are to remain in service during construction. Provide temporary utilities as necessary and as approved by the Engineer.

3.2 BYPASSING DURING CONSTRUCTION

A. Bypassing of untreated or partially treated wastewaters to surface waters or drainage courses will not be permitted.

B. In the event accidental bypassing is caused by the Contractor's operations, the Owner shall immediately be entitled to employ others to stop the bypassing without giving written notice to the Contractor. All costs incurred by the Owner to stop or prevent the bypass shall be paid by the Contractor.

C. Penalties imposed on the Owner as a result of any bypass caused entirely or in part by the actions of the Contractor, his/her employees, or subcontractors, shall be borne in full by the Contractor, including legal fees and other expenses to the Owner resulting directly or indirectly from the bypass. Under the terms of discharge permits issued to the Owner, in the event accidental bypassing occurs, the Owner is liable for the following penalties: Up to $25,000 per day per violation per federal law.

3.3 REMOVAL OF EXISTING STRUCTURES AND EQUIPMENT

A. The Contractor shall remove all existing equipment, structures, piping, valves, and other items as indicated on the Drawings. Where the plans indicate "Remove and Save", the Contractor shall carefully remove the item and protect it so as to avoid damage, shall thoroughly clean it, and stockpile it at a location on the site designated by the Engineer. Where the plans indicate "Remove and Reinstall", or "Relocate", the items shall be carefully removed and re-erected or reinstalled at another location as shown, after cleaning and such repairs and adjustments made as are necessary. Where indicated to be "Remove and Waste", the Contractor shall remove the item and dispose of it off the site at his expense or may salvage it for his own gain.

B. The Owner reserves the first right of refusal if a need is identified for removed items. If a request is made by the Owner, the Contractor shall provide a schedule of values to identifying their associated value. After all parties agree to terms of change order, Contractor shall deliver the items to the Owner at an area identified by the Engineer on the plant site or storage area.

3.4 COORDINATION WITH PLANT OPERATIONS

A. The Contractor shall coordinate his operations with the operations of the plant. The Contractor shall notify the Engineer in writing of the Contractor's planned procedure for each specific alteration of existing facilities at least two weeks before the alteration begins.

The Contractor shall not begin an alteration until specific permission has been granted by the Engineer in each case. The Engineer will coordinate the Contractor's planned procedure with the plant operating personnel. The making of connections to existing facilities or other operations that interfere with the operation of existing equipment shall be completed only after written approval has been granted by the Engineer and shall be completed as quickly as possible and with as little delay as possible.

B. Any operational functions of the existing plant that are required to be done to facilitate Contractor's operation will be done by the plant personnel only.

C. The plant operation and maintenance personnel will cooperate in every way that is practicable in order to expedite Contractor's operation; however, if it is necessary for the proper operation or maintenance of portions of the plant, the Contractor shall reschedule his operations so there shall be no conflict with necessary operations or maintenance of the plant.

3.5 SHUTDOWNS

A. Shutdowns of the plant operations shall be accomplished by City operating personnel only when properly coordinated in advance by the Contractor with the Engineer in accordance with the requirements of this section.

1. The Contractor shall submit a detailed outage plan and time schedule for operations which will make it necessary to remove a tank, pipeline, channel, electrical conduit, equipment or structure from service.

2. The plan shall be submitted to the Engineer for review and approval at least two weeks prior to the scheduled outage.

3. The schedule shall be coordinated with the overall construction schedule and shall meet the restrictions and conditions specified in this section. The detailed plan shall describe the Contractor’s method for preventing bypassing of other treatment units, the length of time required to complete said operation, the necessary personnel and equipment which the Contractor shall provide in order to prevent bypassing of associated treatment units.

4. The plan shall also include a contingency plan if the work cannot be completed as scheduled.

5. The Contractor shall not proceed with the subject work until the submitted plan has been returned to the Contractor with the approval of both the Engineer and the Owner. All costs for preparing and implementing both the outage and contingency plans shall be borne by the Contractor.

6. Contractor shall provide a minimum of two weeks advanced notice in writing for all shutdowns.

B. Shutdowns shall be allowed only when, in the opinion of City operating personnel and the Engineer, projected sewage flows can be safely stored or handled for the duration of the shutdown.

C. All shutdowns shall be kept to the absolute minimum in duration and number.

D. Shutdowns shall be coordinated so that as many items of work requiring such shutdowns as possible can be executed concurrently.

E. The Contractor shall seal off all potential sources of leaks and/or overflows associated with the construction and shall remove all loose materials from the structures and piping prior to resumption of flow at the end of a shutdown.

F. No scheduled shutdown of flow shall begin until all necessary materials and equipment for completion of that work are on the job site and have been checked by the Engineer. This requirement shall not relieve the Contractor of any of his responsibility for completion of the project within the period allowed, but is only to reassure the City and the Engineer that the work item can be completed as scheduled.

G. Piping shutdowns shall be scheduled by the Contractor in coordination with the Engineer and plant operating personnel at least two weeks in advance.

H. Shutdowns shall be initiated and completed only during normal working hours of plant operating personnel.

I. Equipment required for bypass pumping or flow diversions during construction shall be provided, maintained and operated by the Contractor continuously on a 24 hour daily basis. The Contractor shall arrange for refueling of equipment as necessary and shall make appropriate arrangements for back-up equipment in case of failures.

3.6 INTERFERENCE WITH EXISTING LINES AND FACILITIES

A. The Contractor will be required to relocate or replace any pipelines, electric conduits, or other facilities which must be disturbed for new construction work and which are required for plant operation, or make other arrangements satisfactory to the Engineer. Such relocation and replacement may be of temporary type, to be used until work is completed. In the event of accidental damage to existing lines resulting in interruption of service to yard or building lighting circuits or to any other facility which may be needed for use by the Owner prior to the Contractor's next regularly scheduled work period, the Contractor shall repair to the satisfaction of the Engineer such lines prior to stopping work on the day of such damage.

B. At no cost to the Owner, the Contractor will be required to relocate or replace any vaults, boxes, posts, or other facilities which must be disturbed for new construction work and which are required for plant operation, or make other arrangements satisfactory to the

Engineer. This includes, but is not limited to, raising or lowering elevations of existing facilities to align with new finish grade.

3.7 DEWATERING AND CLEANING OF STRUCTURES AND PIPELINES

A. The operating staff will dewater structures and pipelines to the extent this can be accomplished through existing valving and facilities. It will be the Contractor's responsibility to provide necessary pumps, piping, and other equipment to complete the drainage of the structures and pipelines. Dewatering operations shall be conducted in close coordination with operating staff, and no discharges to drainage courses will be permitted.

B. All flushing and cleaning of dewatered structures shall be done by the Contractor in a manner satisfactory to the Engineer. In all cases the Contractor shall conform with OSHA requirements for work in confined spaces, including the provision of adequate ventilation.

3.8 WORK CONSTRAINTS

A. A Dust and Emission Control Program, provided by the Contractor for engineering review and acceptance, must be in place prior to any construction activities. Once accepted by Engineer, Contractor must submit plan to the appropriate regulatory agency for their approval.

B. New pipe tie-ins to existing pipelines: The City does not guarantee that existing valves, gates, and stop plates will completely stop flow within pipe line or structure. The Contractor is to include all costs in its bid to isolate existing flows as needed for new construction.

C. An existing elderberry shrub located within the treatment plant property shall be avoided at all times during construction by installing a 100 foot buffer fence for the entire duration of the construction project and shall be designated as an Environmentally Sensitive Area. The General Contractor is required to provide his construction personnel with an environmental awareness program to inform workers of the elderberry shrub and valley elderberry longhorn beetle. See the US Department of Fish and Wildlife Biological Opinion, (copy available in Appendix), for additional environmental requirements.

D. Giant Garter Snake (GGS) habitat has been delineated within the construction site, as shown in the Biological Opinion (copy available in Appendix). The contractor is responsible for all GGS conservation measures, including limiting construction within the 250 feet of snake habitat to periods between May 1 and October 1 and construction of temporary fencing and warning signs. See Biological Opinion in Appendix for all mitigation requirements.

E. Raw sewage shutdown shall require bypass pumping, as detailed below.

3.9 SEQUENCE OF CONSTRUCTION

A. General: The work shall be accomplished in an order that will allow continued operation (except for temporary shutdowns as specified herein) of the wastewater treatment plant as required to prevent the discharge of untreated or partially treated wastewater. To that end, basic requirements that cannot be violated unless specifically approved by the Engineer are established and a suggested order of work is presented below. The Contractor shall be responsible for final determination of the order of work, subject to the basic rules and other requirements herein.

B. Basic Requirements

1. Except for authorized bypasses to accommodate required modifications, all existing plant operations shall be maintained functionally operable until all new work to be installed under this Contract is completely operable, has been functionally tested in a satisfactory manner, and written notice of acceptance has been received from the Engineer.

2. No work may begin on the project site(s) until all contracts, bonds, and insurance coverage documents have been fully executed and a written Notice to Proceed has been issued to the Contractor.

3. No other work may begin at the project site(s) until the Contractor has satisfactorily produced the required Stormwater Pollution Prevention Plan (SWPPP) and Monitoring and Reporting Plan (M&RP) and implemented appropriate stormwater runoff control facilities, all in accordance with requirements set forth in Specification Section 02270 – Stormwater Runoff Control Program.

4. Provisions for adequate stormwater runoff collection and conveyance, and protection of the environment in accordance with these Specifications and the project Stormwater Pollution Prevention Plan (SWPPP) shall be maintained at all times.

C. Piping Interties and Connections: The Contractor shall complete tie-ins to, but not necessarily limited to, the following lines:

1. Raw Sewage, New Metering Manhole

2. Raw Sewage, vents

D. Required Sequences

1. Influent Pump Station wet well concrete repair shall be completed prior to installation of new mechanical screen and washer compactors.

2. Headworks Modifications:

a. Only one screening channel shall be removed from operation at a time. Installation of the screen and washer/compactor system shall be satisfactorily functionally tested, per specification section 01670, prior to work on the second screening channel.

b. Only one grit basin shall be removed from operation at a time. Installation of the grit basin weirs shall be satisfactorily functionally tested, per specification section 01670, prior to work on the second screening channel.

c. Only one primary clarifier splitter box shall be removed from operation at a time.

3. The installation of the new raw sewage metering manhole shall be done during low flow periods and shutdown shall be limited to two weeks. During installation of the new raw sewage metering manhole, contractor shall provide temporary pumping facilities with compatible variable frequency drives for raw sewage pumping capable of handling a peak combined total flow of 7,000 gpm at 34 feet TDH. Contractor shall provide duty and standby equipment including but not limited to: Pumps, generators, alarms, etc., at all times during temporary pumping. Contractor shall submit a detailed temporary pumping facilities plan for review and approval by the Engineer at least four (4) weeks before beginning the temporary raw sewage pumping. This plan shall provide specific manufacturer's product information for all temporary equipment, piping, instrumentation and electrical to be used by Contractor. All equipment used for temporary pumping facilities shall be in excellent condition.

END OF SECTION

SECTION 01050

SURVEY CONTROL

PART 1 GENERAL

1.1 DESCRIPTION

This section describes the survey information the Owner will provide to the Contractor.

1.2 SURVEY CONTROL INFORMATION PROVIDED BY OWNER

The Owner will provide one set of the construction survey controls at no charge to the Contractor.

1.3 SURVEY CONTROL PROVIDED BY CONTRACTOR

All survey control necessary to complete the work to the lines and grades shown in the contract documents, other than provided for in Section 1.2, shall be provided by the Contractor at no additional cost to the Owner.

1.4 TOLERANCES FOR CONTRACTOR' S MEASUREMENTS

The Contractor's measurements for all stakes, marks, or points set for line, grade, or distance shall be to the nearest 1/100 foot and shall not deviate by more than 2/100 foot from the control line, grade, or distance except as follows:

A. Slope stakes for rough excavation may be set to the nearest 1/10 foot;

B. Trench subgrade shall be established to within 1/10 foot above plan subgrade. The use of a grade pole to establish trench subgrade will be permitted; and

C. Pipe subgrade and joint stakes shall be set to within 2/100 foot of plan subgrade and joint station. Use conventional survey instruments and techniques whenever this degree of accuracy cannot be obtained by use of a grade pole.

The Contractor's measurements of lines, grades, and distances will be subject to checking by the Owner's Representative. The Contractor shall correct immediately any such measurements that do not comply with the above tolerances.

PART 2 MATERIALS

Not used.

PART 3 EXECUTION

3.1 DESCRIPTION

The Contractor is responsible for protecting and maintaining all survey control on the project at no additional cost to the Owner.

END OF SECTION

SECTION 01180

CONSTRUCTION AREA SIGNS

PART 1 GENERAL

1.1 GENERAL

This section sets forth requirements concerning flagging, traffic handling equipment and devices.

1.2 CONSTRUCTION AREA SIGNS

Construction area signs shall be furnished, installed, maintained and removed when no longer required in accordance with the provisions in Section 12, "Construction Area Traffic Control Devices," of the Caltrans Standard Specifications and these special provisions.

1.3 CONTRACTOR'S RESPONSIBILITY

Attention is directed to the Manual of Traffic Contracts published by Caltrans. Nothing in this section is to be construed as to reduce the minimum standard of the Standard Specifications.

1.4 SUBMITTALS

In accordance with Section 01300.

PART 2 MATERIALS

2.1 REFLECTORS, ADHESIVE, SIGNS, RAILING AND OTHER HARDWARE AND EQUIPMENT

The contractor shall furnish reflectors, adhesive, signs, temporary "K" railing and other hardware and equipment as required by the Standard Specifications and State of California Manual of Traffic Controls.

2.2 REFLECTIVE SHEETING

Type IV reflective sheeting for sign panel for portable construction area signs shall conform to the requirements specified under "Prequalified and Tested Signing and Delineation Materials" elsewhere in these special provisions.

2.3 SUBSTRATES FOR STATIONARY MOUNTED SIGNS

Sign substrates for stationary mounted construction area signs may be fabricated from fiberglass reinforced plastic as specified under "Prequalified and Tested Signing and Delineation Materials" elsewhere in these special provisions.

PART 3 EXECUTION

3.1 MODIFICATIONS TO THE CALTRANS STANDARD SPECIFICATIONS:

A. The first paragraph in Section 12-2.02, "Flagging Costs," of the Standard Specifications is amended to read:

The cost of furnishing all flaggers, including transporting flaggers, to provide for passage of public traffic through the work under the provisions in Section 7-1.08, "Public Convenience" and Section 7-1.09, "Public Safety," will be borne by the Contractor. The costs of placing and moving flagging signs and the cost of providing stands or towers for use of flaggers shall be considered as part of the cost of furnishing flaggers.

B. The second sentence in the fourteenth paragraph of Section 12-3.08, "Temporary Railing (Type K)" of the Standard Specifications is amended to read:

Reflectors and adhesive shall be furnished by Contractor.

3.2 EXCAVATIONS

All excavations required to install construction area signs shall be performed by hand methods without the use of power equipment, except that power equipment may be used if it is determined that there are no utility facilities in the area of the proposed post holes.

END OF SECTION

SECTION 01200

PAYMENT PROCEDURES

PART 1 GENERAL

1.1 SUMMARY

Section includes procedures for submitting applications for payment and means used as a basis for Progress Payments, including:

A. Cost Summaries.

B. Payment for Mobilization.

C. Start-up.

D. Demobilization.

1.2 RELATED SECTIONS

Section 01320: Schedule of Values.

1.3 BASIS FOR PROGRESS PAYMENTS

A. Base Application for Payment on the breakdown of costs for each scheduled activity in the Progress Schedule and the Percentage of Completion for each activity.

B. Generate Application for Payment by downloading cost data from the Progress Schedule to a spreadsheet type format. Identify each activity on the Progress Schedule that has a cost associated with it, the cost of each activity, the estimated Percent Complete for each activity, and the Value of Work Completed for both the payment period and job to date.

C. A condition of the processing of Progress Payments shall be the satisfactory maintenance and final submittal of the Contractor's record documents, as determined by the Engineer.

1.4 COST SUMMARIES

A. Prepare Summary of Cost Information for each subcategory of each Major Item of Work listed in the Schedule of Values. Identify the Value of Work Completed for both the payment period and job to date.

B. Cash Flow Summary: Prepare cash flow summary, indicating total dollar amount of work planned for each month of the project. Equate sum of monthly amounts to Lump Sum contract price.

1.5 PAYMENT FOR MOBILIZATION

A. Limit amounts included under Mobilization to the following items:

1. Moving on the site any equipment required for first month operations.
2. Installing temporary construction power and wiring.
3. Establishing fire protection system.
4. Developing construction water supply.
5. Providing field office trailers complete with all specified furnishings and utility services including telephones.
6. Providing on-site sanitary facilities and potable water facilities as specified.
7. Arranging for and erection of Contractor's work and storage yard.
8. Subcontractor insurance and bonds.
9. Obtaining all required permits, licenses, and fees.
10. Developing construction schedule.
11. Provide and erect the project sign.
12. Contractor bonds and insurance.

B. Furnish data and documentation to substantiate the amounts claimed under mobilization.

C. Limit price for mobilization to no more than 5 percent of Contract Price.

1.6 PAYMENT FOR START-UP AND DEMOBILIZATION

Prices for demobilization must total at least 1 percent of Contract Price.

PART 2 MATERIALS

Not used.

PART 3 EXECUTION

Not used.

END OF SECTION

SECTION 01300

SUBMITTALS

PART 1 GENERAL

1.1 DESCRIPTION

Submittals covered by these requirements include manufacturers' information, shop drawings, test procedures, test results, samples, requests for substitutions, trench safety plan and miscellaneous work-related submittals. Submittals shall also include, but not be limited to, all mechanical, electrical and electronic equipment and systems, materials, reinforcing steel, fabricated items, detailed piping layout drawings, and conduit details. The Contractor shall furnish all drawings, specifications, descriptive data, certificates, samples, tests, methods, schedules, and manufacturer's installation and other instructions as specifically required in the contract documents to demonstrate fully that the materials and equipment to be furnished and the methods of work comply with the provisions and intent of the Contract Documents. All calculations and dimensions included in submittals shall be provided in English units.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Section 01010 - General Construction Information and Requirements

B. Section 01200 - Payment Procedures

C. Section 01310 - Progress Schedules and Reports

D. Section 01320 - Schedule of Values

E. Section 01680 – Operation and Maintenance Manuals

1.3 SUBMITTAL PROCEDURE

A. The Contractor shall prepare and submit to the Owner within two weeks after the date of the Preconstruction Conference a complete list of shop drawings and material submittals intended to be delivered. No payment will be made to the Contractor until this list is reviewed and found acceptable to the Owner and the Resident Engineer.

B. At least 30 days prior to his need for approval the Contractor shall forward to the Engineer all submittals required by the individual sections of the specifications. Other than final Operation and Maintenance Manuals (O&M Manuals), all submittals shall be electronically transmitted and forwarded to the Engineer via the Contractor's document management system, unless otherwise noted. Hard copy submittals shall be submitted for final O&M manuals.

1. All submittals shall also be provided in an electronic format which includes all information included in the hard copies. Provide the electronic files on USB flash drive. All text portions shall be provided in MS Word format, spreadsheets in Excel format, drawings in AutoCAD format, graphical portions shall in JPEG format, and all other documents including but not limited to brochures that need to be scanned shall be provided in a searchable PDF format.

C. Identify all submittals including schedules and operation and maintenance manuals on the transmittal form as included in this Section. Obtain an electronic or original copy from the Engineer. Submittals must include submittal number, specification section, plan page reference number (where applicable), the supplier, etc. The Contractor shall also indicate under "Remarks", if the submittal is on the critical path and requires an expedited review.

D. Submittals that are related to or affect each other shall be forwarded simultaneously as a package to facilitate coordinated review. Uncoordinated submittals will be rejected. Do not combine unrelated materials in the same submittal.

E. The Engineer reserves the right to require submittals in addition to those called for in individual sections.

F. The Contractor shall schedule submittals to avoid concentration of submittals in a short time period. Scheduling of submittals shall be included in the Contractor's Progress Schedule.

G. For any hard copy submittals sent, such as O&M Manuals, submittal shall be bound in a three hole-punched binder, which is sized such that when all material is inserted, the binder is not over 3/4 full. Spiral ring type binders are not acceptable.

1. Each binder shall be appropriately labeled on the front cover with the project name, Contract number, equipment supplier's name, specification section(s), and major material contained therein.
2. An index shall be provided on the inside front cover. This index shall itemize the contents of each tab and subtab section. Also list the project name, Contract number, and equipment supplier's name, address, phone number, and contact person on the index page.

H. If the Contractor submits shop drawings of equipment by manufacturers other than those listed in the specifications, he shall provide the following information with the submittal:

1. The name and address of at least three companies or agencies who are currently using the equipment.
2. The name and telephone number of at least one person at each of the above companies or agencies whom the Engineer may contact.
3. A description of the equipment that was installed at the above locations. The description shall be in sufficient detail to allow the Engineer to compare it with the equipment that is proposed to be installed in this project.
4. Refer to Engineer’s approval (1.5, Part C).

I. A copy of the specification section, and all referenced and applicable sections, with any addendum updates included, shall be submitted with each paragraph check-marked to indicated specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the Contractor, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph. The remaining portions of the paragraph not underlined will signify compliance on the part of the Contractor with the specifications. The submittal shall be accompanied by a detailed, written justification for each deviation. Failure to include a copy for the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

J. For each resubmittal, provide a copy of submittal comments and a separate letter, on company letterhead, identifying how each submittal comment has been addressed in the resubmittal.

1.4 SHOP DRAWINGS

A. The term "shop drawings" includes drawings, diagrams, layouts, schematics, descriptive literature, illustrations, schedules, performance and test data, and similar materials furnished by the Contractor to explain in detail specific portions of the work required by the Contract. All dimensions shall be in English units.

B. The Contractor shall coordinate all such drawings, and review them for legibility, accuracy, completeness, and compliance with contract requirements, and shall indicate his approval thereon as evidence of such

coordination and review. Shop drawings submitted to the Engineer without evidence of the Contractor's approval will be returned for resubmission.

C. Approval by the Engineer shall not relieve the Contractor from responsibility for any errors or omissions in such drawings, nor from responsibility for complying with requirements of this Contract, except with respect to variations described and approved in accordance with Paragraph D below.

D. If shop drawings show variations from contract requirements, the Contractor shall describe such variations in writing, separate from the drawings, at time of submission. All such variations must be approved by the Engineer.

1.5 ENGINEER'S APPROVAL

A. The Engineer will indicate his acceptance or disapproval of each submittal, and his reasons for disapproval.

1. If no corrections are required, the submittal review response will be returned marked "NO EXCEPTION NOTED (Confirm)" and work may begin immediately on incorporating the material and equipment covered by the submittal into the project.

2. If limited corrections are required, the submittal review response will be returned marked "NOTE MARKINGS (Confirm)". Work may begin immediately on incorporating the material and equipment covered by the corrected submittal into the project.

3. If insufficient or incorrect data has been submitted, the submittal review response will be returned marked "NOTE MARKINGS (Resubmit)". No work incorporating the material and equipment covered by this submittal into the project may begin until the submittal has been revised, resubmitted, and returned marked either "NO EXCEPTION NOTED (Confirm)" or "NOTE MARKINGS (Confirm)".

4. If the submittal is unacceptable, the submittal review response will be returned marked "REJECTED (Resubmit)". No work incorporating the material and equipment covered by this submittal into the project may begin until a new submittal has been made and returned marked either "NO EXCEPTION NOTED (Confirm)" or "NOTE MARKINGS (Confirm)".

5. If the submittal was not reviewed by Engineer, the submittal review response will be returned marked "NOT REVIEWED".

B. The Contractor shall not change any drawing after it has been marked "NO EXCEPTION NOTED (Confirm)" or "NOTE MARKINGS (Confirm)", or change any approved equipment or material without written permission of the Engineer. The Contractor shall comply with all submittals as marked by the Engineer, to the extent applicable.

C. If more than TWO submittals for a single item are required because of incorrect or insufficient data, or the submittal is unacceptable, or because the Contractor wishes to change previously approved material, then all costs incurred by the Owner for the additional review shall be deducted from monies due the Contractor.

D. Review by Engineer is for the sole purpose of ascertaining general conformity with design. Contractor is responsible for dimensions, fabrication and construction methods, coordination of sub-trades, detail design of components and errors or omissions on shop drawings.

1.6 OPERATION AND MAINTENANCE MANUALS

Manufacturer's printed instructions shall include installation instructions, operating instructions, schematics for electrical and hydraulic systems, maintenance literature, lubrication requirements, and parts lists. Refer to Section 01680, Operation and Maintenance Manuals, for specifics required for the operation and maintenance instructions.

1.7 CERTIFICATES

For those items called for in individual sections, furnish certificates from manufacturers, suppliers, or others certifying that materials or equipment being furnished under the Contract comply with the requirements of these specifications.

1.8 SAMPLES

Samples submitted for preference selection by the Owner or Engineer shall be of sufficient size to clearly illustrate functional characteristics and full range of color, texture, and pattern. A completed submittal review transmittal form must accompany each submitted sample.

1.9 CONSTRUCTION SCHEDULE

As soon as possible after receiving Notice of Award and before any work starts, submit four copies of a Construction Schedule in accordance with Section 01310 showing estimated starting and completion dates for each part of the work. The first progress payment will not be issued until the progress schedule is submitted and approved.

1.10 SCHEDULE OF VALUES

Submit a Schedule of Values (in dollars) in accordance with Section 01320 for the various portions of the work. The schedule shall be based on the Contract Bid Schedule or Bid Form and shall include all bid items. The approved Schedule of Values in conjunction with the approved Construction Schedule will be the basis of the monthly progress payments.

1.11 REVIEW OF SCHEDULES

Submit Schedule of Values and Construction Schedule as a package. Both the Progress Schedule and the Schedule of Values shall be subject to review by Engineer both for format and content.

PART 2 MATERIALS

Not used.

PART 3 EXECUTION

3.1 CONTRACTOR'S JOBSITE DRAWINGS

A. Provide and maintain on the jobsite one complete set of prints of all drawings which form a part of the Contract. Immediately after each portion of the work is installed, indicate all deviations from the original design shown on the Contract Drawings either by additional sketches or ink thereon. Upon completion of the project, deliver this record set to the Engineer.

B. A condition of the processing of Progress Payments shall be the satisfactory maintenance and final submittal of the Contractor's record documents, as determined by the Engineer. The Contractor prepared progress payment estimates shall include an initial block for the Contractor's representative and the Engineer to acknowledge the satisfactory maintenance of the documents.

END OF SECTION

SECTION 01305

PROJECT MEETINGS

PART 1 GENERAL

1.1 SUMMARY

A. Project meetings and conferences are an important administration and communication requirement of all project participants. Meetings will address issues related to the Work, review and coordinate progress of the Work and other matters of common interest to project participants, and includes the following:

1. Preconstruction Conference
2. Progress Meetings
3. Progress Schedule and Progress Billing Methods
4. Submittal Meetings
5. Quality Assurance Meetings
6. Pre-installation Meetings
7. Post Construction Meetings
8. Change Order Meetings
9. Special Meetings

B. Any time during the progress of the work, the Owner and the Engineer shall have the authority to require the Contractor and any subcontractor, supplier, or service providers to participate in job-site conferences on matters which require immediate or special attention. Any notice of such conference shall be duly observed and complied with by the Contractor and subcontractors, suppliers, or service providers without extra cost to the Owner. Participation to be defined as via teleconference, video conference, or on-site conferences.

C. This section describes the requirements for calling for and conducting meetings for the Work. Meeting and conference locations and qualified participants will be determined by the Engineer and the Contractor based on the meeting agenda topics.

D. Minutes will be taken by the Contractor for the Pre-Construction Conference(s) and all Progress and Coordination Meetings hereinafter described. Copies of meeting minutes will be distributed to all attendees within five (5) days after meeting. Attendees will have three

(3) days to submit comments or additions to minutes received from Contractor. Minutes will constitute final documentation of meeting discussion topics, results and action items. Meetings may be recorded by the Resident Engineer for accuracy of meeting minutes.

E. Representatives of entities participating in meetings shall be qualified and authorized to act on behalf of the entity each represents.

1.2 PRECONSTRUCTION CONFERENCE

A. Within 20 days after the Contract Time starts to run, but before any Work at the site is started, the Owners Representative will schedule a preconstruction conference and organizational meeting at a suitable conference room at the Owner's offices or other suitable location. More than one preconstruction conference may be required if the Owner and Contractor deem it is in the best interest of the project to do so. The Resident Engineer will preside at conference.

B. Attending the Preconstruction Conference: Contractor's Project Manager, Contractor's Superintendent(s), Owner, Inspection staff, Design Engineer, Owner's subconsultants, representatives of utilities, major subcontractors and others involved in performance of the Work, and others necessary to agenda.

C. The preconstruction conference will be held to establish a working understanding among the parties as to the Work, and to discuss the project schedule, procedures for handling shop drawings and other submittals, processing Applications for Payment, and maintaining required records.

D. The Preconstruction conference agenda will include:

1. Distribution of Contract Documents.
2. Distribution and discussion of list of major subcontractors and suppliers.
3. Proposed progress schedules and critical construction sequencing.
4. Major equipment deliveries and priorities.
5. Project coordination.
6. Designation of responsible personnel.
7. Procedures and Processing of:
    a. Field decisions.
    b. Proposal requests.
    c. Submittals.
    d. Change Orders.

e. Applications for Payment.

f. Record Documents.

8. Use of Premises:

a. Office, construction, and storage areas.

b. Owner's requirements.

9. Construction facilities, controls, and construction aids.

10. Temporary utilities.

11. Safety and first aid procedures.

12. Security procedures.

13. Housekeeping procedures.

E. The Contractor will record minutes of meeting and distribute copies of minutes within five (5) days of the meeting to participants and interested parties.

1.3 PROGRESS MEETINGS

A. Regular progress meetings shall be conducted at least once a week in the Contractor or Engineer’s field office or other mutually agreed upon place.

B. Written notice and the proposed agenda shall be distributed to each anticipated participant of each meeting at least two (2) days before meeting.

C. The Contractor’s superintendent and subcontractors who are or are actively involved in the Work, or who are necessary to agenda shall attend.

D. The Owner, Engineer, other Owner’s Representatives, and others necessary to agenda will attend.

E. The Contractor shall complete and bring the current Application for Payment, marked up record drawings, and Progress Schedule to each meeting.

F. The Contractor shall preside at meetings.

G. The purpose of Progress Meetings is to:

1. Expedite work of subcontractors or other organizations that are not meeting scheduled progress, resolve conflicts, and coordinate and expedite execution of the Work.

2. Review progress of the Work, Progress Schedule, narrative report, Application for Payment, record documents, and additional items of current interest that are pertinent to execution of the Work.

3. Verify:

   a. Actual start and finish dates of completed activities since last progress meeting.

   b. Durations and progress of activities not completed.

   c. Reason, time, and cost data for Change Order Work that will be incorporated into Progress Schedule and application for payment.

   d. Percentage completion of items on Application for Payment.

   e. Reasons for required revisions to Progress Schedule and their effect on Contract Time and Contract Price.

4. Discuss potential problems which may impede scheduled progress and corrective measures.

H. Engineer will record minutes of meeting and distribute copies within five (5) days of meeting to participants and interested parties.

1.4 PROGRESS SCHEDULE AND PROGRESS BILLING MEETINGS

A. Each month the Contractor shall attend a progress schedule and progress payment meeting with the Owners Representative. At this meeting, the Owners Representative and Contractor are to review the percentage of the work completed and establish an amount to be requested in the Application for Payment. The meeting date shall be scheduled in accordance with the Owner's deadline for submittal of Progress Pay Estimates. Following review of the proposed billing, the Contractor will prepare an Application of Payment and submit to the Resident Engineer for final review and processing.

B. These meetings will also discuss time impact evaluations for change orders and time extension requests, actual and anticipated schedule activity sequence/duration changes, and Contractor delays. These meetings are considered a critical component of the overall monthly schedule update submittal and Contractor shall have appropriate personnel attend.

C. The Engineer can also call for special progress schedule meetings should there be schedule revisions that necessitate such a meeting.

1.5 SUBMITTAL MEETINGS

When required in the individual technical specification, or if requested by the Contractor or the Resident Engineer, a meeting regarding a required submittal will be held to facilitate the timeliness of the submittal preparation and review process. This meeting will convene at a

mutually agreeable place. The party responsible for preparing the submittal shall be in attendance along with the Engineer.

1.6 QUALITY ASSURANCE MEETINGS

The Contractor or the Engineer may request a meeting prior to the start of a particular phase of the project to discuss how the Work shall be accomplished in accordance with the quality requirements of the contract documents, codes, permits and industry standards. All required inspection and testing applicable to this phase of the project will be discussed in detail. The Contractor shall require that all management and quality control personnel employed by the Contractor for this phase of the project are in attendance. Quality assurance meetings might be requested for such phases of the project as site work, concrete, piping, mechanical, specialty subtrades and electrical/instrumentation.

1.7 PRE-INSTALLATION MEETINGS

A. General: The Contractor shall meet with manufacturers and installers of major units of construction which require coordination between subcontractors. Major units of construction which require pre-installation meetings will be identified at the Progress Meetings.

B. Meeting Requirements: The Contractor shall:

1. Require attendance of Superintendent, appropriate manufacturers and installers of major units of constructions, and affected subcontractors.
2. Invite Owner, Engineer, and Owner’s Representative.
3. Preside at meetings.
4. Conduct meetings in Contractor's field office or other mutually agreed upon place.
5. Distribute to each anticipated participant written notice and agenda of each meeting at least four (4) days before meeting.
6. Schedule meeting at least seven (7) days in advance of installation.

C. The Contractor shall record minutes of meeting and distribute copies of minutes within five (5) days of meeting to participants and interested parties.

1.8 POST CONSTRUCTION MEETING

A. General: The Contractor shall meet with and inspect the Work eleven (11) months after date of Substantial Completion with Owner, Engineer, and Owner’s Representative.

B. Meeting Requirements: The Contractor shall

1. Arrange meeting at least fourteen (14) days before meeting.
2. Meet in Owner's office or other mutually agreed upon place.
3. Inspect the Work and draft list of items to be completed or corrected.
4. Require attendance of Superintendent, appropriate manufacturers and installers of major units of constructions, and affected subcontractors.
5. Review service and maintenance contracts, and follow-up with appropriate corrective action when necessary.
6. After meetings, complete or correct defective work and extend correction period accordingly.

1.9 CHANGE ORDER MEETINGS

A. Periodic meetings will be held as needed for the purpose of agreeing on change order costs, reviewing quotation requests, and for reviewing time and expense records if necessary.

B. The Engineer shall preside at meetings.

C. The Contractor, Owner, Engineer, and other Owner's Representatives, and other necessary shall attend.

1.10 SPECIAL MEETINGS

Any time during progress of the Work, the Owner and the Resident Engineer shall have the authority to require the Contractor and any subcontractor, suppliers, or service providers to attend job-site conferences on matters which require immediate or special attention. Any notice of such conference shall be duly observed and complied with by the Contractor and subcontractors, suppliers, or service providers without extra cost to Owner.

PART 2 MATERIALS

Not used.

PART 3 EXECUTION

Not used.

END OF SECTION

SECTION 01310

PROGRESS SCHEDULES AND REPORTS

PART 1 GENERAL

1.1 DESCRIPTION

A. The Progress Schedule for this Project will also be referred to as the Critical Path Method (CPM) Schedule. A CPM network schedule is a graphical depiction of the Contractor's construction plan, showing the sequential activities necessary to complete the Work within the specified contract times and constraints. The CPM network schedule for this project shall depict events and tasks as activities, showing their interrelationships, and shall identify the progress required for each activity before subsequent activities can start. Activities shall be logically presented in a network showing the activities' interrelationships chronologically. Because each activity has an assigned duration, the completed network shall show the critical path of activities that must be completed on time to ensure timely project completion. The earliest and latest start and finish times for each activity shall also be shown. The CPM network shall be comprehensive and shall include all interdependencies and interactions required to perform the Work.

B. The construction schedules and accompanying reports outlined in this section are important to the Owner as they budget, plan and administer the project. The Owner and Engineer will regularly analyze the most current progress schedule during construction to monitor progress status of the project relative to contract times. The Schedule Updates and Weekly Schedules will be an agenda item at all project coordination meetings as project participants work together in prioritizing their respective tasks and action items to efficiently perform their duties.

C. The Time Impact Analyses are very important submittals to the Engineer and Owner as they evaluate activity durations and the relationships between activities before deciding on possible changes to the contract time and/or viable options to mitigate time impacts.

D. By submitting a bid for this Project, the Contractor represents to the Owner that Contractor will have included all costs within its Total Bid Price to fully comply with all scheduling and reporting requirements hereinafter prescribed in this Section.

PART 2 MATERIALS

Not used.

PART 3 EXECUTION

3.1 RESPONSIBLE SCHEDULING PERSON

A. The Contractor shall designate, in writing within five (5) calendar days after Notice of Award the person responsible for preparation, maintenance, updating and revision of all schedules required in this Section.

3.2 SCHEDULING FORMAT AND SOFTWARE

A. Schedule Format: Utilize critical path method (CPM) format.

3.3 PRECONSTRUCTION SCHEDULING MEETING AND PREPARATION

A. The Engineer will conduct a Preconstruction Scheduling Meeting with Contractor's Project Manager and Responsible Scheduling Person within five days (5) calendar days after approval of the Contractor's designated Scheduler. This meeting is separate from the Preconstruction Conference Meeting and is intended to only cover schedule requirements for this project. These requirements would include formatting, color coding, activity detail, coding structure, calendar requirements, reporting requirements, updates, revisions, and schedule delay analysis.

B. Contractor shall present their schedule methodology, planned sequence of operations and proposed activity coding structure. The coding structure shall, at a minimum, include code fields for Project Segment or Phase, Area of Work, Type of Work, Submittal/Procurement/Construction and Responsibilities (this would include all subcontractors). The activity code structure shall be sufficient to allow future sorting and/or grouping by responsibility or subcontractor, area/location, CSI division, milestones and change orders. This will allow the "rollup" of the activities in the form of a Summary Schedule.

C. During preparation of the Preliminary and Baseline Schedules, the Engineer will facilitate Contractor's efforts by being available to answer questions regarding sequencing issues, scheduling constraints, interface points, and dependency relationships.

3.4 PRELIMINARY PROGRESS SCHEDULE

A. Within ten (10) business days after receipt of Notice to Proceed or Preconstruction Conference, whichever occurs first, the Contractor shall submit a Preliminary Progress Schedule in the form of time scaled logic diagram and a bar chart which shows the Contractor's intention to execute the Work within the specified contract times and constraints. The Preliminary Progress Schedule shall cover the following project phases and activities:

1. Procurement and Submittals, including shop drawings and fabrication and delivery of key and long lead time procurement items. The Contractor's submittal information shall show intended submittal dates and shall include, as a minimum, the maximum allowable review period as specified as a separate predecessor activity.

2. The information shall provide sufficient durations for administration, fabrication and transportation to produce realistic delivery dates for the procurement items.

3. All activities planned for the first ninety (90) days in the execution of the Work.

4. The approach to scheduling the remaining activities or phases of the Work shall be represented by at least one summary activity for each major phase or activity. The total duration of the summary activities shall equal the Contract Time.

5. Approximate duration for each summary activity representing the Contractor's best estimate for the work the summary activity represents.

6. Weather days.

B. The Contractor shall produce and provide four (4) complete sets of each of time scaled logic diagram and bar charts in color on 22-inch by 34-inch sheets and one electronic copy on a CD with data in P6 format.

C. The Preliminary Progress Schedule shall describe the activities to be accomplished and their dependency subject to all requirements under these Construction Schedule provisions, as appropriate. The Preliminary Progress Schedule will be used temporarily to record and monitor the progress of the Work until the Baseline Schedule, specified hereinafter, has been completely developed and favorably reviewed. Recorded data on the Preliminary Progress Schedule shall be incorporated into the Baseline Schedule during the first schedule update.

D. The Engineer shall review the Preliminary Progress Schedule and provide any comments, provide favorable review of the Preliminary Progress Schedule, or request a meeting to review the Preliminary Progress Schedule with the Contractor within ten (10) days of receipt of the schedule. If requested, the Contractor shall participate in a review and evaluation of the schedule with the Engineer. Any revisions necessary as a result of this review shall be resubmitted for review by the Engineer within five (5) days.

E. No progress payments will be made prior to submission and acceptance of the CPM Preliminary Schedule by the Engineer.

F. The Preliminary Progress Schedule shall be updated as required by Engineer until the Baseline Schedule, specified hereinafter, has been accepted.

3.5 BASELINE SCHEDULE SUBMITTAL

A. The Contractor shall submit an acceptable Critical Path Method (CPM) Baseline Schedule to the Engineer within fifteen (15) days after the receipt of Engineer’s comments on the

Preliminary Progress Schedule. Subsequent revisions to Baseline Schedule shall be submitted as set forth hereinafter.

B. The Contractor shall include with the Baseline Schedule Submittal a signed statement from each Subcontractor, which confirms they have evaluated the Contractor's Baseline Schedule and agree that the Baseline Schedule accurately depicts the quantity, logic and durations for all activities assigned to their company.

C. The Engineer shall review the schedule and provide any comments, its favorable review of the schedule, or request a meeting to review the schedule with the Contractor within fifteen (15) days of receipt of the schedule. If requested, the Contractor shall participate in a review and evaluation of the proposed network diagrams and analysis by the Engineer. Any revisions necessary as a result of this review shall be resubmitted for review by the Engineer within ten (10) days. When completed, the favorably reviewed schedule shall then be the schedule to be used by the Contractor for planning, organizing, and directing the work, and for reporting progress. If the Contractor thereafter desires to make significant changes in its method of operating and scheduling, the Contractor shall notify the Engineer in writing stating the reasons for the change.

D. No more than two (2) progress payments will be made prior to submission and acceptance of the CPM Baseline Schedule by the Engineer.

E. Failure to include an activity required for execution of the Work does not excuse Contractor from completing the Work and portions thereof within specified contract times and contract price. Failure of Contractor to include required schedule constraints, sequences or milestones in schedule shall not relieve Contractor of obligation to conform to requirements of Contract. Acceptance of schedule shall not waive Contract requirements. In event of conflict between accepted schedule and Contract requirements, terms of Contract shall govern at all times, unless requirements are waived in writing by the Owner.

F. Contractor shall not unilaterally change the accepted Baseline Schedule without the prior written notification to and acceptance and consent of the Engineer, excepting only the reporting of Actual Start, Actual Finish, and Activity Progress. The accepted Baseline Schedule shall be used for comparison with the current updated schedule, and possible revised schedules, during the Contract.

3.6 BASELINE SCHEDULE REQUIREMENTS

A. The Contractor's proposed CPM Baseline Schedule and all updates or revisions thereto, shall meet the following requirements:

1. Schedule and Project Completion: The Baseline Schedule and all updates or revisions shall show completion of the project within the required contract times and constraints on the Work.

2. If the Contractor's schedule is based on less time than the maximum time allowed for milestone(s) or Contract completion no compensation for extended overhead expenses will be considered until the expiration of the entire time periods provided for in the Contract as adjusted by any time extensions granted other than compensable time extensions.

3. Acceptance of the Contractor's Base CPM Schedule, monthly updates or revised schedule, when based on less time than the maximum time allowed for milestone(s) or Contract completion does not serve to change any Contract duration, nor serve as a waiver of the Contractor's nor the Owner's right to utilize the full amount of time specified in the Contract, unless so modified in a Contract Change Order.

B. Schedule Logic: Schedule shall be assembled to show order in which Contractor proposes to carry out Work, indicate restrictions of access, availability of Work areas, and availability and use of manpower, materials and equipment. The Contractor shall indicate all dependencies and logic between activities so that it may be established what effect the progress of any one activity has on the schedule. The following criteria shall form basis for assembly of schedule logic.

1. Which activities must be completed before subsequent activities can be started?

2. Which activities can be performed concurrently?

3. Which activities must be started immediately following completed activities?

4. What major facility, equipment or manpower restrictions are required for sequencing these activities?

C. Resource Loading: Contractor shall input manpower and equipment data on each schedule activity. Manpower data shall consist of the manhours estimated to perform each task, categorized by trade. Equipment data shall consist of equipment hours estimated to perform each task, categorized by piece of equipment. Resource loading shall reflect a reasonable plan for accomplishing Work. Individual activities may be sequenced within limits of available float. Critical or near critical paths resulting from use of manpower or equipment restraints shall be kept to a minimum. Near critical path identified as path with five (5) or less working days of float. The Engineer will not review the resources as these shall be deemed to be within the Contractor's means and methods of work. The Contractor shall determine and allocate the proper resources to complete the Project by the specified Contract completion date.

D. After the Baseline Schedule is accepted by the Engineer, Contractor is to submit a schedule histogram depicting total craft manpower for Contractor's own labor forces and those of each subcontractor. This manpower schedule shall be submitted electronically on a CD with one paper copy.

E. Network Activities: The selection and number of detailed network activities shall be subject to favorable review by the Engineer and shall meet the following requirements:

1. All Work activities should be of sufficient detail to ensure adequate planning and execution of the Work and such that schedules provide an appropriate basis for monitoring and evaluating the progress of the Work. A work activity is defined as a single task that requires time and resources (manpower, equipment and/or material) to complete in a continuous operation, excluding submittal activities, review/acceptance activities, and fabrication/procurement activities. Durations for on-site work activities shall be in working days and shall not exceed ten (10) workdays. Passive on-site activities such as curing and testing periods can be in calendar days if desired by Contractor. All such passive on-site activities shall be included in the Contractor's schedule and durations should be as specified in the Contract Documents.

2. The submittal and approval of samples and equipment, fabrication of special material and equipment and their installation and testing. Should the Contractor expect multiple submittals and deliveries for materials or equipment from the same supplier, the Contractor shall show each planned submittal and delivery and the logic to the respective on-site Work activity(s).

3. The critical path shall be shown on all reports and on the graphic network logic diagram. The activities which constitute the critical path shall be identified.

4. Progress milestone events or other significant stages of completion, as defined in Section 01020 – Work Constraints and Sequence of Construction. System shutdown and tie-in dates must be specifically and conspicuously identified and included on the schedule.

5. The lead time required for testing, inspection and other procedures required prior to acceptance of the work. All witnessed factory tests shall be shown as individual activities.

6. The activity numbers shall be grouped by responsibility, phases, milestones, work area, trade and subcontractor to provide logical summary activities.

7. All activities of the Owner and the Engineer that affect progress along with required contract dates for completion of all parts of the work.

8. All activities of utilities, regulatory agencies and permitting agencies.

9. All mobilization and demobilization activities, including temporary controls.

10. Schedule shall show all hydraulic testing of structures, pipe testing, field testing, training and demonstration periods as required. Field testing and training activities should be broken down to reflect all individual system and equipment components.

11. Float shall not be an activity unless approved by the Engineer.

F. Network Logic Diagram: The graphic network diagram shall include for each activity, the description, activity number, the estimated duration in workdays, and all activity relationship lines. The network diagram shall be drawn for the early start and early finish of all activities. The diagrams shall show elements of the project in detail and an entire project summary. Diagrams shall show the order and interdependence of all activities and sequence in which the work is to be accomplished as planned by the Contractor and its

subcontractors. The basic concept of a network analysis diagram shall be followed to show how the start of a given activity is dependent on the completion of preceding activities and its completion restricts the start of following activities. The Primavera layout of the network logic diagrams shall be time-scaled and show the following as a minimum:

1. Activity numbers and description
2. Activity duration and total float
3. Critical path, highlighted in red color
4. Relationships between activities and lag times, if any
5. Start, completion and milestone dates

G. The layout of the columns, printed on left hand side of bar chart, shall include the following as a minimum:

1. Activity ID Number
2. Activity Description
3. Original Duration
4. Remaining Duration
5. Early Start, Early Finish, Late Start and Late Finish dates
6. Percent Complete
7. Current Total Float
8. Change in Float since Original Baseline
9. Change in Float since previous update.

H. Float – “Total Float" or “Float” shall be defined as the difference between the early finish and late finish dates for an activity. On the CPM Schedule delineate the specified Contract duration and identify the planned completion of the Work as the final finish milestone. The time period between these two dates, if any, shall be considered float. Float in any activity, milestone completion date or Contract completion date shall be considered a resource available to both the Owner and the Contractor. Neither the Owner nor the Contractor has ownership of the float.

I. The parties agree that float, as properly shown on the baseline schedule and all updates thereto, is not for the exclusive benefit of either party. Consequently, either party may, without liability to the other for actual or liquidated damages for delay, delay a schedule activity provided that such delay shall not cause the float of the affected activity to become negative. If the float of the activity is already negative, as shown on the most recent schedule update, either party may delay such activity, without liability to the other for actual or liquidated damages for delay, provided that such delay shall not cause the negative float of the delayed activity to exceed the negative float of all other schedule activities. If the project has interim milestones with separate liquidated damages, only

delays by the Owner to the Project Critical Path shall potentially entitle the Contractor to extended overhead costs.

J. Pursuant to these float sharing requirements, use of float suppression techniques such as preferential sequencing or logic, special lead or lag logic restraints, extended activity durations or imposed dates shall be cause for rejection of any schedule submittal.

K. Owner-furnished Equipment or Materials (If Applicable): Immediately after Award of Contract, Contractor shall obtain from Engineer anticipated delivery dates of Owner-furnished equipment or materials if they are not already specified in the Contract Documents. These dates shall be shown on Baseline Construction Schedule in same manner indicated by Engineer.

L. Baseline Tabular Report: The Baseline Schedule submission should include a tabular report of all activities grouped by Area, Phases (as may be applicable), and sorted by early start, then total float, then early finish. For each activity, the following information shall be provided: 1) Activity ID and Description; 2) Original Duration; 3) Total Float; 4) Early/Late Starts and Finishes; and 5) Responsibility. This report should also include a project calendar indicating all non-working periods and an Activity Code dictionary which identifies all code values and code titles used.

3.7 WEATHER CONDITIONS AND WEATHER DAY ALLOWANCE

A. Seasonal weather conditions shall be considered in the planning and scheduling of work activity durations influenced by high or low ambient temperatures or precipitation to ensure the completion of the Work within the Contract Time. No time extensions will be granted for the Contractor's failure to take into account such weather conditions for the location of the Work and for the period of time in which the Work is to be accomplished.

B. The expected loss of working days specified in the Supplementary General Conditions, Weather Days, shall be included in a separate identifiable critical activity labeled "Weather Days Allowance" to be included as the last critical activity of the project schedule. When weather days are experienced, and are approved as such by the Engineer, the Contractor shall either:

C. Increase the duration of the current critical activity(ies) by the number of weather days experienced, or

D. Add a critical activity to the schedule to reflect the occurrence of the weather day(s).

E. The duration of the weather day allowance activity shall be reduced as weather days are experienced and included in the schedule. Any remaining weather days in the weather day allowance activity at the completion of the project shall be considered as float and shall not be for the exclusive use or benefit of either the Owner or Contractor.

3.8 UPDATING THE BASELINE SCHEDULE

A. Contractor shall update the Baseline Schedule on a monthly basis (or at shorter intervals if deemed necessary by Engineer to identify corrections necessary, such as work activities fifteen (15) days or more behind schedule) for the purpose of recording and monitoring the progress of the work. The Updated Baseline Schedule shall incorporate changes mutually agreed upon by Contractor and Engineer during preceding periodic reviews and changes resulting from approved Change Orders and Field Orders.

B. Tabular Reports: Each Updated and Revised Schedule shall include a separate report that provides a comparative analysis between updated or revised schedule and previously accepted schedule submitted to Engineer. This report shall be provided electronically on a CD in Microsoft Word and also one paper copy and shall include the following information:

1. List of all Activities deleted since last schedule update.
2. List of all Activities added since last schedule update.
3. List of all Activities with any changes in original duration since last schedule update.
4. List of all changes in percent completes for each activity since last schedule update.
5. List of all Activities who should have began since last schedule update and did not.
6. List of all Activities that should have completed since last schedule update and did not.
7. List of all changes in activity Total Floats since last schedule update.
8. List of all changes in activity Free Floats since last schedule update.
9. List of any activity description or number changes since last schedule update.
10. List of all activity relationship changes, additions or deletions since last schedule update.
11. List of all changes to any schedule constraints since last schedule update.

C. This report shall also include a narrative explaining any significant updates or revisions inputted in the schedule since last schedule update, current or anticipated problems affecting the progress of Work, impact of these problems and the measures taken to mitigate impact.

D. The Owner will not make monthly progress payments to the Contractor until the Engineer has received and accepted all schedule updates and reports as herein specified. The Contractor should submit schedule updates and reports to Engineer at least five (5) days before Contractor's submission of its request for progress payment for same monthly period.

3.9 SCHEDULE REVISIONS

The conditions under which the Engineer may require revisions of the Construction Schedule include the following:

A. When delay in completion of any work item or sequence of work items results in an estimated extension of project completion by either fifteen (15) working days or by five percent (5%) of the remaining duration of time to complete the Contract, whichever is less. This slippage duration may be reduced further for any contract time that is a critical fixed completion date which must be met.

B. When delays in submittals or deliveries make re-planning or re-scheduling of the work necessary.

C. When the schedule does not represent actual prosecution and progress of the work.

D. When any change to the sequence of activities, the completion date for major portions of the work, or changes occur which affect the critical path.

E. When Contract modification necessitates schedule revision.

3.10 BI-MONTHLY SCHEDULE

A. Submit to Engineer, on the last working day of every week, a progress schedule showing the activities completed during the previous week and the Contractor's schedule of activities for the following three (3) weeks.

B. The Bi-Monthly Schedule may be a CPM schedule or a bar chart but shall utilize the logic and conform to the status of the current progress schedule. In the event that the Weekly Schedule no longer conforms to the current schedule Contractor may be required to revise the schedule in accordance with Article, "Revisions to Schedule".

C. The activity designations used in the Bi-Monthly Schedule shall be consistent with those used in the Baseline Schedule and the monthly Schedule Updates.

D. The format of the Bi-Monthly Schedule shall be as agreed upon between the Contractor and the Engineer.

3.11 TIME IMPACT ANALYSIS

A. When change orders are initiated, delays are experienced, or the Contractor desires to revise the schedule logic, the Contractor shall submit to the Engineer a written Time Impact Analysis illustrating the influence of each change, delay, or Contractor request on the current contract schedule completion date. Each Time Impact Analysis shall include an

analysis demonstrating how the Contractor proposes to incorporate the change order, delay, or Contractor request into the Schedule. The analysis shall demonstrate the time impact based on the date of occurrence of the change, delay or revision; the status of construction at that point in time; and the impact of all affected activities.

B. Activity time delays will not automatically mean that an extension of Contract Time is warranted or due the Contractor.

C. It is possible that a strike or contract modification will not affect existing critical activities or cause non-critical activities to become critical, i.e., a strike or modification may result in only absorbing a part of the available total float that may exist within an activity chain of the network, thereby not causing any effect on the Contract completion date or time.

D. The Contractor acknowledges and agrees that mitigation for delays due to changes, differing site conditions, and other causes will require revision of preferential sequences of the Work before proposing an updated schedule which supports a delay to the Project as a whole. When a delay to the Project as a whole can be avoided by revising preferential sequencing, and the Contractor chooses not to implement the revisions, the Contractor will be entitled to a time extension but is not entitled to compensation for extended overhead.

E. Float or slack shall not be for the exclusive use or benefit of the Owner or the Contractor. Extensions of time for performance will be granted only to the extent that the equitable time adjustments for the activity or activities affected exceeds the total float along the activity chain involved at the time the change was ordered or the delay occurred.

F. Time Impact Analyses shall be submitted in triplicate and within fifteen (15) days after a delay occurs or with the Contractor's cost proposal in response to a notice of change from the Engineer. In cases where the Contractor does not submit a Time Impact Analysis for a specific change order, delay, or Contractor request within the specified period of time, then it is mutually agreed that the particular change order, delay, or Contractor request has no time impact on the Contract completion date and no time extension is required.

G. Approval or rejection of Time Impact Analyses by the Engineer and the Owner will be made within fifteen (15) days after receipt of the Time Impact Analysis unless subsequent meetings and negotiations are necessary.

H. Upon approval, a copy of the Time Impact Analysis signed by the Engineer and Owner will be returned to the Contractor.

I. Upon mutual agreement by both parties, schedule revisions illustrating the influence of change orders, delays, and/or Contractor requests will be incorporated into the next schedule update.

3.12 RESPONSIBILITY FOR COMPLETION

Contractor agrees that at the sole judgment of Engineer, whenever it becomes apparent from the current monthly Updated Contract Baseline Schedule that the contract completion date and/or any milestone dates will not be met, Contractor will take the appropriate following actions, acceptable to Engineer, at no additional cost to Owner:

A. Increase construction labor in such quantities and crafts as will substantially eliminate, in the judgment of Engineer, the backlog of work.

B. Increase the number of working hours per shift, shifts per working day, working days per week, or the amount of construction equipment, or any combination of the foregoing, sufficiently to substantially eliminate, in the judgment of Engineer, the backlog of work. This paragraph shall not be construed to allow work outside the allowable hours and days specified in the Contract Documents.

C. Reschedule activities to achieve maximum practical concurrence of completion of activities.

3.13 FINAL SCHEDULE SUBMITTAL

A. As a condition precedent to the release of retainage the final Schedule Update shall be identified by the Contractor as the As-Built Schedule.

B. The As-Built Schedule shall reflect the exact manner in which the project was constructed by reflecting actual start and completion dates for all activities accomplished on the project.

C. The As-Built Schedule shall be signed and certified by the Contractor's Project Manager and Responsible Scheduler as being an accurate record of the way in which the project was actually constructed.

3.14 CONTRACTOR'S DAILY REPORTS

The Contractor shall maintain daily job reports recording all significant activity on the project, including number of workers on site, active construction equipment used, notable deliveries, work activities, delays, interruptions or any problems encountered. The Contractor shall use the daily reports to record this information and submit this form to the Engineer no later than the following morning for the previous work day. If there is no work preformed on any given day, the Contractor shall note the reasons for no work and submit a daily report to the Engineer on those days also. Failure to stay current with daily reporting will be just cause for the Owner not processing a progress payment until reports are submitted.

END OF SECTION

SECTION 01320

SCHEDULE OF VALUES

PART 1 GENERAL

1.1 SUMMARY

This section includes the requirements for the preparation, format, and submittal of Schedule of Values. The Schedule of Values cost breakdown will be subject to the approval of the Engineer, and upon request, the Contractor shall substantiate the price for any or all items and provide additional level of detail, including quantities of work. The cost breakdown shall be sufficiently detailed to permit its use by the Engineer as one of the bases for evaluating requests for payments (unless otherwise approved by the Engineer, no single line item shall be greater than $50,000, with the exception of major equipment procurement). The Engineer shall be the sole judge of the adequacy of the cost breakdown.

The Schedule of Values shall be solely used to determine progress payments. The cost breakdown shall not be considered in determining payment or credit for additional or deleted work.

The cost breakdown shall be generally in the same format as the Contract specifications divisions and subdivisions, with major items of work listed individually. The cost breakdown shall be by structure, civil, landscaping, or other logical division of work. The cost breakdown for architectural, structural, mechanical, and electrical work shall include separate items for identifiable portions of the structures. The cost breakdown shall include separate costs for any testing, startup and training required. Measurable approximate quantities of work performed by the Contractor or its subcontractors shall be provided. For quantities that are the sum total of several individual quantities, backup summaries shall be provided which list the individual descriptions and quantities. These summaries then will be used to determine the quantities of work in place in subsequent progress payment requests.

The above is a statement of the intent of the Contract Documents to provide a high level of detail, acceptable to the Engineer to allow a fair and reasonable estimate to be made of the value of work installed. The detail of the cost breakdown must be sufficient to provide timely processing of the monthly progress payment request.

1.2 PREPARATION

A. Prepare Schedule of Values identifying costs of major items of Work and other costs shown in example form at end of this Section.

B. Divide the Work into the following major items of Work:

1. Mobilization (Not to exceed five percent (5%) of the Total Base Bid Amount). See further Mobilization description below.
2. Submittals, Bonds and Insurance
3. Sheeting and Shoring
4. Sitework
5. Demolition of Existing Facilities
6. Removal and Disposal of Materials (Concrete and AC)
7. Relocation of Unusable Soil Materials
8. Import Engineered Fill
9. Headworks Improvements
10. Yard Piping
11. Electrical, Instrumentation, and SCADA Communication
12. Allowances
13. Demobilization (Not to be less than one percent (1%) of the Total Base Bid Amount). See further Demobilization description below.
14. Miscellaneous

C. Mobilization: Limit amounts included under Mobilization to the following items:

1. Moving on the site any equipment required for first month operations.
2. Installing temporary construction power and wiring.
3. Establishing fire protection system.
4. Developing construction water supply.
5. Providing field office trailers complete with all specified furnishings and utility services including telephones.
6. Providing on-site sanitary facilities and potable water facilities as specified.
7. Arranging for and erection of Contractor's work and storage yard.
8. Subcontractor insurance and bonds.
9. Obtaining all required permits, licenses, and fees.
10. Developing construction schedule.
11. Contractor bonds and insurance.

Furnish data and documentation to substantiate the amounts claimed under mobilization.

Amount paid for mobilization shall not exceed five percent (5%) of the Contract Price.

D. Demobilization

The lump sum bid for demobilization shall not be less than one percent (1%) of the total bid price. Demobilization shall include site cleaning and restoration of surfaces within the job site, post-construction meeting, removal of all temporary facilities and equipment from the work area, disconnection of the temporary construction utilities and turnover of project to the Owner.

Contractor may apply for payment of demobilization after the overall project substantial completion is achieved and the project begins to demobilize.

E. Assign prices to major items of Work that aggregate the Contract Price. Base prices on costs associated with scheduled activities based on the Project Schedule for each major item of Work.

F. Include in the schedule a value for over excavation of structures in case poor soils are found at the foundation elevations.

1.3 SUBMITTALS

A. Submit preliminary Schedule of Values for all the Work which includes quantities and prices of items which when added together equal the Contract Price and subdivides the Work into component parts in sufficient detail to serve as the basis for progress payments during the performance of Work. Such prices shall include an appropriate amount of overhead and profit applicable to each item of Work. Preliminary Schedule of Values shall be submitted within ten days after receipt of Notice to Proceed.

B. Submit corrected schedule of values within 10 days upon receipt of reviewed Schedule of Values, but no later than 10 days prior to anticipated submittal of first Application for Payment.

C. Upon request, support prices with data that will substantiate their correctness.

D. If activities are added or removed from the Construction Schedule revise the Schedule of Values and resubmit.

PART 2 MATERIALS

Not used.

PART 3 EXECUTION

3.1 EXAMPLE SCHEDULE OF VALUES

The following is a partial example of an acceptable form for the Schedule of Values using Construction Standards Institute (CSI) Divisions. Contractor shall expend table to provide detailed information on each division for full documentation of total costs of each major work item:

Schedule of Values					
Item	**Description of Item**	**Qty**	**Unit**	**Unit Cost**	**Total Cost**
9.	Headworks Improvements				
a.	Division 01 - General Requirements				
b.	Division 02 - Sitework				
	i. Excavation				
	ii. AB placement				
	iii. Backfill, native				
	iv. Dewatering				
	v. Sheeting and shoring				
	vi. Compaction				
c.	Division 03 – Concrete				
	i. Forming				
	ii. Rebar				
	iii. Slab placement				
	iv. Wall placement				
	v. Sack testing				
d.	Division 04 – Masonry				
e.	Division 05 – Metals				
f.	Division 06 – Wood and Plastics				
g.	Division 07 – Thermal & Moist. Protect.				
h.	Division 08 – Doors & Windows				
i.	Division 09 – Finishes				
j.	Division 10 - Specialties				
k.	Division 11 - Equipment				
l.	Division 12 – Furnishings				
m.	Division 13 – Special Construction				
n.	Division 14 – Conveying Systems				
o.	Division 15 - Mechanical				
p.	Division 16 - Electrical				
	TOTAL FOR THIS ITEM				

END OF SECTION

SECTION 01330

SAFETY PLAN

PART 1 GENERAL

1.1 SUMMARY

A. The Contractor shall be solely and completely responsible for conditions of the jobsite, including safety of all persons and property during performance of the Work. This requirement shall apply continuously and not be limited to normal working hours. Safety provisions shall conform to U.S. Department of Labor (OSHA), the California Occupational Safety and Health Act (CalOSHA), and all other applicable Federal, State, County, and local laws, ordinances, codes, including but not limited to the requirements set forth below, and any regulations that may be detailed in other parts of these Contract Documents. In the event of conflicting requirements, the most stringent requirement as it pertains to the Contractor's safety responsibility shall be followed by the Contractor.

B. No provision of the Contract Documents shall act to make the Owner, the Construction Manager, Engineer or any other party than the Contractor responsible for safety. The Contractor agrees that for purposes of California Labor Code Section 6400 and related provisions of law the Contractor, the Contractor's privities and any other entities acting pursuant to this contract will be "employers" responsible for furnishing employment and a place of employment that is safe and healthful for the employees, if any, of such entities acting pursuant to this contract and that neither the Owner nor the Construction Manager, Engineer or their respective officers, officials, employees, agents or volunteers or other authorized representatives will be responsible for having hazards corrected and /or removed at the location(s) where the work is to be performed. The Contractor agrees that neither the Owner nor the Construction Manager, Engineer or their respective officers, officials, employees, agents or volunteers or other authorized representatives will be responsible for taking steps to protect the Contractor's employees from such hazards, or for instructing the Contractor's employees to recognize such hazards or to avoid the associated dangers. The Contractor agrees that with respect to the work to be performed under this contract and the location(s) where such work is to be performed, the Contractor will be responsible for not creating hazards, and for having hazards corrected and/or removed. The Contractor agrees that through the safety obligations contained in this contract and the Contractor's own inspection of the site(s) where the contract work is to be performed, the Contractor is aware and has been notified of the hazards to which the Contractor's employees may be exposed in the performance of contract work. The Contractor has taken and/or will take appropriate, feasible steps to protect the Contractor's employees from such hazards, and has instructed and/or will instruct its employees to recognize such hazards and how to avoid the associated dangers. The Contractor agrees that neither the Owner nor the Construction

Manager, Engineer or their respective officers, officials, employees, agents or volunteers or other authorized representatives will be “employers” pursuant to California Labor Code Section 6400 and related provisions of law with respect to the Contractor, the Contractor's privities or other entities acting pursuant to this contract.

C. The Contractor shall indemnify, defend and hold Owner and Construction Manager, Engineer and their respective officers, officials, employees, agents and volunteers or other authorized representatives harmless to the full extent permitted by law concerning liability related to the Contractor’s safety obligations.

D. If death or serious injuries or serious damages are caused, the accident shall be reported immediately by telephone or messenger to both the Construction Manager and the Owner. In addition, the Contractor shall furnish the Construction Manager with a copy of the Employer's Report of Injury immediately following any incident requiring the filing of said report during the prosecution of the Work under this Contract. The Contractor shall also furnish the Construction Manager with a copy of the Employer's Report of Injury involving any subcontractors on this Project. The Contractor shall make all reports as are, or may be, required by any authority having jurisdiction, and permit all safety inspections of the Work being performed under this Contract.

E. If a claim is made by anyone against the Contractor or any subcontractor on account of any accident, the Contractor shall promptly report the facts in writing to the Construction Manager, giving full details of the claim.

1.2 SAFETY STANDARDS

The Contractor shall comply with all applicable provisions of the Safety and Health Regulations of Construction, promulgated by the Secretary of Labor under Section 107 of the Contract Work Hours and Safety Standards Act (40 USC 327 et. seq.) as set forth in Title 29, C.F.R., CAL/OSHA, and the regulations issued thereunder. Compliance shall be the Contractor's sole responsibility, and neither the Owner, the Construction Manager nor the Engineer shall have any liability for non-compliance for additional safety requirements.

1.3 SAFETY PROGRAM

The Contractor shall establish, implement, and maintain a written injury prevention program as required by Labor Code Section 6401.7. Before beginning the Work, the Contractor shall file with the Construction Manager a written Contractor Safety Program that provides for the implementation of all of the Contractor's safety responsibilities in connection with the Work at the Project site and the coordination of that program and its associated procedures and precautions with safety programs, precautions and procedures of each of its subcontractors and other Contractors performing work at the Project site. The Contractor shall be solely responsible for initiating, maintaining, monitoring, coordinating, and supervising all safety programs, precautions, and procedures in connection with the Work and for coordinating its programs, precautions, and procedures of the other contractors and subcontractors performing the Work at the Project site. The Safety Program should contain all the necessary elements for the Contractor

to administer its program on the Project site. At a minimum, this written Safety Program shall address the elements required by Labor Code Section 6401.7.

The Contractor's compliance with requirements for safety and/or the Construction Manager's acceptance for filing of the Contractor's Safety Program shall not relieve or decrease the liability of the Contractor for safety. The Construction Manager's review of the Contractor's Safety Program is only to determine if the above listed elements are included in the program.

1.4 SAFETY PLAN

A. Detail the Methods and Procedures to comply with California, Federal, and Local Health and Safety Laws, Rules and Requirements for the duration of the Contract Times. Include the following:

1. Identification of the Certified or Licensed Safety Consultant who will prepare, initiate, maintain and supervise safety programs, and procedures.
2. Procedures for providing workers with an awareness of safety and health hazards expected to be encountered in the course of construction.
3. Safety equipment appropriate to the safety and health hazards expected to be encountered during construction. Include warning devices, barricades, safety equipment in public right-of-way and protected areas, and safety equipment used in multi-level structures.
4. Methods for minimizing employees' exposure to safety and health hazards expected during construction.
5. Procedures for reporting safety or health hazards.
6. Procedures to follow to correct a recognized safety and health hazard.
7. Procedures for investigation of accidents, injuries, illnesses and unusual events that have occurred at the construction site.
8. Periodic and scheduled inspections of general work areas and specific work stations.
9. Training for employees and workers at the jobsite.
10. Methods of communication of safe working conditions, work practices and required personal protection equipment.

B. Assume responsibility for every aspect of Health and Safety on the jobsite, including the health and safety of Subcontractors, suppliers, and other persons on the jobsite.

1. Forward available information and reports to the Safety Consultant who shall make the necessary recommendations concerning worker health and safety at the jobsite.
2. Employ additional health and safety measures specified by the Safety Consultant, as necessary, for workers in accordance with OSHA guidelines.

C. Transmit to Owner and Engineer copies of reports and other documents related to accidents or injuries encountered during construction.

D. A copy of the Project Specific Safety Plan shall be delivered to the Owner within 30 days of the Notice to Proceed. Plan shall include, but is not limited to, biological hazards associated with wastewater, hazardous atmospheres, chemicals, fuels, and compressed gases, and/or physical hazards in the form of operating machinery, high voltage electrical systems and moving and stored water.

E. A copy of the Project Specific Safety Plan shall be maintained on site and available for review.

1.5 SAFETY SUPERVISOR

A. The Contractor shall appoint an employee as safety supervisor who is qualified and authorized to supervise and enforce compliance with the Safety Program. The Contractor shall notify the Construction Manager in writing prior to the commencement of work of the name of the person who will act as the Contractor's safety supervisor and furnish the safety supervisor's resume to the Construction Manager.

B. The Contractor will, through and with its Safety Supervisor, ensure that all of its employees and its subcontractors of any tier, fully comply with the Project Safety Policies. The Safety Supervisor shall be a full-time employee of the Contractor whose responsibility shall be for supervising compliance with applicable safety requirements on the Project site and for developing and implementing safety training classes for all job personnel. The Owner shall have the authority to require removal of the Contractor's Safety Supervisor if the representative is judged to be improperly or inadequately performing the duties; however, this authority shall not in any way affect the Contractor's sole responsibility for performing this work safely, nor shall it impose any obligation upon the Owner to ensure the Contractor performs its work safely.

1.6 SAFETY AND PROTECTION

A. The Contractor shall take all necessary precautions to prevent damage, injury, and loss to:

1. All employees on the Project, employees of all subcontractors, and other persons and organizations who may be affected thereby;

2. All the Work and materials and equipment to be incorporated therein, whether in storage on or off the site; and

3. Other property at the site or adjacent thereto, including trees, shrubs, lawns, walks, wetlands, pavements, roadways, structures, utilities, and underground facilities not designated for removal, relocation, or replacement in the course of construction.

B. The Contractor shall comply with all applicable laws and regulations of any public body having jurisdiction for the safety of persons or property or to protect them from damage, injury or loss and shall erect and maintain all necessary safeguards for such safety and protection. The Contractor shall notify owners of adjacent property and of underground

facilities and utility districts when prosecution of the Work may affect them and shall cooperate with them in the protection, removal, relocation, and replacement of their property. All injury or loss to any property caused, directly or indirectly, in whole or in part, by the Contractor, any subcontractor, supplier or any other person or organization directly or indirectly employed by any of them to perform or furnish any of the Work or anyone for whose acts any of them may be liable, shall be remedied by the Contractor.

C. General Safety Requirements

1. No smoking shall be allowed inside wastewater treatment plant boundary or in any area designated No Smoking or Flammable Storage, unless specifically authorized by Owner.
2. All acts or conditions believed to be unsafe shall be promptly reported to the nearest employee of the Owner
3. All acts or conditions believed to be unsafe shall be promptly reported to the nearest employee of the Owner, to the Owner's Project Manager, and provide to the Owner (before the end of the workday the unsafe condition or act was observed) a completed Contractor's Report of Unsafe Condition/Act Form (see Appendix A of this specification).
4. Contractors are responsible for providing their employees with the required safety equipment such as, but not limited to, gas detection meters, rescue equipment, and personal protective equipment.
5. Contractor shall not move or relocate the Owner's first-aid equipment, blankets, stretchers, emergency eyewash/shower units, or any other safety equipment, without the permission of the Owner.
   Contractors who damage equipment or pipes, or drop objects into tanks, shall report the incident immediately to the nearest employee of the Owner and complete the Contractor's Report of Damage to Owner's Equipment or Property Form (see Appendix A of this specification).

1.7 EXCAVATION SAFETY

A. In accordance with the provisions of Section 6705 of the Labor Code, the Contractor shall submit, in advance of excavation of any trench or trenches five feet or more in depth, a detailed plan showing the design of shoring, bracing, sloping, or other provisions to be made for worker protection from the hazard of caving ground during the excavation of such trench or trenches. If such plans vary from the shoring system standards set forth in the Construction Safety Orders of the Division of Industrial Safety in Title 8, Subchapter 4, Article 6, California Code of Regulations, the plans shall be prepared and signed by a registered civil or structural engineer employed by the Contractor, and all costs therefore shall be included in the price named in the Contract for completion of the work as set forth in the Contract Documents. Nothing in this Section shall be deemed to allow the use of a shoring, bracing, sloping, or other protective system less effective than that required by the Construction Safety Orders. Nothing in this Section shall be construed to impose a tort liability on the Owner, the Engineer, the Construction Manager, nor any of their officers, officials, employees, agents, consultants or volunteers. The Owner's review of the Contractor's excavation plan is only for general conformance to the Construction Safety Orders.

B. If there is a potential atmospheric hazard such as oxygen deficiency or toxic gases, the atmospheres in the excavation shall be tested before employees enter any excavation.

C. Contractor shall have a competent person on-site who will make daily inspections of excavations, adjacent areas, and protective systems. The competent person will be responsible for ensuring that the protective system is based upon soil classifications, and that it provides the required protection in accordance with CCR, Title 8, Section 1541.1.

D. Sloping or benching for excavations greater than 20 feet deep shall be designed by a registered civil engineer. Design specifications shall be submitted to the Owner upon request.

E. Prior to commencing any excavation, the Contractor shall designate in writing to the Construction Manager the "competent person(s)" with the authority and responsibilities designated in the Construction Safety Orders.

1.8 SAFETY EMERGENCIES

A. In emergencies affecting the safety or protection of persons or the Work or property at the Project site or adjacent thereto, the Contractor, without special instruction or authorization from the Construction Manager, is obligated to act to prevent threatened damage, injury or loss. The Contractor shall give the Construction Manager prompt written notice if the Contractor believes that any significant changes in the Work or variations from the Contract Documents have been caused thereby.

B. All accidents involving lost work time or damaged Owner's property shall be reported to the Owner or designee on the same workday the incident occurred. A copy of the Contractor's Injury/Fatality Incident Report and/or the Contractor's Report of Damage to Owner's Equipment/Property shall be provided to Owner or its representative within 24 hours of the incident. See Appendix A of this specification for forms.

C. Should a serious accident or emergency occur, or if an emergency requires off-site emergency responders (police, fire, medical, etc.), Contractor shall immediately notify, including nights, weekends, and holidays, the Owner using contact information provided in the Emergency Contact Information Form (see Appendix A of this specification).

D. Should a serious accident or emergency occur, Owner reserves the right to conduct an accident investigation of the incident, either in conjunction with, or separate of, the Contractor. The Contractor shall provide complete access to the Owner's representative(s) and shall allow the Owner's representative(s) to take photos and witness statements.

E. If a claim is made by anyone against the Contractor or any subcontractor on account of any accident, the Contractor shall promptly report the facts in writing to the Owner, giving full details of the claim.

F. Emergency Action Plan

1. Contractor shall have a written Emergency Action Plan that is applicable to the work site and work activities being performed.
2. Contractor is responsible for ensuring the availability of emergency medical services for its employees. Contractor employees who will render basic first aid are to be trained and immediately available. Contractor shall also provide its own first aid kit(s) that contain the minimum first-aid supplies as determined by a licensed physician or in accordance with CCR, Title 8, Section 1512.
3. Contractor shall be apprised of the Owner's site-specific Emergency Action Plan procedures that are applicable to the worksite and Contractor's work activities, including the Owner's emergency alarm system(s).
4. To facilitate prompt emergency services, Contractor shall:
   a. Determine who is responsible for making emergency calls and;
   b. Conspicuously post a list of emergency phone numbers, a map of the closest hospital, known and potential safety hazards, and other information to be transmitted.

1.9 SAFETY VIOLATIONS

Should the Contractor fail to correct an unsafe condition, the Owner shall have the right to notify the Contractor through the Construction Manager that an unsafe condition may exist and must be corrected or the work in question can be stopped until the condition is corrected to the satisfaction of the Owner. No extension of time or additional compensation will be granted as a result of any stop order so issued. The notification and suspension of such work or the failure to provide such notification and suspension by the Owner shall not relieve the Contractor of its sole responsibility and liability for safety and the correction of any unsafe conditions.

The Owner shall have the authority to require the removal from the project of any worker and the foreman and/or superintendent in responsible charge of the work where safety violations occur.

1.10 EQUIPMENT SAFETY PROVISIONS

The completed Work shall include all necessary permanent safety devices, such as machinery guards and similar safety items, required by the State and Federal (OSHA) industrial authorities and applicable local and national codes. Further, any features of the Work, including Owner-selected equipment, subject to such safety regulations shall be fabricated, furnished, and installed in compliance with these requirements. All equipment furnished shall be grounded and provided guards and protection as required by safety codes. Where vapor-tight or explosion-proof electrical installation is required by safety codes, this shall be provided. Contractors and manufacturers of equipment shall be held responsible for compliance with the requirements included herein. The Contractor shall notify all equipment suppliers and subcontractors of the provisions of this paragraph.

1.11 CONFINED SPACES

A. The Project requires work in confined spaces and requires compliance with CAL/OSHA and Federal OSHA requirements. Confined spaces for the purposes of this Section shall be as defined by the Division of Industrial Safety. Work within confined spaces of this project is subject to the definitions and applicable provisions of Section 5156 et. seq., Title 8, Division 1, Chapter 4, Subchapter 7, Group 16, Article 108 of California Code of Regulations, and Title 29 Part 1926 of the Code of Federal Regulations.

B. In addition the Owner classifies the following existing facilities as confined space: the interior of pipelines, vaults, manholes, reservoirs and any other such structure or space which is similarly surrounded by confining surfaces as to permit the accumulation of dangerous gases or vapors. The confined spaces are "permit" confined spaces as defined by OSHA and Cal/OSHA and therefore entry is allowed only through compliance with a confined space entry permit program by the contractor that meets the requirements of 8 C.C.R. Section 5157. While the above mentioned locations have been identified as permit confined spaces, other permit confined spaces may exist. It shall be the responsibility of the Contractor to identify and classify these confined spaces.

C. It is anticipated that the Contractor may encounter hazardous conditions within these permit confined spaces which include, but are not limited to the following:

1. Exposure to hydrogen sulfide, methane, carbon dioxide and other gases and vapors commonly found in municipal sewers which could have or has the potential of having Immediate Danger to Life or Health Conditions (IDLH).
2. Exposure to atmosphere containing insufficient oxygen to support human life.
3. Exposure to combustible, flammable and/or explosive atmosphere.
4. Exposure to sewage which may contain bacteriological, chemical and other constituents harmful to humans.
5. Work in conditions where engulfment or entrapment may occur.
6. Work in environments which may be slippery and/or have uneven work surfaces.
7. Work in structures where workers may trip, slip and/or fall several feet.
8. Exposure to an oxygen enriched environment.

D. No entry into a confined space shall be permitted until written permission from the Owner has been granted.

E. Whenever Contractor and Owner's personnel are working simultaneously in a confined space, the activities will be coordinated prior to entry so that employees of one employer do not endanger the employees of any other employer. Coordination of entry procedures must include procedures for emergency evacuation.

F. The Contractor shall debrief Owner at the conclusion of the entry operations regarding any hazards confronted or created in permit-required confined spaces during entry operations.

1.12 HAZARD COMMUNICATION

A. No hazardous chemical in quantities greater than 5-gallons or 10-lbs shall be brought onto the Owner's premises without first gaining approval from the Owner using the Request to Use/Store Hazardous Substances on Owner's Property Form (see Appendix A of this specification).

B. MSDS's for all hazardous chemicals brought onto Owner's premises shall be kept on the OWNER'S premises and made available to Owner's employees and their representative upon request.

C. Contractors who bring hazardous substances to the work site must take the appropriate safety precautions to protect the Contractor's and Owner's employees from harmful exposure.

D. All hazardous substances not used in the work by the end of the project shall be removed from the work site by the Contractor.

1.13 LOCKOUT/TAGOUT

A. Work involving systems shutdown or startup (e.g. tie-ins, connections, equipment shutdowns, etc.) shall be coordinated with, and approved by, the Engineer and Owner, as required in Specification Section 01020 of the Contract Documents.

B. The Contractor and its representatives are not permitted to take any equipment off line, to open or close valves or turn circuits or control switches off or on. These tasks are to be performed only by Operations & Maintenance personnel designated by the Owner. Under no circumstances shall Contractor initiate shutdown procedures of any work, processes or equipment. The Contractor shall follow the Owner's lockout/tagout procedures.

C. Whenever work is to be performed on any equipment or systems that may result in hazardous energy exposures to workers or other affected personnel, all sources of energy (primary and secondary) shall be de-energized and locked out or blocked first by the Owner's authorized representative and followed by the Contractor.

D. Lockout procedures shall comply with the most stringent applicable standard, (e.g. CCR Title 8, CFR Parts 1910 and 1926, NEC) and shall include the following:

1. Lockout procedures shall be coordinated between the Contractor and Owner's designated representative.

2. All locks shall be individually keyed. Group or crew locks are not allowed.

3. All equipment or systems that have been locked out shall have a current accident prevention tag noting the reason for placing the tag, name of the individual placing the tag, how that person may be contacted, and the date the tag was placed.

4. No employee shall remove another employee's lock(s) or tag(s). Any exceptions shall be coordinated between the Contractor and the Owner's designated representative.

E. If equipment or systems cannot be locked out or blocked, suitable tagout procedures shall be implemented. Only the person whose signature is on the accident prevention tag may remove it. Any exceptions to this shall be coordinated between the Contractor and Owner's designated representative.

F. Upon completion of the work, energizing equipment is prohibited until all tags and locks have been removed. The person removing the last tag is responsible for re-installation of guards and for warning all affected personnel.

1.14 PUBLIC SAFETY AND CONVENIENCE

The Contractor shall conduct his work so as to ensure the least possible obstruction to traffic and inconvenience to the general public and the residents in the vicinity of the Work and to ensure the protection of persons and property. No road or street shall be closed to the public except with the permission of the Construction Manager and the written approval by the proper governmental authority. Fire hydrants on or adjacent to the Work shall be accessible to firefighting equipment. Temporary provisions shall be made by the Contractor to ensure the continued use of sidewalks, private and public driveways and proper functioning of gutters, sewer inlets, drainage ditches and culverts, irrigation ditches and natural water courses. The Contractor shall provide public protection by installing and maintaining the appropriate barricades, fences, guardrails, overhead protection, or any other necessary form of protection. Pedestrian or vehicle barriers shall be used around all open pits, manholes, or excavation openings when left unattended.

In accordance with California Business and Professions Code Section 7058, no person or entity shall set up or remove roadway construction zones, lane closures, flagging, or traffic diversions on any roadway unless that person or entity holds a valid and current C31 specialty license from the California Contractors State License Board. (C31 - A construction zone traffic control contractor prepares or removes lane closures, flagging, or traffic diversions, utilizing portable devices such as cones, delineators, barricades, sign stands, flashing beacons, flashing arrow trailers, and changeable message signs, on roadways, including but not limited to public streets, highways, or any public conveyance.)

1.15 CRANE OPERATION

All Contractors shall only permit operators who have a valid certificate of competency (certificate) issued in accordance with CCR Title 8 Section 5006.1 by an Accredited Certifying Entity for the type of crane to be used, to operate mobile cranes regulated under Section 5006.1. Further, the same certification requirements as those identified in the CCR, for the type of crane to be used shall also apply to operators of cranes having a boom length of less than 25 feet or a maximum rated load capacity of less than 15,000 pounds.

1.16 ASBESTOS RELATED WORK

All work involving asbestos containing material must be performed in accordance with California Labor Code, Sections 6501.5 through 6510, inclusive, and California Administrative Code, Title 8, Section 5208 and all other pertinent laws, rules, regulations, codes, ordinances, decrees and orders.

1.17 PROVISIONS FOR HANDLING EMERGENCIES

A. It is possible that emergencies may arise during the progress of the Work, which may require special treatment or make advisable extra shifts of labor forces to continue the Work for twenty-four (24) hours per day. These emergencies may be caused by damage or possible damage to nearby existing structures or property by reason of the work under construction, or by storm, accidents, or leakage. The Contractor shall be prepared in case of such emergencies to make all necessary repairs and shall promptly execute such work when required.

B. Upon start of the Work, Contractor shall provide means for immediate emergency notification of Contractor's designated representative and designated emergency alternates.

PART 2 MATERIALS

Not used.

PART 3 EXECUTION

Not used.

APPENDIX A

CONTRACTOR'S REPORT OF UNSAFE CONDITION/ACT FORM

CONTRACTOR INSTRUCTIONS:
Contractor employee observing hazardous condition or near-miss incident completes and gives to their Supervisor. Contractor representative reviews and gives to Owner's Project Manager.

HAZARDOUS CONDITION/NEAR-MISS INCIDENT: (completed by reporting employee**)**

Employee Name (*optional):* _____ Date of This Report: _____

Date Unsafe Condition or Event Witnessed: _____ Location of Unsafe Condition or Event: _____

Describe Unsafe Condition or Event: _____

Do You Have Suggestions to Remedy the Situation or Prevent Recurrence: _____

Type of Hazard: ❑ Imminent ❑ Serious ❑ General ❑ Regulatory

REVIEWED BY: _____ **SUBMITTED TO:** _____ **DATE:** _____
Contractor's Rep. ***Owner's Rep***

OWNER'S PROJECT MANAGER: A completed copy of this form is to be given to the Contractor representative and the original given to the Owner's Safety Officer for filing.

CONTRACTOR'S REPORT OF DAMAGE TO OWNER'S EQUIPMENT/PROPERTY FORM

1. Contractor (Name of Company): _____ Contact Number:_____

2. Name/Title of person completing this report: _____ Phone number:_____

3. Date of accident: _____Time: _____am/pm Day of the Week:_____

4. Whether Conditions: _____ Temperature: ____F

5. Roadway or Surface Conditions: ❑ Wet ❑ Dry ❑ Icy ❑ N/A
   ❑ Other:_____

6. Location where accident occurred:_____
   (Include specific areas, equipment, processes, etc.)

7. Owner's Equipment Involved (Description and Serial Nos.):_____

8. Any Personal Injuries? ❑ Yes ❑ No
   Estimated Value of damages:
   Owner's Property:_____ Third party damages: _____

   For vehicle accidents only:
   Contractor's vehicle involved:_____
   Year make body style
   Vehicle License No.
   Driver (Name): _____ Drivers' License No. _____
   Driver's address: _____ Phone No. _____
   Vehicle damages (describe): _____
   _____
   _____

   Passengers (Names): _____

   Other Vehicle(s) involved: _____
   Year make body style
   Driver (Name): _____ Drivers' License No. _____
   Driver's address: _____ Phone No. _____
   Insurance Company Name: _____
   Vehicle damages (describe): _____
   _____
   _____

   Passengers (Names): _____

9. Witness (es) to the Accident:
   Name: _____ Name: _____
   Address: _____ Address: _____
   Phone No. _____ Phone No. _____

   _____
   Supervisor's Signature: Date this report completed:

REQUEST TO USE/STORE HAZARDOUS SUBSTANCES ON OWNER'S PROPERTY FORM

OWNER'S STAFF INSTRUCTIONS:

- Owner's Project Manager or designee provides this form to Contractors who plan to bring hazardous substances in quantities greater than 5-gallons or 10-lbs onto Owners properties, or whose work activities may expose Owner's employees to hazardous substances.
- Owner's Project Manager or designee reviews for completion and ensures a complete MSDS has been attached.
- Owner's Project Manager or designee ensures the MSDS is copied to the affected management personnel before the hazardous substance is opened or used on Owner's property.

CONTRACTOR INSTRUCTIONS:

Make a copy of this form and complete for each chemical/hazardous substance exceeding the Owner's threshold amounts that will be stored or used on Owner's property. Attach the respective MSDS(s) to each completed form. An MSDS *must* be provided for all hazardous substances exceeding the Owner's threshold amounts that will be used or stored on Owner's property.

PERSON SUBMITTING INFORMATION: _____ **POSITION:** _____

COMPANY NAME: _____
TELEPHONE NUMBER: _____ **EMAIL:** _____

CHEMICAL NAME: _____
QUANTITY TO BE BROUGHT ONTO OWNER PROPERTIES:
____ # Drums X ____ Drum Vol. (gal) = ____ Total Gallons

____ # Tanks X ____ Tank Vol. (gal) = ____ Total Gallons

OTHER: Total lbs or gallons = _____

CHEMICAL TO BE USED AND/OR STORED ON OWNER'S PROPERTY BY:
[ ] Prime Contractor [ ] Subcontractor [ ] Other: _____

WHAT WILL CHEMICAL BE USED FOR? _____

APPROXIMATELY HOW LONG WILL THE CHEMICAL BE USED/STORED ON OWNER'S PROPERTY? _____

[ ] NFPA or [ ] HMIS Rating
HEALTH ____ FLAMMABILITY ____ REACTIVITY ____ SPECIFIC HAZARD/PPE _____

WHERE WILL CHEMICAL BE STORED? _____

WILL CHEMICAL BE STORED USING SECONDARY CONTAINMENT? [ ] YES [ ] NO

CONTRACTOR'S INJURY/FATALITY INCIDENT REPORT FORM

1. Contractor (Name of Company): _____ Contact Number:_____

2. Name/Title of person completing this report:_____ Phone#_____

3. Date of accident: _____ Time: _____ am/pm: Day of the week:_____

4. Location where accident occurred:_____
(Include specific areas, equipment, _____
processes, etc.)

5. Injury type: __Lost time injury __Serious injury __Recordable Injury __Fatality

6. Name of the injured party: _____ Employment date of hire:_____

7. Occupation of injured party: _____ Male Female___

8. Job activities being performed when the accident occurred:_____
_____

---

9. Primary Cause of the Accident:_____

10. Secondary or other contributing factors such as:
❑ Defective/unsafe equipment ❑ Safeguards missing ❑ Environmental conditions
❑ Lack of training ❑ Not following safety rules ❑ Lightning
❑ Not wearing protective equip. ❑ Working at unsafe speed ❑ Ventilation
❑ Horse-play ❑ Improper use of tools ❑ Poor housekeeping
❑ Lack of safety rules ❑ Lack of proper warning ❑ Slippery/uneven surfaces
❑ Physical limitation ❑ Improper storage
❑ Other:_____

11. Type of injury and body part(s) affected:_____

12. __On-site first aid __Off-site medical care __Required an ambulance or other emergency medical responder
13. Was the incident a fatality or an injury that required hospitalization for more than 24 hours for more than observation? __Yes __No

14. Was CalOSHA notified: __Yes __No Date/Time notification was made:_____

15. Contractor's Workers' Compensation Insurance Notified? __Yes __No
Date/Time notification made:_____

16. Agencies who were called and/or responded to the accident:
❑ Fire ❑ Police ❑ Insurance Representative ❑ CalOSHA Other:_____

17. Was the accident investigated? __Yes __No By whom?_____ Report Available?_____

18. Supervisor's Correction Action taken:_____
_____
_____

Supervisor's Signature:_____ Date this report completed:_____

OWNER'S EMERGENCY CONTACT INFORMATION FORM

OWNER'S EMERGENCY CONTACTS (To be filled out by the Owner's Project Manager for each project.)

PLEASE NOTE: It is the Contractor's responsibility to notify any appropriate regulatory authorities or outside emergency responders. This list is only meant to identify the Owner's staff that must be notified under the following events, in addition to any other appropriate emergency notifications.

In Case Of…	Immediately Contact:	If Unavailable, Contact:	How To Report:
Employee Injury			1. Phone or In Person ***AND*** 2. Complete Contractor's Injury/Fatality Incident Report
Damage to Owner's Property			1. Phone or In Person ***AND*** 2. Contractor's Report of Damage to Owner's Equipment or Property
Emergency Requiring Outside Assistance (*e.g. fire, violence, chemical spill, etc.)*			1. Phone or In Person
Harassment			1. Phone or In Person
Need Process Shut Down/Return to Service (*e.g. lockout/tagout)*			1. Phone or In Person ***AND*** 2. Fill out Plant/Process Shutdown Request-Return to Service Forms
Need to Bring Hazardous Substances Onto OWNER'S Property in Amounts Exceeding the Owner's Threshold Amounts Listed in Request to Use/Store Hazardous Substances on Owner's Property			1. Phone or In Person ***AND*** 2. Complete Request to Use/Store Hazardous Substances on Owner's Property Form

BIOLOGICAL HAZARDS IN WASTEWATER FACT SHEET

Wastewater contains bacteria, fungi, parasites, and viruses that can cause intestinal, lung, and other infections. Proper equipment, work practices, and personal protective equipment (PPE) can help protect you from these agents.

Some Biological Hazards That May Be in Wastewater

Bacteria may cause diarrhea, fever, cramps, and sometimes vomiting, headache, weakness, or loss of appetite.

Fungi

- Aspergillus can lead to allergic symptoms (such as runny nose) and sometimes can lead to lung infection or make asthma worse. If you have other health problems, you may be more likely to get sick from aspergillus.

Parasites

- Cryptosporidium and giardia lamblia may cause diarrhea, nausea and stomach cramps.
- Roundworm (ascariasis). Most people have no symptoms. With a lot of roundworms, you may cough and have trouble breathing or you may have pain in your belly and blocked intestines.

Viruses

- Hepatitis A causes liver disease. You may feel tired, have stomach cramps, nausea, jaundice (yellow skin) or diarrhea or not be hungry. The Center for Disease Control says sewage workers are not at more risk of hepatitis A infection than other workers.

Bloodborne viruses are a hazard mainly to workers in health care facilities. Hepatitis B and HIV are bloodborne.

- Hepatitis B causes liver disease. You may feel tired, have jaundice (yellow skin), have stomach cramps, nausea, or not be hungry. The disease has not been linked to exposure to sewage in the U.S.
- Human immunodeficiency virus (HIV) causes AIDS. There are no known cases of wastewater workers getting HIV from their jobs in the U.S.

Protecting the Worker

For work around wastewater, engineering controls and work practices are the best ways to protect workers from exposures to disease. When engineering controls are not possible, use personal protective equipment (PPE).

OSHA says the employer should give the worker:

- Training and education about the hazards of wastewater
- A place onsite with clean water for washing your hands
- A place to wash and clean up after work
- The right PPE, such as gloves, goggles, a face shield, water-resistant suit, or respirator – depending on the job
- Clean areas set aside for eating and smoking
- Cleaning facilities or services for clothing and equipment. (If clothing is badly soiled, change out of it. Keep equipment clean to limit your exposures to the disease-causing agents.)

What you can do:

- Most important: **Wash your hands well with clean water and soap before you eat or smoke and after work.**
- **Do not touch your nose, mouth, eyes, or ears with your hands, unless you have just washed.**
- Keep your fingernails short; use a stiff soapy brush to clean under your nails.
- Wear waterproof gloves when you handle wastewater, sludge, or grit.
- Always wear gloves when your hands are chapped or burned or you have a rash or a cut.
- Do not keep your soiled work clothes with your other clothes.
- Report any injury or illness you think you got from work right away.
- DO NOT wear shorts or open-toed shoes when working around sewage.
- **If you do get sick, be sure to tell your doctor you've worked in a sewage or wastewater treatment plant.** That information will help the doctor.

Vaccinations

You should have current shots for tetanus and diphtheria. If you want to know about shots to prevent hepatitis A, ask a nurse or doctor.

For more information, call the Center to Protect Workers' Rights (CPWR) (202-962-8490 or **www.cpwr.com**), the National Center for Infectious Diseases (**www.cdc.gov/ncidod**) , National Institute for Occupational Safety and Health (NIOSH) (1-800-35-NIOSH or **www.cdc.gov/niosh**), or OSHA (1-800-321- OSHA or **www.osha.gov**)

END OF SECTION

SECTION 01340

REQUESTS FOR INFORMATION AND CLARIFICATIONS

PART 1 GENERAL

1.1 DESCRIPTION

A. Should the Contractor discover conflicts, omissions, or errors in the Contract Documents, or have any questions concerning interpretation or clarification of the Contract Documents, or if it appears to the contractor that work to be done or any matter relative thereto are not sufficiently detailed or explained in the Contract Documents, then, before proceeding with the work affected, the Contractor shall immediately notify the Engineer in writing and request interpretation, clarification, or additional detailed instructions concerning the work. The Contractor shall ask for any clarification or request for information immediately upon discovery, but no less than fifteen (15) days prior to the start date of the activities related to the clarification, based on the latest updated and accepted construction schedule. Regardless of the number of RFI's submitted, Contractor will not be entitled to additional compensation.

B. A RFI is not to be used for request for materials/equipment substitutions or value engineering/cost reduction incentive proposals.

1.2 RFI PROCEDURES

A. Contractor review and submittal:

1. Contractor's review: Before submitting each RFI, the Contractor shall carefully review the following for relevant information:

   a. All field measurements, quantities, dimensions, specified performance criteria, installation requirements, materials, catalog numbers, and similar information with respect thereto.

   b. All materials with respect to intended use, fabrication, shipping, handling, storage, assembly, and installation pertaining to the performance of the Work.

   c. All information relative to means, methods, techniques, sequences, and procedures of construction and safety precautions and programs incident thereto.

   d. The coordination of each Shop Drawing or Sample with other Shop Drawings and Samples and with the requirements of the Work and the Contract Documents.

e. The Contract Documents.

f. The Project correspondence and documentation.

2. Submittal requests

a. The Contractor shall submit all requests for clarification and/or additional information in writing through the Engineer to the Engineer using a request for information (RFI) form. Contractor shall provide a detailed written statement that indicates the specific Drawings or Specifications in need of clarification and the nature of the clarification requested.

b. All RFIs shall be electronically transmitted and forwarded to the Engineer via the Contractor's document management system, unless otherwise noted. Each RFI shall be dated and bear a signed certification that Contractor has performed the review defined above. No consideration for review by Engineer of any RFI will be made for any item which has not been certified by the Contractor. All non-certified RFI's will be returned to Contractor without action taken by Engineer, and any delays caused thereby shall be the total responsibility of Contractor.

c. Each RFI shall be limited to one subject.

B. RFI numbering system: The initial RFI shall be numbered as RFI 001 and all subsequent questions shall be numbered consecutively with the date of issue, except for re-issuance of a respective RFI in which the subscript A, B, C, etc., will be added until the RFI is resolved. If Contractor believes the RFI reviewer's response is incomplete, Contractor shall issue another RFI (with the same RFI number with the letter "A" indicating if it is a follow-up RFI) to Engineer clarifying original RFI. Additionally, Engineer may return RFI requesting additional information should original RFI be inadequate in describing condition.

C. Owner's RFI review and response time:

1. Except as may otherwise be provided herein, the Engineer will return electronic response to each RFI form to Contractor, with comments noted thereon or on a separate comment sheet, within a reasonable amount of time, but no more than fifteen (15) calendar days following their receipt from Contractor, or if it is necessary to extend this period, the Engineer shall notify the Contractor in writing as to when a decision will be provided.

2. Engineer's review will be only to provide clarification and interpretation of the Contract Documents. Engineer's review shall not relieve Contractor for the responsibility for compliance with the Contract Documents.

3. Engineer's review will not extend to means, methods, techniques, sequences, or procedures of construction (except where a particular means, method, technique, sequence, or procedure of construction is specifically and expressly called for by the Contract Documents) or to safety precautions or programs incident thereto.

4. The Engineer may furnish additional detailed written instructions to further explain the work, and such instructions shall be a part of the contract documents. Clarifications will be issued using the above RFI system. Should additional detailed instructions in the opinion of the Contractor constitute work in excess of the scope of the contract, the Contractor shall submit notification immediately and written notification thereof to the Engineer no more than seven (7) days following receipt of such instruction, and in any event prior to the commencement of work thereon. If the Engineer considers it justified, the instructions of the Engineer will be revised or a proposed change order will be issued for the Owner's consideration. The Contractor shall have no claim for additional compensation or extension of the schedule because of any such additional instructions unless the Contractor provides the Engineer written notice thereof within the time frame specified above. In addition, the Contractor shall within fifteen (15) days from the date of notification provide detailed justification and analysis as well as complete pricing and schedule CPM fragmentary network to support any request for time extension.

5. Should the Contractor proceed with the work affected before receipt of a response from the Engineer, any portion of the work which is not done in accordance with the Owner's interpretation, clarifications, instructions, or decisions subject to removal or replacement and the Contractor shall be responsible for all losses.

6. RFI's will not be recognized or accepted, if in the opinion of the Owner or Engineer, that one of the following conditions exists:

    a. The Contractor submits an RFI as a submittal.

    b. The Contractor submits the RFI under the pretense of a contract documents discrepancy or omission without thoroughly reviewing the documents. In this case, the Contractor shall be responsible for both the Engineer's and Engineer's administrative costs to process the RFI. Such costs will be deducted from Contractor's progress payments.

    c. The Contractor submits the RFI in a manner that suggests that specific portions of the contract documents are assumed to be excluded, or be taken as an isolated portion of the contract documents in part rather than whole.

    d. The Contractor submits an RFI in an untimely manner without proper coordination and scheduling of work or related trades.

7. The Engineer's review shall not relieve Contractor from the entire responsibility for any variation from the requirements of the Contract Documents unless Contractor has in writing called attention to each such variation at the time of each RFI submittal and Engineer has given written approval of each such variation by specific written notation thereof incorporated in the RFI review; nor will any review by Engineer relieve Contractor from responsibility for compliance with the requirements for careful review above.

PART 2 MATERIALS

Not used.

PART 3 EXECUTION

Not used

END OF SECTION

SECTION 01610

SEISMIC DESIGN CRITERIA

PART 1 GENERAL

1.1 SUMMARY

Section includes: Seismic design criteria for the following:

A. Contractor or vendor provided design for support systems and anchorage of mechanical equipment, electrical equipment and distributed systems (i.e. piping, conduit, ducting, other), shall be, in accordance with section 1.3, and as called for below:

1. Where the mechanical or electrical equipment has a weight of four hundred pounds (400 lbs) or more.

2. Where the mechanical or electrical equipment has a weight of less than four hundred pounds (400 lbs) and a center of mass located four feet (4’-0”) or more above the adjacent floor level.

3. Where mechanical or electrical equipment has a weight of twenty pounds (20 lbs) or less or, in the case of a distributed system that has a weight of five pounds per feet (5 lbs/ft) or less, seismic anchorage need not be considered. Where multiple distributed systems are supported off of the same system their combined weight must be used in determining if design is required for the support system.

4. Typical Details may have been provided for supporting mechanical equipment, electrical equipment and distributed systems (i.e. piping, conduit, ducting, other) as well as for stairs, ladders, and other miscellaneous items in the construction documents. These Typical Details are to be used for a minimum standard for style, size, and materials and shall be used as a guide for the contractor in designing the specific item or system utilized on the project Design for these systems shall be provided in the submittal. The design shall include details and calculations stamped and signed by a Civil or Structural engineer registered in the State of California.

B. Contractor or vender to provide seismic design of tanks and anchorage of tanks.

C. Other Contractor or vender provided structures or items as specified or indicated on the Drawings.

D. In addition to the requirements of A-C above, provide seismic design for support systems, internal connections and packaged components as called for below:

1. Seismic design of Premanufactured Modular Mechanical and Electrical Systems (i.e. Electrical Switch Boards, Motor Control Centers, Standby Generators and Skid Mounter Systems with an Enclosure), where the Premanufactured Mechanical and Electrical Modules are six feet (6'-0") or taller and that contain or support mechanical and electrical components shall be designed in accordance with ASCE 7-16 Chapter 15 'Nonbuilding Structures Similar to Buildings'. Nonstructural components contained or supported within the modular systems shall be designed in accordance with ASCE 7-16 Chapter 13. Provide design that includes details and calculations stamped and signed by a Civil or Structural engineer registered in the State of California.

2. If Premanufactured Modular Mechanical and Electrical Systems (i.e. Electrical Switch Boards, Motor Control Centers, Standby Generators and Skid Mounter Systems with an Enclosure) is 'Prequalified' in accordance with ASCE 7-16 Chapter 13 section 13.2.2, it is exempt from the requirements of Section 4.a above. Manufacturer shall provide seismic qualification based on a nationally recognized testing standard procedure, such as ICC-ES AC 156. Seismic qualification by experience data based on nationally recognized procedures is also acceptable. Seismic pre-approval from OSHPD will also satisfy this requirement. Certification must be provided for either listed option. Certification must show seismic capacities are equal to or exceed the seismic demands that are project specific.

3. Section 1.1.D shall not apply to Skid-Mounted Equipment without an enclosure (i.e. pumps), and single large components, such as air handlers, cooling towers, chillers and boilers.

E. In accordance with the Building Code, internal elements in a water bearing structures, such as equipment and accessories that are attached to the structure, shall be designed for the lateral loads due to sloshing liquid in addition to the inertial forces.

F. All design calculations shall be per the 2019 CBC and the 2019 CBC Chapter 16 load combinations.

1.2 RELATED WORK SPECIFIED ELSEWHERE

Section 01300: Submittals.

1.3 REFERENCES

A. International Code Council (ICC).

B. 2019 California Building Code (CBC).

C. American Society of Civil Engineers

1. 7-16 Minimum Design Loads for Buildings and Other Structures (ASCE 7)

D. American Concrete Institute

1. Anchoring to Concrete of 318-14 Building Code Requirements for Structural Concrete (ACI 318-14)

a. Chapter 17 -Anchoring to Concrete

E. California Office of Statewide Health Planning and Development's (OSHPD) Seismic Preapproval.

1.4 SYSTEM DESCRIPTION

Design Requirements: Design in accordance with the requirements of the 2019 CBC and ASCE 7.

A. Risk Category, III

B. Site Class, D

C. Spectral Acceleration Parameter, S_S: 0.605g

D. Spectral Acceleration Parameter, S_1:0.246g

E. Design Spectral Acceleration at short period, S_{DS}: 0.531g

F. Design Spectral Acceleration at 1-Second Period, S_{D1}: 0.346g

G. Component Amplification Factor, a_P: In accordance with ASCE 7-16, Tables 13.5-1and 13.6-1.

H. Component Response Modification Factor, R_P: In accordance with ASCE 7-16, Tables 13.5-1 and 13.6-1.

I. Overstrength Coefficients, Ωo: In accordance with ASCE 7-16, Tables 13.5-1and 13.6-1

J. Component Importance Factor, I_P: In accordance with ASCE 7-16, Section13.1.3 but not less than 1.25

K. Component Response Modification Factor, R: In accordance with ASCE 7-16, Tables 15.4-1 and 15.4-2

L. Overstrength Coefficients, Ωo: In accordance with ASCE 7-16, Tables 15.4-1and 15.4-2

M. Deflection Amplification Factor, Cd: In accordance with ASCE 7-16, Tables15.4-1 and 15.4-2

N. Importance Factor, Ie: In accordance with ASCE 7-16, Section 15.4.1.1 but no less than 1.25.

O. Do not use friction to resist sliding due to seismic forces.

P. Do not use more than 60 percent of the weight of the mechanical and electrical equipment for designing anchors for resisting overturning due to seismic forces.

Q. Do not use more than 60 percent of the weight of the tank for resisting overturning due to seismic forces.

R. Anchor design capacity is to be independent of reinforcing steel in the concrete providing ductility.

S. Use anchor bolts, bolts, or welded 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.

1. Do not use concrete anchors, flush shells, adhesive anchors, powder actuated fasteners, or other types of anchors unless indicated on the Drawings or accepted in writing by the Engineer.

2. 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.

T. Where adhesive anchors are allowed, personnel used for installation shall be certified by an applicable certification program per ACI 318-14 section 17.8.2.2.

1.5 SUBMITTALS

A. Shop Drawings and Calculations: Submit shop drawings and seismic calculations in accordance with Section 01300. Calculations to be attached to the approved equipment/piping/tank submittal (to coordinate appropriate dimensions, weights and pertinent information).

B. Calculations shall be signed and stamped by a Civil or Structural Professional Engineer licensed to practice in the state where the project is located. All calculations shall be provided in English units.

PART 2 MATERIALS

Not used.

PART 3 EXECUTION

Not used.

END OF SECTION

SECTION 01615

WIND DESIGN CRITERIA

PART 1 GENERAL

1.1 SUMMARY

Section includes: Wind design criteria for the following:

A. Section Includes: Wind design criteria for the following:

1. Design of equipment, light poles, flag poles, antenna poles, freestanding walls, solid signs, tanks, facilities, buildings and all other structures as indicated in ASCE 7.
2. Wind design shall be considered for all cases listed, unless equipment is ‘housed’ in an enclosed structure or when it can be demonstrated that Wind design does not govern.
3. The minimum Wind loading for other elements that are not defined in ASCE 7 shall be sixteen pounds per square foot (16 lbs/ft2) multiplied by its area.

B. Design of anchorage for the Item A, listed above.

C. Other structures or items as specified or indicated on the Contract Drawings and as required by the latest California Building Code.

1.2 RELATED WORK SPECIFIED ELSEWHERE

Section 01300: Submittals

1.3 REFERENCES

A. International Code Council (ICC).

B. 2019 California Building Code (CBC).

C. American Society of Civil Engineers.

1. ASCE 7-16 Minimum Design Loads for Buildings and Other Structures (ASCE 7).

1.4 SYSTEM DESCRIPTION

Design Requirements: Design in accordance with the requirements of the 2019 CBC and ASCE 7.

A. Risk Category: III

B. Basic Wind Speed (3 second gust):

1. Ultimate design wind speed, V_{ULT} = 100 mph

2. Nominal design wind speed, V_{ASD} = 85 mph

C. Exposure Category: C

D. Topographic Factor, K_{tz} = shall be in accordance with ASCE 7-16 Standard.

E. Use anchor bolts, bolts, or welded studs for anchors for resisting wind forces. Anchor bolts used to resist wind forces shall have a standard hex bolt head. Do not use anchor bolts fabricated from rod stock with an L or J shape.

1. Do not use concrete anchors, flush shells, adhesive anchors, powder actuated fasteners, or other types of anchors unless indicated on the Drawings or accepted in writing by the Engineer.

2. Wind forces must be resisted by direct bearing on the anchors used to resist wind forces. Do not use connections which use friction to resist wind forces.

F. Where adhesive anchors are allowed, personnel used for installation shall be certified by an applicable certification program per ACI 318-14 section 17.8.2.2.

G. Anchor design capacity is to be independent of reinforcing steel in the concrete providing ductility.

1.5 SUBMITTALS

A. Shop Drawings and Calculations: Submit complete shop drawings and wind calculations in accordance with Section 01300.

B. Calculations shall be signed and stamped by a Civil or Structural Professional Engineer licensed to practice in the state where the project is located. All calculations shall be done in English units.

PART 2 MATERIALS

Not used.

PART 3 EXECUTION

Not used.

END OF SECTION

SECTION 01620

QUALITY CONTROL AND INSPECTION

PART 1 GENERAL

1.1 CONTRACTOR'S QUALITY CONTROL

A. General: The Contractor is to ensure that products, services, workmanship and Site conditions comply with the requirements of the Contract Documents by coordinating, supervising, testing and inspecting its Work. The Contractor shall utilize only suitably qualified, skilled and trained personnel experienced in the tasks required to complete the Work in accordance with the quality requirements of the Contract Documents. Should there be no quality basis specifically prescribed for any portion of the Work, the quality and testing procedures shall be in accordance with the best-accepted practices of the construction industry for the locale of the Project, for projects of this type, or standards set by engineering or technical societies (e.g. ASTM or ASHRAE), whichever is more stringent.

B. Quality of Work: The Contractor's quality of Work shall include, but not be limited to, the following requirements:

1. Quality of Products: Unless otherwise indicated or specified, all products shall be new, free of defects, and fit for the intended use. Materials manufactured over one year, prior to shipment to the Project site, shall not be allowed on the Project (as identified by manufacturer's serial numbers/labels/stamps).

2. Quality of installation: All Work shall be produced plumb, level, square and true, or true to indicated angle, and with proper alignment and relationship between the various elements, as shown on or required by Contract Documents.

3. Protection of Completed Work: Take all measures necessary to preserve completed Work free from damage, deterioration, soiling, and staining, until acceptance by Owner.

4. Standards and Code Compliance and Manufacturer's Instructions and Recommendations: Unless more stringent requirements are indicated or specified, comply with manufacturer's instructions and recommendations, reference standards and building code research report requirements in preparing, fabricating, erecting, installing, applying, connecting, and finishing Work.

5. Deviations from Standards and Code Compliance and Manufacturer's instructions and Recommendations: Secure Owner's advanced written consent. Document and explain all deviations from reference standards and building code research report

requirements and manufacturer's product installation instructions and recommendations, including acknowledgement by the manufacturer that such deviations are acceptable and appropriate for the Project.

6. Verification of Quality: Work shall be subject to verification of quality by Owner in accordance with provisions of the Contract Documents.

C. Defective Work: Defective Work shall be modified, replaced, repaired or redone by the Contractor at no change in Contract Sum or Contract Time. Acceptance of Defective Work, without specific written acknowledgement and approval of Owner, shall not relieve the Contractor of the obligation to correct such Work. Should Owner determine that it is not feasible or in Owner's interest to require Defective Work to be repaired or replaced, an equitable reduction in Contract Sum shall be made by agreement between Owner and Contractor. If equitable amount cannot be agreed upon, a Construction Change Directive will be issued and the amount in dispute resolved in accordance with the Contract Documents. Owner and Owner's consultants disclaim any and all responsibility for Work produced not in conformance with the Drawings and Specifications. Contractor shall have full responsibility for all consequences resulting from Defective Work, including without limitation all delays, disruptions, extra inspection and correction costs by Contractor and Owner and re-Work, and extra time and costs of all types. Contractor waives excuses for defective work relating to Owner's prior review of Submittals and/or prior failure to notice Defective Work in place on inspection.

PART 2 MATERIALS

Not used.

PART 3 EXECUTION

3.1 INSPECTION AND TESTING

A. General:

1. Where the Contract Documents require work to be field tested or approved, it shall be tested in the presence of the Construction Manager or its authorized representative. The Construction Manager shall have the right to witness all on-site tests performed by the Contractor and any shop tests. The results of any tests performed by the Contractor shall be made available for the information of the Construction Manager. Inspections, tests or favorable reviews by the Construction Manager or others shall not relieve the Contractor from its obligation to perform the work in accordance with the requirements of the Contract Documents or for its sole responsibility for the quality of workmanship and materials.

2. Except as specifically required under the technical specifications for testing and inspection, all tests for materials furnished by the Contractor will be done in accordance with commonly recognized standards of national organizations. Where

tests are to be performed by the Construction Manager or by an independent laboratory or agency, the Contractor shall furnish such samples of all materials as required by the Construction Manager without charge. The sample or samples of materials to be tested shall be selected by such laboratory or agency, or the Construction Manager, and not by the Contractor. No material for which the Contract Documents require the submittal and approval of tests, certificates of compliance or other documentation shall be incorporated in the Work until such submittal has been made and approved. The Contractor shall provide safe access, including plants where materials or equipment are manufactured or fabricated, for the Construction Manager and inspectors to adequately inspect the quality of work and the conformance with the Contract Documents. The Contractor shall furnish the Construction Manager the necessary labor and facilities for such things as excavation in the compacted fill to the depths required to take samples. The Contractor shall provide adequate lighting, ventilation, ladders and other protective facilities as may be necessary for the safe performance of inspections.

3. Upon completion of the Work the Construction Manager will conduct a final inspection. Records shall be available at all reasonable hours for inspection by other local or State agencies to ascertain compliance with laws and regulations.

4. Neither the employment of independent testing and inspection agency nor observations or tests by Owner and Owner's consultants shall in any manner relieve the Contractor of obligation to perform Work in full conformance to all requirements of the Contract Documents. The Owner reserves the right to reject all Work not in conformance to the requirements of the Contract Documents, or otherwise Defective.

B. Notice:

1. The Contractor shall notify the Construction Manager in writing at least twenty-four (24) hours before any field testing or special inspections are required to be performed by the Construction Manager or independent laboratory furnished by the Owner. The Contractor shall notify the Construction Manager at least two hours before any inspection is required to be performed or to witness the Contractor's on-site field testing.

2. Whenever the Contractor varies the period during which work is carried on each day, the Contractor shall give due notice to the Construction Manager so that proper inspection may be provided. Any work done in the absence of the Construction Manager shall be considered to be rejected. It will be the responsibility of the Contractor to demonstrate to the satisfaction the Construction Manager that the work meets all conditions of the specification and if such conditions are not met to remove the work.

3. The Contractor shall give the Construction Manager written notification at least thirty (30) days prior to the shipment of materials and equipment to be tested and/or inspected at the point of origin. Satisfactory tests and inspections at the point of origin shall not be construed as a final acceptance of the materials and equipment nor shall such tests and inspections preclude retesting or reinspection at the site of the Work.

C. Costs of Testing:

1. The Contractor shall be responsible for, and shall pay for, all quality control and off-site tests of materials required including all source and mix design tests for the approval of soil and concrete materials. The Owner will perform the soils and concrete confirmation tests detailed in the Technical Specifications during the performance of the Work. Owner will retain and pay a qualified testing agency to perform soil compaction testing and work identified as requiring special inspections and testing as defined by CBC section 1701. All other testing required by the technical specifications shall be the responsibility of the Contractor.

2. The Contractor shall be responsible for, and shall pay for, all source quality control and all on-site tests of materials required, except those tests specifically noted to be performed and paid for by the Owner.

3. The Construction Manager shall have the authority to require additional tests or inspections due to the manner in which the Contractor executes its work. Examples of such additional tests and inspections include; tests of materials substituted for previously accepted materials, or substituted for specified materials, or retests made necessary by failure of material to comply with the requirements of the Specifications. Where such tests and inspections are required by Contract to be performed by the Owner, the Owner will pay for the additional tests and inspections but will issue an unilateral Change Order to deduct these costs from the Contract price.

D. Work Covered Prior to Inspection and/or Testing: Work requiring inspection and/or testing shall not be concealed or buried prior to the acceptance of such inspection or testing. Work covered without the favorable review or consent of the Construction Manager shall, if required by the Construction Manager, be uncovered for inspection and/or testing at the Contractor's expense.

E. Work Covered With Prior Inspection and/or Testing: If the Construction Manager considers it necessary or advisable that covered work which was favorably inspected and tested be uncovered for reinspection and/or retesting, the Contractor, at the Construction Manager's request, will uncover, expose or otherwise make available for observation, inspection or testing as the Construction Manager 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 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, testing and reconstruction, and a Change Order shall be issued for such additional work.

F. Coordination of County, City Building and Other Inspections: The Contractor is completely responsible for scheduling all County, City and any other agency inspections in accordance with the County, City and agency requirements. The Contractor shall notify the Construction Manager of all building and other work component inspection notices and

schedules. Failure of the Contractor to properly coordinate and schedule these inspections shall not be cause for time extensions.

G. Special Tests and Inspections: As provided for in the Contract Documents, laws and regulations, specialized tests and inspections shall be performed by special inspectors certified by the International Code Council (ICC). Unless otherwise stated in the Contract Documents, each of these tests will be performed and paid for by the Owner.

H. Inspections and Tests by Serving Utilities: Unless otherwise indicated in the Contract Documents, the Contractor shall cause, schedule and conduct inspections and tests by serving Utilities required for the Work under this Contract.

I. Inspections and Tests by Serving Manufacturers: Unless otherwise indicated in the Contract Documents, the Contractor shall cause all required tests and inspections to be conducted by materials, equipment or systems manufacturers. Additionally, all tests and inspections required by materials, equipment or systems manufacturers as conditions of warranty or certification of Work shall be made, the cost of which shall be included in the Contractor's bid.

3.2 TEST WATER

A. The Owner will furnish water for testing to the Contractor, free of charge, as is available from the Owner's water system. The conveyance of water shall be the responsibility of the Contractor and shall be at the Contractor's expense.

B. The Contractor shall submit a written request of water needs for testing including a description, volume, location and duration of use to the Construction Manager for approval. The Construction Manager will designate the type of water, locations where connections may be made and the backflow protection, if required. The Contractor is responsible for providing, installing and testing the backflow prevention device at the Contractor's expense. The Construction Manager may also require a meter on the connection depending on the volume of water requested.

C. There may be short periods of time when water is not available from the Owner's system.

END OF SECTION

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SECTION 01640

PRODUCT HANDLING

PART 1 GENERAL

1.1 DESCRIPTION

Work Included: Protect products scheduled for use in the work by means including, but not necessarily limited to, those described in this Section.

1.2 RELATED WORK SPECIFIED ELSEWHERE

Documents affecting work of this Section include, but are not necessarily limited to:

A. Section 01010: General Construction Information and Requirements

Additional procedures also may be prescribed in other sections of these Specifications, including specific handling instructions recommended in the Manufacturer’s literature.

1.3 QUALITY ASSURANCE

Include within the Contractor's quality assurance program such procedures as are required to assure full protection of work and materials.

1.4 MANUFACTURERS' RECOMMENDATIONS

Except as otherwise approved by the Engineer, determine and comply with manufacturer’s recommendations on product handling, storage, and protection. Rotating equipment storage shall include recommended manual rotation frequency with a log prepared by the Contractor to demonstrate specification compliance. The Contractor shall contact the Engineer prior to performing the scheduled rotation. An Inspector may accompany the Contractor’s workmen during the required rotation.

1.5 PACKAGING AND DELIVERY

A. Deliver products to the job site in manufacturer's packaging material with seals unbroken and labels intact until time of use. Promptly remove damaged material and unsuitable items

from the job site, and promptly replace with material meeting the specified requirements, at no additional cost to the Owner.

B. The Engineer may reject as non-complying such material and products that do not bear identification satisfactory to the Engineer as to manufacturer, grade, quality, and other pertinent information.

C. Copies of all equipment delivery tags shall be provided to the Engineer on a daily basis with delivery tag indicating equipment number, item description, model number, and serial number.

D. Packing and Marking:

1. All equipment shall be adequately and effectively protected against damage from moisture, dust, handling or other cause during transport from manufacturer's or supplier's premises to site.

2. Each item or package shall be clearly marked with a fitting or distinguishing mark which shall be shown on the packing lists. Copies of packing lists shall be delivered to the Engineer.

3. Stiffeners shall be used where necessary to maintain shapes and to give rigidity. Parts of equipment shall be delivered in assembled or sub-assembled units where possible.

E. Identification of Equipment: Each item of equipment shall have firmly affixed to it a label or tag with its equipment number or other discrete identifying mark.

F. Delivery of Equipment: The Owner's personnel will not accept materials or equipment deliveries for the Contractor.

1.6 PROTECTION

A. Protect finished surfaces, including jambs and soffits of openings used as passageways, through which equipment and materials are handled.

B. Provide protection for finished floor surfaces in traffic areas prior to allowing equipment or materials to be moved over such surfaces.

C. Maintain finished surfaces clean, unmarred, and suitably protected until accepted by the Owner.

D. Protect materials and equipment from the effects of weather, sunlight, extreme temperatures, etc., when exposure of the materials or equipment to the elements would cause degradation of, or damage to, the material, equipment or coating system. Progress

payments for materials and equipment stored on-site will only be made when the materials or equipment are suitably stored.

E. Storage of Equipment: During the interval between the delivery of equipment to the site and installation, all equipment shall be safely stored in a manner acceptable to the Engineer. Equipment shall be stored in an enclosed space affording protection from vandalism, weather, dust and mechanical damage and providing favorable temperature, humidity and ventilation conditions to ensure against equipment deterioration. Rotating equipment shall be turned or exercised as recommended by the Manufacturer.

F. Protection of Equipment after Installation: After installation, all equipment shall be protected as specified by the manufacture. During concrete operations, including finishing, all equipment that may be affected by cement dust must be completely covered. During painting operations, all grease fittings and similar openings shall be covered to prevent the entry of paint. Electrical switchgear, unit substation and motor load centers shall not be installed until after all concrete work and sandblasting in those areas have been completed and accepted.

G. Exercise installed equipment and provide maintenance per manufacturer's recommendations until the project is accepted by the Owner.

1.7 REPAIRS AND REPLACEMENTS

A. In event of damage, promptly make replacements and repairs to the approval of the Engineer and at no additional cost to the Owner.

B. Additional time required to secure replacements and to make repairs will not be considered by the Engineer to justify an extension in the Contract Time of Completion.

PART 2 MATERIALS

Not used.

PART 3 EXECUTION

Not used.

END OF SECTION

SECTION 01666

TESTING OF PIPELINES, GRAVITY SEWER LINES, AND MANHOLES

PART 1 GENERAL

1.1 DESCRIPTION

A. The work of this section consists of leak testing all pipelines, gravity sewer lines, manholes, and related valves and fittings. Repaired work shall be retested and if still rejected shall be repaired or replaced to the satisfaction of the Engineer at no additional cost to the Owner.

B. Testing Methods:

1. Pipelines - water test,
2. Gravity Sewer Lines - air test,
3. Manholes - vacuum test,
4. Air piping – air test,
5. SDR 26&35 – additional mandrel testing.
6. Gas piping – as detailed below.

1.2 QUALITY ASSURANCE

A. Flow meters shall record the actual volume plus or minus 2 percent.

B. Air test gauges shall be ANSI/ASME B40.1, Grade 3A (plus or minus 0.25 percent of full scale accuracy), 15 psi dial range.

C. Water test gauges shall be ANSI/ASME B40.1, Grade 2A (plus or minus 0.5 percent of full scale accuracy), dial range approximately twice the required test pressure.

1.3 SUBMITTALS:

A. In accordance with Section 01300.

B. Accuracy certification by approved independent testing labs for flow meters and test gauges. Certifications shall be dated no more than 90 days prior to actual system testing.

C. Prior to testing, provide the following information:

1. All Tests: Describe precautions that will be taken to protect system equipment that might be damaged under test pressures, and the proposed method for rerouting sewer flows where the system must remain in service. Provide pipe test acceptance form, example provided in Appendix A of this Section.

2. High or Low Pressure Water Test: Describe the proposed method for disposal of water used in line testing.

3. Test Bulkheads: Submit test bulkhead locations and design calculations, pipe attachment details, and methods to prevent excessive pipe wall stresses.

4. Air Test: Describe safety devices on air test equipment, and personnel safety precautions during air.

1.4 PROJECT CONDITIONS

A. Testing shall not be performed until each system has been flushed or thoroughly cleaned in accordance with procedures in the section that describes sewer line installation.

B. Water for flushing and testing is available as noted in Section 01010.

1.5 TEST RECORDS

Provide records of each piping installation during the testing. These records shall include:

A. Date of Test.

B. Identification of pipeline, or pipeline section, tested or retested.

C. Identification of pipeline material.

D. Identification of pipe specification.

E. Test fluid.

F. Test pressure.

G. Remarks: Leaks identified (type and location), types of repairs, or corrections made.

H. Certification by Contractor that the leakage rate measured conformed to the specifications.

PART 2 MATERIALS

2.1 MANUAL AIR-RELEASE VALVES FOR BURIED PIPING

Provide temporary manual air-release valves for pipeline test. Construct the pipe outlet in the same manner as for a permanent air valve and after use, seal with a blind flange, pipe cap, or plug and coat the same as adjacent pipe.

2.2 TEST BULKHEADS

Design and fabricate test bulkheads per section VIII of the ASME Boiler and Pressure Vessel Code. Materials shall comply with Part UCS of said code. Design pressure shall be at least 2.0 times the specified test pressure for the section of pipe containing the bulkhead. Limit stresses to 70% of yield strength of the bulkhead material at the bulkhead design pressure. Include air-release and water drainage connections.

2.3 TESTING FACILITIES

Provide all necessary temporary facilities required to accommodate specified testing.

PART 3 EXECUTION

3.1 GENERAL

A. Perform testing in the Engineer's presence after backfill and proper compaction of trenches. Where lines are installed under roadways, parking areas, concrete, or structures, perform tests before and after completion of final subgrade preparation and prior to application of surface courses. Notify Engineer in writing at least 48 hours prior to testing. Notification shall be by the Contractor submitting a test form which shall indicate test date, pipeline to be tested, test requirements and requirements of the Owner.

B. Prepare each section for testing, using adequate bracing; protect system equipment susceptible to damage by test pressures; make provision for installation of Owner's pressure gauge in parallel with Contractor's gauge, if so requested; and maintain services where required.

C. Testing requirements are stipulated in Laws and Regulations; are specified in the specifications covering the various types of piping; and are specified herein. Requirements in Laws and Regulations supersede other requirements of Contract Documents, except where requirements of Contract Documents are more stringent, including higher test pressures, longer test times, and lower leakage allowances.

3.2 PIPELINE TEST PROCEDURE

A. After completion of the installations, Contractor shall test all piping and pipework as herein specified. The Contractor shall furnish all material, equipment, and labor for testing the piping systems.

B. Each system may be tested as a unit or in sections as directed by the Engineer, but each complete system shall successfully meet the requirements specified herein before acceptance by the Engineer.

C. Clean piping before pressure or leak tests.

D. For water testing, the test shall be made by closing valves or providing bulkheads or plugs and filling the pipelines with water, with provisions made for the release of all air in the lines. Lines shall be filled with water 24 hours prior to testing for leakage to allow for absorption of water by pipe or joint material.

E. Specified pressures or heads of water shall be maintained for the periods of time tabulated herein, except where indicated to be air or vacuum, and the leakage determined. Leakage shall not exceed the tabulated values.

F. Test pressures shall be as indicated herein and in Section 15010. The pressure shall be maintained at all times during the test by restoring it whenever it falls an amount of 5 psi for test pressures above 20 psi and 2 psi for test pressures below 20 psi.

G. If leakage is more than allowable, the Contractor shall repair or replace the pipeline and retest it. Do not use paints, asphalts, tars, or other type of pipe compounds to eliminate leaks.

H. The Contractor shall take all necessary precautions to prevent any joints from drawing while the pipelines and their appurtenances are being tested and he shall, at his own expense, repair any damage to the pipes and their appurtenances, or to any other structures, resulting from or caused by these tests.

I. Where any section of the piping contains concrete thrust blocks or encasement, wait at least 10 days after the pour to begin testing.

J. After a satisfactory test, remove the testing fluid, remove test bulkheads and other test facilities, and restore the pipe coatings.

Testing Requirements

Type of Pipe	Test Medium	Minimum Test Period	Maximum Allowable Leakage
Gas	(a)	(a)	(a)
Sanitary Drain	(a)	(a)	(a)
Storm Drain (c)	Water (c)	24 hours	50 gallons per mile per inch diameter. At 5 feet test head.
Service Air	Air	1 hour	0
Low Pressure Air Piping	Air	1 hour	0
Liquid-Containing Lines Not Listed Above	Water	2 hours	(b)

(a) Per applicable plumbing code

(b) Exposed pipe shall have no visible leaks. Otherwise, allowable leakage shall be determined by the following formula:

$$L = \frac{SD\,(P)^{1/2}}{133{,}200}$$

Where:

L = allowable leakage, in gallons per hour

S = length of pipe tested, in feet

D = nominal diameter of the pipe, in inches

P = average test pressure during the leakage test, in pounds per square inch (gauge), where test pressure shall be the higher of 2x working pressure, or minimum of 150 psi.

(c) Water or air testing allowed above groundwater. For water testing, leakage rate is for piping installed above groundwater level. If pipe is installed below groundwater, use air test. For air, see subsection 3.3, testing of gravity sewer piping.

3.3 GRAVITY SEWER SYSTEMS TEST PROCEDURE

A. Air Test: Test lines less than or equal to 30 inches in diameter between manholes with low pressure air. Safety requires regulator or relief valve on pressurizing equipment, set at 8 psig. No one will be allowed in manholes while there is air pressure against test plugs.

Lines greater than 30-inches in diameter shall include individual joint testing as specified.

B. Plug all pipe outlets to resist test pressure. Give special attention to laterals. Plug all other pipes in both upstream and downstream manholes.

C. Supply air into the line until the test pressure of 3.5 psi in excess of the ground water pressure is attained or 8 psi, whichever is greater. Allow at least 5 minutes for air temperature in the test section to stabilize.

D. Reestablish the test pressure, and start a stop watch. Determine the time required for pressure to drop 1.0 psig.

E. For 6-inch and smaller pipe only, if the pressure does not drop during the stabilization period, and no additional air has been added, the section undergoing test will have passed without further testing.

F. The pipe section will also have passed if the time observed for the pressure to drop 1.0 psigB is greater than that determined by using Table 1.

Determine the test time from the table below (minimum time 60 seconds).

Minimum Test Time for Various Pipe Sizes

Size	Time per 100-feet	Size	Time per 100-feet	Size	Time per 100-feet
4-inch	0.3-min.	12-inch	1.8-min.	24-inch	3.6-min
6-inch	0.7-min.	15-inch	2.1-min.	27-inch	4.2-min.
8-inch	1.2-min.	18-inch	2.4-min.	30-inch	4.8-min.
10-inch	1.5-min.	21-inch	3.0-min.		

G. When a combination of more than one pipe size is under test, the calculated time for the larger pipe shall apply.

H. For larger sewer pipes, refer to the material specification for testing requirements.

I. Any potions which fail the test shall be repaired and retested until they meet the requirements in the attached table of this section.

3.4 VISUAL TEST FOR PIPELINES

Interior visual inspection shall be conducted by the Owner and/or CCTV inspection may be performed by the Owner. The Owner's Inspector shall visibly inspect the line and record findings. Preliminary inspections may be performed by outside contractors, but shall not be accepted by Engineer as an official record.

The sewer system shall be completely cleaned by an approved method prior to visual inspection. The sewer system shall be rejected if any of these conditions exist:

A. Standing water or sags greater than ½-inch in depth.

B. Standing water in services.

C. Offset joints.

D. Cracked pipe.

E. Infiltration.

3.5 TELEVISION TEST FOR PIPELINES

Any portion of the new piping system may be TV'd by the Owner. Any construction deficiencies discovered during TV'ing shall be corrected by the Contractor and the line TV'd again. There will be no cost to the Contractor for the initial TV test. All re-inspection costs including soil density testing, quality assurance observation, and re-testing inspection, shall be paid for by the Contractor.

3.6 DEFLECTION TESTING OF FLEXIBLE PIPE

All flexible PVC pipe shall be tested for over-deflection as specified below.

3.7 LEAKAGE TEST FOR MANHOLES

Sewer manholes shall pass a vacuum test consisting of the following criteria and procedures:

A. The Contractor shall notify the Engineer at least 72-hours in advance to be present during testing without exception.

B. The test shall be performed after assembly of the manhole, but prior to backfilling. The Contractor shall perform the test and supply all test equipment. A City Inspector shall witness the test results.

C. Lift holes shall be filled with non-shrinking grout prior to testing.

D. Pipe entering and existing the manhole shall be plugged. Securely brace the plugs to prevent them from being drawn into the manhole. Unused channels shall be permanently plugged with a plastic or clay stop and filled with grout.

E. A vacuum of 10-inches of mercury shall be drawn to start the test. The amount of time required for the vacuum to drop to 9-inches shall be measured. The manhole will pass the test if the amount of elapsed time is greater than 60 seconds for a 48-inch manhole, 75 seconds for a 72-inch manhole, and 120 seconds for a 84-inch manhole. A liquid filled vacuum gauge shall be used for testing.

F. If the manhole fails the initial test, necessary repairs shall be made with a non-shrink grout while the vacuum is still being drawn. Retesting shall proceed until the elapsed times are satisfactory.

G. After passing the vacuum test, all joints shall then be mortared, inside and out. Outside mortared joints shall be allowed to dry before backfilling.

3.8 ADDITIONAL TESTING FOR PLASTIC PIPING AND FITTINGS

A. Field Inspection for Plastic Pipe and Fittings: Installed pipe shall be tested to ensure that vertical deflections for plastic pipe do not exceed the maximum allowable deflection. All SDR 26 and 35 PVC Sewer Pipe shall be mandrel tested by the Contractor as outlined below. All C905 PVC pipe may be measured by the Engineer for over-deflection above 3%. Maximum allowable deflections for SDR 26 and 35 pipe shall be governed by the mandrel requirements stated herein and shall nominally be the percentage listed of the maximum average ID.

Nominal Pipe Size	Percentage
Up to and including 12-inch	5.0
Over 12-inch to and including 30-inch	4.0
Over 30-inch	3.0

B. The maximum average ID shall be equal to the average OD per applicable ASTM Standard minus two minimum wall thicknesses per applicable ASTM Standards. Manufacturing and other tolerances shall not be considered for determining maximum allowable deflections.

C. Deflection tests shall be performed not sooner than 30 days after completion of placement and densification of backfill. The pipe shall be cleaned and inspected for offsets and obstructions prior to testing.

D. For all pipes less than 24-inch ID, a rigid mandrel shall be pulled through the pipe by hand to ensure that maximum allowable deflections have not been exceeded. Prior to use, the mandrel shall be certified by the Engineer. Use of an uncertified mandrel or mandrel altered or modified after certification will invalidate the test. If the mandrel fails to pass, the pipe will be deemed to be overdeflected.

E. Unless otherwise permitted by the Engineer any overdeflected pipe shall be uncovered and, if not damaged, reinstalled. Damaged pipe shall not be reinstalled but shall be removed from the Work site. Any pipe subjected to any method or process other than removal, which attempts, even successfully, to reduce or cure any overdeflection, shall be uncovered, removed from the Work site and replaced with new pipe.

F. The mandrel shall:

1. Be rigid, non-adjustable, odd-numbering-leg (9 legs minimum) mandrel having an effective length not less than its nominal diameter.

2. Have a minimum diameter at any point along the full length as follows:

Pipe Material	Nominal Size (inches)	Minimum Mandrel Diameter [(a)] (inches)
PVC-ASTM D 3033 (SDR 35)	6	5.619
	8	7.309
	10	9.137
	12	10.963
	15	13.849
PVC-ASTM F 679 (T-1 Wall)	18	16.924
	21	19.952
	24	22.446
	27	25.297
	30	28.502
	36	35.03

(a) Mandrel diameters of SDR 26 pipe shall be based on 4% deflection of the average inside diameter.

3. Be fabricated of steel, be fitted with pulling rings at each end, be stamped or engraved on some segment other than a runner indicating the pipe material specification, nominal size and mandrel OD, (e.g., PVC D 3034-8”-7.524”; and be furnished in a suitable carrying case labeled with the same data as stamped or engraved on the mandrel.

4. All costs incurred by the Contractor attributable to mandrel and deflection testing, including any delays, shall be borne by the Contractor at no cost to the Owner.

APPENDIX A
PIPE TEST ACCEPTANCE FORM

Project Name _____	
Project Location _____	
Contractor_____	Date of Test _____
Pipe Section to Be Tested Process _____ Starting Point _____ Ending Point _____	
Pipe Material _____	Spec Section: _____
Test Fluid Air ☐ Water ☐ +Mandrel ☐	
Starting Pressure (gauge reading) _____	Ending Pressure (gauge reading) _____
Test Start Time: _____	Test End Time: _____
Initial Test ☐	Re-Test ☐
Pass ☐	Fail ☐

Comments:
(If this is a re-test, describe repairs made or actions taken. If test requires mandrel and deflection measurements, include here)

END OF SECTION

SECTION 01670

EQUIPMENT AND SYSTEM TESTING AND STARTUP

PART 1 GENERAL

1.1 DESCRIPTION

This section contains requirements for Performance Testing, Facility Startup/Operational Testing, and the Demonstration Period for all the mechanical, electrical, and instrumentation, equipment and systems. In addition, this section contains requirements for the documentation of all testing work. This section supplements the specific testing requirements found in the individual sections of these Specifications.

1.2 RELATED WORK

A. Section 01300: Submittals

B. Section 01675: Training

C. Section 01680: Operating and Maintenance Manuals

D. Section 11010: General Mechanical Equipment Provisions

1.3 GENERAL SEQUENCE OF TESTING AND STARTUP

The general sequence of testing and startup will proceed as follows. Expanded information on each item is presented later in this Section:

A. SUBMITTALS: All relevant submittals, operation and maintenance manuals and factory testing shall be completed and acceptable to the Engineer.

B. CALIBRATION: All test equipment to be used during the testing shall be calibrated.

C. TESTING PREPARATION: Preparation for actual testing will then take place (visual inspections, lubrication, etc.)

D. PERFORMANCE TESTING (8 HOURS): Performance Testing shall be conducted on each piece of equipment to verify its operation prior to putting the entire system on-line.

Performance Testing will be for a continuous 8-hour period for each piece of equipment. Additional information as required in specification Section 11010.

E. TRAINING: Training of the Owner's personnel shall take place after the Contractor has verified that the individual pieces of equipment are in working order.

F. FACILITY STARTUP/OPERATIONAL TESTING (5-DAYS): Facility Startup/Operational Testing will then follow. The Operational Testing is to verify that the facility as a whole is functioning properly. Operational Testing will be for a continuous 5-day period.

G. DEMONSTRATION PERIOD (30-DAYS): The Demonstration Period will be used to demonstrate the longer term functionality of the facility. The Demonstration Period will be for a continuous 30-days.

1.4 CONTRACTOR'S TESTING MANAGER

The Contractor shall appoint a qualified professional as the Contractor's Testing Manager to manage, coordinate, and supervise the Testing Program. The qualified professional shall have at least (5) five years experience in managing the startup and operation of mechanical, electrical, instrumentation, HVAC, and piping systems.

1.5 SUBMITTALS

Submittals shall be provided in accordance with Section 01300 and shall include the following information:

A. The Contractor shall designate in writing the appointed Testing Manager, including a resume demonstrating compliance with the requirements of this Section, to the Engineer prior to implementation of the Testing Program.

B. Submit the credentials and certification of the testing laboratory proposed by the Contractor for calibration of all test equipment.

C. A schedule for the Performance Testing, Facility Startup/Operational Testing, and Demonstration Period updated monthly (weekly when testing is taking place).

D. An Equipment Testing Plan to be used during Performance Testing. An example 8-hour testing plan template is provided in an Appendix to this Specification.

E. A Facility Startup/Operational Testing and Demonstration Plan. An example 5-day testing plan template is provided in an Appendix to this Specification.

F. Calibration and Performance Test results, documented as required by the test program, of equipment or system prior to commencement of the Operational Test.

G. The original and three copies of all records produced during the Testing Program.

H. Completed Equipment Test Report forms for each piece of equipment.

PART 2 MATERIALS

2.1 EQUIPMENT TESTING PLANS

A. The objective of the Equipment Testing Plan shall be to demonstrate, to the Engineer's complete satisfaction, that the structures, systems, and equipment meet all the performance requirements. In addition, the Equipment Testing Plan shall produce a record of baseline operating conditions for the Owner.

B. The Contractor shall participate with the Engineer in the development of the Equipment Testing Plan which will be based on the detailed testing requirements as stated in the individual Specification sections. The Equipment Testing Plan shall be divided into the various process systems. The Equipment Testing Plan shall include tests and documentation procedures for the calibration of all analysis instruments and control sensors followed by step-by-step procedures for the Performance Testing, Facility Startup/Operational Testing, and Demonstration Testing for each individual item of mechanical, electrical, and instrumentation equipment, and for the facility as a whole as specified in the individual Sections. The Contractor shall be responsible for leading the development of the Equipment Testing Plan effort and the Equipment Testing Plan shall be reviewed and accepted by the Engineer prior to beginning any testing.

C. The Contractor shall submit Equipment Test Report Forms for each item of equipment to be tested. The minimum information to be included shall be as follows:

1. Project Name.
2. Equipment or item tested (including tag numbers).
3. Date and time of test.
4. Type of test performed (Performance or Operational).
5. Test conditions.
6. Manufacturer’s representatives present during testing (if applicable)
7. Temporary systems required during the testing (if applicable)
8. Test results.
9. Calibration documentation for all test equipment (including test laboratory)

10. Signature space for Contractor and Engineer.

11. Additional information as required in specification Section 11010 and Division 16.

D. The Contractor shall prepare a testing schedule in bar graph form establishing the time period when the Contractor plans to proceed with the testing of the completed systems and each system element. The schedule shall include a description of the temporary systems and installations planned to allow testing to take place. The schedule shall detail the sequence, time and duration of Performance Testing, Facility Startup/Operational Testing, and the Demonstration Period. No testing or startup shall take place on dates and times other than those given in the testing schedule.

PART 3 EXECUTION

3.1 CONTRACTOR'S RESPONSIBILITIES

A. The Contractor shall provide, at no expense to the Owner, all fuel, chemicals, compressed air supplies, all labor, temporary piping, valves, gauges, test equipment, heating, ventilating, air conditioning and all other items and work required to complete the tests. Temporary facilities shall be maintained until permanent systems are in service.

B. The Contractor shall arrange for the manufacturer's representatives to revisit the Site as often as necessary to correct malfunctions to the Engineer's satisfaction.

C. The Contractor shall provide at least two weeks notice to third-party SCADA programmer to allow for coordination on commissioning.

3.2 CONTRACTOR'S TESTING MANAGER

A. The Contractor's Testing Manager shall organize qualified representatives of equipment suppliers, subcontractor's, the Contractor's independent testing laboratory, and others, as appropriate, to calibrate and test the equipment, systems, and the facility as a whole. Testing shall follow the procedures and sequences as described in the Equipment Testing Plan.

B. Test results shall be documented on forms provided in the Equipment Testing Plan, including but not limited to the Equipment Test Report, as previously described.

C. The Contractor's Testing Manager shall conduct at least weekly meetings with the test team and the Engineer beginning one week prior and continuing during equipment testing periods to discuss procedures and testing results.

D. The Testing Manager shall be present during equipment testing, facility startup, and meetings and shall be available at all times during the Demonstration Period.

3.3 TEST EQUIPMENT CALIBRATION

A. The Contractor shall conduct a calibration program for all instruments, gages, meters, monitors, and thermometers used for determining the performance of equipment and systems to be tested.

B. All test equipment (gages, thermometers, meters, analysis instruments, and other equipment) used for calibrating or verifying the performance of equipment installed under this contract shall be calibrated to an accuracy at least as accurate as the tolerance specified for the item being tested with ±2% of actual value at full scale being the maximum allowable. Test equipment employed for individual test runs shall be selected so that expected values as indicated by the detailed performance specifications will fall between 60 and 85% of full scale.

C. Pressure gages shall be calibrated in accordance with ANSI/ASME B40.1. Thermometers shall be calibrated in accordance with ASTM E77. Liquid flow meters, including all open channel flow meters and all meters installed in pipelines with diameters greater than 2" shall be calibrated in situ using either the total count or dye dilution methods. Ultrasonic level and magnetic type flow meters shall be calibrated per manufacturers' recommendations. For gas flow meters installed in piping systems with diameters greater than 6", factory calibration curves for the primary element shall be submitted and the transmitters shall be calibrated onsite per factory specifications.

3.4 TESTING PREPARATION

The following steps apply to each process system or facility as it is readied for startup and operation:

A. SUBMITTALS: All submittals relevant to installation practices, equipment, piping, anchorage calculations, instrumentation, materials, and testing plans have been submitted to the Engineer and received "No Exceptions Taken” or “Make Corrections Noted" review status.

B. FACTORY TESTING: Where required prior to the shipment of equipment to the site, complete factory testing. Such testing may be both unwitnessed and witnessed by the Engineer and/or Owner as specified and at their discretion.

C. OPERATIONS AND MAINTENANCE MANUALS: Operations and maintenance manuals for equipment shall be submitted and receive "No Exceptions Taken” or “Make Corrections Noted” review status.

D. CONSTRUCTION COMPLETE: Construction is substantially complete so that facility is ready to be used for its intended purposes and all signage is posted. All construction deficiencies shall be corrected prior to testing, unless agreed by Owner that testing can begin concurrent with correcting a construction deficiency.

E. INSPECTION: Inspect and clean equipment, devices, connected piping, and structures to ensure they are free of foreign material.

F. LUBRICATION: Lubricate equipment in accordance with manufacturer's instructions.

G. REGULATORY AGENCY APPROVALS: Conduct inspections by and tests for regulatory agencies (Fire Marshal, Air Quality Control Board, etc.) and receive approvals needed to operate system. Provide written information required by regulatory agencies.

3.5 PERFORMANCE TESTS

A. General:

1. Each item and system of mechanical, electrical, and instrumentation equipment installed under this contract shall be tested for 8-hours continuously to demonstrate compliance with the performance requirements of the individual Specification sections, unless otherwise specified.

2. Follow the approved Equipment Testing Plan and detailed procedures specified. Unless otherwise indicated, furnish all labor, materials, and supplies for conducting the test and taking all samples and performance measurements. Prepare Performance Test reports summarizing test methods and results as described in the Equipment Testing Plan.

3. The Contractor is responsible for performance testing of all project equipment and systems in all modes of operation including remote PLC modes of operation.

4. The Contractor shall test the utility, chemical feed, safety equipment and other support systems before testing the process system.

B. Pressure and leakage tests: Pressure and leakage tests shall be conducted in accordance with applicable portions of Divisions 1, 2, 3, 10, and 15 and shall be completed prior to any testing of connected mechanical equipment or valves. All tests shall be witnessed by the Engineer.

C. Calibration: Calibration of analysis instruments, sensors, gages, and meters installed under this contract shall proceed on a system-by-system basis. No equipment or system Performance Tests shall be performed until instruments, gages, and meters to be installed in that particular system have been calibrated and the calibration work has been witnessed by the Engineer. Calibrate testing equipment in accordance with the manufacturer’s instructions. The Contractor shall execute and submit completed Instrument Calibration Test Data Forms.

D. Mechanical systems: Manufacturer's representatives shall confirm that all equipment and valves are properly installed before first operation and shall conduct/oversee the initial operation and testing. All mechanical systems shall be tested as specified in the individual equipment specification sections and as follows:

1. Ensure and demonstrate that equipment and valves operate properly and reliably. Open and close valves by hand and operate other devices to check for binding, interference, or improper functioning.

2. Inspect hand and motorized valves for proper adjustment. Tighten packing glands to insure no leakage, but permit valve stems to rotate without galling. Verify valve seats are positioned for proper flow direction.

3. Tighten leaking flanges or replace flange gasket. Inspect screwed joints for leakage.

4. Equipment that is capable of automatic or remote operation shall be tested first in manual mode. Limit switches shall be set and adjusted on all valves so equipped. Setpoints on all pressure regulating, pressure relief, vacuum relief, and other valves with setpoints shall be confirmed and reset as directed by the Engineer.

5. Remove rust preventatives and oils applied to protect equipment during construction.

6. Flush lubrication systems and dispose of flushing oils. Recharge lubrication system with lubricant recommended by manufacturer.

7. Flush fuel system and provide fuel for testing and start-up.

8. Install and adjust packing, mechanical seals, O-rings, and other seals. Replace defective seals.

9. Remove temporary supports, bracing, or other foreign objects installed to prevent damage during shipment, storage, and erection.

10. Check rotating machinery for correct direction of rotation and for freedom of moving parts before connecting driver. Turn rotating equipment by hand when possible to confirm that equipment is not bound.

11. Perform cold alignment and hot alignment to manufacturer's tolerances.

12. Adjust V-belt tension and variable pitch sheaves.

13. Startup tests of pumps, motors, and VFD’s shall be performed to verify pump performance and operation over the full operating range from minimum head/flow up to maximum head/maximum capacity.

14. Install gratings, safety chains, handrails, shaft guards, and sidewalks prior to Facility Startup/Operational Testing.

E. Electrical systems: Testing shall be performed in three stages as specified in the individual equipment specification sections, Division 16 and as follows:

1. The first stage shall consist of electrical equipment testing prior to energization and operation of electrical equipment. Testing, calibration, and setting of electrical conductors, equipment, protective devices, grounding, and other components as specified in the electrical sections of the Specifications shall be conducted prior to equipment startup. This also includes bumping all motors to verify the direction of rotation. Unsatisfactory equipment test results shall require that the equipment be

repaired and re-tested until acceptable results are obtained at no additional cost to the Owner.

2. The second stage of electrical testing shall occur after energization and start-up of equipment and shall consist of complete testing of all other equipment as specified in the Electrical Sections.

3. The third stage of testing will take place during the Operational Testing and shall include all possible operating scenarios, alarm conditions, prohibitive interlocks, and indication functions.

4. Contractor shall coordinate with third-party SCADA programmer, at least two weeks in advance of each process startup and commissioning date.

F. Instrumentation: Conduct field calibration, loop acceptance, and end-to-end testing as specified in the individual Instrumentation Sections. Bench or field calibrate instruments and make required adjustments and control point settings. Energize transmitting and control signal systems, verify proper operation, ranges, and settings. Demonstrate proper operation of each instrument loop function including alarms, local and remote controls, instrumentation and other equipment functions. Generate signals with test equipment to simulate operating conditions in each control mode. Contractor shall coordinate with third-party SCADA programmer, at least two weeks in advance of each process startup and commissioning date.

G. Permanent utilities: Conduct Performance Tests on utilities impacted, constructed, or modified by construction, as specified in the applicable Sections.

H. HVAC systems: Balance HVAC systems, measuring airflow (cfm) static pressure, and component pressure losses. Furnish written report documenting results of balancing.

I. Demonstration: Demonstrate proper rotation, alignment, speed, flow, pressure, vibration, sound level, adjustments, and calibration over the full operating range of equipment and systems. Perform initial checks in the presence of and with the assistance of the manufacturer's representative.

J. Telecommunications system testing: Telecommunications testing shall be as specified in the applicable Section.

3.6 TEST RESULTS

A. Test results shall be within the tolerances stated in the individual Specification sections. If no tolerances have been specified, test results shall conform to tolerances established by recognized industry practice. When, in Engineer’s opinion, equipment meets performance requirements specified, such equipment will be accepted as to conforming with Contract requirements.

B. Should any doubt, dispute, or difference arise between the Engineer and the Contractor regarding the test results or the methods or equipment used in the performance of the testing, then the Engineer may order the test to be repeated. If the repeat test, using such methods or equipment as the Engineer requires, substantially confirms the previous test, then all costs in connection with the repeat test will be paid by the Owner, otherwise the costs shall be borne by the Contractor. All costs associated with repeat testing due to failed test results shall be borne by the Contractor, including the Engineers expenses.

C. If any portion of the work should fail to fulfill the contract requirements and is adjusted, altered, renewed, or replaced, tests on that portion of the work together with all other affected portions of the work, shall, be repeated within reasonable time and in accordance with the specified requirements. The Contractor shall pay to the Owner all reasonable expenses incurred by the Owner, including the costs of the Engineer, as a result of repeating such tests.

3.7 POST TEST INSPECTION

Once Performance Testing has been completed, all machines shall be rechecked for proper alignment and realigned, as required. All equipment shall be checked for loose connections, unusual movement, or other indications of improper operating characteristics. Any deficiencies shall be corrected to the satisfaction of the Engineer. All machines or devices, which exhibit unusual or unacceptable operating characteristics, shall be disassembled and inspected. Any defects found during the course of the inspection shall be repaired or the specific part or entire equipment item shall be replaced to the complete satisfaction of the Engineer, at no cost to the Owner.

3.8 MANUFACTURER'S CERTIFICATE OF PROPER INSTALLATION

A. Upon completion of Performance Testing and prior to Facility Startup/Operational Testing, the Contractor shall submit the Manufacturer's Installation Certification Form certifying that the equipment:

1. Has been properly installed, adjusted, aligned, and lubricated.
2. Is free of any stresses imposed by connecting piping or anchor bolts.
3. Is suitable for satisfactory full-time operation under full load conditions.
4. Operates within the allowable limits for vibration.
5. Controls, protective devices, instrumentation, and control panels furnished as part of the equipment package are properly installed, calibrated, and functioning.
6. Control logic for start-up, shutdown, sequencing, interlocks, and emergency shutdown have been tested and are properly functioning.

B. The Contractor shall also submit the Manufacturer's Installation Certification Form signed by the electrical and/or instrumentation Subcontractor certifying:

1. Control logic that resides in motor control centers, control panels, and circuit boards furnished by the electrical and/or instrumentation subcontractor has been calibrated and tested and is properly operating.

2. Control logic for equipment start-up, shutdown, sequencing, interlocks and emergency shutdown has been tested and is properly operating.

C. The Contractor shall co-sign the Manufacturer's Installation Certification Form along with the manufacturer's representative and Subcontractors and deliver the reports to the Engineer prior to Facility Startup/Operational Testing.

3.9 TRAINING

The Contractor shall conduct the training of the Owner's staff as specified for equipment and facility operation and maintenance before each associated system is placed into service. Refer to Section 01675 – Training for specific requirements.

3.10 FACILITY STARTUP AND OPERATIONAL TESTING

After completion of all Performance Testing and operator training the Contractor shall begin the Facility Startup and conduct Operational Tests of each system as described herein. Contractor shall conduct the Operational Test for a continuous 5-day period.

A. Facility Startup/Operational Plan:

1. Develop a plan in conjunction with Owner's operations personnel detailing step-by-step instructions for startup of each unit process and the complete facility.

2. Include a method of evaluation and overall performance reports for each unit process, utilizing the Startup and Performance Evaluation Forms. Startup and Performance Evaluation Forms will minimally include the following:

a. Description of unit process being started.

b. All equipment and devices included in the unit process.

c. Unit process startup procedures (i.e., valves to be open/closed, order of equipment startup, etc.).

d. Requirements for water, power, chemicals, etc. needed for startup.

e. Space for performance evaluation comments.

B. Owner's responsibilities:

1. Assist Contractor in developing a Facility Startup and Demonstration Plan detailing step-by-step instructions for startup of each unit process and the complete facility.

2. Provide water and power for testing and facility startup, unless otherwise indicated.

3. Operate process units and devices, with support of Contractor.

4. Provide labor and materials as required for sampling and laboratory analyses.

C. Facility startup/operational testing period:

1. Startup sequence of the unit processes shall be in accordance with the Facility Startup/Operation Plan developed by the Contractor and the Owner, and as approved by the Engineer.

2. Startup of the entire facility or any portion thereof shall be considered complete when, in the opinion of the Engineer, the facility or designated portion has operated in manner intended for 5-continuous days, without interruption, unless otherwise specified. This period is in addition to training, or Performance Test periods specified elsewhere.

3. Repeat the Operational Test when malfunctions or deficiencies cause shutdown or partial operation of the facility or results in performance that is less than specified, as determined by the Engineer. Any interruption will require the startup then in progress to be stopped and restarted for an additional 5-continuous days, after corrections are made.

D. Facility performance evaluation:

1. During the Facility Startup/Operational Testing Period, conduct a performance evaluation to determine the full capabilities of the facility and performance of the computer system, until all unit processes are operable and under control of the computer system.

2. Certify, on the Startup and Performance Evaluation Forms that each unit process is capable of performing its intended function(s), including fully automatic and computerized operation.

3.11 DEMONSTRATION PERIOD

A. After successful completion of the Performance, Facility Startup/Operational Testing and when the Owner is ready to accept the system, the system shall be placed into full operational condition.

B. The Contractor, Engineer, and the Owner's operations personnel shall first develop an outline of the steps for the startup and initial operation of each area under actual operating conditions of the equipment and systems. The document shall serve as guidance for the Demonstration Period.

C. The Owner's certified operations personnel shall operate the facility under the direction and supervision of the Contractor for a 30-day period. The Contractor shall be available within 24-hours notice to provide repairs, assistance, or adjustments in case of failure of any portion of the system.

D. During the Demonstration period, the Owner shall be responsible for all normal operational costs and the Contractor shall bear the costs of all necessary repairs or replacements, including labor and materials.

E. Owner reserves the right to simulate operational variables, equipment failures, routine maintenance scenarios, etc., to verify the functional integrity of the system.

F. The facility shall be fully operational, performing all functions for which it was designed. If, during the Demonstration Period the aggregate amount of time used for repairs, alterations, or unscheduled adjustments to any equipment or systems that renders the affected equipment or system inoperative exceeds 10-percent of the Demonstration Period, then the Demonstration Period will be deemed to have failed. In the event of failure, a new Demonstration Period will recommence after correction of the cause of failure. Any new Demonstration Periods shall have the same requirements and durations as the first period.

G. Time of beginning and ending of the Demonstration Period shall be agreed upon by the Contractor Owner and the Engineer, in advance of initiating the Demonstration Period.

H. At the end of the Demonstration Period and when all corrections required by the Engineer to assure a reliable and completely operational facility are complete and all test reports have been submitted and approved, the Engineer shall issue a Final Completion Certification, unless otherwise noted in the General Conditions.

APPENDIX A

EXAMPLE 8-HOUR PERFORMANCE TEST PLAN TEMPLATE

_____(*equipment*)____ 8-Hr. Performance Test Plan

Note: ___(Equipment) ___8-Hr. Performance testing will be performed in conjunction with integral equipment "xyz1", "xyz2" & "xyz3" 8-hr Performance testing.

Inspector Contractor

Int. ____ ____ **A. Verify visual inspection of ___*(equipment)*___.**

Comments:_____

_____

Int. ____ ____ **B. Verify control and power wire loop checks complete.** Provide documentation.

Comments:_____

_____

Int. ____ ____ **C. Verify SCADA programming completed.**

Comments:_____

_____

Int. ____ ____ **D. Perform electrical testing as per attached template sheets.** Confirm submittal acceptance of harmonics study and coordination/short circuit analysis prior to energizing any equipment (see 16011). Confirm megger test, VFD test, instrumentation testing, I/O testing, gauge calibration, and all other electrical testing have been complete. Provide filled in documentation based on the templates provided in specification section Div 16 specs.

Comments:_____

_____

Int. ____ ____ **E.** **Verify vendor start up has been completed.** Provide vendor start up documentation.

Comments:_____

_____

Int. ____ ____ **F.** **Set downstream process ___*(xyz)*___ to Auto, and coordinate with plant operations for permission to discharge water.**

Comments:_____

_____

Int. ____ ____ **G.** **Manually start equipment. Close ____*(valves, gates, xyz)*__ and check alarm is activated in SCADA and equipment automatically shut down.** Note equipment warnings ____*(don't run dry, xyz)*____.

Comments:_____

_____

Int. ____ ____ **H.** **Verify related equipment _____*"xyz1, xyz2, and xyz3"*_____ are sending flow to ____*(equipment)*__ as per "*xyz1*" , "*xyz2*" , and "*xyz3*" 8-hour performance testing plans.**

Comments:_____

_____

Int. ____ ____ **I.** **Set ____*(equipment)*___ in "auto" and run them through SCADA, for 8-hrs each.** Check that all status items are read in SCADA, see attached P&IDs to confirm all I/O.

Comments:_____

_____

Int. ____ ____ **J.** **Verify ____*(equipment)*___ are working properly.** See attached process control narrative to ensure proper operation strategy (before, during and after equipment startup).

Comments:_____

_____

____

Int. ____ ____ **K.** **Open ____*(equipment)*___ associated equipment _____*(SOV wash water, conveyor, automatic gates, xyz)*_____ are working properly.** Associated equipment should be run through SCADA and they should open for a pre-set amount of time when equipment is off

Comments:_____

_____

APPENDIX B

EXAMPLE 5-DAY OPERATIONAL TEST PLAN TEMPLATE

____*(xyz process)*___ 5-Day Operational Testing

Inspector Contractor

Int. ____ ____ **1. Verify process upstream equipment _____*(xyz, xyz, and xyz)*___ 8-Hr performance test is complete and is working properly. Ensure liquid is available for testing *(sludge, chemical, gas, water, xyz)*____.**

Comments:_____

_____

Int. ____ ____ **2. Verify process downstream equipment _____*(xyz, xyz, and xyz)*___ 8-Hr performance test is complete and is working properly. Ensure liquid is available for testing *(sludge, chemical, gas, water, xyz)*____.**

Comments:_____

_____

Int. ____ ____ **3. Verify process associated equipment _____*(xyz, xyz, and xyz)*___ 8-Hr performance test is complete and is working properly. Ensure liquid is available for testing *(sludge, chemical, gas, water, xyz)*____.**

Comments:_____

_____

Int. ____ ____ **4. Place disconnect power in the "ON" position, and ___*(process xyz)*___ systems in "AUTO". Confirm they are picked up by SCADA.**

Comments:_____

_____

Int. ____ ____ **5. Start upstream equipment in Auto and run ___*(equipment xyz)*___ trough SCADA.**

Comments:_____

_____

Int. ____ ____ **6. Coordinate with Operational Staff and verify they are ready to receive discharge into their system.**

Comments:_____

_____

Int. ____ ____ **7. Verify all necessary valves are in open position.**

Comments:_____

_____

Int. ____ ____ **8. Start downstream equipment in Auto and run ___*(equipment xyz)*___ through SCADA.**

Comments:_____

_____

Int. ____ ____ **9. Start process equipment in Auto and run ___*(equipment xyz)*___ through SCADA, all equipment should start and stop automatically.**

Comments:_____

_____

Int. ____ ____ **10. Check process control narrative to ensure all equipment is running as designed (time delay, water level, position switch, etc).**

Comments:_____

_____

Int. ____ ____ **11. Verify level indicators, flow meters, pressure gauges, etc. are working properly and signals are being picked by SCADA (see attached P&ID).**

Comments:_____

_____

Int. ____ ____ **12. Close downstream *(gates, valves, xyz)* in system. This should send out an alarm and automatically shut down *xyz, xyz2, and xyz3* systems.**

Comments:_____

_____

Int. ____ ____ **13. Process fluids for 5-days. And verify every system is working properly.**

Comments:_____

_____

END OF SECTION

SECTION 01675

TRAINING

PART 1 GENERAL

1.1 DESCRIPTION

This section contains requirements for training the Owner's personnel, by persons retained by the Contractor specifically for the purpose, in the proper operation and maintenance of the equipment and systems installed under this contract. All costs for training shall be the responsibility of the Contractor.

1.2 RELATED WORK

A. Section 01300: Submittals

B. Section 01670: Equipment and System Testing and Startup

C. Section 01680: Operation and Maintenance Manuals

1.3 QUALITY ASSURANCE

A. The Contractor shall provide on-the-job training of the Owner's personnel for all equipment identified in the technical specifications. The training sessions shall be conducted by qualified, competent, experienced (two years minimum), manufacturers' factory-trained representatives (not sales representatives) of the various equipment manufacturers. Representatives shall be thoroughly familiar with instructional methods in addition to the subject matter.

B. If, in the opinion of the Owner, an appropriately knowledgeable person did not provide the scheduled training, such training shall be rescheduled and repeated with a suitable instructor at no additional cost to the Owner.

C. Training shall include instruction of operating personnel in equipment operation in one session, and preventive maintenance and instruction of station mechanics, electricians, and electronics technicians in normal maintenance up to major repair in a separate session.

1.4 SUBMITTALS

A. The Contractor shall submit a training plan to the Engineer for review, in accordance with the provisions of Section 01300 – Submittals. The submitted training plan shall include lesson materials in addition to a training schedule as follows:

1. A class agenda and lesson plans for each training session to be conducted by the manufacturer's representatives shall be submitted. In addition, training manuals, handouts, visual aids, and other reference materials shall be included.

2. Date, time, and subject of each training session and identity the qualifications of individuals to be conducting the training.

3. Provide a training schedule with a minimum of two sessions of each class to facilitate the attendance of the Owner’s personnel. Concurrent classes will not be allowed.

B. The Contractor shall submit a list of all equipment items or systems for which training will be provided in accordance with the specifications. The list shall include item number, specification section, description and required training in hours.

PART 2 MATERIALS

2.1 GENERAL

Where specified in Divisions 11, 15, and 16 the Contractor shall conduct training sessions for the Owner's operating personnel in one session to instruct the staff on the proper operation of the equipment, and maintenance and repair personnel in a separate session to instruct the staff on the proper care and maintenance of the equipment and systems installed under this contract. Training shall take place at the site of the work and under the conditions specified in the following paragraphs.

2.2 OPERATION AND MAINTENANCE MANUALS

If training is being conducted on equipment, systems, or products for which an operations and maintenance manual is required, this manual shall be compete, approved by the Engineer and used during the classroom instruction. Approved operating and maintenance manuals shall be available to Owner personnel at least 30-days prior to the date scheduled for the individual training session. Refer to Section 01680 – Operating and Maintenance Materials, for additional requirements.

2.3 LOCATION

Field training sessions shall take place at the site of the equipment. Classroom training facility will be provided by the Owner.

2.4 LESSON PLANS

A. A class agenda shall be prepared and submitted to the Engineer as least 4 weeks in advance of the training sessions. Formal written lesson plans shall be prepared for each training session. Lesson plans shall contain an outline of the material to be presented along with a description of visual aids to be utilized during the session, and the training materials shall include a list of tasks which the Owner's employees may perform with the equipment. Each plan shall contain a time allocation for each subject.

B. One complete set of originals of the lesson plans, training manuals, handouts, visual aids, and reference material shall be the property of the Owner and shall be suitably bound for proper organization and easy reproduction. The Contractor shall furnish three copies of necessary training manuals, handouts, and reference materials and one copy of necessary visual aids at least two weeks prior to each training session. It is estimated that 5 to 10 persons will attend each training session. The Owner will determine the actual number of students and provide and estimated "headcount" one week prior to the class, so that the instructor can furnish the class room materials, samples, and handout for all those in attendance. Five additional copies of all classroom materials, samples, handouts, etc. shall be provided during the training session.

2.5 FORMAT AND CONTENT

For complex equipment and systems, the training for operation personnel and for maintenance personnel shall be provided as separate entities. The training for maintenance personnel shall be further subdivided into two trade groups: mechanical maintenance and electrical/instrumentation maintenance. Each training session shall be composed of time spent both in the classroom and at the specific location of the equipment or system. As a minimum, a training session shall cover the following topics for each item of equipment or system:

Topic	Operations Personnel	Maintenance and Repair Personnel
Familiarization	X	X
Safety	X	X
Operation (Start-up, Shut-down, Normal & Emergency)	X	X
Instrumentation	X	X
Electrical and Mechanical Troubleshooting		X
Preventive Maintenance	X	X
Lubrication of Equipment	X	X
Corrective Maintenance, Repair, and Overhaul		X
Lockout Procedures, Alarm, and Fail-Safe Operation	X	X
Parts (Including Inventory of Spare Parts		X
Local Representatives		X
Operation and Maintenance Manuals	X	X

2.6 VIDEO RECORDING

The Contractor shall record, or retain the services of a commercial video taping service to record, each training session. The videotape shall be transferred onto DVD-R and two copies shall be provided to the Owner. The Contractor shall advise all manufacturers providing training sessions that the material will be video taped.

Video equipment shall include an adjustable focal-distance range from 6 inches to infinity, and produce a minimum resolution of 1280x720. Audio equipment shall be 16-bit minimum.

PART 3 EXECUTION

3.1 TRAINING

A. Training shall be conducted after the Performance Testing and prior to the Facility Startup/Operational Testing. Refer to Section 01670 – Equipment and System Testing, Startup and Demonstration for additional information.

B. Classes shall be scheduled such that classroom sessions are interspersed with field instruction in logical sequence. The Contractor shall consolidate short training sessions into combined sessions so that staff time is more efficiently used. The Contractor shall provide a minimum of two training sessions, each of the required length, on each system, piece of equipment, or "topic." Organize training sessions into maintenance versus operation topics and identify on schedule.

C. No training sessions shall be scheduled for Mondays or Fridays, or legal holidays recognized by the Owner. The Contractor shall coordinate the scheduling of training sessions and the length of the classes with the Owner's Utilities Operations Superintendent.

D. The following services shall be provided for each item of equipment or system as required in individual Specification sections. Additional services shall be provided, where specifically required in individual Specification sections.

1. As a minimum, classroom equipment training for operations personnel shall include:

    a. Using slides and drawings, discuss the equipment’s specific location in the plant and an operational overview.

    b. Purpose and plant function of the equipment.

    c. A working knowledge of the operating theory of the equipment.

    d. Start-up, shutdown, normal operation, and emergency operating procedures, including a discussion on system integration and electrical interlocks, if any.

    e. Identify and discuss safety items and procedures.

f. Routine preventative maintenance, including specific details on lubrication and maintenance of corrosion protection of the equipment and components.

g. Operator detection, without test instruments, of specific equipment trouble symptoms.

h. Required equipment exercise procedures and intervals.

i. Routine disassembly and assembly of equipment if applicable (as judged by the Owner on a case-by-case basis) for purposes such as operator inspection of equipment.

2. As a minimum, hands-on equipment training for operations personnel will include:

a. Identify location of equipment and review the purpose.

b. Identifying piping and flow options.

c. Identifying valves and their purpose.

d. Identifying instrumentation:

1) Location of primary element.

2) Location of instrument readout.

3) Discuss purpose, basic operation, and information interpretation.

e. Discuss, demonstrate, and perform standard operating procedures and round checks.

f. Discuss and perform the preventative maintenance activities.

g. Discuss and perform start-up and shutdown procedures.

h. Perform the required equipment exercise procedures.

i. Perform routine disassembly and assembly of equipment if applicable.

j. Identify and review safety items and perform safety procedures, if feasible

3. Classroom equipment training for the maintenance and repair personnel will include:

a. Theory of operation.

b. Description and function of equipment.

c. Start-up and shutdown procedures.

d. Normal and major repair procedures.

e. Equipment inspection and troubleshooting procedures including the use of applicable test instruments and the "pass" and "no pass" test instrument readings.

f. Routine and long-term calibration procedures.

g. Safety procedures.

h. Preventive maintenance such as lubrication; normal maintenance such as belt, seal, and bearing replacement; and up to major repairs such as replacement of major equipment part(s) with the use of special tools, bridge cranes, welding jigs, etc.

4. Hands-on equipment training for maintenance and repair personnel shall include:

   a. Locate and identify equipment components.

   b. Review the equipment function and theory of operation.

   c. Review normal repair procedures.

   d. Perform start-up and shutdown procedures.

   e. Review and perform the safety procedures.

   f. Perform Owner approved practice maintenance and repair job(s), including mechanical and electrical adjustments and calibration and troubleshooting equipment problems.

   g. Review and use equipment manufacturers' manuals in the hands-on training.

5. Electrical System Training shall be provided for the electrical system. Specific emphasis shall be as follows:

   a. Overview of the plant’s electrical system.

   b. Discussion of each item of power distribution equipment in the overall plant.

   c. Loop system operation and possible sectionalizing arrangements.

   d. System protection.

   e. Automatic bus transfer to standby system.

   f. System power monitoring/control.

   g. Maintenance/Fault troubleshooting.

E. Maintain a log of classroom training including: Instructors, topics, dates, time, and attendance.

F. The Contractor shall replace equipment that is damaged during the training exercises at no additional cost to the Owner.

END OF SECTION

SECTION 01680

OPERATING AND MAINTENANCE MANUALS

PART 1 GENERAL

1.1 DESCRIPTION

Operating and Maintenance information shall be provided in accordance with this section and as required in the technical sections of these Specifications. Operating and Maintenance information shall be provided for each maintainable piece of equipment, equipment assembly or subassembly, and material provided or modified under this contract. Operating and Maintenance manuals must be submitted and accepted before Performance Testing or on-site training may start.

1.2 RELATED WORK

A. Section 01300: Submittals

B. Section 01670: Equipment and System Testing and Startup

C. Section 01675: Training

1.3 TRANSMITTAL PROCEDURE

A. Unless otherwise specified, Operating and Maintenance information and data shall be transmitted in accordance with Section 01300 – Submittals. Only complete sets of Operating and Maintenance manuals will be reviewed for acceptance. The Contractor shall submit three (3) copies of the Preliminary Manuals for the Engineer's review. After receiving the Engineer's acceptance, five (5) copies of the final manuals shall be submitted (including 5 hard copies as detailed below and 5 PDF copies on USB flash drives). The USB flash drive shall be clearly labeled with text similar to the binder cover (including, project name, product numbers, client, and title.)

B. If the manufacturers' standard brochures and manuals are used to describe Operating and Maintenance procedures, such brochures and manuals shall be modified to reflect only the model or series of equipment used on this project. Extraneous material shall be crossed out neatly or otherwise annotated or eliminated.

PART 2 MATERIALS

2.1 MANUAL FORMAT

One binder shall be provided for each piece of equipment (for example, sump pumps will have a separate binder from vertical turbine pumps) and the Operating and Maintenance information shall be submitted in the following manner.

A. Size: 8-1/2 inches by 11 inches.

B. Paper: 20-pound minimum, white for typed pages.

C. Text: Manufacturer's printed data, or neatly typewritten.

D. Arrange printing so that punched holes do not obliterate data and use hole reinforcements for bound in plan sheets.

E. Provide fly-leaf for each separate product, or each piece of operating equipment, with typed description of product and major component parts of equipment and provide with heavy section dividers with numbered plastic index tabs.

F. Provide each manual with title page, and typed table of contents with consecutive page numbers. Place contents of entire set, identified by volume number, in each binder.

G. Cover and Spine: Identify each volume with typed or printed title "OPERATION AND MAINTENANCE MANUAL, VOLUME NO. __OF__", if applicable, and list:

1. Project title.
2. Designate the system or equipment for which it is intended.
3. Identity of separate structure as applicable.
4. Identity of general subject matter covered in manual.
5. Identity of equipment number and Specification section.

H. Assemble and bind material in same order as specified, as much as possible.

I. Material shall be suitable for reproduction, with quality equal to original. Photocopying of material will be acceptable, except for material containing photographs.

J. Binders:

1. Preliminary Manuals: Heavy paper covers.

2. Final Manuals: Commercial quality, substantial, permanent, three-ring, D-ring, binders with durable, cleanable, plastic binders, plastic-coated section dividers, and plastic sheet lifters prior to first page and following last page.

K. Table of contents neatly typewritten, arranged in a systematic order:

1. Contractor, name of responsible principal, address, and telephone number.

2. List of each product required to be included, indexed to content of each volume.

3. List with each product: Name, address, and telephone number of Subcontractor, Supplier, installer, and maintenance contractor, as appropriate.

a. Identify area of responsibility of each.

b. Provide local source of supply for parts and replacement.

4. Identify each product by product name and other identifying numbers or symbols as set forth in Contract Documents.

L. Product Data:

1. Include only those sheets that are pertinent to specific product and delete references to inapplicable information.

2. Clearly annotate each sheet to identify specific product or part installed and identify data applicable to installation.

M. Drawings: Supplement product data with Drawings as necessary to clearly illustrate:

1. Relations of component parts of equipment and systems.

2. Control and flow diagrams.

3. Coordinate drawings with Project record documents to assure correct illustration of completed installation.

4. Do not use Project record documents as maintenance manual drawings.

5. Provide reinforced punched binder tab, bind in with text.

6. Reduced to 8-1/2 inches by 11 inches, or 11 inches by 17 inches folded to 8-1/2 inches by 11 inches.

7. Where reduction is impractical, fold and place in 8-1/2-inch by 11-inch vinyl envelopes bound in text.

8. Identify Specification section and product on Drawings and envelopes.

N. Instructions and Procedures: Within text, as required to supplement product data:

1. Delivery, handling, storage, maintenance during storage, assembly, erection, installation, startup, adjusting, testing, operating, shutdown in emergency, troubleshooting, maintenance, interface, and as may otherwise be required.

2. Organize in a consistent format under separate heading for each different procedure.

3. Provide a logical, sequence of instructions for each procedure. Provide information sheet for Owner's personnel, including:

   a. Proper procedures in the event of failure.

   b. Instances that might affect the validity of Warranties or Bonds.

O. All manuals shall also be provided in an electronic format which includes all information included in the Operation and Maintenance Manuals. Provide the electronic files on USB flash drive. All text portions shall be provided in MS Word format, spreadsheets in Excel format, drawings in AutoCAD format, graphical portions shall in JPEG format, and all other documents including but not limited to brochures that need to be scanned shall be provided in a searchable PDF format. These files shall become the property of the Owner for use in training programs and other uses.

PART 3 EXECUTION

3.1 GENERAL

A. Operating and Maintenance information shall be bound in sturdy, heavy-duty 3-ring binders. One binder shall be provided for each piece of equipment (for example, sump pumps will have a separate binder from vertical turbine pumps). The binders shall be clearly labeled on the front and spine identifying the equipment located in the Operating and Maintenance Manual. For ease of identification, each manufacturer's brochure and manual shall be appropriately labeled with the equipment name and equipment number as it appears in these Contract Documents. The information shall be organized in the binders in numerical order by the equipment numbers assigned in the Specifications. The binders shall be provided with a table of contents and tab sheets to permit easy location of desired information.

B. Operating and Maintenance manuals shall contain the names, addresses, and telephone numbers of the manufacturer, the nearest representative of the manufacturer, and the nearest supplier of the manufacturer's equipment and parts.

C. Provide identification of all parts of each component, assembly, subassembly, and accessory. Include special hardware requirements, such as requirement to use high-strength bolts and nuts. Identify parts by make, model, serial number, and source of supply to allow reordering without further identification. Provide clear and legible illustrations, drawings, and exploded views to enable easy identification of the items. When illustrations omit the part numbers and description, both the illustrations and separate listing shall show the index, reference, or key number which will cross-reference the illustrated part to the listed part. Parts shown in the listings shall be grouped by components, assemblies, and subassemblies. Include control and flow diagrams and panel wiring diagrams. Coordinate drawings to ensure correct illustration of completed installation.

D. All manuals shall also be provided in an electronic format which includes all information included in the Operation and Maintenance Manuals. Provide the electronic files on USB flash drive. All text portions shall be provided in MS Word format, spreadsheets in Excel format, drawings in AutoCAD format, graphical portions shall in JPEG format, and all other documents including but not limited to brochures that need to be scanned shall be provided in a searchable PDF format. These files shall become the property of the Owner for use in training programs and other uses.

3.2 OPERATING INSTRUCTIONS

Specific instructions, procedures, and illustrations shall be provided for the following phases of operations in addition to those required in other sections of this Specification:

A. Safety precautions: List personnel hazards for equipment and list safety precautions for all operating conditions.

B. Operator pre-start: Provide requirements to set up and prepare each system for use.

C. Startup, shutdown, and post shutdown procedures: Provide step-by-step procedures for start-up, break-in, shutdown, and post-shutdown operations. Include recommendations for installation, adjustment, calibration, troubleshooting, regulation, control, stopping, and shutdown operations. Summer and winter operating instructions shall be included as required.

D. Normal operations: Provide control diagrams with data to explain operation and control of systems and specific equipment.

E. Emergency operations: Provide emergency procedures for equipment malfunctions to permit a short period of continued operation or to shut down the equipment to prevent further damage to systems and equipment, as applicable. Include emergency shutdown instructions for fire, explosion, spills, or other foreseeable contingencies. Provide guidance on emergency operations of all utility systems including valve locations and portions of systems controlled.

F. Operator service requirements: Provide instructions for services to be performed by the operator such as lubrication, adjustments, and inspection.

G. Environmental conditions: Provide a list of environmental conditions (temperature, humidity, and other relevant data) which are best suited for each product or piece of equipment and describe conditions under which equipment should not be allowed to run.

3.3 PREVENTATIVE MAINTENANCE

The following information shall be provided for preventive and scheduled maintenance to minimize corrective maintenance and repair:

A. Lubrication data: Provide lubrication data in accordance with these Specifications and the manufacturer' requirements of the respective equipment. Lubrication Information shall include the required lubricants and lubrication schedules. For each required lubricant, provide a list of acceptable equivalents from at least one different major manufacturer whose products are locally available. Provide the following information:

1. A table showing recommended lubricants for specific temperature ranges and applications;

2. Charts with a schematic diagram of the equipment showing lubrication points, recommended types and grades of lubricants, and capacities; and

3. A lubrication schedule showing service interval frequency.

B. Preventive maintenance plan and schedule: Provide manufacturer's schedule for routine preventive maintenance, inspections, tests, and adjustments required to ensure proper and economical operation and to minimize corrective maintenance and repair. Provide manufacturer's projection of preventive maintenance man-hours on a daily, weekly, monthly, and annual basis. Include procedures for disassembly, repair, and assembly, alignment, adjusting, and checking. Supply a table showing the predicted life of parts subject to wear. Provide the Manufacturer's printed operating and maintenance instructions.

3.4 CORRECTIVE MAINTENANCE

A. Manufacturer's recommendations shall be provided on procedures and instructions for correcting problems and making repairs.

1. Troubleshooting guides and diagnostic techniques: Provide step-by-step procedures to promptly isolate the cause of typical malfunctions. Describe clearly why the checkout is performed and what conditions are to be sought. Identify tests or inspections and test equipment required to determine whether parts and equipment may be reused or require replacement.

2. Wiring diagrams and control diagrams: Wiring diagrams and control diagrams shall be point-to-point drawings of wiring and control circuits including factory-field interfaces. Provide a complete and accurate depiction of the actual job-specific wiring and control work. On diagrams, number electrical and electronic wiring and pneumatic control tubing and the terminals for each type identically to actual installation numbering.

3. Maintenance and repair procedures: Provide instructions and list tools required to restore product or equipment to proper condition or operating standards.

4. Removal and replacement instructions: Provide step-by-step procedures and list required tools and supplies for removal, replacement, disassembly, and assembly of components, assemblies, subassemblies, accessories, and attachments. Provide tolerances, dimensions, settings, and adjustments required. Instructions shall include a combination of text and illustrations.

5. Spare parts and supply lists: Provide lists of spare parts and supplies required for maintenance and repair to ensure continued service or operation without unreasonably delays. Special consideration is required for facilities at remote locations. List spare parts and supplies that have a long lead-time to obtain. The spare parts list shall include the name, address, telephone number, and FAX number of authorized repair facilities, address of factory, and location of a local supplier where spare parts are to be obtained.

6. Corrective maintenance man-hours: Provide manufacturer's projection of corrective maintenance man-hours including craft requirements by type of craft. Corrective maintenance that requires participation of the equipment manufacturer shall be identified and tabulated separately.

B. Test results: Provide copies of factory test reports as specified in the applicable equipment section. After field testing is completed, insert field test reports as specified in the equipment section. Include performance curves and engineering data.

3.5 APPENDICES

The following information shall be provided; include information not specified in the preceding paragraphs but pertinent to the maintenance or operation of the product or equipment.

A. Warranty information: List and explain all of the warranties, bonds and service agreements and include the servicing and technical precautions prescribed by the manufacturers or contract documents to keep the warranties in force. Include the proper procedures in event of failure.

B. Personnel training requirements: Provide information available from the manufacturers to use in training designated personnel to operate and maintain the equipment and systems properly. Refer to Section 01675 – Training for additional training information.

C. Testing equipment and special tool information: Provide information on test equipment required to perform specified tests and any special tools needed for the operation, maintenance, and repair of components.

3.6 FIELD CHANGES

Following the acceptable installation and operation of an equipment item, the item's instructions and procedures shall be modified and supplemented by the Contractor to reflect any field changes or information requiring field data.

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SECTION 01700

CONTRACT CLOSEOUT

PART 1 GENERAL

1.1 DESCRIPTION

This section includes the contract closeout requirements including final cleanup, maintenance and guarantee requirements, preparation and submittal of closeout documents, and post-construction inspection.

1.2 RELATED WORK

A. Section 01670: Equipment System Testing and Startup

B. Section 01675: Training

C. Section 01680: Operation and Maintenance Manuals

1.3 CLOSEOUT TIMETABLE

The Contractor shall establish dates for equipment testing, interim final inspections, and on-site instructional periods (as required under the Contract). These dates shall take into account the interim completion dates noted in the Special Provisions. Such dates shall be established not less than five working days prior to beginning any of the foregoing items, to allow the City, the Engineer, and their authorized representatives sufficient time to schedule attendance at such activities. The testing requirements of Section 01670 shall be adhered to.

1.4 FINAL CLEANUP

The Contractor shall promptly remove from the vicinity of the completed work, all rubbish, unused materials, concrete forms, construction equipment, and temporary structures and facilities used during construction. Final acceptance of the work by the Owner will be withheld until the Contractor has satisfactorily complied with the foregoing requirements for final cleanup of the project site.

1.5 MAINTENANCE AND GUARANTEE

A. The Contractor shall comply with the maintenance and guarantee requirements contained in the General Conditions and Supplementary Conditions.

B. Replacement of earth fill or backfill, where it has settled below the required finish elevations, shall be considered required repair work, and any repair or resurfacing constructed by the Contractor which becomes necessary by reason of such settlement shall likewise be considered required repair work.

C. The Contractor shall make all repairs and replacements promptly upon receipt of written order from the Owner. If the Contractor fails to make such repairs or replacements promptly, the Owner reserves the right to do the work and the Contractor and his surety shall be liable to the Owner for the cost thereof.

1.6 BOND

The Contractor shall provide a bond to guarantee performance of the provisions contained in Paragraph "Guaranty" above, and the General Conditions.

1.7 GUARANTY AND BONDS

The Contractor shall provide the Owner with an executed Guaranty Form and provide specified additional warranties, guarantees, and bonds from manufactures and suppliers.

PART 2 MATERIALS

2.1 CLEANING MATERIALS

As recommended by the manufacturer of surface to be cleaned.

2.2 REPAIR OR REPLACEMENT MATERIALS

Materials used in repairing or replacing surfacing shall be equivalent to the installed surface.

PART 3 EXECUTION

3.1 CLEANING

A. Exterior Cleaning: Sweep paved surfaces; rake other surfaces or grounds.

B. Final Cleaning: Remove all tools, equipment, surplus materials, and rubbish. Refinish surfaces of existing facilities that are marred, scratched, or damaged to match original

condition. Remove grease, dirt, stains, foreign materials, and labels from interior and exterior finished surfaces. Do any required waxing and polishing. At time of final inspection, project shall be thoroughly clean and ready for use.

3.2 TESTING AND STARTUP

Provide Owner with all documentation of equipment and system testing and startup in accordance with Section 01670 - Equipment and System Testing and Startup.

3.3 TRAINING

Provide Owner with all documentation of training in accordance with Section 01675 – Training.

3.4 OPERATION AND MAINTENANCE MANUALS

Provide Owner with the final operation and maintenance manuals in accordance with Section 01680 – Operation and Maintenance Manuals.

3.5 PROJECT RECORD DRAWINGS

A. Using red colored pencil, make changes on a set of clean full-size drawings. Show all changes and revisions to the original design that affect the permanent structures and will exist in the completed work. Reference underground utilities to semi-permanent or permanent physical objects. Reference water, sewer, telephone, and electric lines to corners of buildings. Show invert elevations at structures, grade changes, valves, and fittings for all pipelines 6-inches in diameter and larger. Include schematic diagrams for all electrical equipment with terminal numbers shown.

B. Keep record drawings current. Inspection will be made monthly and will be required prior to the submittal of Progress Payments. Certification by Contractor of accuracy and completeness will be required on monthly submitted payment requisitions. Project record drawings are the property of the Owner and shall be delivered to the Engineer before closeout.

3.6 SUBSTANTIAL COMPLETION AND FINAL INSPECTION

A. Submit written certification that the project, or a designated portion of the project, is substantially complete, and request, in writing, a final inspection. The Engineer will make an inspection within 10 days of receipt of the request.

B. When the Engineer determines that the work is substantially complete, he will prepare a list of deficiencies that need to be corrected before final acceptance and issue a certificate of Substantial Completion with the deficiencies noted.

C. If the Engineer determines that the work is not substantially complete, he will immediately notify Contractor, in writing, stating reasons. After completing work, the Contractor shall resubmit certification and request a new final inspection.

3.7 ACCEPTANCE OF THE WORK

A. After all deficiencies have been corrected to the satisfaction of the Engineer; a Letter of Final Acceptance will be issued by the Engineer.

B. Acceptance may be given before correction of deficiencies that do not prevent operation and use of the facility; however, in such case, an amount equal to twice the Engineer's estimated value of each deficient item or item of remaining work will be withheld until the work is accomplished or the deficiency repaired to the Engineer's satisfaction.

C. Until receipt of Letter of Final Acceptance, Contractor shall be responsible for the work of this Contract.

3.8 OPERATING INSTRUCTIONS

In accordance with Section 01675, after equipment and systems are complete and operating as defined in Section 01670, the Contractor or his suppliers shall, in cooperation with Engineer, instruct Owner personnel how to operate them.

3.9 START-UP/TRAINING

In accordance with Section 01675, The Contractor shall demonstrate systems and instruct Owner personnel in their correct operation. This instruction shall include familiarizing Owner personnel with locations of switches, junction boxes, and circuiting. The Contractor shall have completed all startup and training defined in each individual applicable specification before project closeout.

3.10 CLOSEOUT SUBMITTALS

A. Submit before payment request.

B. Project Record Drawings: As specified above.

C. Written Guarantees and Bonds: As specified in individual sections.

D. Spare Parts, Special Tools, and Materials: As specified in individual sections.

E. Keys and Keying Schedule: Submit all keys including duplicates. Wire all keys for each lock securely together. Tag and plainly mark with lock number or equipment identification,

and indicate physical location, such as building and room name or number, or panel or switch number.

F. Operating Handles and Special Tools: Clearly identify as to related equipment.

3.11 CLOSEOUT DOCUMENTS AND SPARE PARTS

Submit the following at least seven (7) days prior to final payment request:

A. Testing and Startup Forms

B. Training documentation

C. Project Record Drawings

D. Operation and Maintenance Manuals

E. Written Guarantees and Bonds: As specified in individual sections.

F. Spare Parts, Special Tools, and Materials: As specified in individual sections.

G. Keys and Keying Schedule: Submit all keys including duplicates. Wire all keys for each lock securely together. Tag and plainly mark with lock number or equipment identification, and indicate physical location, such as building and room name or number, or panel or switch number.

H. Evidence of Payment and Release of Liens and Stop Payment Notices.

3.12 POST-CONSTRUCTION INSPECTION

Before expiration of guaranty period, Engineer will inspect project and notify Contractor in writing of any deficiencies.

END OF SECTION

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SECTION 02010

SUBSURFACE CONDITIONS

PART 1 GENERAL

1.1 DESCRIPTION

Soil investigation reports have been prepared by BSK and Associates, and Kleinfelder, Inc. Several supplements have also been prepared. The geotechnical reports are as follows:

A. Addendum No. 7 – CBC 2019 Update Proposed WWTF Phase VI Expansion Project, BSK and Associates, dated February 4, 2022.

B. "Geotechnical Investigation Report, Proposed Additions, Merced WWTF" prepared by BSK and Associates, dated June 30. 2005.

C. "Addendum to Final Geotechnical Report, Primary Clarifier No. 3, Pavement Design, Merced WWTF", prepared by BSK and Associates, dated August 24, 2005.

D. "Addendum to Geotechnical Report, Proposed Additions, Merced WWTF", prepared by BSK and Associates, dated April 7, 2006.

E. "City of Merced WWTF, Soils Investigation of Basins ESB-5 and ESB-6," prepared by Kleinfelder, Inc., dated May 25, 2006.

F. "Report for Geotechnical Investigation Proposed Hartley Slough Bridge, Merced WWTF", prepared by BSK and Associates, dated June 14, 2006.

G. "Addendum No. 3 – Chemical Building Geotechnical Investigation Report, Merced Wastewater Treatment Plant, Merced, California", prepared by BSK and Associates, dated November 5, 2007.

H. "Addendum Letter No. 1, Proposed Merced Waste Water Treatment Plant Expansion Volume Loss", prepared by Kleinfelder, Inc., dated January 21, 2008.

I. "Addendum No. 4 – Geotechnical Investigation Report, Phase V Improvements", prepared by BSK and Associates, dated June 28, 2010.

J. "Addendum No. 5 – Geotechnical Investigation Report, Proposed Primary Clarifier No. 3, Phase V Improvements", prepared by BSK and Associates, dated July 28, 2010.

All the above referenced geotechnical reports are available upon request to the Engineer.

Approximate soil boring locations and boring logs included in the reports are for Contractor's information; the reports are not a warrant of subsurface conditions. A copy of these reports are included as appendices to the Specifications.

1.2 ADDITIONAL INFORMATION

Prior to bidding, each Bidder shall visit the site and acquaint himself with all existing conditions. Bidders may make their own subsurface investigations to satisfy themselves as to site and subsurface conditions including, but not limited to, soil moisture conditions and current groundwater elevations. Such subsurface investigations shall be performed only under time schedules and arrangements approved in advance by the Owner. Neither the Owner nor its Consulting Design Engineers guarantee the accuracy of the information contained in the Geotechnical Report or any interpretation, deduction, or conclusion given in the report relative to subsurface conditions. Further it shall be the responsibility of the Contractor to satisfy himself of the type of soil and the level of the water table to be encountered during construction of the facilities. The bidder shall make his own deductions and conclusions as to the nature of the materials to be excavated; the difficulties which may arise from the subsurface conditions and of doing any other work affected by the subsurface conditions and shall accept full responsibility therefore.

1.3 QUALITY ASSURANCE

A Geotechnical Engineer will be retained by the Owner to provide testing and inspection of work in connection with excavating, filling, compacting, and grading.

PART 2 MATERIALS

Not used.

PART 3 EXECUTION

Not used.

END OF SECTION

SECTION 02100

DEMOLITION, CLEARING, GRUBBING, AND STRIPPING

PART 1 GENERAL

1.1 DESCRIPTION

Work included: Demolition, clearing, grubbing, and stripping required for this work includes, but is not necessarily limited to:

Removal of weeds, surface rock, and all debris at all locations identified for new construction and new grading and/or site work.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Section 02010 – Subsurface Conditions

B. Section 02200 – Earthwork

C. Section 02223 – Trenching, Backfilling, and Compacting

D. Section 02225 – Structure Excavation and Backfill

E. Section 02233 – Watering

F. Section 03100 – Concrete

1.3 LIMITS OF WORK

Perform demolition, clearing, grubbing, and stripping operations to the following limits:

A. Demolition: Perform demolition of existing facilities as designated on the contract drawings.

B. Clearing: Perform clearing operations throughout the project site, as required for completion of the work designated on the contract drawings.

C. Grubbing: Perform grubbing operations at all locations identified for clearing.

D. Stripping: Perform stripping operations at all locations identified for demolition, new construction and new grading and/or site work.

E. This project must be in compliance with the 2019 California Green Building Council Standards Code.

1.4 PROJECT CONDITIONS

A. Dust Control: Use all means necessary to prevent the spread of dust during performance of the work; thoroughly moisten all surfaces as required to prevent dust being a nuisance to the public, neighbors, and concurrent performance of other work on the site. Wind in excess of 10 MPH causing dust to leave site will require Contractor to limit dust causing activities.

B. Burning: On-site burning will not be permitted.

C. Protection: Use all means necessary to protect existing objects designated to remain and, in the event of damage, immediately notify the Engineer and make all repairs and replacements necessary for approval by the Engineer at no additional cost to the Owner.

PART 2 MATERIALS

2.1 TEMPORARY BARRICADES

Unless otherwise specifically approved by the Engineer, use only new and solid lumber of utility grade or better to construct temporary barricades around the objects designated to remain.

2.2 PRUNING PAINT

Use only a pruning paint specially formulated for horticultural application to cut or damaged plant tissue and approved by the Engineer for use on this work.

2.3 EXPLOSIVES

Do not use explosives on this work unless approved by the Engineer.

2.4 OTHER MATERIALS

All other material, not specifically described but required for proper completion of the work of this Section, shall be as selected by the Contractor subject to approval of the Engineer.

PART 3 EXECUTION

3.1 GENERAL DEMOLITION, CLEARING, GRUBBING, STRIPPING

A. This project must be in compliance with the 2019 California Green Building Council Standards Code.

3.2 PREPARATION

A. Notification: Notify the Engineer at least two full working days prior to commencing the work of this section.

B. Site Inspection

1. Prior to all work of this section, carefully inspect the entire site and all objects designated to be removed and to be preserved. The Drawings do not purport to show all objects existing on the site. Before commencing the work of this section, verify with the Engineer all objects to be removed and all objects to be preserved.

2. Locate all existing inactive utility lines to be encountered by the new work and determine all requirements for disconnecting and capping. Abandonment of piping requires capping at each end or plugging with concrete to the satisfaction of the Engineer.

3. Locate all existing active utility lines traversing the site and determine the requirements for their protection to the satisfaction of the Engineer.

C. Scheduling

1. Schedule all work in a careful manner with all necessary consideration for neighbors, operation of the existing facilities, and the public.

2. Avoid interference with the use of, and passage to and from, adjacent buildings and facilities.

D. Disconnection of Utilities: Before starting site operations, disconnect or arrange for the disconnection of all utility services designated to be removed, performing all such work in accordance with the requirements of the utility company or Owner involved.

E. Protection of Utilities: Preserve in operating condition all active utilities traversing the site and designated to remain.

3.3 STRUCTURE DEMOLITION

A. Facilities so designated on the plans shall be demolished, and all materials there from shall become the property of the Contractor and shall be removed and disposed of away from the site. Any equipment or pipework connected within a structure which is designated to be removed and saved or relocated shall be removed before demolition begins. All other equipment within the structure shall become the property of the Contractor.

B. All concrete and rock shall be removed to a depth of at least 2.5 feet below the finished grade unless otherwise noted and shall be disposed of off-site. Concrete not removed shall be broken to prevent entrapment of water, as directed by the Engineer. Concrete includes all reinforcement and embedded items. Pipework and conduit within 10 feet of a structure shall also be removed to a depth of 2.5 feet below existing grade unless otherwise noted. Existing concrete structures below new structural foundations shall be completely removed.

C. Safety Requirements: The Contractor's attention is directed to the provisions of Subpart T of the OSHA Safety and Health Standards for Construction. The Contractor shall perform all the work hereunder in accordance with said provisions, and where in conflict, the more stringent shall apply.

D. Backfill and Grading: After facilities have been demolished and all material removed, any remaining depression or hole shall be backfilled and the area finish graded as specified in Section 02200. Rubble and broken concrete will not be allowed to be used as fill material.

3.4 ROADWAY DEMOLITION

A. Where shown on the contract drawings, Contractor shall remove entire pavement section including base material. This will also be necessary where deemed by the Engineer that extensive pipe construction has caused a loss of pavement integrity. Base material may be stockpiled and reused where appropriate and only with the approval of the Engineer.

B. Asphalt concrete, concrete curb, and gutter materials to be demolished shall be broken up and removed from the site by the Contractor at no additional cost to the Owner.

3.5 PIPE DEMOLITION

A. Unless otherwise specified, or in conflict with a proposed pipeline or structure, all pipes shown to be demolished shall be abandoned in place and have each end capped with at least a 24-inch long plug of at least class 4 concrete or grout material within the pipe. Piping subject to internal pressure upon abandonment shall be capped with pressure retaining caps or plugs. Pipes below new structural foundations shall be completely removed.

B. All pipe materials to be removed including pipe, fittings, valves, and thrust blocking shall be disposed away from the site by the Contractor at no additional cost to the Owner.

3.6 CLEARING AND GRUBBING

A. Clearing, Grubbing, and Stripping

1. The Contractor shall restrict clearing and grubbing to the areas designated for new construction or adjustment of grades on the plans. Surrounding trees shall be protected from damage.

2. Remove and dispose of trees, snags, stumps, shrubs, brush, limbs, and other vegetative growth to the limits defined in Section 1. 3. Remove all evidence of branches greater than 1-inch in diameter of thickness. Remove and dispose of trash piles and rubbish. Protect structures and piping above and below ground, trees, shrubs, and vegetative growth and fencing which are not designated for removal or which exist outside project limits.

3. Where limbs or roots of trees designated to remain extend into work areas, the limbs or roots shall be trimmed in accordance with the provisions of this section.

4. Remove all surface rocks and all stumps, roots, and vegetation within the limits of construction. Roots shall be removed to at least 2.5 feet below proposed finish grade.

    a. Conventional means shall be used to remove rocks, expect isolated boulders exceeding 5 feet in dimension; these will require special excavation techniques (such as chiseling, air tools or rock splitting).
    b. Blasting excavation is not allowed unless approved by the Engineer.

5. After grubbing, strip the organic material to the limits defined in Section 1. 3 to a depth of not less than 2-inches. Upon completion of the stripping operation, the exposed surface must be proof-rolled under the observation of the City's geotechnical field representative (to detect soft or pliant area) and then scarified at a minimum of 8-inches, uniformly moisture conditions to 2-percent above optimum moisture, and compacted to 90-percent relative compaction. The remaining material, if utilized for structural fill, shall not exceed a concentration of organics in excess of 5 percent by dry weight. Dilution shall be accomplished by means of disking.

B. Felling of Trees

1. Use all necessary care to protect the roots and branches of trees designated to remain, and to prevent damage to persons and properties.

2. Immediately after felling a tree, remove the branches, cut trunk and limbs as necessary for removal, and clear the debris.

C. Trimming of Trees

1. In company with the Engineer, ascertain the limbs and roots which are to be trimmed and clearly mark them to designate the approved point of cutting.

2. Cut evenly, using proper tools and skilled workmen to achieve neat severance with the least possible damage to the tree.

3. Promptly coat the cut area with the approved pruning paint in strict accordance with the manufacturer's recommendations.

4. In the case of root cuts, apply wet burlap or other protection approved by the Engineer, as required, to prevent drying out.

3.7 DISPOSAL OF STRIPPINGS

The stripped materials shall be removed from the project site at no cost to the Owner.

3.8 CONSTRUCTION OF BARRICADES

A. Layout

1. At all trees designated to be preserved, construct a temporary barricade around the tree at the tree's approximate drip line.

2. Make barricades at least three feet high, consisting of two inch by four inch or larger wood posts set at least 18 inches into the ground at not more than six feet on centers, joined at the top by one inch by six inch or larger wood boards firmly nailed to the posts. Metal post with orange safety fencing may also be used if allowed by the local Owner having jurisdiction.

B. Protection

1. Take special care in setting posts to not damage tree roots.

2. Do not permit stockpiling of materials or debris within the barricaded area nor permit the earth surface to be changed in any way except as specifically approved by the Engineer.

C. Maintenance: All protective fencing shall be inspected and maintained by the contractor at weekly intervals. Any damaged fencing shall be restored within one week.

D. Removal of Barricades: All protective fencing including posts and fabric shall be removed from the site at the completion of the work at the Contractor’s expense.

3.9 REMOVAL OF DEBRIS

A. Remove all debris from the site and leave the site in a neat and orderly condition to the approval of the Engineer. Dispose of debris off site at a location approved by the Engineer.

B. Removal of demolished materials shall be included in the applicable lump sum base bid item and shall not be paid on a unit cost basis.

END OF SECTION

SECTION 02140

DEWATERING

PART 1 GENERAL

1.1 SCOPE

The work of this section consists of providing all labor, materials, and equipment necessary to dewater trench and structure excavations. Refer to the Specification Section 02010 – Subsurface Conditions, and the Geotechnical report included at the end of the Specifications.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Section 01300 - Submittals

B. Section 02010 - Subsurface Conditions

C. Section 02200 - Earthwork

D. Section 02223 - Trenching, Backfilling, and Compacting

E. Section 02225 - Structure Excavation and Backfill

1.3 SUBMITTALS

A. In accordance with Section 01300.

B. Two weeks prior to installation of dewatering facilities and commencement of excavation, submit:

1. A dewatering plan prepared and stamped by a California Registered Geologist and/or a Certified Hydrogeologist and submitted to the Engineer for approval.

2. Drawings and descriptions indicating numbers, locations, arrangements, depths, capacities, and construction details, as applicable, of all dewatering system equipment and components, including standby equipment and components.

3. Methods of disposal of pumped water.

4. Methods of diverting precipitation and surface water away from excavations.
5. Method for collecting and removing precipitation within excavations as necessary.
6. Copies of executed permits necessary to perform work.

1.4 PERMITS

The Contractor shall obtain and comply with all required permits for the dewatering system and operation, disposal of water, and pay all associated fees.

The Contractor shall be responsible for obtaining coverage under California Regional Water Quality Control Board, Central Valley Region (Central Valley Regional Water Board), Waste Discharge Requirements, Limited Threat Discharges to Surface Water (Order R5-2016-0076, NPDES No. CAG995002), if appropriate, for any dewatering activity, including removal of groundwater, removal of accumulated rainwater or removal of water from cofferdams or diversions resulting in a discharge to a surface water of the United States. Dewatering activities, within the boundary of the Central Valley Regional Water Board, shall comply with the conditions of the Central Valley Regional Water Board Limited Threat General Order, all conditions provided by the Regional Water Board in a Notice of Applicability for coverage under the Limited Threat General Order, and shall be in accordance with Caltrans BMP# NS-2 Dewatering Operations.

Following completion of dewatering activities, the Contractor shall be responsible for filing with the Central Valley Regional Water Board a Request for Termination of Coverage under the Limited Threat General Order.

PART 2 MATERIALS

2.1 FACILITIES AND EQUIPMENT

The Contractor shall provide all necessary facilities and equipment for the dewatering operations.

PART 3 EXECUTION

3.1 GENERAL REQUIREMENTS

A. The Contractor shall have on hand, at all times, sufficient pumping equipment and machinery in good working condition and shall have available, at all times, competent workmen for the operation of the pumping equipment. Adequate standby equipment shall be kept available at all times to insure efficient dewatering and maintenance of dewatering operation during power failure.

B. Dewatering shall commence at an appropriate time prior to commencing excavation, and shall be continuous until facilities and structures are completed, backfilled, and, as appropriate, filled with water to prevent damage from hydrostatic uplift and/or floatation.

C. Excavations extending below site groundwater levels or encountering perched groundwater within permeable soil layers shall be dewatered. Dewatering of narrow trench excavations that penetrate less than a few feet below the groundwater level and do not encounter loose and/or cohesionless soils may be possible by directing inflow to a sump where water can be removed by a pump. Temporary dewatering of wider, deeper, and/or more extensive excavations may require well points, perimeter trench drains, and/or deep sumps. To help maintain bottom stability of wider, deeper, and/or more extensive excavations, groundwater levels shall be drawn-down a minimum of 5 feet below the lowest portion of the excavation.

D. Dewatering shall at all times be conducted in such a manner as to preserve the undisturbed bearing capacity of the subgrade soils at proposed bottom of excavation and protect temporary excavation slope stability during construction. If foundation soils are disturbed or loosened by the upward seepage of water or an uncontrolled flow of water, the affected areas shall be excavated and replaced with drain rock on geotextile fabric at no additional cost to the Owner.

E. Due to the potential for ground settlement attributable to temporary dewatering, the contractor shall survey all existing structures in the vicinity of the proposed dewatering operation, prior to the commencement of the dewatering operation. The contractor shall monitor the existing structures for settlement, both total and differentia, throughout the dewatering operation. A daily report for each structure shall be prepared by the contractor and provided to the Engineer identifying the original baseline elevation; the elevation measured each day, and corresponding total and differential settlement. Modifications to the dewatering program may be necessary, as determined by the Engineer, should dewatering induced settlements be detected.

3.2 DISPOSAL OF WATER

A. The Contractor may dispose of the water into existing drainage courses at the plant site, subject to any applicable permitting to be obtained by the Contractor.

B. The Contractor shall be responsible to design and control the dewatering operations such that disposal of water does not cause erosion or other damage and such that water to be disposed of is free from silt and other objectionable materials. Settling basins and/or other means shall be used as necessary.

C. The Contractor shall utilize applicable construction activity Best Management Practices (BMP) for the project. Refer to "Caltrans Storm Quality Handbooks, Construction Site Best Management Procedures Manual", May 2017 or latest edition. Groundwater discharges are included in Section NS-2.

D. The Contractor shall be responsible for obtaining coverage under the Central Valley Regional Water Board Limited Threat General Order for any dewatering activity, including removal and discharge of groundwater, accumulated rainwater and removing water from cofferdams or diversions, if necessary. Dewatering activities shall comply with the conditions of the Central Valley Regional Water Board Limited Threat General Order and all conditions provided by the Regional Water Board in a Notice of Applicability for coverage under the Limited Threat General Order.

3.3 TERMINATION OF DEWATERING

The termination of dewatering operations shall be performed in such a manner as to maintain the undisturbed state of the natural foundation soils, prevent disturbance of compacted backfill and prevent flotation or movement of structures, pipelines, and sewers. If damage occurs due to improper termination of dewatering, the Contractor is responsible to repair the damage to the satisfaction of the Engineer. Dewatering devices/features shall either be removed or abandoned in place in accordance with legal regulatory requirements and as approved by the Geotechnical Engineer.

3.4 RESTORATION

Restore existing infrastructure to conditions equivalent to those existing prior to the start of work, including repair of any settlement-related damage.

END OF SECTION

SECTION 02200

EARTHWORK

PART 1 GENERAL

1.1 DESCRIPTION

The work of this section consists of excavation, filling, compaction, and grading for earthen embankments, roadways, and landscape fills including removal of unsuitable materials from the roadbed and beneath fill areas.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Section 02010 – Subsurface Conditions

B. Section 02100 – Demolition, Cleaning, Grubbing, and Stripping

C. Section 02140 – Dewatering

D. Section 02223 – Trenching, Backfilling, and Compacting

E. Section 02225 – Structure Excavation and Backfill

F. Section 02233 – Watering

G. Section 02270 – Stormwater Runoff Control Program

H. Section 02272 – Vegetative Erosion Control

I. Appendix A – Geotechnical Report

1.3 DEFINITIONS

A. Local Borrow: Local borrow consists of approved soil from on-site. Borrow material shall meet the requirements of Engineered fill.

B. Engineered Fill: On-site soil that meets the requirement of Part 2.2. of this section. The engineered fill shall be free (less than 3% by weight) of organic and deleterious materials.

C. Imported Engineered Fill: All imported soil that meets the requirement of Part 2.2. of this section. The engineered fill shall be free of deleterious materials.

D. Lime Treated Soil: On-site soil treated with high calcium quicklime as recommended by the project geotechnical engineer.

E. Non-Engineered Fill: On-site soil that do not meet the requirements of Part 2.2 of this section.

F. On-site Soil: Soil that is selected from the surplus material obtained from on-site excavation.

G. Over-excavation: Over-excavation consists of authorized removal and satisfactory disposal of unsuitable soil located below subgrade surface. The Engineer determines the unsuitability of the soil.

H. Relative Compaction: Relative compaction is defined as the ratio, in percent, of the as-compacted dry density to the laboratory maximum dry density. The laboratory maximum dry density is defined in accordance with ASTM D1557, latest edition. In-place density will be determined in accordance with ASTM D1556 or D6938, latest edition.

I. Subbase: A layer of specified uniform bedding or leveling course between the base of a structure/foundation and subgrade.

J. Subgrade: Surface remaining after completing the excavation or top surface of fill or backfill immediately below subbase or bedding as applicable.

K. Standard Specifications: Where reference is made to Standard Specifications, reference shall mean: State of California, Business and Transportation Agency, Department of Transportation (Caltrans), Standard Specifications, latest edition, excluding measurement and payment items.

L. Well Graded: Well graded as used in this section defines a mixture of soil particle sizes that have no specific concentration or lack thereof of one or more sizes. Well graded is used to help define a material that, when properly compacted, produces a strong and relatively incompressible soil.

1.4 QUALITY ASSURANCE

Testing required to determine compliance for the work of this section will be the responsibility of the Owner and at the Owner's expense. The Contractor shall cooperate by rerouting equipment or by temporarily closing the immediate work area being tested. Areas where test results indicate noncompliance shall be corrected before placing additional fill. Retesting of previously failing test areas will be charged to the Contractor in accordance with the Geotechnical Engineer's current rate schedule.

1.5 PROJECT CONDITIONS

Maintain fills, slopes, and ditches within the limits of the new construction until final acceptance. Repair areas damaged as a result of storms or construction. Take necessary precautions to prevent the entrance of soils and other materials into streambeds, lakes, or water courses.

PART 2 MATERIALS

2.1 GENERAL

A. All fills shall be nearly free (less than 5% by volume) of from organic materials or other deleterious debris. The fill soil maximum particle size shall be less than 3 inches. Frozen material will not be permitted as fill.

B. The near-surface, on-site soils should not be used for engineered fill within the upper 24 inches of subgrade to support structures such as concrete slab-on-grade and shallow equipment and building foundations.

2.2 ENGINEERED FILL

A. All imported fill materials to be used for engineered fill shall be sampled and tested by the project Geotechnical Engineer prior to being transported to the site.

B. Engineered fill material shall be utilized in the construction of earthen embankments, access roadways and all other areas identified on the contract drawings or as directed by the Geotechnical Engineer. Engineered fill shall meet the following minimum requirements:

Table 2.1
Engineered Fill Requirements

Engineered Fill Requirement		Test Procedures	
		ASTM [(a)]	Caltrans [(b)]
Gradation			
Sieve Size	**Percent Passing**		
3 inch	100	D422	202
¾ inch	70-100	D422	202
No. 4	50-100	D422	202
No. 200	20-70	D422	202
Plasticity			
Liquid Limit	**Plasticity Index**		
<40	<20	D4318	204
Organic Content			
Less than 3%		D2974	--
Expansion Potential (ASTM D4829)			
Less than 20%	--	--	--

(a) American Society for Testing and Materials Standards (latest edition).

(b) State of California, Department of Transportation, Standard Test Methods (latest edition).

C. On-site soil could be used as engineered fill if it meets the requirements of Table 2.1 of this section and as approved by the Geotechnical Engineer.

D. The expansive on-site soils could be treated with high-calcium quicklime to reduce their expansion potential to meet the engineered fill criteria presented in Table 2.1 of this section. If lime treatment is to be performed for this purpose, additional testing and evaluation will be necessary to evaluate the proper lime application rate for treatment. On-site soil that contains sulfate may not be suitable for lime treatment per geotechnical report. Refer to Section 3.4.A.1.

2.3 AGGREGATE BASE

Aggregate base shall be Class 2 aggregate base, ¾" maximum, conforming to the Caltrans Standard Specifications.

2.4 CRUSHED ROCK

Material shall be crushed rock of one-inch (1") maximum size, with no material passing a Number four (#4) sieve.

2.5 GEOTEXTILE FABRIC

Geotextile fabric used in conjunction with aggregate base as an underlayment for access roadways shall be Propex 2006, Mirafi 600X, or equal. Overlap fabric minimum 1ft. The fabric shall be composed of high-tenacity polypropylene yarns, woven into a stable network to retain relative position. Fabric shall be inert to biological degradation and resistant to naturally encountered chemicals, alkalis, and acids.

Geotextile fabric used in conjunction with crushed rock base or gravel beneath structures shall be Mirafi 140N, Propex Geotex 401, Propex 4551, Reed and Graham RG60N, or equal. Overlap fabric minimum 1ft. Fabric shall be non-woven geotextile composed of polypropylene fibers, formed into a stable network of fibers retaining their relative position. The fabric shall be inert to biological degradation and resistant to naturally encountered chemicals, alkalis, and acids.

2.6 WATER FOR COMPACTION/DUST CONTROL

Water for compaction and dust control shall be clean and free of oil, acids, salts, and other deleterious substances. Water shall be supplied by the Contractor at no additional expense to the Owner. The Contractor shall provide all necessary labor and equipment to bring the water, and shall be responsible for the repair of any damage to the existing facilities that can be attributed to this operation.

2.7 IMPORTED MATERIAL ACCEPTANCE

All tests necessary for the Contractor to locate acceptable imported material shall be made by the Contractor. Certification that the material conforms to the Specification requirements along with copies of the test results from a qualified commercial testing laboratory shall be submitted to the Engineer for approval at least 30 days before the materials is required for use. All aggregate samples shall be furnished by the Contractor, at the Contractor's sole expense. Samples shall be representative and be clearly marked to show the source of the material and the intended use on the project. Sampling of the aggregate source shall be done by the Contractor under the supervision of the Engineer in accordance with ASTM D75. Tentative acceptance of the aggregate source shall be based on an inspection of the source by the Engineer and the certified test results submitted by the Contractor to the Engineer. No imported materials shall be delivered to the site until the proposed source and materials tests have been tentatively accepted in writing by the Engineer.

Final acceptance will be based on the tests made on samples of material taken from the completed and compacted course. The completed course is defined as a course or layer that is ready for the next layer or the next phase of construction. All testing for final acceptance shall be performed by the Engineer.

If tests conducted by the Contractor or the Engineer indicate that the material does not meet Specification requirements, material placement will be terminated until corrective measures are submitted and accepted by the Engineer. Material which does not conform to the Specification requirements and is placed in the work shall be removed and replaced at the Contractor's sole expense. Sampling and testing performed by the Contractor shall be done at the Contactor's sole

expense. Retesting of failed test sections performed by the Engineer will be charged to the Contractor in accordance with the Geotechnical Engineer's current rate schedule.

2.8 DUST CONTROL

A. Dust Control: Use all means necessary to prevent the spread of dust during performance of the work; thoroughly moisten all surfaces as required to prevent dust being a nuisance to the public, neighbors, and concurrent performance of other work on the site. Wind in excess of 10 MPH causing dust to leave site will require Contractor to limit dust causing activities.

PART 3 EXECUTION

3.1 GENERAL

The Contractor shall do all grading, filling-in or excavating as required to completely grade the site to lines and grades shown, and to provide for the indicated drainage. Where finish grade corresponds practically with existing grade, the ground shall be worked-up and graded-off evenly with existing grade.

3.2 STRIPPING

Perform clearing, grubbing, and stripping in accordance with Section 02100.

3.3 ORIGINAL GROUND PREPARATION

Perform all excavation of every description, regardless of the type, nature, or condition of material encountered as specified, shown on the contract drawings, or required to accomplish the construction.

A. Over-Excavation: The zone of over-excavation shall extend laterally a minimum of 5 feet outside the limits of the structure. If the Engineer or Geotechnical Engineer directs the Contractor to perform over-excavation, the excess excavation and fill will be paid for as extra work. If the Contractor excavates below the required grade by chance, the Contractor shall fill the over-excavation at no cost to the Owner.

B. Scarification and Recompaction: Following site stripping, grubbing, and any required over-excavation, areas to receive engineered fill or concrete slabs supported-on-grade shall be scarified to a depth of 8 inches, uniformly moisture-conditioned to 2 percent of optimum moisture content, and compacted to 90 percent relative compaction. Within pavement areas (asphaltic cement and concrete) the top 12 inches of subgrade shall be scarified uniformly moisture conditioned to 2 percent above the optimum moisture content and compacted to at least 95 percent relative compaction**.**

3.4 GENERAL FOUNDATION SUBGRADE

A. Lime Treatment:

1. Lime Treatment is not to be used on site, unless otherwise approved by the Engineer.

B. Subsurface Structure Subgrades:

We anticipate subsurface structure excavations will extend below site groundwater levels. As a result, the bottom conditions are expected to be wet and unstable. Several alternatives exist for providing a stable working surface at the bottoms of such excavations. Following excavation and removal of all loose or disturbed materials, at least 12 inches of clean crushed rock surrounded by a filter fabric (Amoco 4551 or equivalent) shall be placed over the subgrade soil to provide a uniform base and leveling course below the structure. The crushed rock layer shall be compacted prior to construction of the structure over it.

As an alternative to crushed rock and fabric, a minimum 6-inch thick layer of lean concrete may be used as a base course or subgrade soil may be stabilized by treating it with quicklime as directed by the Geotechnical Engineer.

C. Embankment Fill Subgrades:

Not Applicable to Project.

3.5 GENERAL COMPACTION REQUIREMENTS

Unless otherwise noted on the drawings, compaction shall be as follows:

Area	Relative Compaction
Embankment, Backfill and Earth Pads	90%
Beneath Structures	90%
Upper 12 inches of pavement subgrade	95%
Fill deeper than 5 feet	95%
Landscape Areas	90%

3.6 REMOVAL OF WATER

Provide and operate equipment adequate to keep all excavations and trenches free of water. Remove all water during periods when pipe is being laid, during the placing of backfill, and at such other times as required for efficient and safe execution of the work. Avoid settlement or damage to adjacent property. Dispose of water in a manner that will not damage adjacent property. When dewatering open excavations, dewater from outside the structural limits and from a point below the bottom of the excavation when possible. Water disposal shall meet all

Federal, State, and local requirements. Construction dewatering shall be in accordance with Section 02140.

3.7 MOISTURE CONTROL

A. During compaction operations, maintain optimum moisture content as required per Section 3.5. in each lift of the earth fill. Maintain moisture content uniform throughout the lift. Insofar as practicable, add water to the material at the site of excavation. Supplement, if required, by sprinkling the earth fill. If the moisture content of the earth fill cannot be lowered to within the specified limit by aeration in a reasonable length of time, the Contractor shall import fill with which the specified moisture content can be achieved. At the time of compaction, the water content of the material shall be within the optimum water content range for the material being used.

B. Do not compact fill material which contains excessive moisture to obtain the required compaction. Aerate the material by blading, discing, harrowing, or other methods, to hasten the drying process.

3.8 COMPACTION TESTS

The Geotechnical Engineer will determine in-place density and moisture content by any one or combination of the following methods: ASTM D1556 or D6938. The Contractor will cooperate with this testing work by excavating and leveling small test areas as designated by the Geotechnical Engineer. Tests in which either the moisture content requirements are not achieved or yield relative compaction results below the required minimum compaction requirements will constitute failure. Areas failing to meet the specified moisture content limits and/or minimum specified relative compaction shall be immediately reworked until such time as the minimum compaction requirements are achieved. Re-testing of previously failing test areas will be backcharged to the Contractor in accordance with the Geotechnical Engineer’s current rate schedule.

3.9 SITE GRADING

Perform all earthwork to the lines and grades as shown and/or established by the Engineer. Shape, trim, and finish slopes of channels to conform with the lines, grades, and cross sections shown. Make slopes free of all exposed roots and stones exceeding 2-inches in diameter.

3.10 DISPOSAL OF EXCESS EXCAVATION

A. Dispose of all excess excavated materials, in the areas as designated on the construction drawings or as directed by the Engineer. Material shall be placed level or sloped and compacted at a 90% relative compaction as directed by the Engineer at no cost to the Owner. If disposal location is not specifically identified on the drawings, haul and dispose all excess excavated materials off site, at no additional expense to the Owner.

B. This project must be in compliance with the 2019 California Green Building Council Standards Code and shall meet the construction waste management and disposal mandates.

3.11 DITCHES

Construct drainage swales, ditches, and inlet and outlet ditches for culverts as shown or as directed. Trim ditch slopes neatly to line. Final flow line grade shall be reasonably uniform to provide free drainage without puddling. Ditches shall be over-built where puddling is anticipated. The slope of all ditches shall be trimmed to leave a smooth and compacted surface. Surfaces trimmed with a backhoe are unacceptable.

3.12 SLOPE FINISHING

Fill slopes shall be over-built and cut back into firm material to finish grade.

3.13 PLACEMENT OF CRUSHED ROCK OR GRAVEL

Where crushed rock or gravel base is required, envelope the rock or gravel with geotextile fabric.

3.14 EROSION AND SEDIMENT CONTROL

The site shall be protected from erosion and sediment transport at all times utilizing a combination of best management practices (BMP) as identified below. Refer to General and Supplemental Conditions, General Stormwater Pollution Prevention Plan (SWPPP), and Contract Drawings for more information and prepare a site specific SWPPP in accordance with all applicable standards.

A. Temporary Erosion & Sediment Control: Stormwater BMPs shall be employed in a system such that erosion and sediment transport shall be significantly minimized from unprotected earthwork activities. Refer to specification Sections 02270 for Stormwater Runoff Control Program and Section 02272 for SWPPP requirements.

B. Permanent Erosion & Sediment Control: The permanent stormwater BMPs shall be employed in a system such that erosion and sediment transport shall be significantly minimized from unprotected earthwork activities. Refer to the contract drawings for location of all drainage ditches, fill areas, asphalt concrete roads, landscaped areas, and graveled areas. Track walking or other acceptable method shall be utilized on all embankment slopes. See Specification Section 02270 and 02272 for SWPPP requirements.

END OF SECTION

SECTION 02223

TRENCHING, BACKFILLING, AND COMPACTING

PART 1 GENERAL

1.1 DESCRIPTION

The work of this section consists of trenching and backfilling for the construction and installation of pipelines, conduits and cables. All trenching will be open cut, unless otherwise approved in writing. It includes all clearing and grubbing, trenching or tunneling, construction of cribbing and cofferdams, dewatering, incidental work, and providing specified backfill.

1.2 RELATED WORK SPECIFIED ESLEWHERE

A. Section 01300: Submittals

B. Section 01666: Testing of Pipelines, Gravity Sewer Lines, and Manholes

C. Section 02010: Subsurface Conditions

D. Section 02100: Demolition, Clearing, Grubbing, and Stripping

E. Section 02200: Earthwork

F. Section 02229: Utility Line Marking

G. Section 02233: Watering

H. Section 02270: Stormwater Runoff Control Program

I. Section 02513: Asphalt Concrete Paving

J. Section 03100: Concrete

K. Section 10400: Identifying Devices

L. Section 15010: General Process and Onsite Utility Piping Provisions

M. Division 16: Electrical

N. Appendix A: Geotechnical Report

1.3 SUBMITTALS

A. Submit six copies of a report from a testing laboratory verifying that material conforms to the specified gradations of characteristics for granular material, imported sand, rock refill for foundation stabilization, and water.

B. Submit method of compaction in pipe zone including removal sequence of shoring where used.

C. Provide written description of barricading, shoring, cribbing, bracing, and sloping precautions.

1.4 PROJECT CONDITIONS

A. Obtain all required permits and licenses before installing utilities under existing roads, other than County roads, and follow the rules and requirements of the authority having jurisdiction.

B. Arrange construction sequences to provide the shortest practical time that the trenches will be open to avoid hazard to the treatment plant staff, subcontractors, and public, and to minimize the possibility of trench collapse.

1.5 ROCK EXCAVATION

Rock excavation is not anticipated on this project. Please see the Special Provisions for the definition of rock excavation as it pertains to extra work.

A. Conventional means shall be used to remove rocks, expect isolated boulders exceeding 5 feet in dimension; these will require special excavation techniques (such as chiseling, air tools or rock splitting).

B. Non-explosive techniques are required, including ripping, chiseling, drilling, rock-splitting, etc. Blasting excavation is not allowed unless approved by the Engineer.

1.6 TESTING FOR COMPACTION

A. The City will test for compaction at locations determined by the City.

B. Relative compaction is defined as the ratio, in percent, of the as-compacted dry density to the laboratory maximum dry density. The laboratory maximum dry density is defined in accordance with ASTM D1557, latest edition. As-compacted dry density will be determined in accordance with ASTM D3017 or D2922, latest edition.

C. Where compaction tests indicate a failure to meet the specified compaction, the City will take additional tests every 50 feet in each direction until the extent of the failing area is identified. Rework the entire failed area until the specified compaction has been achieved.

1.7 STREET ZONE

The street zone includes the asphalt concrete and aggregate base pavement section placed over the trench backfill.

1.8 TRENCH ZONE

The trench zone includes the portion of the trench from the top of the pipe zone to the bottom of the street zone in paved areas or to the existing surface in unpaved areas.

1.9 PIPE ZONE

The pipe zone shall include the full width of trench from the bottom of the pipe or conduit to a horizontal level above the top of the pipe, as shown on the contract drawings. Where multiple pipes or conduits are placed in the same trench, the pipe zone shall extend from the bottom of the lowest pipes to a horizontal level above the top of the highest or topmost pipe.

1.10 PIPE BASE OR BEDDING

The pipe base or bedding shall be defined, unless noted otherwise on the Drawings, as a minimum 6-inches thick layer of material immediately below the bottom of the pipe or conduit and extending over the full trench width in which the pipe is bedded.

PART 2 MATERIALS

2.1 ENGINEERED FILL (TYPE 1)

Engineered fill shall consist of excavated native or imported material conforming to requirements of Section 02200.

2.2 IMPORTED SAND (TYPE 2)

Imported washed sand used for the pipe bedding, conduit and pipe zones shall be free of clay or organic material and have the following gradation:

Sieve Size	Percent Passing by Weight
3/8-INCH	100
No. 4	90 – 100
No. 30	12 – 50
No. 100	5 – 20
No. 200	0 – 5

Imported sand shall have a sand equivalent not less than 28 per ASTM D 2419.

2.3 CLASS 2 AGGREGATE BASE (TYPE 3)

Backfill material consisting of Class 2 Aggregate Base in accordance with Caltrans Standard Specifications Section 26-1.02. Recycled material such as recycled concrete or recycled ashaltic concrete shall not be used, unless approved by the Engineer.

2.4 IMPORTED PEA GRAVEL (TYPE 4)

Imported hard, durable crushed rock or angular pea gravel (with or without sandy fines) that is free of debris, clay lumps, recycled and organic materials and having the following gradation:

Sieve Size	Percent Passing by Weight
3/4-INCH	100%
3/8 INCH	90 - 95%
No. 4	5 - 25%
No. 40	0 – 5%
No. 200	0%

2.5 ¾-INCH CRUSHED ROCK (TYPE 5)

Crushed rock base and gravel are defined as natural or crushed rock, free from organic matter, and meeting the following gradation:

Sieve Size	Percent Passing by Weight
1 -inches	100

¾ -inch	90 – 100
3/8”	20 - 55
No. 4	0 – 10
No. 8	0 – 5

Durability Index shall be at least 40 per California Test Method No. 229 or ASTM D3744.

2.6 CEMENT SLURRY (TYPE 6)

Cement slurry backfill materials shall be according to Caltrans Standard Specification Section 19-3.062 and shall consist of cement, fine aggregate/sand and sufficient water for workability. It shall contain at least 188 lbs cement for each cubic yard of material. Slurry shall be thoroughly machine-mixed and shall be placed with one hour after initial mixing.

2.7 BACKFILL MATERIAL SCHEDULE (FOR PLACEMENT)

Unless otherwise call out on the plans, backfill materials shall be provided according to the following schedule:

Location	Material
Street Zone	Class 2 AB (Type 3)
Trench Zone	Engineered/Native Fill (Type 1) Class 2 AB (Type 3)
Pipe Zone	Imported Sand (Type 2) Class 2 AB (Type 3)
Bedding	Imported Sand (Type 2) Class 2 AB (Type 3)

2.8 REFILL FOR FOUNDATION STABILIZATION

Loose materials at trench bottoms resulting from excavation disturbances should be removed to firm soil. If soft, loose or unstable areas are encountered these areas should be over-excavated to a firm base or a depth of 2 feet. Refill consists of materials for filling the over excavation as approved by the Geotechnical Engineer. Refill shall meet the material requirements specified for pipe zone. As an alternative, crushed rock, enveloped in geotextile fabric may be utilized subject to the approval of the Geotechnical Engineer.

2.9 CONCRETE FOR PIPE ENCASEMENT AND THRUST BLOCKS

A. Thrust blocks are not allowed on this Project.

B. Concrete for pipe encasement and thrust blocks shall be per Section 03100, unless otherwise shown in the drawings.

C. Provide thrust blocks at fittings in pipe having rubber gasket bell and spigot or unrestrained mechanical joints as directed by the Engineer. Provide thrust blocks at all dead ends, valves, tees and elbows 11-1/4° and greater, or as noted on contract plans and in the general or specific pipe specifications.

D. Size thrust block bearing area for 1500 PSF, unless noted otherwise on Drawings. Size thrust blocks based on the test pressures provided in the contract documents. All thrust forces shall be calculated according to "AWWA Manual M41".

2.10 WATER FOR COMPACTION

Water for compaction shall be clean and free of oil, acids, salts, and other deleterious substances. Water shall be supplied by the Contractor at no additional expense to the Owner. Water shall be available as defined in Specification Section 02233. The Contractor shall coordinate with the Engineer for the use of the water shall provide all necessary labor and equipment to extract, transport and apply the water for compaction, and shall be responsible for the repair of any damage to the existing facilities which can be attributed to this operation.

2.11 COFFERDAM AND CUTOFF COLLARS

For steep trenches, provide concrete cut-off collar to prevent surface and groundwater concentration and erosion. For trench slopes over 10%, install concrete cut-off collar at intervals no more than 100-feet (on center). For trench slopes over 15%, install concrete cut-off collar at intervals no more than 50-feet (on center).

PART 3 EXECUTION

3.1 COMPACTION REQUIREMENTS

Unless otherwise shown in the drawings or otherwise described in the specifications for the particular type of pipe installed, relative compaction in pipe trenches shall be as follows:

A. Pipe Base: 95% relative compaction.

B. Pipe Zone: 95% relative compaction.

C. Backfill in Trench Zone not Beneath Paving or Aggregate Base Access Roadways: 90% relative compaction.

D. Backfill in Trench Zone to Street Zone in Paved Areas or Within Limits of Aggregate Base Roadways: 95% relative compaction.

E. Backfill in Street Zone in Paved Areas or within Limits of Aggregate Base Roadways: 95% of relative compaction.

F. Refill for Foundation Stabilization: 95% relative compaction.

G. Refill for Overexcavation: 95% relative compaction.

H. Where compaction tests indicate a failure to meet the specified compaction, the Owner will take additional test every 50 feet in each direction until the extent of the failing area is identified. Rework the entire failed area until the specified compaction has been achieved.

3.2 MATERIAL REPLACEMENT

Remove and replace any trenching and backfilling material which does not meet the specifications, at the Contractor's expense. Note that this project must be compliant with the 2019 California Green Building Standards Code.

3.3 SLOPING, SHEETING, SHORING, AND BRACING OF TRENCHES

Trenches shall have sloping, sheeting, shoring, and bracing conforming with 29CFR1926, Subpart P – Excavations, CAL/OSHA requirements, and the General Conditions.

3.4 SIDEWALK, PAVEMENT, AND CURB REMOVAL

Cut bituminous and concrete pavements regardless of the thickness and curbs and sidewalks prior to excavation of the trenches with a pavement saw or pavement cutter. Width of the pavement cut shall be at least equal to the required width of the trench at ground surface plus 6-inches past each side of the trench. Haul pavement and concrete materials from the site. Do not use for trench backfill.

3.5 TRENCH WIDTHS

Trench widths in the pipe zone shall be as shown in the drawings. If no details are shown, the maximum width shall be 24 inches greater than the pipe outside diameter. Comply with 29CFR Part 1926 Subpart P – Excavations. Trench width at the top of the trench will not be limited except where width of excavation would undercut adjacent structures and footings. In such cases, width of trench shall be such that there is at least two feet between the top edge of the trench and the structure or footing.

3.6 TRENCH EXCAVATION

Excavate the trench to the lines and grades shown in the drawings with allowance for pipe thickness, sheeting and shoring if used, and for pipe base or special bedding. If the trench is excavated below the required grade, refill any part of the trench excavated below the grade at no additional cost to the City with foundation stabilization material. Place the refilling material over the full width of trench in compacted layers not exceeding 6-inches deep to the established grade with allowance for the pipe base or special bedding.

3.7 DEWATERING

A. Provide and maintain means and devices to remove and dispose of all water entering the trench excavation during the time the trench is being prepared for the pipelaying, during the laying of the pipe, and until the backfill at the pipe zone has been completed. These provisions shall apply at all times during construction, including the noon hour as well as overnight. Dispose of the water in a manner to prevent damage to adjacent property and in accordance with regulatory agency requirements. Do not drain trench water through the pipeline under construction. Do not allow groundwater to rise around the pipe until jointing compound has set hard.

B. Dewater in accordance with Section 02140.

3.8 LOCATION OF EXCAVATED MATERIAL

A. During trench excavation, place the excavated material only within the working area. Do not obstruct any roadways or streets. Conform the federal, state, and local codes governing the safe loading of trenches with excavated material. All trenches shall be backfilled at the end of each day's operation.

B. Until permanent AC paving can be replaced, the Contractor shall backfill the trench to grade and maintain the subgrade and surface in a condition that is suitable to support and safely carry traffic. New AC paving shall be placed within one (1) week after backfilling and trench, unless otherwise approved by the Engineer.

3.9 LENGTH OF OPEN TRENCH

At no time shall the length of open trench exceed 500 feet in advance of pipelaying or amount of pipe installed in one working day, whichever is less, and not more than 500 feet in the rear of pipelaying, except as modified by encroachment permit requirements.

A. At the end of each working day, the entire trench shall be backfilled to match existing surface. The length of open trench which may be left unattended overnight shall be limited to 20 feet or one pipe length, whichever is shorter.

B. For any section of trench that will be left unattended the Contractor shall:

1. Isolate the trench from unauthorized access with rigid barricades and/or temporary fencing and clearly mark and delineate it with warning signs, reflective cones, and warning lights.

2. If within the street right-of-way, plate the trench using trench plates and provide sheeting shoring and bracing to support the trench plates sufficient to carry H-20 traffic loads. Applicable state, county, and municipal traffic safety rules will govern installation and maintenance of trench plates.

3.10 TRENCH EXCAVATION IN BACKFILL AND EMBANKMENT AREAS

Construct trench excavation for pipe, pipes, or conduit in backfill or embankment areas in accordance with the following procedures:

A. Construct and compact the embankment to an elevation of 1-foot minimum over the top of the layer of the largest pipe or conduit to be installed.

B. Excavate trench in the compacted backfill or embankment. Place cement slurry in the pipe base and pipe zone. Compact backfill above the pipe zone to the relative compaction required for trench zone backfill.

3.11 FOUNDATION STABILIZATION

A. After the required excavation has been completed, the City will inspect the exposed subgrade to determine the need for any additional excavation. It is the intent that additional excavation be conducted in all areas within the influence of the pipeline where unacceptable materials exist at the exposed subgrade. Overexcavation shall include the removal of all such unacceptable materials that exists directly beneath the pipeline to the required trench width and to the depth required. Backfill the trench to subgrade of pipe base with refill material for foundation stabilization. Place the foundation stabilization material over the full width of the trench and compact in layers not exceeding 6-inches deep to the required grade. Foundation stabilization work shall be executed in accordance with a change order.

B. Refill used by the Contractor for his convenience will not receive any additional payment.

3.12 INSTALLING BURIED PIPING

A. Backfill per the detailed piping specification for the particular type of pipe and per the following.

B. Handle pipe in such a manner as to avoid damage to the pipe. Do not drop or dump pipe into trenches under any circumstances.

C. Inspect each pipe or fitting prior to placing into the trench. Inspect the interior and exterior protective coatings. Patch damaged areas in the field with material recommended by the protective coating manufacturer. Clean ends of pipe thoroughly. Remove foreign matter and dirt from inside of pipe and keep clean during and after installation.

D. All pipelines indicates in the construction drawings shall be properly identified using the following methods:

1. Install locator tape in accordance with details specified in Section 02229.

2. Furnish and install colored pipe (applicable to PVC pipe only) – Potable Water/Blue, Reclaimed Water/Purple, Sanitary Sewers/Green, White may be used only with prior approval of the Engineer.

3. Locator wire shall be installed in accordance with details specified in Section 02229.

4. Alternate systems for marking water pipelines may only be used with prior approval of the Engineer.

E. Grade the bottom of the trench to the line and grade to which the pipe is to be laid, with allowance for pipe thickness and bedding depth. Remove hard spots that would prevent a uniform thickness of bedding. Place the specified thickness pipe base material over the full width of trench. Grade the top of the pipe base ahead of the pipelaying to provide firm, continuous, uniform support along the full length of pie, and compact to the relative compaction specified herein. After laying each section of the pipe, check the grade and alignment and correct any irregularities prior to laying next joint.

F. Excavate bell holes at each joint to permit proper assembly and inspection of entire joint. Fill the area excavated for the joints with the bedding material specified or detailed in the drawings.

G. Install cofferdams and concrete cutoff collars are required to prevent erosion and water movement.

H. When installing pipe, do not deviate more than 1-inch from line or 1/4 –inch from grade. Measure elevation at the pipe invert. The Contractor shall verify pipe grade at not more than 50 feet intervals, in the presence of the City's Representative.

I. After pipe has been bedded, place pipe zone material simultaneously on both sides of the pipe, in maximum 6-inch lifts, keeping the level of backfill the same on each side. Carefully place the material around the pipe so that the pipe barrel is completely supported and that no voids or compacted areas are left beneath the pipe. Use particular care in placing material on the underside of pipe to prevent lateral movement during subsequent backfilling.

J. For pipe sizes greater than 12-inches in diameter, no more backfill material than the lesser of 6-inches or 1/3rd of the pipe diameter shall be placed prior to shovel slicing. Sufficient

care shall be taken to prevent movement of the pipe during shovel slicing. Shovel slicing shall be witnessed by the Field Inspector and/or Engineer.

K. Compact each lift to the relative compaction specified herein.

L. Push the backfill material carefully onto the backfill previously placed in the pipe zone. Do not permit free fall of the material until at least 2 feet of cover is provided over the top of the pipe. Do not drop sharp, heavy pieces of material directly onto the pipe or the tamped material around the pipeline. Do not operate heavy equipment over the pipe until at least 3 feet of backfill has been placed and compacted over the pipe.

M. When pipelaying is not in progress, including the noon hours, close the open ends of pipe. Do not allow trench water, animals, or foreign material to enter the pipe.

N. Remove and dispose of all water entering the trench during the process of pipelaying. Keep the trench dry until the pipelaying and jointing are completed.

3.13 BACKFILL COMPACTION

Compact per the detailed piping specification for the particular type of pipe and per the following:

A. Compact trench backfill to the specified relative compaction. Compact by using mechanical compaction or hand tamping. Do not use high impact hammer-type or heavy equipment except where the pipe manufacturer warrants in writing that such use will not damage the pipe. Ponding or jetting is not allowed.

B. Compact material placed within 12-inches of the outer surface of the pipe by hand tamping and/or small hand held tamping equipment.

C. Do not use any axle-driven or tractor-drawn compaction equipment within 5 feet of building walls, foundations, or other structures.

3.14 CEMENT SLURRY BACKFILL

When cement slurry backfill is utilized, pipe shall be supported by mounding imported backfill material or sandbags filled with imported backfill material. Pipe shall not be supported on wooden or concrete blocks.

END OF SECTION

SECTION 02225

STRUCTURE EXCAVATION AND BACKFILL

PART 1 GENERAL

1.1 DESCRIPTION

The work of this section consists of all structure excavation and backfill required to complete the work, including rock excavation, furnishing select or imported backfill, and disposal of surplus or unsuitable material.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Section 01300 – Submittals

B. Section 02010 – Subsurface Conditions

C. Section 02100 – Demolition, Clearing, Grubbing and Stripping

D. Section 02140 – Dewatering

E. Section 02200 – Earthwork

F. Section 02233 – Watering

G. Section 02270 – Stormwater Runoff Control Program

H. Section 02400 – Sheeting, Waling and Shoring

I. Appendix A – Geotechnical Reports

1.3 QUALITY ASSURANCE

Evaluation of all fill materials and testing required to determine compliance for the work of this section will be the responsibility of the Contractor and at the Contractor's expense. Areas where test results indicate noncompliance shall be corrected before placing additional backfill.

1.4 PROJECT CONDITIONS

Take necessary precautions to prevent the entrance of soils and other materials into streambeds, lake, or other water sources.

1.5 RELATIVE COMPACTION TEST

A. The Owner shall test for compaction at locations determined by the Engineer.

B. Relative compaction is defined as the ratio, in percent, of the as-compacted dry density to the laboratory maximum dry density. The laboratory maximum dry density is defined in accordance with ASTM D1557, latest edition. As-compacted dry density is defined in accordance with ASTM D3017 or D2922, latest edition.

C. Where compaction tests indicate a failure to meet the specified compaction, the Contractor will take additional tests every 50 feet in each direction until the extent of the failing area is identified. Rework the entire failed area until the specified compaction has been achieved at no cost to the Owner.

PART 2 MATERIALS

2.1 IMPORTED NON-EXPANSIVE BACKFILL

Fill Requirement		**Test Procedures**	
		ASTM [(a)]	**Caltrans [(b)]**
Gradation			
Sieve Size	**Percent Passing**		
3 inch	100	D422	202
¾ inch	70-100	D422	202
No. 4	65-100	D422	202
No. 200	20-45	D422	202
Plasticity			
Liquid Limit	**Plasticity Index**		
<30	<12	D4318	204
Organic Content			
Less than 3%		D2974	--
Expansion Potential (ASTM D4829)			
Less than 20	--	--	--

(a) American Society for Testing and Materials Standards (latest edition)

(b) State of California, Department of Transportation, Standard test Methods (latest edition)

2.2 CRUSHED ROCK

See Section 02200 for Material Requirements.

2.3 AGGREGATE BASE

See Section 02200 for Material Requirements.

2.4 DRAIN ROCK

See Section 02200 for Material Requirements.

2.5 DRAIN ROCK FABRIC

See Section 02200 for Material Requirements.

2.6 ENGINEERED FILL

See Section 02200 for Material Requirements.

PART 3 EXECUTION

3.1 CLEARING

Perform clearing operations in accordance with Section 02100.

3.2 STRUCTURAL EXCAVATION

A. General: All excavation for structures shall be done to the dimensions and levels indicated on the drawings or specified herein.

B. Under all deeper structures, the Contractor shall:

1. Excavate to subgrade, remove and dispose of organic material and unsuitable soils.
2. Scarify the surface a minimum depth of 8-inches, bring the moisture content to 2 percent above optimum and compact to 90 percent minimum relative compaction.
3. For uniform base and leveling course below structures, refer to Section 02200.3.4.B.

4. At grade or near grade structures are covered in Part 3.3 of this section.

C. Under all pavements, the Contractor shall:

1. Excavate to below subgrade, remove and dispose of organic material and unsuitable soils.

2. Scarify the surface a minimum depth of 8-inches, bring the moisture content to 2 percent above optimum and compact between 90 percent relative compaction.

3. Compact upper 12 inches of pavement subgrade to at least 95% relative compaction.

4. For class 2 aggregate base thickness, refer to Section 02513 Asphalt Concrete Paving.

D. Excavation shall be made to such width outside the lines of the structure to be constructed therein as may be required for proper working methods, the erection of forms and the protection of the work. Care shall be taken to preserve the foundation surfaces shown on the drawings in an undisturbed condition. If the Contractor excavates or disturbs the foundation surfaces shown on the drawings or specified herein without written authorization of the Engineer, the Contractor shall replace at his expense such foundations with compacted gravel foundation fill or other material approved by the Engineer in a manner which will show by test an equal bearing strength with the undisturbed foundation material at no cost to Owner.

E. Bracing, Sheeting, and Shoring: Care shall be exercised in excavating for lower footings not to disturb bearing under higher adjacent footings or structures. Existing structures and pipework shall be adequately braced and cared for so that no damage will result. The Contractor shall submit structural calculations and drawings stamped and signed by a civil or structural engineer registered in the State of California showing members, connections, and anchorage of the proposed bracing, sheeting, and shoring. All bracing, sheeting, and shoring shall conform to CAL/OSHA requirements. The Contractor shall provide suitable sheeting and shoring, where necessary, for protection of the excavations. All such sheeting and shoring shall be removed unless otherwise specifically authorized.

F. Unsuitable Materials: To suit field conditions, excavation below the depths shown may be ordered, but changes may only be made as directed by the Engineer. Soft, spongy, or unsuitable bearing material of any kind shall be entirely removed down to solid bearing soil and replaced with an engineered fill that meets the requirements of Table 2.1 of Section 02200 Earthwork. In such event only the excess excavation and fill will be paid for as extra work.

G. Dewatering: Any water that may be encountered or that may accumulate in excavations shall be removed and kept out by pumping or other approved methods, and all construction shall be carried on in the dry. Water shall be kept down until structures are complete to above water, safe from uplift and horizontal water pressure and the backfill has been placed. Dewatering shall be in accordance with Section 02140.

H. Approval of Excavation: The Contractor shall notify the Engineer when excavation for a structure is complete and no forms, reinforcing steel or concrete, shall be placed until the excavation has been approved by the Engineer. Once the excavation is approved, the Contractor must protect the work from flooding or groundwater uplift.

I. Disposal of Surplus Soil or Soil High in Organics: Excavated material determined by the Engineer to be unsuitable, or in excess of the amounts required for backfill shall be stockpiled or disposed, as follows:

1. Topsoil shall be stockpiled separately from other excavation materials.

2. Removed topsoil shall first be placed and compacted in a 6-inch layer on the surface of filled slopes. Surplus topsoil shall be spread at the surface of the land application area as directed by the Engineer.

3. Surplus excavation may be spread under topsoil at the land application area as directed by the Engineer. Material shall be screened to exclude rocks larger than 4-inches. Rocks shall be disposed offsite.

J. Excavation of Rock/Boulders:

1. Conventional means shall be used to remove rocks, expect isolated boulders exceeding 5 feet in dimension; these will require special excavation techniques (such as chiseling, air tools or rock splitting).

2. Non-explosive techniques are required, including ripping, chiseling, drilling, rock-splitting, etc. Blasting excavation is not allowed.

3.3 ENGINEERED FILL

A. General: All soil under pavements, embankments, and at other locations where indicated on the drawings or identified in this specification or as directed by the Geotechnical Engineer shall be made using engineered fill subgrade, carefully controlled and compacted on a prepared native subgrade. The near-surface, on-site soils consist predominantly of lean and fat clays. These soils shall not be used for engineered fill within the upper 24 inches of subgrades to support the following structures (see Section 3.3.B of the specification):

1. Metering Manhole

B. Imported non-expansive engineered fill in conformance with Table 2.0 shall be compacted in the upper 24 inches (and 3 feet beyond) of subgrade under the above structures.

C. Surface Preparation: The surface on which fill is to be placed shall be free of all vegetation, debris, or other objectionable material, and all large roots shall be grubbed out to a depth of at least 2 feet below footing, slab, or pavement elevations and 5 feet beyond the limits of the proposed improvements. The surface shall be scarified to a depth of 8 inches, brought to a moisture content to 2 percent above optimum and compacted to 90

percent relative compaction. It may be necessary to adjust the moisture content of the subgrade soil by watering or aeration to bring the moisture content of the soil near optimum in order that the specified densities can be obtained.

D. Placement of Fill:

1. Fill materials shall be spread in a maximum of 8-inch loose lifts and shall have a specified uniform moisture content. If necessary to obtain uniform distribution of moisture, water shall be added to each layer by sprinkling and the soil disced, harrowed, or otherwise manipulated after the water is added. If the material is too wet, the moisture content shall be reduced as necessary by spreading and aerating.

2. Field density tests shall be used to check the compaction of the fill materials. Sufficient tests shall be made on each layer by the Engineer to assure adequate compaction throughout the entire area. If the dry densities are not satisfactory, the Contractor will be required to increase the weight of the roller or the number of passes as required to produce the specified densities at no cost to the Owner.

3. Where trenches must be excavated in Engineered Fill these trenches shall be backfilled with the fill materials excavated. The backfill shall be placed in 8-inch layers and each layer compacted with pneumatic tampers to provide densities as specified above. Backfill placed adjacent to walls shall be placed in a similar manner to that specified for backfill in excavated trenches.

4. No fill shall be placed during weather conditions which will alter the moisture content of the fill materials sufficiently to make adequate compaction impossible. After placing operations have been stopped because of adverse weather conditions, no additional fill material shall be placed until the last layer compacted has been checked and found to be compacted to the specified densities.

3.4 BACKFILL AGAINST STRUCTURES

A. Walls for the following listed subsurface structures shall be backfilled with imported non-expansive fill (that meets the requirements of Table 2.0 of this Section):

1. Metering Manhole

B. The zone of non-expansive fill should extend at least 3 feet behind the wall. Engineered fill shall be used beyond the 3 feet non-expansive fill zone. For structures and buildings not listed above, non-expansive fill zone is not needed and engineered fill shall be used for backfill. Alternative to non-expansive fill, well graded sandy gravels such as Caltrans Class 2 aggregate base material could be used for structure backfill upon review and approval by the Geotechnical Engineer. Backfill shall be uniformly moisture conditioned to 2 percent above the optimum moisture content placed in horizontal lifts less than 8 inches in loose thickness and compacted to 90 percent relative compaction.

C. Do not place backfill against newly constructed concrete structures for a period of 14 days unless authorized by the Engineer, and not until the concrete has reached the specified 28-

day compressive strength requirement, as detailed in Specification Section 03100. Hand-held compactors shall be used for backfill against concrete walls within a horizontal distance of H/2 of the structure, where H is defined as the vertical height of the backfill above the foundation.

3.5 ONSITE SOILS

A. On-site soils may be used as an alternative to import fill, only if segregated, stockpiled, and approved for use by geotechnical engineer. Contractor shall perform lab testing to sufficiently determine the percentage of lime needed to meet the specifications. Geotechnical engineer shall observe mixing of lime with soil. Lime treatment shall be done on all segregated soils as specified below.

END OF SECTION

SECTION 02229

UTILITY LINE MARKING

PART 1 GENERAL

1.1 DESCRIPTION

The work of this section consists of furnishing and installing utility line marking, identifying devices for valves, and underground warning tape for buried utilities.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Section 01300: Submittals

B. Section 02200: Earthwork

C. Section 02223: Trenching, Backfilling, and Compacting

D. Section 10400: Identifying Devices

E. Section 15010: General Process and Onsite Utility Piping Provisions

F. Division 16: Electrical

1.3 SUBMITTALS

A. In accordance with Section 01300.

B. Samples: 24-inch strips of tape, 2 surface markers, and valve tags.

C. Certification that the materials used in the tape fabrication meet the requirements of this section.

D. Submit a complete schedule of all surface markers and valve box identification tags.

PART 2 MATERIALS

2.1 MARKING TAPE

A. Capable of being inductively detected electronically.

B. Construction: Metallic foil laminated between two layers of plastic film not less than 2 inches wide. The adhesive shall be colored and be compatible with the foil and film.

C. Film: Inert plastic. Each film layer shall be not less than 0.0005 inch thick (1/2 mil).

D. Foil: Not less than 0.001 inch thick (1 mil).

E. Imprint: ¾-inch or larger bold black letters.

F. Underground warning tape for buried utilities shall be imprinted with the legend identified in the Underground Utilities Schedule found in Part 3 of this Section.

G. Legend: The buried utility line tape shall be identified with imprint such as "CAUTION: SEWER LINE BELOW" and the identification repeated on approximately 24-inch intervals.

H. Detectable marking and warning tape shall be as manufactured by Lineguard, Inc., Paul Potter Associates, both of Wheaton, Illinois; Griffolyn Company, Inc., of Houston, Texas, Carlton Industries of La Grange, Texas; Brady of Milwaukee, WI; and Seton Nameplate of Branford, CT, or approved equal.

2.2 SURFACE MARKERS

A. All piping shall include surface markers:

1. Local stakes (directly above pipe): Carsonite CRM3-072-01 with 4" x 5" anchor bard kit (as distributed by Berntsen International, SURV-KAP Inc., or approved equal).
2. Offset stakes (adjacent to piping): Carsonite Tufflex Utility Marker – purple.

B. Affix the following labels to all piping surface stake markers:

1. For local markers, located directly above piping: affix purple caution decals with white lettering stating– "Caution reclaimed water line, buried below" affixed to all local stakes, #5337-RWL. Also affix decal stating "Underground Service Alert – Call Before You Dig (811)".
2. For offset markers, located adjacent to the piping: affix purple caution decals with white lettering stating – "Caution reclaimed water line, xyz-feet offset", where xyz will be specific to the actual offset distance to the pipe (and represents

the distance, to the nearest foot, measured perpendicular, from the face of the marker post to the center of the piping). Also affix decal stating "Underground Service Alert – Call Before You Dig (811)".

2.3 TRACER WIRE

A. Tracer wire shall be 10 AWG soft drawn solid copper. All tracer wire shall be insulated. Insulation shall be in the color (s) indicated in the Underground Utility Marking Schedule found in Paragraph 3.4 of the Section.

B. Tracer wire shall be brought to the surface at each valve box, fire hydrant, manhole, structure, and any other location indicated in the Project Drawings. Tails shall be able to extend not less than 18 inches above finished grade.

PART 3 EXECUTION

3.1 MARKING TAPE

A. Install tape in backfill directly over each buried utility line, directly above the pipe zone. Multiple strands of tape needed for different sized pipe:

Pipe Size	Tape Strands Required
¾" – 12"	1
15" – 30"	2
36" and larger	3

B. Install warning tape in backfill, with the legend facing up, directly over each buried utility line, directly above the pipe zone, unless otherwise noted on the drawings.

C. Where utilities are buried in a common trench, identify each line by a separate warning tape. Bury tapes side by side directly over the applicable line.

D. Tape color shall conform to typical industry standards.

E. For "Reclaimed Water" pipe, wrap the pipeline with metallic tape, 12-inches minimum width, purple in color labeled "Reclaimed Water". Wrap spirally around the pipe throughout the entire pipe length, with a pitch such that no gap greater then 12-inches exists longitudinally down the pipe. Secure circumferentially at intervals not exceeding 2 pipe diameters with duct tape.

F. For above grade piping identification markers, see specification section 10400.

3.2 SURFACE MARKERS

Outside paved areas, provide stakes for pipelines 14-inch and larger at 250 feet intervals and at all changes in alignment or end or pipe.

3.3 TRACER WIRE

A. Tracer Wire shall be installed for each pipeline indicated in the table below. Tracer wire shall be secured to the top of each pipeline at intervals not to exceed 4 feet.

B. Tracer wire shall be brought to the surface at each valve box, fire hydrant, manhole, structure, and any other location indicated in the Project Drawings. Tails shall be able to extend not less than 18 inches above finished grade.

3.4 UNDERGROUND UTILITY MARKING SCHEDULE

Utility diameter sizes 12-inches and smaller shall have 3-inch wide marking tape, all others shall be 12-inches wide. Underground warning tape shall be color coded as specified below and shall be imprinted with a two-line message. The top shall read, "CAUTION CAUTION..." and the bottom line shall read as indicated below:

Service	Width	Color	Legend	Tracer Wire
Potable Water	3"/12"	Blue	Buried Water Line Below	Blue/Black
Reclaimed Water	3"/12"	Purple	Buried Reclaimed Water Line Below	Purple/Black
Raw Water	3"/12"	Green	Buried Non-Potable Water Below	Black
Treated Water	3"/12"	Green	Buried Non-Potable Water Below	Black
Gravity Sewer	3"/12"	Green	Buried Sewer Below	Green/Black
Sewer Main Force	3"/12"	Green	Buried Sewer Below	Green/Black
Other Non-Potable Water (Sludge, Etc.)	3"/12"	Green	Buried Non-Potable Water Below	Black
Natural Gas/Fuel Oil	3"/12"	Yellow	Buried Gas/Fuel Line Below	Yellow
Compressed Air	3"	Orange	Buried Compressed Air Service Below	N/A
Storm Drain	3"/12"	Green	Buried Storm Drain Below	N/A
Chemical (SHC, SHX, Lime, etc.)	3"	Yellow	Buried Chemical Service Below	N/A

Service	Width	Color	Legend	Tracer Wire
Electric	3”	Red	Buried Electrical Service Below	N/A
Communications/Fiber Optics/Cable/Telephone	3”	Orange	Buried Communications Service Below	N/A
All Others	3”	Yellow	Caution Buried Utility Below	N/A

END OF SECTION

SECTION 02233

WATERING

PART 1 GENERAL

1.1 DESCRIPTION

The work of this section consists of furnishing, hauling, and applying water required in the compaction of embankments, backfills, subgrade, and base course, and for landscaping, dust control, and other construction operations.

PART 2 MATERIALS

2.1 WATER

A. Non-potable water is available at the project site. Use of non-potable water for construction and testing purposes shall be coordinated by the Contractor at the Contractor's expense.

B. Non-potable well water for construction and testing purposes will be available from the Owner at no cost to the Contractor. The Contractor will be allowed to draw water only at the locations approved by the Engineer. The Contractor shall be responsible for coordinating with the Engineer for the use of this water.

C. Potable water is not available at the project site. Potable water for use by the Contractor for Construction or other purposes shall be coordinated by the Contractor at the Contractor’s expense.

D. No provision in this section is intended to prevent the Contractor from making arrangements for water from other than Owner sources. All costs involved shall be the responsibility of the Contractor.

PART 3 EXECUTION

3.1 EQUIPMENT

A. Contractor shall provide all necessary pumping equipment, piping, meters, tanks, and water trucks to withdraw and utilize the water. Water trucks shall be of at least 1,000 gallon

capacity, equipped with a spray bar of ample capacity and design to ensure uniform application of water in the amounts required.

B. The Contractor shall identify all equipment using or hauling “Reclaimed Water” and “Non-Potable Water” to notify workmen of potential for contact. Signage shall be as approved by the Engineer.

END OF SECTION

SECTION 02270

STORMWATER RUNOFF CONTROL PROGRAM

PART 1 GENERAL

1.1 DESCRIPTION

A. This specification section describes requirements for compliance with State Water Resources Control Board (State Board) National Pollutant Discharge Elimination System (NPDES) General Permit for Storm Water Discharges Associated with Construction and Land Disturbance Activities Order No. 2009-009-DWQ (Construction General Permit), as amended by Order No. 2012-006-DWQ and Order No. 2010-014-DWQ. The Construction General Permit contains requirements for the preparation and implementation of a Stormwater Pollution Prevention Plan (SWPPP) to minimize surface water pollution from construction-related activities prior to disturbing a site. Requirements to perform a Risk Assessment, to prepare and implement a Construction Site Monitoring Program (CSMP) and select appropriate Best Management Practices (BMPs) to be employed by the Contractor to reduce or eliminate sediment and other pollutants in stormwater and non-stormwater discharges to local surface waters during all phases of construction are also contained within the Construction General Permit. The Contractor will be responsible for compliance with the Construction General Permit and any other applicable stormwater regulations. The Contractor will be required to produce a SWPPP and CSMP, pursuant to the requirements of the Construction General Permit.

B. The Contractor will be responsible for producing all of the documentation necessary to obtain coverage under the Construction General Permit prior to the commencement of construction activity. The Contractor shall prepare all documentation as specified in Attachment B “Permit Registration Documents (PRDs)" to Comply with the Terms of the General Permit to Discharge Storm Water Associated with Construction Activity General Instructions” of the Construction General Permit.

C. This specification section, in addition to specification Section 02272, details the minimum essential elements of the SWPPP, Risk Assessment and CSMP. The Contractor will be responsible for employing a Qualified SWPPP Developer (QSD) to develop a complete SWPPP that includes all elements set forth in Section XIV, “Storm Water Pollution Prevention Plan”, of the Construction General Permit. In addition, the Contractor will be responsible for implementing a CSMP consistent with the requirements in Attachment C “Risk Level 1 Requirements”, Attachment D “Risk Level 2 Requirements”, or Attachment E “Risk Level 3 Requirements” of the Construction General Permit, and a “Risk Determination Worksheet” included in Appendix 1 of the Construction General Permit.

D. The Contractor will be responsible for complying with all aspects of the Construction General Permit, including the development and implementation of a SWPPP, by a QSD, and CSMP prior to disturbing the site and commencing construction. The initial SWPPP and CSMP must be reviewed and accepted as part of the construction contract by the Engineer before they are considered finalized. Further, all Permit Registration Documents (PRDs) prepared for obtaining coverage under the Construction General Permit must be reviewed and accepted as a part of the construction contract by the Engineer before they are considered finalized for submittal via the Stormwater Multiple Applications and Report Tracking System (SMARTS).

E. Disposal of construction water from operations such as groundwater dewatering and water used for testing, disinfecting, and flushing pipelines is not part of the work under this section. Refer to Sections 02140, and 02223 for permit requirements for those discharges.

1.2 RELATED INFORMATION DESCRIBED ELSEWHERE

A. Section 01010 - General Construction Information and Requirements

B. Section 01300 - Submittals

C. Section 02140 - Dewatering

D. Section 02223 - Trenching, Backfilling, and Compacting

E. Section 02272 - Vegetative Erosion Control

F. California Stormwater Quality Association (CASQA) Stormwater Best Management Practice Handbook, Construction: www.cabmphandbooks.com/construction.asp

G. California Stormwater Quality Association, Construction Site Best Management Practices (BMP) Handbook/Portal, 2019: http://www.casqa.org/LeftNavigation/BMPHandbooksPortal/tabid/200/Default.aspx

H. State Water Resources Control Board Construction Storm Water Program website: http://www.swrcb.ca.gov/water_issues/programs/stormwater/construction.shtml

1.3 STORM WATER DISCHARGES ASSOCIATED WITH CONSTRUCTION ACTIVITY AND LAND DISTURBANCE ACTIVITIES GENERAL PERMIT

A. The Contractor shall read and be familiar with all requirements contained in the Construction General Permit necessary to implement and maintain a viable SWPPP and CSMP. The Contractor shall comply with all the requirements set forth in the Construction General Permit.

B. The Contractor shall note that compliance with the requirements contained in the Construction General Permit may require the use of pollution control procedures outside the limits of immediate construction activity, (e.g., tarping haul truck to prevent fugitive dust or debris).

1.4 NOTICE OF INTENT

To obtain coverage under the Construction General Permit, a Notice of Intent (NOI) must be filed via SMARTS prior to commencement of construction activity. A copy of the completed NOI and Waste Discharge Identification (WDID) Number must be included in the SWPPP. The Contractor shall complete the NOI and provide a copy to the Owner with the completed SWPPP and CSMP, which will ultimately be Certified and filed by Owner. The Contractor shall prepare all documentation as specified in Attachment B "Permit Registration Documents (PRDs) to Comply with the Terms of the General Permit to Discharge Storm Water Associated with Construction Activity General Instructions" of the Construction General Permit. All PRDs must be provided by the Contractor in electronic form for submittal via SMARTS.

1.5 RISK ASSESSMENT

The Contractor shall conduct a Risk Assessment to determine the project's Risk Level using the procedure described in Appendix 1 "Risk Determination Worksheet" of the Construction General Permit. There are two elements used to define the project's overall risk; 1) Project Sediment Risk, and 2) Receiving Water Risk. These two elements are used to further define the project into three risk categories which are identified as Levels 1, 2, and 3. These Risk Levels determine the type and extent of monitoring and reporting as further described in Attachment C "Risk Level 1 Requirements", Attachment D "Risk Level 2 Requirements" and Attachment E "Risk Level 3 Requirements" of the Construction General Permit. The results of the Risk Assessment must be submitted and approved by Engineer prior to uploading to SMARTS. The Risk Assessment shall be included within the PRDs that are submitted electronically via SMARTS.

1.6 SUBMITTALS

A. Within ten (10) calendar days after issuance of the Notice of Award, the Contractor shall submit (as per Section 01300, Submittals), at a minimum, the following information for review and, upon acceptance by the Engineer, incorporation into the SWPPP:

1. SWPPP Compliance Certification-Contractor(s) (form in Caltrans Stormwater Quality BMP Handbook Appendix B);
2. Contractor's Summary of Responsibilities;
3. Erosion Prevention Plan, narrative and detailed graphic (figures shall not be at scales greater than 100 feet per inch);
4. Sediment Control Plan, narrative and detailed graphic (figures shall not be at scales greater than 100 feet per inch);

5. Documentation of Qualifications for the Qualified SWPPP Developer(s) and Qualified SWPPP Practitioner(s) designated for the project;

6. Confirmation that the Contractor has obtained a SMARTS account and appropriate username information;

7. Rain Event Action Plan (REAP), if Risk Level 2 or Risk Level 3 project as described in the Construction General Permit;

8. Project Construction Schedule (refer to Caltrans BMP #SS-1);

9. BMP Selection and Implementation Schedule (refer to Caltrans BMP Handbook or CASQA Stormwater Construction BMP Handbook);

10. Contractor's weather forecast source (i.e., National Weather Service rain gauge or website or Company and report name or on-site rain gauge) for storm event preparation;

11. Hazardous Materials Inventory List with reference to Contractor's Hazardous Materials Business Plan (Federal and County requirement);

12. Safety Plan: Cal OSHA. Title 8, Chapter 4, Subchapter 4 - Construction Safety Orders Sections 1500 through 1938 and Subchapter 7 – General Industrial Safety Orders, with emphasis on chemical handling and storage (refer to www.dir.ca.gov/samples/search/query.htm).

B. The submittal shall detail the Contractor's selected BMPs with brief justification on why that BMP is selected, the intended installation date and location on the site. BMP materials and specifications shall be provided, including, where applicable, reference to BMPs described in the Construction General Permit and specification Section 02272. If the Contractor believes additional or alternative BMPs are necessary, details shall be provided. The Contractor will be required to revise, or supplement, submitted information that is inadequate or incomplete in the opinion of the Engineer.

C. Once the information is compiled, the Contractor will finalize and submit the proposed SWPPP, all Permit Registration Documents, and NOI for coverage under the Construction General Permit to the Owner and Engineer for final acceptance. The SWPPP will be kept on-site for reference in compliance monitoring.

D. The Contractor shall submit all of the PRDs required for submittal of an NOI for coverage under the Construction General Permit to the Engineer for review and acceptance. All PRDs must be provided in an electronic format compatible with SMARTS.

E. In the event the Contractor desires to implement environmental protection BMPs differently than detailed in the Plans and Specifications or the SWPPP, the Contractor may provide a submittal with his alterations/amendments to the Engineer. All alterations or amendments must get prior authorization from the Engineer as outlined in the SWPPP. However, if the Contractor desires to implement alternative BMPs to those detailed exclusively in the SWPPP for an emergency repair to prevent an offsite discharge, he may

do so without prior consent. No schedule delays will be allowed due to BMP revisions proposed by the Contractor, unless authorized by the Owner.

F. Within 90 days of completion of construction activities, the Contractor shall prepare a Notice of Termination (NOT) of coverage under the Construction General Permit for electronic submittal via SMARTS. The Contractor will be responsible for meeting all of the conditions for termination of coverage, as specified in Section II.D of the Construction General Permit and including all of the required items in the NOT.

1.7 MEASUREMENT AND PAYMENT

The Contractor shall be responsible for all costs associated with the development of NOI and Permit Registration Documents, including the SWPPP and CSMP. The Contractor shall be responsible for maintaining and implementing the SWPPP and CSMP consistent with Construction General Permit requirements. This includes the installation, maintenance, and removal of erosion and sediment control practices specified in the SWPPP upon completion of the project or as requested by the Engineer. These costs shall be included in the lump sum bid amount.

PART 2 MATERIALS

2.1 STORMWATER POLLUTION PREVENTION PLAN

A. The Contractor shall utilize all materials as approved and as necessary to implement a successful site-specific SWPPP in accordance with the requirements specified in the Construction General Permit. Refer to specification Section 02272 for materials used in vegetative erosion control and CASQA Construction Stormwater BMP Handbook/Portal for material used in additional BMPs.

B. The Contractor is responsible for appointing a Qualified SWPPP Practitioner (QSP) to implement the BMPs to maintain positive pollution prevention, as described in the SWPPP, in response to the monitoring program reports, or as circumstances require. Materials and the costs thereof, for stormwater pollution prevention, are the responsibility of the Contractor.

PART 3 EXECUTION

3.1 GENERAL

A. The SWPPP, NOI and CSMP shall be provided by the Contractor and submitted to the Owner. The SWPPP and CSMP must be accepted by the Owner and the Engineer prior to commencement of construction activities in the field.

B. The Contractor shall be responsible for employing a Qualified SWPPP Developer (QSD) to compose, revise and certify the SWPPP.

C. The Contractor will provide, at a minimum, site specific information as listed in 1.6 Submittals.

D. Contractor shall provide SWPPP in electronic format suitable for upload to SMARTS (i.e. .doc / .pdf), and shall upload the SWPPP to SMARTS following approval.

E. The Contractor shall comply with all conditions identified in the Construction General Permit, which apply to the work under this contract.

F. The Contractor shall be responsible for the compliance of his personnel and subcontractors with the SWPPP and implementation of the CSMP.

G. The SWPPP (document) shall be kept on site during construction activity and made available upon request of a representative of the State Board, Regional Water Quality Control Board (Regional Water Board), and/or other regulatory agency.

H. The Contractor shall employ BMPs as detailed in the SWPPP during and post construction operations to adequately prevent the discharge of pollutants to surface waters, including the municipal storm sewer system.

I. The Contractor shall be responsible for employing a QSP to oversee implementation of the SWPPP & BMP's to comply with the Construction General Permit.

3.2 STORMWATER POLLUTION PREVENTION PLAN

The SWPPP shall include the required elements set forth in Section XIV, "Storm Water Pollution Prevention Plan", of the Construction General Permit. At a minimum, the SWPPP shall provide a description of potential sources which are likely to add significant quantities of pollutants to stormwater discharges or which may result in non-stormwater discharges from the construction site. The SWPPP, in accordance with this specification section and specification Section 02272, shall also provide guidelines on how to prevent potential pollutants and commingled waters from leaving the site, as well as wind-induced sediment transport. The CSMP shall be included within the SWPPP as an appendix or a separate chapter. Risk assessment worksheets shall also be included within the SWPPP as an appendix or a separate chapter.

3.3 CONSTRUCTION SITE MONITORING PROGRAM

A. The Contractor shall implement the CSMP based on the Risk Level determined during the Risk Assessment. Specific monitoring and reporting requirements are required based on the assigned Risk Level. The Contractor shall also be responsible for monitoring and inspecting his actions and the activities of those responsible to the Contractor.

B. Monitoring and Inspection:

The Contractor will be responsible for maintaining an Activity Log, which includes documentation of the following information:

1. Location (using grid map) of weekly construction activities;
2. Confirmation that the appropriate BMPs have been installed per the respective BMP specifications by a QSP;
3. Confirmation that each BMP is being properly maintained per the respective BMP specifications by a QSP;
4. Any corrective action taken by the Contractor to ensure proper BMP installation and maintenance;
5. Confirmation that proper housekeeping is being maintained at the site;
6. Confirmation that trash/debris is being controlled and properly stored in covered containers;
7. Confirmation that identified oil spills/leaks are being cleaned up and the contaminated waste and soils are being properly stored and disposed of;
8. Evidence that any leaking equipment or vehicles are being taken out of service and repaired prior to continued use; and
9. Records of all Construction General Permit required visual inspections and sample collection.

C. The Contractor's Activity Log input will be reviewed for accuracy and completeness by the Engineer or an assigned representative of the Owner. The logs become a part of the Stormwater SWPPP/CSMP as partial evidence of compliance with stormwater management regulations. Any deficiencies identified by the Engineer will be brought to the Contractor's attention and shall be corrected at no additional cost to the Owner.

D. In addition to the Activity Log, it is the Contractor's responsibility to report to the Owner any discharges immediately after discovery. At the Owner's discretion, the Contractor may be required to notify the appropriate regulatory agency (i.e. Regional Water Board, DHS). These discharges may include, but are not limited to:

1. fuels
2. oils
3. chemicals
4. sanitary wastes
5. process and wash waters
6. sediment laden waters

E. The Contractor shall allow representatives of the Owner, the Agency, the State Board, the Regional Water Board, and/or other regulatory agencies to enter the construction site, inspect the construction site for compliance, and sample and monitor the construction site discharges.

F. The CSMP may extend past the completion date for this contract. The Contractor's responsibilities for the CSMP will cease upon closure of three conditions: 1) acceptance by the Owner of all work under the contract; 2) the Contractor submits information to the Engineer verifying the site meets the criteria for the NOT, which the Contractor will complete for electronic submittal via SMARTS for approval; and 3) final acceptance not given by Owner until the State Board or Regional Water Board issues approval of the NOT.

G. The Contractor will be responsible for implementing an CSMP based on the determined Risk Level consistent with the requirements in Attachment C "Risk Level 1 Requirements", Attachment D "Risk Level 2 Requirements, and Attachment E "Risk Level 3 Requirements" of the Construction General Permit.

H. The Contractor will be responsible for preparing an annual report by September 1 of each year for electronic submittal via SMARTS. Annual reports are required to include all elements identified in Section XVI of the Construction General Permit, including certification of compliance with the requirements specified in Section XVI of the Construction General Permit.

3.4 DUTY TO COMPLY

A. The Contractor shall comply with all conditions identified in the Construction General Permit, SWPPP, and CSMP. Non-adherence with the conditions specified in the Construction General Permit may constitute a violation of the Clean Water Act and the Porter-Cologne Water Quality Control Act and may be grounds for enforcement action by the State, which can carry civil or criminal penalties (some cases under Porter-Cologne exceed CWA penalties of $37,500 per day).

B. The Contractor shall take all reasonable steps to minimize or prevent any discharge in violation of the Construction General Permit.

3.5 COMPLIANCE CERTIFICATION

A. A QSD of the Contractor shall certify the Contractor's stormwater handling roles and responsibilities by signing the "SWPPP Compliance Certification" for the SWPPP (included in Caltrans BMP Handbook Appendix B), as well as annual reports required under the Construction General Permit. The purpose of these forms is to certify that the construction activity is, and has been, in compliance with or has been modified to comply with, the requirements of the Construction General Permit and the SWPPP.

B. During construction, if the Contractor determines that he cannot maintain the site in full compliance with the Construction General Permit and SWPPP requirements, he shall notify the Engineer and Owner immediately. It shall be the responsibility of the Contractor to provide a written Notice of Noncompliance to the Regional Water Board within 30 days of knowledge of the following noncompliant conditions; which the Contractor may need to provide information for:

1. Failure to certify, by July 1 of each year, that the project's construction activities comply with the provisions of the SWPPP and the Construction General Permit;

2. Failure to implement the BMPs listed within the SWPPP, in accordance with the schedule outlined within the SWPPP;

3. Failure to conduct inspection, monitoring and/or reporting as described within the SWPPP; and/or

4. Failure to initiate corrective actions to BMP breaches, failures, and emergency situations.

C. The Contractor shall prepare an annual report by September 1 of each year for electronic submittal via SMARTS. Annual reports are required to include all elements identified in Section XVI of the Construction General Permit, including certification of compliance with the requirements of the Construction General Permit.

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SECTION 02272

VEGETATIVE EROSION CONTROL

PART 1 GENERAL

1.1 DESCRIPTION

The work of this specification section consists of furnishing and installing vegetative erosion control as specified herein. Vegetative erosion control shall be applied on all disturbed areas that are not paved, graveled, lined, or landscaped, including all graded or disturbed areas at the wastewater treatment plan site and access road. This section describes both the vegetative erosion control efforts with and without anchored straw. The approach without straw shall be utilized from May 1st until October 15th and the process utilizing anchored straw from October 15th through April 30th.

1.2 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this section.

B. Planting materials shall meet or exceed the specifications of federal, state, and local laws requiring inspection for plant disease and insect control.

1.3 SUBMITTALS

A. Comply with pertinent provisions of Section 01300.

B. Submit complete materials list of items proposed to be submitted under this section, complete data on source and quality, and sufficient data to demonstrate compliance with the specified requirements.

PART 2 MATERIALS

2.1 FERTILIZER

A. Commercial fertilizer shall be ammonium phosphate (16-20-0) and contain a minimum of 16 percent nitrogen, 20 percent available phosphoric acid, zero percent water soluble potash, uniform in composition, dry and free flowing, pelleted or granular.

B. All fertilizer shall be delivered in unbroken or unopened containers, labeled in accordance with applicable State regulations and bearing the warranty of the producer for the grade furnished.

2.2 SEED

A. All seed shall be delivered to the site tagged and labeled in accordance with the California Agricultural Code, and shall be acceptable to the County Agricultural Commissioner. Seed mixture shall be guaranteed for a minimum of 80% germination.

B. Bag tag figures will be evidence of purity and germination. Time since date of seed test shall not exceed 9 months.

C. Seed shall be of a quality that weed seed shall not exceed 0.5 percent of the aggregate of pure live seed (PLS) (percent germination x percent purity) and other material.

D. Seed shall be a mixture acceptable to the City of Merced and Merced County standards. Mixture shall include following in proportion to application rates:

Grasses and Legumes	Pound/Acre
Fescye (Vulpia myuros)	8
California Brome (Bromus carinatus)	5
Blue Wildrye (Elymus glacus)	5
Meadow Barley (Hordeum brachyantherum)	5
Rose Clover (Trifolium hirtum)	8
Wildflowers	
Yarrow (Achillea millefolium)	2
California Poppy (Eschscholzia californica	2
Tidy Tips (layia fremontii)	2

E. Seed shall be furnished separately or in mixture of the proportionate quantities listed above in standard containers with the variety and net weight shown. Based on bag tags, seeding rates shall be adjusted to insure the required amounts of pure live seed.

2.3 INOCULANTS

A. The inoculant for treating legume seeds shall be a pure culture of Nitrogen fixing bacteria prepared specifically for the plant species and shall not be used later than the date indicated on the container. A mixing medium, as recommended by the manufacturer or approved substitute, shall be used to bond the inoculant to the seed. For nonpellet inoculated seed, two times the amount of the inoculant recommended by the manufacturer shall be used and seed shall be sown within 24 hours.

B. For pellet inoculated seed, at least 30 pounds of inoculant shall be used per 1,000 pounds of raw seed and the seed shall be labeled to show the Lot Number, Expiration Date, and Percent Coat of the finished product. Pellet inoculated seed shall be kept cool and sown within 180 days. Use only fresh, age-dated inoculant specifically labeled for the legume to be seeded.

2.4 WOOD FIBER MULCH

A. Wood fiber shall be a wood cellulose fiber that contains neither germination nor growth inhibiting factors. The wood fiber shall be produced from nonrecycled wood such as wood chips or similar wood materials. It shall be manufactured in such a manner that after addition and agitation in slurry tanks with fertilizer, seed, water, and other approved additives, the fibers in the material will become uniformly suspended to form a homogeneous slurry; and that when hydraulically sprayed on the ground, the material will form a blotter-like ground cover impregnated uniformly with seed; and which after application, will allow the absorption of moisture and allow the rainfall to percolate to the underlying soil. It shall be colored with a nontoxic water-soluble green dye to provide a proper gauge for metering of material over ground surfaces.

B. The wood fiber mulch may also be produced from the following materials:

1. Recycled wood fiber, such as wood chips or similar wood materials;

2. A combination of recycled newsprint and cardboard materials that contain at least 50 percent cardboard; or

3. A combination of recycled newsprint and non-recycled wood fiber or recycled wood fiber materials that does not contain more than 50 percent newsprint.

C. Cellulose shall be certified to indicate that laboratory and field testing of the product has been accomplished and that it meets all of the foregoing requirements based on testing. Weight specifications of this material from suppliers and for all application shall refer only to air dry weight of the fiber material.

D. Absolute air dry weight is based on the normal standards of the Technical Association of the Pulp and Paper Industry for wood cellulose and is considered equivalent to 10% moisture. Each package of the cellulose fiber shall be marked by the manufacturer to show the air dry weight content.

E. Alternate Mulching Methods: Contractor may either stockpile topsoil (or "duffing") and reapply it six inches thick to exposed areas as approved by the Engineer. Or, Contractor may use mechanically punched clean (free of noxious weed seeds and molds), rice barley, or wheat straw with fibers at less than six inches in length, as approved by the Engineer.

2.5 TACKIFIER

Tackifier/soil binder material shall be one of the following and shall have the property to be evenly dispersed and suspended in water when agitated: M-Binder, Sentinel, Ecotak-SAT, Fish-STIK, Soil Master WR, and Soil Sement.

2.6 WATER

See Specification Section 02233 for water availability. Add to the slurry mixture in sufficient amount to spread uniformly the required quantity of hydromulch solids.

2.7 STRAW

Straw shall be new straw derived from rice, wheat, oats, or barley that meets the County Agricultural Commissioner's standards for weed pests. Clearance shall be obtained from the County Agricultural Commissioner, as required by law, before straw obtained outside the county in which it is to be used is delivered to the site.

PART 3 EXECUTION

3.1 APPLICATION PROCEDURE

A. General: Erosion control shall consist of surface preparation, seeding, fertilization, mulching, and maintenance, and potentially irrigation. Prior to October 15th, all vegetative erosion control efforts utilizing the hydroseed technique without straw will be the two-stepped process of applying seed, inoculant (if applicable), fertilizer, water, and wood fiber mulch, followed by second step of more mulch, water and tackifier/soil binder. Post October 15 application shall include a middle step of blown straw, which shall then be anchored. After the Engineer has accepted the graded surface, it shall be seeded and mulched. Seeding shall be done preferably between September 15th and October 15th, however, hydroseeding can be used as a BMP during the construction season prior to September 15th, if appropriate measures are additionally provided for (i.e. eliminate vehicular traffic on area).

B. Site Preparation: Large rocks (2-1/2" or greater) should be removed from the slopes. Any uneven area should be graded so that water will not collect and cause concentrated flows; refer to Caltrans BMP# SS-4: Hydroseeding, for grading prior to hydroseeding. If the soil surface is crusted from a previous rain, then it should be raked or dragged to break it up. Small clods or a rough appearance should not be of concern as they help to hold the seed and the rainfall. Remove all trash, weeds, and other debris.

C. Seedbed preparation shall be suspended when soil moisture conditions are not suitable for obtaining a satisfactory seedbed.

D. Fertilization: Fertilizer shall not be applied more than 15 days prior to seeding. Fertilizer shall be distributed uniformly over the seedbed at the rate of 500 pounds per acre.

E. Fertilizer shall be applied in any way that will result in uniform distribution. It is recommended that fertilizer be applied hydraulically by hydroseeder in the form of a slurry. The slurry shall also contain the required seed, inoculants (if applicable), mulch, and water. Fertilizer shall not remain in the slurry longer than two (2) hours.

F. Seedings: The seed shall be drilled, broadcast, or distributed uniformly in a water slurry by hydroseeder. The seeds shall be covered by approximately ¼- to ½-inch mulch.

G. The hydroseeder shall be equipped with a built-in continuous agitation system of sufficient operating capacity to produce a homogeneous slurry and a discharge system that will apply the slurry to the slopes at a continuous and uniform rate.

H. Seed shall not remain in the slurry longer than 30 minutes. The slurry in this first application shall also contain wood fiber mulch at the rate of 500 pounds per acre and the required fertilizer.

I. Application rates for wood fiber mulch products that have moisture contents greater than 15 percent shall be increased by the following factor, c:

J. $$c = \frac{85\ percent}{percent\ \ fiber\ (\ solids\ )\ in\ \ product}$$

K. The wood fiber shall not remain in the slurry longer than two (2) hours. Water used shall be potable water or Class 1 or 2 agricultural irrigation water.

L. The slurry shall be continuously mixed and shall be mixed for at least five (5) minutes after the last addition before application starts. The slurry shall be applied uniformly over the site at a rate that is nonerosive and minimizes runoff.

M. Mulching Areas Equal to or Greater Than 2:1 Slope (netting installation regardless of application date): Material shall be hand punched straw or wood fiber blankets or bio-composite reinforcing matting. Regions with concentrated flow shall have American Excelsior Curlex Enforcer II or equal while regions with high velocity flows shall have American Excelsior Curlex III or equal. Netting rolls shall be applied up and down the slope with a 4-inch minimum side-to-side overlap and a 3-foot minimum end-to-end overlap.

N. The upper end of the netting shall be buried at least eight (8) inches into the soil. Overlap of matting shall be provided. Anchor pin or staple spacing shall be five (5) feet down sides

and center of rolls driven perpendicularly into soil. Spacing at top end and at end overlaps shall be one (1) foot. If manufacturer installation recommendations are more conservative, manufacturer recommendations take precedence.

O. Mulching Areas Less Than 2:1 Slope (hydromulch seeding installation):

1. General Equipment Requirements: Use hydraulic equipment for the application of the fertilizer, seed, and slurry of prepared wood pulp of the type approved by the Engineer. This equipment shall have a built-in agitation system and operating capacity sufficient to agitate, suspend and homogeneously mix a slurry containing up to 40 pounds of fiber plus combined total of 70 pounds fertilizer solids for each 100 gallons of water. The slurry distribution lines shall be large enough to prevent stoppage and be equipped with a set of hydraulic spray nozzles which will provide a continuous non-fluctuating discharge and delivery of the slurry of the prescribed quantities uniformly, without misses, waste, or erosion. The slurry tank shall have a minimum capacity of 1,000 gallons and be mounted on a traveling unit which may be either self-propelled or drawn with a separate unit which will place the slurry tank and spray nozzles within sufficient proximity to the areas to be seeded so as to provide uniform distribution. The Engineer may allow equipment with smaller tank capacity provided that the equipment has the necessary agitation system and sufficient pump capacity to spray the slurry in a uniform coat.

2. Mulching Application May 1st to October 15th:

   a. Wood fiber with tackifier shall be distributed uniformly over the seeded area in a water slurry by hydroseeder. Application shall be made within 48 hours following seeding.

   b. The hydroseeder shall be equipped with a built-in continuous agitation system of sufficient operating capacity to produce a homogeneous slurry and a discharge system that will apply the slurry to the slopes at a continuous and uniform rate.

   c. The slurry in this second step of application shall contain wood fiber at the rate of 1500 pounds per acre and tackifier. The wood fiber shall not remain in the slurry longer than two (2) hours. Water used shall be potable water or Class 1 or 2 agricultural irrigation water.

   d. Irrigation: Irrigation of hydroseeded regions shall only be mandated if application is prior to September 15th, and early rains caused germination. Irrigation shall continue until natural atmospheric moisture is enough to sustain growth.

3. Mulching Application October 15TH to May 1st:

   a. A straw covering shall be distributed uniformly over the seeded area within 48 hours after seeding. Straw shall be applied at the rate of two (2) tons per acre. The straw shall be applied by hand, blower, or other suitable equipment. If straw is applied by blower, it shall not be chopped in lengths less than six (6) inches.

b. Anchoring The Mulch Mechanically: The straw mulch shall be anchored in place via hand tools, mulching rollers, disks, or similar types of suitable equipment alone or in combination with a hydro-mulch material and shall be performed in a satisfactory manner.

c. Anchoring Straw Mulch With Hydro-Process: All applications from October 15th to May 1st shall utilize a hydro-mulch anchoring process. The hydro-mulch material shall be applied uniformly over the straw in a water slurry by hydroseeder within 48 hours following mulching. The hydromulch shall be wood fiber mulch, a tackifier, and water in the following portions per acre:

Tackifier	Rate (pounds)	Wood Fiber Mulch (pounds)	Water (gallons)
M-Binder	100	150	700
Ecotak-SAT	100	150	700
Sentinel	100	500	2,000
Fish -STIK	60	500	3,000
Soil Master WR	100	250	1,000

1)

d. The hydroseeder shall be equipped with a built-in continuous agitation system of sufficient operating capacity to produce a homogeneous slurry and a discharge system that will apply the slurry to the slopes at a continuous and uniform rate.

e. The materials shall not remain in the slurry longer than two (2) hours. Water used shall be potable water or Class I or 2 agricultural irrigation water.

f. The slurry shall be continuously mixed and shall be mixed for at least five (5) minutes after the last addition before application starts. The slurry shall be applied uniformly over the site at a rate that is non-erosive and minimizes runoff.

P. Preliminary Inspection: Notify the Engineer 48 hours in advance of all seeding. Inspection and favorable review of the completed work shall begin the plant establishment period.

Q. Plant Establishment Maintenance:

1. General plant maintenance shall immediately follow seeding and continue until all seeded areas are 85% germinated and covered with acceptable stands of grass and clover.

2. Protect areas against all damage, including erosion and trespass, and provide proper safeguards. Maintain and keep in good repair all temporary barriers erected to prevent trespass. Check all barriers and temporary fencing daily, and make immediate repairs or replacements.

3. Repair all damage to seeded areas.

4. Contractor shall irrigate as necessary (refer to 3.1.F.2.d) to maintain a minimum moisture of 30% percent to a depth in soil of two (2) inches to ensure vigorous growth.

5. Continue maintenance for at least 45 days or until the grass is established as accepted by Engineer.

R. Initial Inspection for Acceptance: Initial inspection for acceptance will be conducted upon completion of maintenance replacements, and corrective work. Three (3) days notice shall be given. If project improvements, corrective work, and maintenance have not been performed as specified and to the satisfaction of the Engineer, maintenance shall continue at Contractor's expense until such time as work has been successfully completed.

S. Guarantee, Replacement, and Final Acceptance:

1. Guarantee all planting to be in a healthy, thriving condition until the end of the maintenance period.

2. Replace all seeded areas not in vigorous condition as soon as directed by Engineer. Repair any erosion in areas where grass does not become established. Seed mixture used for replacement must be of the same type and quantity as specified in this specification section.

3. Final acceptance requires a four (4) inch high stand of plant material, 200 grass plants/ft^2, and 100% coverage (i.e. no areas larger than one [1] ft^2 with less than the specified coverage).

END OF SECTION

SECTION 02400

SHEETING, WALING, AND SHORING

PART 1 GENERAL

1.1 DESCRIPTION

The work of this section covers protective installations consisting of shores, wales, braces, posts, piling, sheeting, anchorages and fastenings required for the work of this project.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Section 01300 - Submittals

B. Section 02140 - Dewatering

C. Section 02223 - Trenching, Backfilling, and Compacting

1.3 QUALITY ASSURANCE

A. In accordance with Section 01300.

B. Design Criteria. Contractor shall design and construct temporary and permanent sheeting, shoring, and cofferdams, which are to be used as an aid in construction and portions shall be left in permanently to prevent sediment scour. Design shall be prepared in conformance with applicable requirements of Article 6, “Excavations, Trenches, Earthwork” of Construction Safety Orders of California State Division of Occupational Health and Safety. In addition, sheet piling design shall be based on the material requirements specified herein. Sloping of excavations shall not be employed below the groundwater or maximum aqueduct water elevation. Designs shall be prepared and signed by a Civil or Structural Engineer registered in the State of California and shall be based on the stresses for various materials of construction contained in the International Building Code latest Edition and latest supplement. The allowable stresses permitted by the International Building Code may be increased 15 percent for temporary shoring used as an aid to construction.

C. Prior to the start of any work involving sheeting and bracing, the Contractor shall obtain a valid excavation permit from the Cal OSHA District office as required. A copy of the

permit and all accompanying drawings, data, and calculations shall be submitted to the Engineer for record purposes only and not for review or approval.

1.4 SUBMITTALS

A. Submit to the Engineer for record purposes copies of the drawings and calculations used to determine the strength, size, and stability of the protective installations. All designs submitted under this section shall be signed by a Structural or Civil Engineer duly registered in the State of California.

B. Prior to the start of any work involving sheeting and bracing, the Contractor shall obtain a valid excavation permit from the Cal OSHA District office as required. A copy of the permit and all accompanying drawings, data, and calculations shall be submitted to the Engineer for record purposes only and not for review or approval.

1.5 ALTERNATIVES

The use or application of alternative methods and materials, or the employment of propriety systems in lieu of those specified herein, will be allowed if the Contractor demonstrates their suitability in conformance with the design submittal and excavation permitting requirements of Paragraph 1.4 and the quality assurance requirements of Paragraph 1.3. Demonstration of suitability and compliance with these specifications and approval of the Owner shall be required.

PART 2 MATERIALS

2.1 MATERIALS

Sheet Piling – Designated to be left in place.

A. Sheeting shall be continuous interlock type. Steel sheeting shall be made in accordance with ASTM A857 from steel meeting the requirements of ASTM A570, Grade 30. Sheeting shall be hot-dipped galvanized per ASTM A123 at a rate of two ounces per square foot total both sides. The sides of each piece of sheeting shall be furnished with an interlock that is continuous for the full length of the sheeting. The interlock shall have an opening of sufficient width to allow free slippage of the adjoining sheet. Sheeting shall be "Metric Sheeting" as manufactured by Contech Construction Products, Inc.

B. Dimensions and Section Properties. Steel sheet piling used for cofferdams or shall be standard rolled metric sections. The sheeting shall be galvanized after fabrication and have the minimum physical and sectional properties; Physical Properties: 5 gauge (0.209 inches), Sectional Properties: Modulus – 6.28 in 3, Moment of Inertia – 11.04 in 4.

PART 3 EXECUTION

3.1 INSTALLATION

A. General. Install sheeting and bracing for trench and structure excavation as the work requires. Butt planks to and/or interlock sheets to exclude groundwater and fines, preventing the erosion of voids outside sheeting. In soft, wet ground drive sheeting to a lower level as excavation progresses so that sheeting is embedded in undisturbed earth. Bracing of sheet piling may be permitted to penetrate the structural concrete only as approved by the Engineer. Refer to Section 03100. Install wales and struts at close intervals so as to prevent displacement of the surrounding earth and to maintain safe conditions in the work area. Any damage proven to result from improper installation shall be the responsibility of the Contractor.

Temporary sheeting for trench and structure excavation may be removed and re-used. Withdraw individual planks alternatively as the backfill is raised, maintaining sufficient sheeting and bracing to protect the work and workmen. Remove bracing completely. Where unstable conditions occur in the underlying strata from any cause, and withdrawal of sheeting will endanger the work, a portion of the sheeting, including bracing, may be left in place with approval of the Owner. Remove all wood within a zone extending to four (4) feet below finished grade. Leaving such material in place shall not be cause of an increase in Contract in price.

B. Sheet Piling. The Contractor has the option of using steel sheet piling for temporary protective installations. All piling installations shall be continuous.

1. Installation of Sheet Piling. Depth of piling shall be sufficient to prevent heave when the trench is dewatered. Piles shall be driven with a hammer with an adequate capacity to complete pile driving without changing hammers. The use of air or water jets to assist in driving the sheet piling will be permitted, providing that the last 5 feet of advance is by driving. Piles shall be driven accurately to the lines and grades shown or required, with each section interlocked with the sheet piles driven previously. To ensure proper alignment of the sheet piles, a driving template or jig shall be used. If any pile is damaged during driving, it shall be removed and replaced. If piles are driven out of interlock or are not properly plumbed or aligned, the piles shall be pulled and re-driven.

2. Prevention of Damage. In installing, cutting off, or removing sheet piles, every precaution shall be taken to ensure that damage to the structure or pipeline does not occur. If damage does occur, the Contractor shall perform the necessary repairs at his own expense.

3.2 PROTECTION OF EXISTING FACILITIES

It is the Contractor’s responsibility to protect existing facilities from the consequences of his work. Where any sloped excavation infringes on or potentially endangers any existing facilities

or structures, provide shoring, sheeting, and bracing according to shop drawings and calculations signed and stamped by a structural or civil engineer registered in the State of California.

END OF SECTION

SECTION 02513

ASPHALT CONCRETE PAVING

PART 1 GENERAL

1.1 DESCRIPTION

This section includes materials, testing, and installation of asphalt concrete pavement, aggregate base course, herbicide, prime coat, tack coat, and seal coat.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Section 01300 - Submittals

B. Section 02200 – Earthwork

C. Appendix – Geotechnical Reports

1.3 SUBMITTALS

Submit in accordance with Section 01300 copies of a report from a testing laboratory verifying that aggregate material and asphalt binder conform to the specified gradations or characteristics.

1.4 STANDARD SPECIFICATIONS

Where reference is made to State Specifications, reference shall mean California Department of Transportation (Caltrans) Standard Specifications, and, where appropriate, the Merced County Transportation Department Standards.

In case of conflict between any requirements set forth in this Section and any provisions of the Merced County Transportation Department Standards, the most stringent requirement will govern.

PART 2 MATERIALS

2.1 ASPHALT CONCRETE PAVING

Asphalt concrete paving shall conform to Type A in Section 39 of the State Specifications, having ½-inch-maximum medium grading with paving grade asphalt PG 64-(16) (10) unless otherwise directed by the Engineer. Recycled asphalt, reclaimed asphalt paving (RAP) may be used up to 15% of the hot mix asphalt, as defined in Section 39 of State Specifications.

2.2 AGGREGATE BASE COURSE

Aggregate base shall be Class 2 aggregate base, ¾-inch-maximum size per Section 26 of the State Specifications. Aggregate shall contain no detectable asbestos, or recycled materials such as waste concrete or recycled asphalt concrete.

2.3 TACK COAT

Tack coat shall be a paint binder of asphaltic emulsion per Section 94 of State Specifications.

Tack Coat shall conform with Viscosity Grade AR1000 paving asphalt per Section 92 in the State Specifications.

Tack coat shall be Rapid-Setting Type per Section 94 of the State Specifications. Use Slow-Setting Type per Section 94 of the State Specifications if a delay or more than 4 hours is expected between application of tack coat and paving operations.

2.4 ASPHALT BINDER

Asphalt binder to be mixed with the aggregate shall be paving asphalt grade PG 64-(16) (10) conforming to Section 92 of State Specifications.

Asphalt shall be Viscosity Grade PG64-16. Asphalt content in the pavement shall be 5.5% to 6.0%.

2.5 AGGREGATE FOR ASPHALT CONCRETE

Aggregate shall be Type B per Section 39-2.02 of State Specifications. Aggregate shall contain no detectable asbestos.

2.6 SEAL COAT

Seal coat shall be Type II Slurry seal per Section 37 of State Specifications.

2.7 REDWOOD HEADER

Size of redwood headers shall be 2-inches by the depth of the asphalt concrete paving; minimum size shall be 2-inches by 4-inches. Redwood shall be Construction Grade as per California Redwood Association conforming to Sections 57 and 58 of State Specifications) (Construction Heart Grade stamped by the California Lumber Inspection Service.

2.8 HERBICIDE OR WEED KILLER

Use a CalTrans approved herbicide from the approved chemical list.

2.9 PAINT FOR TRAFFIC AND PARKING LOT STRIPING AND MARKING

Provide white thermoplastic paint per Section 84 of the State Specifications.

2.10 GEOTEXTILE FABRIC

Use Amoco 2006 or equal.

PART 3 EXECUTION

3.1 PAVEMENT REMOVAL

A. Initially cut asphalt concrete pavement with pneumatic pavement cutter or other equipment at the limits of the excavation and remove the pavement. After backfilling the excavation, saw cut asphalt concrete pavement to the full depth of pavement at a point not less than 9 inches outside the limits of the excavation or the previous pavement cut, whichever is greater, and remove the additional pavement.

B. Saw cut concrete pavement, including cross gutters, curbs and gutters, sidewalks, and driveways, to the full depth of pavement at a point 1 foot beyond the edge of the excavation and remove the pavement.

The concrete pavement may initially be cut at the limits of the excavation by other methods prior to removal and the saw cut made after backfilling the excavation. If the saw cut falls within 3 feet of a concrete joint or pavement edge, remove the concrete to the joint or edge.

C. Make arrangements for and dispose of the removed pavement.

D. Final pavement saw cuts shall be straight along both sides of trenches, parallel to the pipeline alignment, and provide clean, solid, vertical faces free from loose material. Saw cut and remove damaged or disturbed adjoining pavement. Saw cuts shall be parallel or perpendicular to the pipeline alignment or the roadway centerline, unless otherwise shown on contract drawings.

3.2 PAVEMENT INTERFERENCE:

A. At no cost to the owner, the Contractor will be required to relocate or replace any vaults, boxes, posts, or other facilities which must be disturbed for new construction work and which are required for plant operation, or make other arrangements satisfactory to the Engineer. This includes, but is not limited to, raising or lowering elevations of existing facilities to align with new finish grade.

3.3 PAVEMENT INSTALLATION:

New asphalt concrete pavement installation shall be as follows:

	Pavement Sections		
Name of Streets	**TI**	**AC (inches)**	**AB (inches)**
Parking Areas	5.5	3.0	12.0
Main Roads	6.5	4.0	14.0

Notes: AC = Asphalt Concrete

AB = Class 2 Aggregate Base (R-Value = [29] [79])

3.4 PAVEMENT REPLACEMENT

This project must be in compliance with the 2019 California Green Building Council Standards Code.

3.5 INSTALLATION

Producing, hauling, placing, compacting, and finishing of asphalt concrete shall conform to Section 39 of the State Specifications. Apply seal coat to all paving except open graded asphalt concrete.

3.6 CONNECTIONS WITH EXISTING PAVEMENT

Where new paving joins existing paving, saw cut the existing surfaces 12 inches back from the joint line full depth. Dispose of waste material offsite. Tack prior to placing the asphalt concrete. Meet lines shall be straight and the edges vertical. Paint the edges of meet line cuts with liquid asphalt or emulsified asphalt prior to placing asphalt concrete. After placing the asphalt concrete, seal the meet line by painting with a liquid asphalt or emulsified asphalt and then immediately cover with clean, dry sand.

3.7 PREPARATION OF SUBGRADE

A. Scarify subgrade to a depth of 12 inches below finished subgrade elevation, uniformly moisture conditioned between 2 and 4 percent above optimum and compacted to 95% minimum relative compaction. Shape subgrade to line, grade, and cross section shown in the drawings. The subgrade shall be considered to extend over the full width of the base course.

B. The finished subgrade shall be within a tolerance of 0.05 of a foot of the grade and cross section shown and shall be smooth and free from irregularities and at the specified relative compaction.

3.8 PROOF ROLLING

Proof roll the prepared base material surface to check for unstable areas. Proof rolling shall be accomplished using a water truck or similar equipment with a rear axle load of at least 18,000 pounds with tires inflated to at least 65 psi. Paving work shall begin only after areas have been corrected and are ready to receive paving. The Engineer must be present during proof rolling.

3.9 PLACING AGGREGATE BASE COURSE

Place aggregate base course to a minimum thickness as specified for the roadway. Compact to 95% relative compaction. Install in accordance with Section 26 of the State Specifications.

3.10 COMPACTION OF AGGREGATE BASE AND LEVELING COURSES

Compaction and rolling shall begin at the outer edges of the surfacing and continue toward the center. Apply water uniformly throughout the material to provide moisture for obtaining the specified compaction. Compact each layer to the specified relative compaction before placing the next layer.

3.11 PLACING PRIME COAT

Prime coat shall be installed when warranted by project conditions and as directed by the Engineer. Apply prime coat to the surface of the leveling course of aggregate base at the rate of 0.25 gallon per square yard per Section 39-4.02 in the State Specifications.

3.12 PLACING TACK COAT

Apply tack coat on surfaces to receive finish pavement at the rate of 0.10 gallon per square yard per Section 39-4.02 of State Specifications. Apply tack coat to metal or concrete surfaces that will be in contact with the asphalt concrete paving.

3.13 PLACING ASPHALT PAVING

Install in accordance with Section 39-6 in the State Specifications. Type B mix shall be spread and compacted before temperature of mix drops below 200º F and shall be placed only when the atmospheric temperature is above 50º F.

3.14 COMPACTION OF ASPHALT CONCRETE PAVING

Compact until roller marks are eliminated and a density of 92% minimum to 98% maximum has been attained per ASTM D2041. Compacting equipment shall be vibratory drum rolled or equal conforming to the provisions of Section 39-5.02, "Compacting Equipment" unless Engineer approved alternative compaction equipment.

3.15 APPLYING SEAL COAT

Apply fog seal coat at the rate of 0.10 gallon per square yard.

Apply Slurry seal coat at the rate of 10 to 18 pounds of dry aggregate per square yard.

Apply seal coat, if indicated on the Contract Drawings, and in accordance with Section 37 of the State Specifications.

3.16 JOINTS

A. Where new paving joins existing paving, saw cut the existing surfaces 12 inches back from the joint line full depth. Dispose of waste material offsite. Tack prior to placing the asphalt concrete. Meet lines shall be straight and the edges vertical. Paint the edges of meet line cuts with liquid asphalt or emulsified asphalt prior to placing asphalt concrete. After placing the asphalt concrete, seal the meet line by painting with a liquid asphalt or emulsified asphalt and then immediately cover with clean, dry sand.

B. Place each asphaltic paving layer as continuous as possible to keep the number of joints to a minimum. Create joints between old and new pavement, between successive days work, and where the mixture has become cold (less than 140 degrees F). Make these joints in such a manner as to create a continuous bond between the old and new pavement construction courses. Offset joints in successive, overlaying courses by at least 6 inches.

C. Transverse Joints: If placing of material is discontinued or if material in place becomes cold, make a joint running perpendicular to the direction traveled by the paver. Before placement continues, trim the edge of the previously placed pavement to a straight line perpendicular to the paver and cut back to expose an even vertical surface for the full thickness of the course. When placement continues, position the paver on the transverse joint so that sufficient hot mixture will be spread in order to create a joint after rolling that conforms to the required smoothness. If the temperature of the previously placed pavement material drops below 140 degrees F before paving is resumed, give the exposed vertical face a thin coat of liquid asphalt just before paving is continued.

D. Longitudinal Joints: Coat longitudinal joints that are not completed before the previously laid mixture has cooled to a temperature below 140 degrees F, with liquid asphalt just before paving is continued.

3.17 SURFACE TOLERANCE

A. Finished grades shall not deviate more than 0.01 foot in 12 feet in elevation parallel with the road centerline and 0.02 foot in 12 feet in elevation transverse to the centerline from the grades indicated in the drawings.

B. After paving has been installed and compacted, spray water over the entire paved area. Correct any areas where water collects and does not drain away.

3.18 APPLYING PAINT FOR TRAFFIC AND PARKING LOT STRIPING AND MARKING

Apply in accordance with Section 84 of the State Specifications.

END OF SECTION

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SECTION 02601

MANHOLES AND CLEANOUTS

PART 1 GENERAL

1.1 DESCRIPTION

The work of this section consists of the furnishing of materials and constructing therewith new manholes and cleanouts as shown on the drawings.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Section 01300 - Submittals

B. Section 01666 - Testing of Gravity Sewer Lines and Manholes

C. Section 02223 - Trenching Backfilling and Compacting

D. Section 02225 - Structure Excavation and Backfill

E. Section 03100 - Concrete

F. Section 07110 - Waterproofing

1.3 QUALITY ASSURANCE

Standards, American Association of State Highway and Transportation Officials (AASHTO) and American Society for Testing and Materials (ASTM).

1.4 SUBMITTALS

Shop Drawings and catalog cut sheets shall be submitted for manhole, frames and covers, precast manhole bases and sections, joint sealer, cleanout meter box, pressure clean-out covers, and epoxy lining in accordance with Section 01300.

PART 2 MATERIALS

2.1 FRAMES AND COVERS

A. All castings for manhole frames and covers shall be of tough, uniform quality, gray iron, free from cracks, holes, swells, cold shuts or other defects and be of workmanlike finish. Castings for frames and covers shall conform to the requirements of the "Specifications for Gray Iron Castings," Class 25 (ASTM A48).

B. Horizontal surfaces of manhole cover seats and under surface of the seat cover which rests upon the frame shall be machined. After machining, it shall not be possible to rock any cover after it has been seated in any position in its frame. Manhole frames and covers shall be designed for heavy duty, H-20 traffic loading. All manholes shall be provided with a nominal 24-inch diameter cover unless otherwise noted on the drawings. Manhole frames shall be capable of receiving standard non-shifting manhole extension (riser) rings.

C. Manhole frames and covers shall match the City Standard and manufactured by Phoenix P1090, or equal. The wording in the covers shall include the work "sewer" in the lid.

2.2 PRECAST CONCRETE MANHOLE SECTIONS

Manholes shall be constructed of precast reinforced manhole sections conforming to ASTM C478 and as shown. Precast concrete rings, cones, and flat slabs shall be manufactured by a process that will produce a dense, homogeneous concrete section of first quality. Cement used in all precast sections shall conform to State Specifications "Type II Modified".

2.3 PRECAST MANHOLE BASES

Precast manhole bases as manufactured by Teichert Precast, 8160 Signal Court, Sacramento, CA 95824; Hanson Concrete Products, or equal, may be used, subject to approval.

2.4 PRECAST CONCRETE MANHOLE FLAT LID

A. Designed to meet H-20 loading requirements.

B. Tested in accordance with ASTM C497.

2.5 CONES

All manhole cones shall be eccentric unless otherwise shown on the plans and conform to ASTM designation C478.

2.6 JOINT SEALER

The joint sealer shall be Ram-Nek by K.T. Snyder Company, Inc.; Kent-Seal by Hamilton-Kent, or equal.

2.7 CLEANOUTS

For pedestrian loading (300 psf): Cleanout covers shall be concrete meter box with cover, Brooks No. 36; Christy B9 Utility Box, with B9D lid, or equal.

For traffic loading (H20): Cleanout covers shall be concrete meter box with cover, Brooks No. 3.5-T PB; Christy B1017 utility box with H20 lid, or equal.

2.8 MORTAR

One part Portland cement, 1 part hydrated lime, and 6 parts sand.

2.9 NON-SHRINK GROUT

Shall be non-shrink epoxy type suitable for pressure grouting, Embeco; Master Builders Co., or equal.

2.10 INTERIOR AND EXTERIOR COATINGS

A. Interior: System C, 100% Solids Epoxy, per Specification Section 09900.

B. Exterior: Buried exterior concrete shall be coated with an emulsified asphalt coating, Specification Section 07110.

PART 3 EXECUTION

3.1 SETTING BASES

A. Construct to grades, lines and elevations shown on the drawings or staked in the field. Shape tops of the bases by means of accurate bell-ring forms to receive the barrel section. Wet setting is not permitted. Joint sealer shall be placed on the first joint after the Engineer has approved the manhole base for stacking. The concrete shall cure a minimum of 24 hours before stacking the barrel sections.

Pour foundations on 12-inches of compacted crushed rock wrapped in filter fabric. See section 02200 and standard manhole details.

B. Precast bases shall be placed on 12-inches of compacted crushed rock wrapped in filter fabric. See section 02200 and standard manhole details.

C. Pipe Stubs shall be built into the structures as shown on the plans. The outer ends shall be sealed securely by a removable stopper of the same material as the branch.

3.2 SETTING PRECAST SECTIONS

Precast-reinforced concrete sections shall be set so as to be vertical and with sections in true alignment. Joints shall be primed and made with sealer applied in strict accordance with the manufacturers printed instructions.

3.3 FIELD CONNECTIONS

Openings for field connections shall be made with a motor driven cutting tool which will provide a smooth round opening no more than 3 inches larger than the outside diameter of the pipe being connected. Jack hammers and chipping hammers will not be allowed. Seal field connections with non-shrink grout.

3.4 INTERIOR DROPS

Install interior drops as detailed on the plans.

3.5 INVERT CHANNELS

Smooth and semi-circular in shape conforming to the inside of the adjacent sections. Make changes in flow direction by a smooth curve of radius as large as permitted by manhole size. Make changes in size and grade gradually and evenly. See plans for details.

3.6 SETTING FRAMES AND COVERS

Frames and covers shall be set as detailed on the plans for various locations.

3.7 CLEANOUTS

Installation of cleanouts shall be as detailed on the drawings.

3.8 EPOXY MANHOLES AND WET WELLS

As schedule herein and other locations designated on the contract drawings shall be epoxy lined. Sewer manholes requiring an epoxy lining shall first pass a vacuum test (water testing will not be allowed) and shall then be constructed as follows:

A. The exterior of the manhole, wet well, etc. shall be coated with an asphaltic material and wrapped in 8 mils polyethylene prior to backfilling.

B. All voids and imperfections in the interior of the manhole shall be mortared or "sacked" smooth with a cement paste composed of 50% Portland cement and 50% sand. The mortar mixture shall be manually worked into the dampened surface with sufficient pressure to completely fill voids and imperfections. The surface shall then be finished smooth. This process shall be continued until the entire manhole surface (base, barrel, cone, neck, and joints) is smooth and free of imperfections.

C. Upon receiving the Engineer's approval of the sacking, the outlet channel(s) of the manhole to be epoxied and the first upstream manhole shall be mechanically plugged to prevent water flow. The newly sacked manhole shall cure for a period of 28 days. A visqueen test for the absence of moisture may be required by the Engineer.

D. The epoxy lining may be applied after the 28 day curing period has ended. An accepted method of epoxy application is as follows:

1. Mask off the metal frame.
2. Sandblast the interior concrete surfaces of the sewer manhole.
3. Apply a sealer/primer and allow to cure per the manufacturer's recommendations. Application may be withheld if, in the opinion of the Engineer, the walls of the manhole exceed the recommended moisture content.
4. Apply an approved epoxy to obtain a minimum thickness of 80 mils and allow to cure per the manufacturer's recommendations.
5. Verify the thickness and adherence of the coating samples, to the satisfaction of the Engineer by submittal and testing of samples by an approved lab and complying with ASTM Standards.
6. Repair the sampled areas and allow the repairs to cure.
7. "Spark test" the entire epoxy surface area. The electrode shall provide a minimum of 10,000 volts. Areas failing the spark test shall be removed, repaired, and retested.
8. After approval from the Engineer, remove the masking from the metal frame and use Sika Flex (or approved equal) sealant to caulk the transition joint between the epoxy coating and the metal frame.
9. Use Sika Flex (or approved equal) sealant at the concrete/pipe interface.
10. Remove the plugs.

E. The following shall receive a lining and coating as specified above:

1. Drop manholes;
2. Manholes on sewer service;

3. Manholes on sludge service.

3.9 MANHOLE TESTING

A. Perform testing in the Engineer's presence prior to backfill and interior coating. Notify Engineer at least 48 hours prior to testing.

B. Sewer manholes shall be tested in accordance with the requirements of Section 01666.

END OF SECTION

SECTION 02623

FILTER FABRIC

PART 1 GENERAL

1.1 SUMMARY

Section Includes: Nonwoven Engineering Fabrics (Geotextile).

1.2 REFERENCES

American Society for Testing and Materials (ASTM):

A. D3776 - Test Methods for Mass per Unit Area (Weight) of Fabric

B. D4491 - Test Methods for Water Permeability of Geotextiles by Permittivity

C. D4632 - Test Method for Grab Breaking Load and Elongation of Geotextiles

D. D4833 – Test Method for Index Puncture Resistance of Geotextiles, Geomembranes and Related Products

1.3 DEFINITIONS

Filter Fabric: Nonwoven filter fabric manufactured from polyester, nylon, or polypropylene material, or any combination thereof.

1.4 PROJECT CONDITIONS

Take field measurements to determine the exact lengths and dimensions of the surfaces to receive the fabric.

1.5 SUBMITTALS

A. Product Data.

B. Samples.

C. Quality Control Submittals:

1. Certificates of Compliance.

2. Manufacturer's Instructions.

1.6 DELIVERY, STORAGE, AND HANDLING

Storage and Protection: Furnish engineering fabrics in protective covers capable of protecting the fabric from ultraviolet rays, abrasion, and water.

PART 2 MATERIALS

2.1 MANUFACTURERS

One of the following or equal:

A. Amoco 4550.

B. Mirafi 140N.

2.2 MATERIAL REQUIREMENTS

Physical Properties: Meet the following minimum requirements.

Property [(a)]	Test Method	Requirements
Weight, minimum	ASTM D3776	4.8 ounces per square yard
Grab tensile strength (ultimate)	ASTM D4632	120 pounds
Grab tensile elongation (ultimate)	ASTM D4632	50 percent
Puncture strength	ASTM D4833	40 pounds
Permittivity, minimum	ASTM D4491	1.8 per second

(a) Minimum average roll values.

PART 3 EXECUTION

3.1 PREPARATION

A. Surface Preparation: During grading operations, take care not to disturb or scarify the subgrade. This may require use of lightweight dozers for low strength soils such as saturated, cohesionless, or low cohesion soils. Recompact if subgrade is scarified.

B. Prior to placement of fabric; prepare surface to smooth conditions free of debris, depressions, or obstructions which may damage the fabric.

3.2 INSTALLATION

A. Follow manufacturer's installation instructions and as complemented herein.

B. Place the geotextile fabric smoothly without folds or wrinkles.

C. Use special care when placing the geotextile in contact with the soil so that no void spaces occur between the geotextile and the prepared surface.

D. Overlap the geotextile sheets according to manufacturer's installation.

E. Place drainage aggregate on the geotextile as specified.

3.3 FIELD QUALITY CONTROL

Inspection: Before covering, the conditions of the fabric will be observed by the Engineer to determine that no holes or rips exist in the fabric. Repair all such occurrences by placing a new layer of fabric extending beyond the defect in all directions a distance equal to the minimum overlap required for adjacent rolls.

END OF SECTION

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SECTION 02850

LANDSCAPE ROCK

PART 1 GENERAL

1.1 SUMMARY

Section includes requirements for provision of landscaping ground cover.

1.2 SUBMITTALS

Product Data: Submit rock material source and gradation, per Specification Section 01300. Three samples of not less than 50 pounds per bag shall be provided for Engineer approval of landscaping rock.

PART 2 PRODUCTS

2.1 MATERIALS

Landscaping Rock:

A. Imported landscaping rock to be free from lumps or balls of clay and contain no calcareous coatings, caliche, organic matter, or deleterious substances. Rounded rock is unacceptable, rock shall be crushed angular material with a minimum of 3 angular faces on each piece.

B. Landscaping rock shall be subject to acceptance by the Engineer.

C. Rock material to be from a single source and present a uniform appearance.

D. Landscaping rock grading requirements:

Sieve Size	Percent Passing
2-inch	95 – 100
1-½-inch	85 – 90
1-inch	0 – 10

E. Landscape Fabric: Provide a suitable fabric with a 10-year warranty in this application. Fabric shall be a minimum of 3.5-ounce, poly-spunbound, weed control fabric. Manufactured by DeWitt Company, or equal. Fabric shall be UV resistant, and color shall be earth tone or white.

PART 3 EXECUTION

3.1 EXAMINATION

Verification of Conditions: Verify all site conditions before beginning work.

3.2 PREPARATION

Protection: Prior to beginning work of the Section, protect existing underground installations.

3.3 LANDSCAPE ROCK INSTALLATION

A. Prior to placing landscape rock, grade area to a true and even condition subject to approval by the Engineer. Install fabric, overlap joints a minimum of 12 inches.

B. Provide soil treatment for control of unwanted plant life using one of the following products, or equal:

1. Dupont, Karmex 80W.
2. Drexel Chemical Corps, Diuron 4L

C. Evenly distribute landscaping rock at the designated areas to a minimum depth of 4-inches.

D. After placing and grading landscaping rock, lightly water to remove fine material from the surface.

3.4 PROTECTION

Take special care to prevent erosion from surface drainage from other areas. Repair or replace any damage from such drainage.

END OF SECTION

SECTION 03071

EPOXIES

PART 1 GENERAL

1.1 SUMMARY

Section Includes:

A. Epoxy.

B. Epoxy gel.

C. Epoxy bonding agent.

1.2 RELATED SECTIONS

Section 03072 - Epoxy Resin/Portland Cement Bonding Agent.

1.3 REFERENCES

American Society for Testing and Materials (ASTM):

A. D638 - Standard Test Method for Tensile Properties of Plastics.

B. D695 - Standard Test Method for Compressive Properties of Rigid Plastics.

C. D790 - Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.

1.4 SYSTEM DESCRIPTION

Performance Requirements:

A. Provide epoxy materials that are new and use them within shelf-life limitations set forth by manufacturer.

B. Perform and conduct work of this Section in neat orderly manner.

1.5 SUBMITTALS

A. Product Data: Submit manufacturer's data completely describing epoxy materials.

B. Quality Control Submittals:

1. Manufacturer's installation instructions.

PART 2 MATERIALS

2.1 MATERIALS

A. Epoxy: Water-insensitive 2-part type low viscosity epoxy adhesive material containing 100 percent solids and meeting or exceeding following characteristics when tested in accordance with standards specified: Manufacturers: One of the following or equal:

1. Master Builders, Inc., Concressive Standard LVI.

2. Sika Chemical Corp., Sikadur 35 Hi-Mod LV.

Physical Characteristic	Test Method	Required Results
Tensile Strength	ASTM D638	8,000 pounds per square inch minimum at 14 days and 77 degrees Fahrenheit cure.
Flexure Strength	ASTM D790	11,000 pounds per square inch minimum at 14 days and 77 degrees Fahrenheit cure.
Compressive Strength	ASTM D695	16,000 pounds per square inch minimum at 24 hours and 77 degrees Fahrenheit cure.
Bond Strength	--	Concrete shall fail before failure of epoxy.
Gel Time for 5 Mil Film	--	Four hours maximum at 77 degrees Fahrenheit.
Elongation	ASTM D638	1 percent minimum at 14 days and 77 degrees Fahrenheit.

B. Epoxy Gel: Manufacturers: One of the following or equal:

1. Sika Chemical Corp., Sikadur 31, Hi-Mod Gel.

C. Epoxy Bonding Agent: Manufacturers: One of the following or equal:

1. Master Builders, Inc., Concressive 1001 Liquid LPL.

2. Sika Chemical Corp., Sikadur 32, Hi-Mod.

3. If increased tack time is required for concrete placement, epoxy resin -Portland cement bonding agent as specified in Section 03072 may be used instead of epoxy bonding agent.

D. Non-Shrink Epoxy Grout

1. ASTM C1107, Army COE CRDC 621, Grade B and C.

a. Fluid consistency over a range of 45 degrees to 95 degrees F over a 30 minute working time.

2. Manufacturers

a. Master Builders, Master-Flow 928 Epoxy Grout or equal.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install and cure epoxy materials in accordance with manufacturer's installation instructions.

B. Epoxy:

1. Apply in accordance with manufacturer's installation instructions.

C. Epoxy Gel:

1. Apply in accordance with manufacturer's installation instructions.

2. Use for vertical or overhead work, or where high viscosity epoxy is required.

3. Epoxy gel used for vertical or overhead work may be used for horizontal work.

D. Epoxy Bonding Agent:

1. Apply in accordance with manufacturer's installation instructions.

2. Bonding agent will not be required for filling form tie holes or for normal finishing and patching of similar sized small defects.

END OF SECTION

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SECTION 03072

EPOXY RESIN/PORTLAND CEMENT BONDING AGENT

PART 1 GENERAL

1.1 SUMMARY

Section Includes: Epoxy resin/portland cement bonding agent.

1.2 REFERENCES

A. American Society for Testing of Materials (ASTM):

1. C109 - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or [50-mm] Cube Specimens).
2. C348 - Standard Test Method for Flexural Strength of Hydraulic-Cement Mortars.
3. C496 - Standard Test Method for Splitting Tensile Strength of Cylindrical Concrete Specimens.
4. C882 - Standard Test Method for Bond Strength of Epoxy-Resin Systems Used With Concrete By Slant Shear.

B. Federal Highway Administration (FHWA):

1. Program Report Number: FHWA/RD 86/193.

PART 2 MATERIALS

2.1 MANUFACTURERS

A. Sika Corporation, Lyndhurst, New Jersey, Sika Armatec 110.

B. Substitutions: The use of other than the specified product will be considered providing the Contractor requests its use in writing to the Engineer. This request shall be accompanied by:

1. A certificate of compliance from an approved independent testing laboratory that the proposed substitute product meets or exceeds specified performance criteria, tested in accordance with the specified test standards.

2. Documented proof that the proposed substitute product has a one year proved record of performance of bonding portland cement mortar/concrete to hardened portland cement mortar/concrete, confirmed by actual field tests and fives successful installations that the Engineer can investigate.

2.2 MATERIALS

Epoxy Resin/Portland Cement Adhesive:

A. Component "A" shall be an epoxy resin/water emulsion containing suitable viscosity control agents. It shall not contain butyl glycidyl ether.

B. Component "B" shall be primarily a water solution of a polyamine.

C. Component "C" shall be a blend of selected portland cements and sands.

D. The material shall not contain asbestos.

E. PERFORMANCE CRITERIA

F. Properties of the Mixed Epoxy Resin/Portland Cement Adhesive:

1. Pot Life: 75 to 105 minutes.
2. Contact Time: 24 hours.
3. Color: Dark gray.

G. Properties of the Cured Epoxy Resin/Portland Cement Adhesive:

1. Compressive Strength in Accordance with ASTM C109:
    a. One Day: 810 pounds per square inch minimum.
    b. Seven Days: 6,000 pounds per square inch minimum.
    c. Twenty-Eight Days: 8,000 pounds per square inch minimum.
2. Splitting Tensile Strength in Accordance with ASTM C496:
    a. Twenty-Eight Days: 540 pounds per square inch minimum.
3. Flexural Strength:
    a. 1,100 pounds per square inch minimum in accordance with ASTM C348.

4. Bond Strength in Accordance with ASTM C882 Modified at 14 Days:

    a. Zero Hours Open Time: 1,900 pounds per square inch minimum.

    b. Twenty-Four Hours Open Time: 1,500 pounds per square inch minimum.

5. The epoxy resin/portland cement adhesive shall not produce a vapor barrier.

6. Material must be proven to prevent corrosion of reinforcing steel when tested under the procedures as set forth by the Federal Highway Administration Program Report Number FHWA/RD86/193. Proof shall be in the form of an independent testing laboratory corrosion report showing prevention of corrosion of the reinforcing steel.

PART 3 EXECUTION

3.1 INSTALLATION

A. Mixing the Epoxy Resin: Shake contents of Components "A" and Component "B". Empty all of both components into a clean, dry, mixing pail. Mix thoroughly for 30 seconds with a jiffy paddle on a low-speed with 400 to 600 revolutions per minute drill. Slowly add the entire contents of Component "C" while continuing to mix for a minimum of 3 minutes and until uniform with no lumps. Mix only that quantity that can be applied within its pot life.

B. Placement Procedure:

1. Apply to prepared surface with stiff-bristle brush, broom, or "hopper type" spray equipment:

    a. For Hand Applications: Place fresh, plastic concrete/mortar while the bonding bridge adhesive is wet or dry, up to 24 hours.

    b. For Machine Applications: Allow the bonding bridge adhesive to dry for 12 hours minimum.

C. Adhere to all limitations and cautions for the epoxy resin/portland cement adhesive in the manufacturers current printed literature.

3.2 CLEANING

Leave finished work and work area in a neat, clean condition without evidence of spillovers onto adjacent areas.

END OF SECTION

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SECTION 03100

CONCRETE

PART 1 GENERAL

1.1 DESCRIPTION

This section describes the submittal, material, installation, and testing requirements for furnishing and placing formwork, reinforcement, waterstops, and concrete. It also describes finishing and curing requirements, placement tolerances, and testing and repair procedures.

Except as otherwise provided herein, the design and erection shall be in accordance with the applicable provisions of the latest ACI 318 and the concrete "Manual of Concrete Practice".

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Section 01300 - Submittals

B. Section 02200 - Earthwork

C. Section 02225 - Structure Excavation & Backfill

D. Section 03071 - Epoxies

E. Section 03072 – Epoxy Resin/Portland Cement Bonding Agent

F. Section 03480 - Precast Utility Vaults and Catch Basins

G. Section 03700 - Concrete Saw Cutting and Core Drilling

H. Section 05120 - Structural Steel

I. Section 05500 - Metal Fabrications

J. Section 07110 - Waterproofing

K. Section 09900 - Painting

1.3 GOVERNING CODES AND STANDARDS

Furnish and install concrete in conformance with the current following standards:

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

B. ACI-350 - Code Requirements for Environmental Engineering Concrete Structures

C. ACI - American Concrete Institute, Manual of Concrete Practice (MCP), Latest Edition, Applicable Standards

D. CRSI - Concrete Reinforcing Steel Institute

E. SS90 - Caltrans Standard Specification Section 90

F. ASTM - Applicable Standards

G. CCRL - Cement and Concrete Reference Laboratory

H. SEAOC - Structural Engineers Association of California

I. CBC – 2019 California Building Code

1.4 SUBMITTALS: In accordance with Section 01300.

A. Formwork Shop Drawings

1. Before starting concrete work, submit shop drawings of formwork showing size and thickness of members, dimensions and locations of openings and blockouts, vertical limits of concrete placements, horizontal lifts, plywood form pattern, proposed construction joints, form tie elevations and details, and any architectural features to be cast into the concrete. Incorporate the work of all trades.

2. This review is for the purpose of assessing the Contractor's interpretation of the Contract Documents and will not include any considerations of the availability, suitability, constructability, or safety of concrete forming system.

3. Drawings and structural calculations for all concrete other than slabs on grade shall be submitted for record purposes only and not for review or approval. Formwork drawings and structural calculations shall be signed and sealed by a Civil or Structural Engineer registered in California. Where superplastizers are used with Engineer's approval, design formwork to resist full liquid head.

4. The Contractor shall be solely responsible for the design, installation, use, and safe removal of all formwork. The formwork design shall comply with all governing

codes, all Federal, State, and local ordinances; and generally accepted engineering principles.

5. Submit drawings showing the installation and removal sequence and procedures to be used. Include weight of formwork, assumed construction load, proposed minimum concrete strength for stripping of formwork, size and type of reshores, reshore spacing pattern, number of levels of reshores, and assumed load per reshore at each level.

B. Concrete

1. Prepare and submit proposed mix designs along with trial batch test results with a minimum of three test cylinders or a series of production compression tests with a minimum of 20 sets of test data within the last year. All test results shall be signed by a laboratory currently certified by CCRL and actively participating in their sample proficiency program verifying that the components and final products meet the requirements of ACI MCP and these specifications. Mix designs shall include fine, coarse, and combined aggregate gradations.

2. Provide certificates that the cement used complies with ASTM C150 and these specifications.

3. Provide delivery tickets for ready-mix concrete or weighmaster certificates per ASTM C94, including cement weights, aggregate size, the amount of water added at the plant and record of pours. Record the amount of water added on the job on the delivery ticket. Water added at the plant shall account for moisture in both the coarse and fine aggregates.

4. Provide certificate of compliance from the manufacturer of the concrete admixtures with these specifications.

5. Submit concrete drying shrinkage test data along with mix design submittals for concrete with required 28 day compressive strength of 4000 psi and above. Test shall comply with ASTM C157 as modified by SEAOC. The maximum limit for drying shrinkage shall be 0.045% for mix design and 0.058% for field cast after 28 days of drying after the wet cure period.

C. Reinforcing Steel Shop Drawings

1. Before starting concrete work, submit drawings complying with requirements of ACI MCP (latest edition), detailed in accordance with ACI SP66, and adapted to the proposed placement schedule, showing size, dimension, bending, placing, and construction joint details. Submit drawing showing locations of all construction joints. Submit type, size, and location of all slab and bar supports. Submit all reinforcement for a particular structure as a single complete submittal package. Shop fabrication shall not begin until corrected drawings bearing the Engineer's review stamp are returned in accordance with Section 01300.

2. The Contractor shall be wholly and completely responsible for the accuracy of the lists and for furnishing and placing reinforcing steel in accordance with the details shown on the plans and as specified.

3. Submit certified copies of mill test reports for each lot or heat of all reinforcing steel.

D. Shoring: If shoring the structure is required, submit drawings and structural calculations signed and sealed by a Civil or Structural Engineer registered in the State of California showing anticipated loads, members, connections, and anchorage of the proposed shoring system. The submittal is for record purposes only and not for review or approval.

E. Concrete Joints, Waterstops, and Epoxy Bonding Compound

1. Submit manufacturer's literature, catalog data, and statement of compliance with referenced standard and specifications for materials specified herein.

2. Submit material samples of PVC waterstops.

3. Provide technical data sheets for the Contractor's personnel and the Owner covering joint preparation, priming, and sealant materials application.

4. Submit layouts for construction and expansion joints and proposed pour sequence. Unless otherwise noted, maximum length or width of one pour is 30 feet and a maximum area of 900 sf. Where walls meet at a corner, the maximum length of wall from the corner to a construction or expansion joint is 20 feet.

5. Provide epoxy bonding compound manufacturer's specific instructions for use. Provide manufacturer's certifications as to suitability of product to meet job requirements with regard to surface preparation, pot life, set time, vertical or horizontal application, corrosive and/or submerged environments and forming restrictions.

PART 2 MATERIALS

2.1 CONCRETE

A. General: Materials shall conform to Standard Specifications, this specification, and as approved by the Engineer.

B. Portland Cement: Use domestic portland cement that conforms to Standard Specifications "Type II Modified/Type V". Use only one brand of cement in any individual structure. Do not use cement that is damaged, partially set, lumpy, or caked. Reject the entire contents of the sack or container that contains such cement. Do not use salvaged or reclaimed concrete.

C. Water: Water for washing aggregates and for mixing and curing concrete shall be clean, free from oil, acid, alkalies, vegetable matter, or other deleterious substances. No salt or sea water or water containing excessive amount of sodium sulphate, magnesium sulphate or magnesium chloride shall be used.

D. Coarse Aggregate: The coarse aggregate shall consist of clean, hard, dense, tough and durable natural gravel, crushed gravel, or crushed rock, conforming to Standard Specifications. It shall be free from oil, organic matter or other deleterious substances.

E. Fine Aggregate: Fine aggregate shall consist of hard, durable, uncoated natural sand or other approved material, conforming to Standard Specifications. It shall be free from oil or other deleterious substances.

F. Fly Ash: Fly ash shall conform to ASTM C618, Class F or N, except that the loss on ignition shall be limited to 1%.

G. Admixtures

1. A water reducing agent such as Pozzolith, WRDA, or equal shall be used in all concrete. The admixture shall conform to ASTM C494, Type A. Proportioning and mixing shall be as recommended by the manufacturer.

2. Admixtures causing retarded/accelerated setting of cement in concrete shall not be used.

3. Air entraining admixtures with demonstrated compatibility with the concrete mix shall be used as required as a moderate addition to the water reducing agent to obtain the specified percent air in the resultant concrete. The Contractor shall submit data verifying that the admixtures are compatible with the mix. Air-entraining admixture shall conform to ASTM C260.

4. Shrinkage-reducing admixtures may be allowed to minimize the drying shrinkage of concrete. Manufacturer's recommendation's should be strictly followed with regard to dosage and suitability for use in freezing-and-thawing environments.

2.2 REINFORCING

A. Reinforcing Steel Bars: Deformed Bars shall be in accordance with ASTM A615, including Supplementary Requirement S1, Grade 60, and free from rust, scale, oil, or frost. No. 3 bars may be Grade 40.

B. Welded Wire Fabric: Shall be of gauge and mesh size shown and shall meet the requirements of ASTM A185 for plain wire fabric or ASTM A497 for deformed wire fabric. Wire fabric shall be free from rust, scale, oil, and frost.

C. Reinforcement supported from formwork shall rest on Class 1 (plastic protected) bar supports, as specified in "Manual of Standard Practice" by the Concrete Reinforcing Steel Institute (CRSI), Chapter 3.

Reinforcement supported from the ground shall rest on 3-inch high precast concrete blocks not less than 4 inches square, and having a compressive strength equal to the specified compressive strength of the concrete being placed. The precast blocks shall have been

cured as specified for concrete and shall contain soft steel wires embedded therein for fastening to the reinforcing.

D. Details of concrete reinforcement not shown on drawings shall be in accordance with CRSI Manual of Standard Practice.

2.3 REINFORCING BAR COUPLERS

Reinforcing bar couplers shall be internally threaded to receive future threaded reinforcing bars or couplers. The couplers shall be cold-forged to the reinforcing bars or shall be internally threaded to receive threaded reinforcing bars. The ends of the reinforcing bars shall be upset before threading. Reinforcing bars not upset before threading may be used provided the bar size is increased one bar size. The entire assembly shall be capable of developing, in tension and compression, at least 125 percent of the specified yield strength of the bar. Provide plastic screw-caps to protect internal coupler threads. The couplers shall be of Lenton or equal.

2.4 PATCHING GROUT (Dry Pack)

Patching grout shall consist of neat Portland cement, water, and sand passing a No. 8 sieve. The ratio of cement to sand shall be one part Portland cement to two parts sand. Add sufficient water to form a damp formable consistency.

2.5 FORM RELEASE

Form release shall be non-staining and in accordance with Corps of Engineers Specification CE 204 Section 3.03K. Burke Release #1 V.O.C. manufactured by Edoco, or equal.

2.6 NONSHRINK GROUT

Nonshrink grout shall conform to the ASTM-C1107 for Nonshrink Grout, and to these specifications. Use a nongas-liberating type, cement base, premixed product requiring only the addition of water for the required consistency. Grout shall be Masterflow 713, as manufactured by Master Builders Company, Cleveland, OH, Upcon by Upco Co., Cleveland, OH, or equal.

2.7 EPOXY GROUT

See Section 03071 for material requirements.

2.8 JOINT SEALANT

Joint sealant shall be a single component, gray, nonstaining, nonsagging, gun-grade polyurethane sealant, and shall meet ASTM C920 for vertical and horizontal joints and, in addition, is

recommended by the manufacturer for continuous immersion in water. Sealant shall be MasterSeal NP1 by BASF, Sikaflex-1a by Sika Corporation, or equal.

2.9 BACKING ROD FOR EXPANSION JOINTS

Backing rod shall be an extruded closed-cell polyethylene foam rod compatible with joint sealant and as recommended by sealant manufacturer.

The rod shall be ¼-inch larger in diameter than the joint width. Where possible, provide full length sections for the joint and minimize splices. Apply backing rod and bond breaker tape in expansion joints.

2.10 BOND BREAKER TAPE

Bond breaker tape shall be an adhesive-backed glazed butyl or polyethylene tape which will adhere to the premolded joint material or concrete surface. The tape shall be the same width as the joint. The tape shall be compatible with the sealant.

2.11 EXPANSION JOINT FILLERS (Walkways and Sidewalks)

Asphalt impregnated, premolded type, ASTM D1751, ½-inch by depth of slab minus ½-inch.

2.12 PREMOLDED JOINT FILLER

Joint filler shall be preformed, non-extruded type constructed of closed-cell neoprene conforming to ASTM D1752, Type I, as manufactured by W. R. Grace Company of Cambridge, MA; W. R. Meadows, Inc., Elgin, IL; or equal.

2.13 STEEL EXPANSION JOINT DOWELS

Steel expansion joint dowels shall conform to one of the following:

A. Epoxy coated steel bar dowels with a 12-mil coating thickness. Steel bar dowels shall conform to ASTM A36 or ASTM A615, plain rounds, Grade 60. Epoxy coating shall be in conformance with ASTM A775; or,

B. Stainless-steel bar dowels conforming to ASTM A276, Type 302.

2.14 EXPANDED POLYSTYRENE FILLER BLOCK

Expanded polystyrene filler blocks for future construction and expansion joints shall be Styrofoam SM brand as manufactured by Dow Chemical Company, or equal.

2.15 PREFORMED CONTROL JOINT

Preformed control joint shall be a one-piece, flexible, PVC joint former, such as Kold-Seal Zip-Per Strip KSF-150-50-50, manufactured by Vinylex, Corp., Knoxville, Tennessee, or a one-piece steel strip with preformed groove, such as Keyed Kold Retained Kap, manufactured by Burke Concrete Accessories, Inc., San Mateo, CA, or equal. Provide the preformed control joint material in full length unspliced pieces.

2.16 PVC WATERSTOPS

Waterstops shall be extruded from a PVC compound and shall be lock-rib, center-bulb or flat-strip type as manufactured by Greenstreak, Specon, Inc., JPSpecialties, Inc., or equal. Waterstop shall comply with Corps of Engineers Specification CRD-C-572. Waterstops shall be of the dimensions and profile as shown in the drawings.

Waterstops shall be extruded from virgin elastomeric PVC compound, resistant to chemical action with Portland cement, alkalies, acids, and not affected by mildew or fungi. It shall show no effect when immersed for 10 days in a 10% solution of sulfuric or hydrochloric acid, saturated lime solution or salt water. Waterstops shall be such that any cross section will be dense, homogeneous, and free from porosity and other imperfections. Waterstops shall be symmetrical in shape. When tested in accordance with Federal Standard No. 601, the material shall meet the following minimum requirements:

Minimum Requirement	ASTM Specification
Tensile Strength, 2000 psi	D638
Shore hardness A15, 60-80	D2240
Ultimate elongation, 300%	D638
Water absorption, 0.15	D570
Specific gravity, 1.3	D792
Stiffness in flexure, 700 psi	D747
Low temperature brittleness, -35 degrees F	D746
Tear Resistance, 300 lb/in	D624

2.17 BENTONITE WATERSTOPS

Where identified on the pipe penetration drawings, bentonite waterstops shall be bentonite strips,

Volclay “Water Stop-RX”, or equal. Bentonite waterstops shall not be used for structural construction joints unless approved by the Engineer.

2.18 FLOOR HARDENER

Liqui-Hard by W.R. Meadows; Lapidolith by Sonneborn Building Products, Division of Contech, Inc., Minneapolis, Minnesota, or equal. Hardener shall be compatible with curing method used.

2.19 ADHESIVE ANCHORS

Anchors called out on Contract Drawings as epoxy anchor, adhesive anchor or chemical anchors shall be stainless steel threaded rods, nuts, and washers (per respective ICC-ES reports) or Grade 60 rebar for epoxy dowels in two component resin adhesive. Adhesive shall be Simpson Set-XP Epoxy, HILTI RE 500-V3, or equal. Adhesive anchors shall meet the cracked section requirements of CBC 2019 and be suitable for submerged and corrosive environments.

2.20 STRUCTURAL ANCHORS

A. Anchors called out on the Contract Drawings as expansion anchors (EA), expansion bolt (EB), or wedge anchor (WA) shall be stainless steel ITW Redhead Trubolt+, HILTI Kwikbolt TZ, or equal.

B. Adhesive anchors may be substituted for structural anchors if approved by the Engineer.

2.21 CURING MATERIALS

A. Sheet Materials: ASTM C171, 4 mil polyethylene film or waterproof paper.

B. Spray Applied Membrane Forming Liquids: Meet or exceed requirements of ASTM C309, Type 1-D, Class B, except that the loss of water, when tested, shall be not more than 0.15 kilograms per square meter in 24 hours, nor more than 0.45 kilograms per square meter in 72 hours. Shall be a water-base, resin cure with fugitive dye, meeting California Air Regulation Board requirements. Products by Burke, W.R. Meadows, Inc., or equal.

Material shall only be allowed on concrete not scheduled to be coated.

C. Burlap Mats: Burlap mats shall conform to AASHTO M182.

2.22 FORM TIES

A. Notify Engineer 48 hours prior to placement of concrete. Concrete shall not be placed until Engineer has reviewed and approved the placement of all reinforcing steel.

B. Locate form ties on exposed surfaces in a uniform pattern or as indicated on the drawings. Construct form ties so that the ties remain embedded in the concrete except for a removable portion at each end and do not leave an open hole through the concrete. Form ties shall have conical or spherical type inserts with a maximum diameter of 1 inch. Construct form ties so that no metal is within 1 inch of the concrete surface when the forms, inserts, and tie ends are removed. Do not use wire ties. Ties shall withstand all pressures and maintain forms within acceptable deflection limits.

C. Flat bar ties for panel forms shall have plastic or rubber inserts having a minimum depth of 1 inch and sufficient dimensions to permit patching of the tie hole.

D. Ties for water-holding structures or dry structures with access, such as basements or pipe galleries that are below finish grade shall have an integral steel waterstop that is tightly and continuously welded to the tie. The waterstop shall be at least two times larger in the area than the tie cross-sectional area and shall be oriented perpendicular to the tie and symmetrical about the center of the tie. Construct the ties to provide a positive means of preventing rotation or disturbance of the center portion of the tie during removal of the ends.

E. Tapered form ties are allowed for dry structures only that are above finish grade and shall be tapered through-bolts at least 1 inch in diameter at the smallest end or through-bolts that utilize a removable tapered sleeve of the same minimum size.

2.23 BONDING AGENT

See Section 03071 for material requirements.

2.24 CONCRETE GROUT

Grout shall have a minimum compressive strength of 4000 psi at 28 days and shall consist of Portland cement, fine aggregate, coarse aggregate, and air entraining agent, and water which shall conform to the requirements of Section 90 of the Standard Specifications, as modified herein. Grout shall contain a minimum of seven sacks (658 pounds of Portland cement) per cubic yard. Maximum slump shall be four (4) inches. Coarse aggregate shall be 3/8-inch pea gravel. Grading shall be set forth in Section 90 of the Standard Specifications.

PART 3 EXECUTION

3.1 SAFETY REGULATIONS

Comply with all applicable safety regulations including the requirements of "The Construction Safety Orders" of the State of California and the provisions of OSHA.

3.2 CONCRETE MIX COMPOSITION

A. Concrete Composition: Concrete shall consist of Portland cement, fine aggregate, coarse aggregate, an air entraining agent, and water which shall conform to the requirements of Section 90 of the Standard Specifications, and as modified herein.

B. Submittal of Proposed Mix Design

1. The proposed mix design, with samples of rock aggregate and any admixtures to be used, shall be submitted in accordance with Section 01300.

2. Samples of fine and coarse aggregate and any admixtures to be uses in concrete, shall be submitted along with the concrete mix design submittal.

3. The grading or proportioning of the fine and coarse aggregates in the mix shall be changed whenever necessary or desirable, in the opinion of the Engineer, to secure the required economy, workability, density, impermeability or strength, and no additional compensation because of such changes shall be allowed.

C. Concrete Designations: Concrete will be designated as shown in the table below and subsequent sections.

Type of Use	Concrete Class	Maximum Aggregate Size (inches)	Minimum Compression Strength at 28 Days (psi)	Slump (inches)	Max. Water Cementitious Ratio (by weight)	Entrained Air Required (%)
LIQUID CONTAINING STRUCTURES:						
Slabs & Footings on grade	1	1 ½	4000	3 max	0.45	4-½ ± 1-½
Vertical Wall Sections and Columns	1	1	4000	4 max	0.45	4-½ ± 1-½
Mass Concrete and Unformed Slopes	1	1	4000	2 max	0.45	4-½ ± 1-½
OTHER STRUCTURAL CONCRETE:						

Interior and Exterior Slabs, Footings, Caissons, and Pipe Encasements	1	1 ½	4000	3 max	0.45	3 ± 1-½
Vertical Wall Sections and Columns	1	1	4000	4 max	0.45	3 ±1-½
Curbs, Gutters, Sidewalks, Mowing Strips, Fence Posts	3	1	2500	4 max	0.55	3 ±1-½
Thrust Blocks, Concrete Fill	4	1	2000	4 max	0.60	-----
Concrete Lined Channels	2	¾"	3000	3 ½	0.60	5 + 1

D. Concrete Class:

1. Class 1 concrete shall contain a minimum of 675 pounds of cementitious material per cubic yard.

2. Class 2 concrete shall contain a minimum of 590 pounds of cementitious material per cubic yard.

3. Class 3 concrete shall contain a minimum of 505 pounds of cementitious material per cubic yard.

4. Class 4 concrete shall contain a minimum of 420 pounds of cementitious material per cubic yard.

5. Fiberous reinforced concrete shall contain a minimum of 590 pounds of cementitious material per cubic yard. Cementitious material shall be as defined in Section 90 of Standard Specifications.

E. Concrete Compressive Strength

1. Whenever the 28-day compressive strength shown on the plans is 3,500 pounds per square inch or greater, the concrete shall be considered to be designated by compressive strength.

2. When the concrete is designated by compressive strength the mix proportions shall be determined and concrete shall be furnished which contains not less than 675 pounds and not more than 800 pounds of cementitious material per cubic yard of concrete and which conforms to the strengths shown on the plans or as specified.

3. Batch proportions shall be adjusted as necessary to produce concrete having the specified cement factor.

F. Fly Ash: The Contractor may at his option substitute up to 15 percent by weight of fly ash for the cementitious material required herein except where high early strength is specified or where the use of fly ash is prohibited.

G. Aggregate Sizing

1. Coarse aggregate maximum grading shall be as specified in the table above. Grading shall be as set forth in Section 90 of the Standard Specifications.

2. Where the spacing of reinforcing bars is such as to result in minimum clearances, or in other locations where in the opinion of the Engineer difficulties may be experienced in pouring concrete with 1½-inch maximum size aggregate, concrete with 1-inch maximum size aggregate shall be used. In this event the air content shall be increased by ½ %.

3.3 MEASURING MATERIALS

Materials shall be measured by weighing except as otherwise specified or where other methods are specifically authorized by the Engineer. Scales shall be approved by the Engineer and have been certified by the local Sealer of Weights and Measures within one year of use. Each size of aggregate and the cement shall be weighed separately. The accuracy of all weighing devices shall be such that successive quantities can be measured to within one percent of the desired amount. Cement in standard packages (sacks) need not be weighed, but bulk cement and fractional packages shall be weighed.

3.4 CONCRETE MIXING AND DELIVERY

A. All concrete shall be machine mixed at the site, or delivered to the site by transit mixers under conditions approved by the Engineer.

B. No concrete shall be placed in the work after it has started to set. No concrete can be placed more than one hour after it has been mixed.

C. If transit mix is used, the rate of delivery, haul time, mixing time and hopper capacity shall be such that all mixed concrete delivered shall be placed in the forms within one hour from the time of introduction of cement and water to the mixer. All concrete shall be kept continuously agitated until discharged in the hopper at the job site.

D. Ready-mixed concrete shall be batched, mixed, and transported in accordance with ASTM C94 and Chapter 7 of ACI 301. Plant equipment and facilities shall conform to the "Check List for Certification of Ready Mixed Concrete Production Facilities" of the National Ready Mixed Concrete Association.

E. Trucks rejected based on time limit or required test(s) failure shall not return with new concrete to the jobsite within three hours unless approved by the Engineer.

3.5 CONCRETE HANDLING AND PLACEMENT

A. Excavations and Formwork

1. Excavations shall be kept free from water while concrete is being placed, cured and finished therein. Fresh concrete shall be protected at all times from running water.

2. The order of placing concrete in all parts of the work shall be acceptable to the Engineer. In order to minimize the effects of shrinkage, the concrete shall be placed in units as bounded by construction joints shown. The placing of units shall be done by placing alternate units in a manner such that each unit placed shall have cured at least 14 days before the contiguous unit or units are placed.

3. Before placing concrete, all form work shall be cleaned of dirt and construction debris, water-drained, reinforcement securely and properly fastened in its correct position, forms at construction joints re-tightened, all ducts, sleeves, hangers, pipes, conduits, bolts, wires, etc., installed.

4. No concrete shall be placed before the forms and all work that is to be embedded have been set and observed by the Engineer.

5. All formwork and scaffolding shall comply to OSHA safety standards as given in Section 3.1.

B. Concrete Placement

1. Notify Engineer 48 hours prior to placement of concrete. Concrete shall not be placed until Engineer has reviewed and approved the placement of all reinforcing.

2. The working schedule and schedule of placement shall be as shown on the plans and worked out in conjunction with the Engineer. The schedule shall be worked out prior to commencement of work, and shall be rigidly adhered to.

3. Concrete shall be conveyed from the mixer to the place of final deposit as rapidly as practicable by methods which will prevent the separation or loss of the materials. The concrete shall be deposited in the forms as nearly as practicable in its final position to avoid rehandling. Use of vibrators for extensive shifting of the mass of fresh concrete will not be permitted.

4. Concrete shall be placed and consolidated by methods that will not cause segregation of the aggregates and will result in a dense homogeneous concrete which is free of voids and rock pockets. All concrete shall be used while fresh and before it has taken an initial set. Retempering any partially hardened concrete with additional water will not be permitted.

5. Surfaces on which concrete is to be placed shall be dampened with water immediately before placing concrete.

6. Concrete shall not be deposited on frozen or ice-coated ground nor on ice-coated forms, reinforcing steel, embedded items or construction joints.

7. Where pavement or surfacing is to be placed around or adjacent to manholes or drainage inlets which will be located within traffic lanes, such structures shall not be constructed to final grade until after the pavement or surfacing has been placed around these locations.

8. Where a schedule for placing concrete is shown on the plans no deviation will be permitted there from unless approved in writing by the Engineer.

9. Mixed concrete, after being deposited, shall be consolidated until all voids are filled and free mortar appears on the surface. The concrete shall be placed as nearly as possible in its final position and the use of vibrators for extensive shifting of the mass of fresh concrete, will not be permitted.

10. Except for concrete used in cast-in-place piles, fresh concrete shall not be permitted to fall from a height greater than 4 feet without the use of adjustable length pipes, tubes or double belting placed to prevent segregation of the concrete. Double belting shall not be used unless the thickness of the member is less than 16 inches.

11. In vertical sections, concrete shall be deposited continuously in horizontal layers of 24 inches maximum depth so as to maintain a horizontal plastic surface until the completion of the unit. No concrete shall be deposited on concrete which has hardened sufficiently to cause the formation of seams and planes of weakness within the section.

12. Concrete for horizontal members or sections shall not be placed until the concrete in the supporting vertical members or sections is no longer plastic and has been in place at least two hours.

13. In all slabs, concrete shall be deposited in a continuous or monolithic operation to the full thickness of the slab. Each batch shall be dumped against previously placed concrete and not away from it, and shall not be dumped in separate piles and then worked together.

14. The concrete in each integral part of the structure shall be placed continuously, and work will not be allowed to commence on any such part unless sufficiently inspected and approved material for the concrete is on hand, and forces and equipment are sufficient to complete the part without interruption in the placing of the concrete.

C. Concrete Vibrating

1. Consolidate concrete by means of high frequency internal vibrators within 15 minutes after it is deposited in the forms. The vibrators shall not be attached to or held against the forms or the reinforcing steel. The vibrating shall be done with care and in such manner that displacement of reinforcement, ducts, and embedded items is avoided.

2. All concrete shall be consolidated by vibration so that the concrete is thoroughly worked around the reinforcement, around embedded items, and into corners of forms, eliminating all air or stone pockets which may cause honeycombing, pitting, or planes of weakness.

3. Internal vibrators used shall be the largest size and the most powerful that can be properly used in the work, as described in Table 5.1.4 of ACI 309. They shall be operated by competent workmen. Use of vibrators to transport concrete within forms shall not be allowed. The vibrator shall be inserted vertically at uniform spacing over the entire area of the placement. The distance between insertions shall

generally be about 1½ times the radius of action, or such that the area visibly affected by the vibrator overlaps the adjacent just-vibrated area by a few inches. In slabs, the vibrator shall be sloped toward the horizontal as necessary to operate in a fully embedded position.

4. The vibrator shall penetrate rapidly to the bottom of the layer, and at least 6 inches into the preceding layer if there is such. At each insertion, the vibrator shall be held stationary for a time sufficient to consolidate the concrete but not cause segregation, generally from 5 to 15 seconds. The vibrator shall then be withdrawn slowly, at the rate of approximately 3 inches per second.

5. A spare vibrator in good working condition shall be kept on the job site during all concrete placing operations. Where the concrete is to have an as-cast finish, a full surface of mortar shall be brought against the form by the vibration process, supplemented if necessary by spading to work the coarse aggregate back from the formed surface.

6. The use of external vibrators for consolidating concrete will be permitted when, in the opinion of the Engineer, the concrete is inaccessible for adequate consolidation provided the forms are constructed sufficiently rigid to resist displacement or damage from external vibration.

D. Cold Weather Requirements

1. Provide adequate equipment for heating concrete materials and protecting concrete during freezing or near-freezing weather in accordance with ACI 306 and the following paragraphs.

2. When the temperature of the surrounding atmosphere is 40 degrees F or is likely to fall below this temperature, use heated mixing water not to exceed 140 degrees F. Do not allow the heated water to come in contact with the cement before the cement is added to the batch.

3. When placed in the forms during cold weather (as defined in ACI 306), maintain concrete temperature at not less than 55 degrees F for the first five days after placing, and above 35 degrees F for the remainder of the curing period. Provide thermometers to indicate the ambient temperature and the temperature 2 inches inside the concrete surface.

4. There will be no additional reimbursement made to the Contractor for costs incurred for placing concrete during cold weather.

E. Hot Weather Requirements

1. During hot weather, give proper attention to ingredients, production methods, handling, placing, protection, and curing to prevent excessive concrete temperatures or water evaporation in accordance with ACI 305 and the following paragraphs.

2. When the weather is such that the temperature of the concrete as placed would exceed 90 degrees F, use ice or other means of cooling the concrete during mixing

and transportation so that the temperature of the concrete as placed will not exceed 90 degrees F.

3. Take precautions when placing concrete during hot, dry weather to eliminate early setting of concrete. This includes protection of reinforcing from direct sunlight to prevent heating of reinforcing, placing concrete during cooler hours of the day, and the proper and timely application of specified curing methods.

4. There will be no additional reimbursement to the Contractor for costs incurred for placing concrete in hot weather.

3.6 BONDING TO EXISTING CONCRETE

See Section 03072.

3.7 FORMWORK

A. Arrange formwork construction to allow for proper sequencing and removal without damage. Use orderly and symmetrical panel arrangement with minimum number of joints. Before proceeding, secure approval of formwork and procedures.

B. Lumber, prefabricated wood panels, metal, or plastic-lined panels shall be sound and free from any defects that will mar or detract from the surface of the finished concrete. Construct forms sufficiently tight to prevent loss of mortar. Design forms to withstand vibrator action. Treat forms with a nonstaining material to eliminate absorption of water and to act as a form release agent.

C. Thoroughly remove all dirt, mortar, and foreign matter before each use. Where the bottom of the form is inaccessible from within, provide access panels to permit thorough removal of extraneous material before placing concrete.

D. Kerf wood forms inserted for architectural treatment to accommodate swelling without pressure on the concrete.

E. Chamfer all exposed horizontal and vertical edges or other corners ¾-inch, both interior and exterior of structures.

F. Earth trench forms for walls and footings below existing and final grades may be used, if approved after inspection of the trenches, provided the sides are clean, even, vertical, true, and provided the bottoms are level, clean, and without fill, and the width is increased two (2) inches.

G. Where tolerances are not shown elsewhere, permissible deviations from established lines, grades, and dimensions are listed below:

1. Variation from the Plumb

    a. In the lines and surfaces of columns, piers, walls and in any other vertical members: in 10 feet, ¼-inch; in any story or 20 feet maximum, 3/8-inch; in 40 feet or more, ¾-inch.

    b. For exposed corners and other conspicuous lines: in any bay or 20 feet maximum, ¼-inch; in 40 feet or more, ½-inch.

2. Variation from the Level or from the Grades Shown

    a. In floors, ceilings, and beam soffits: in 10 feet, ¼-inch; in any bay or 20 feet maximum, 3/8-inch; in 40 feet or more, ¾-inch; in floors to receive tile, maximum of 1/8" in 10 feet.

    b. For exposed lintels, sills, parapets, horizontal grooves and other conspicuous lines: in any bay or 20 feet maximum, ¼-inch; in 40 feet or more, ½-inch.

3. Variation of the linear building lines from established position in plan and related position of columns, walls and partitions: In any bay or 20 feet maximum, ½-inch; in 40 feet or more, 1 inch.

4. Variation in tank, channel or structural lines in 10 feet, ¼-inch; in 20 feet, 3/8 inch; in 40 feet or more, ½-inch.

5. Variation in the sizes and locations of sleeves, floor openings and wall openings: ¼-inch.

6. Variation in cross-sectional dimensions of columns, beams and piers, and in the thickness of slabs and walls: minus, ¼-inch; plus, 3/8-inch.

7. Footings

    a. Variation in Dimensions in Plan: Minus, ½-inch; plus, 2-inch.

    b. Misplacement or Eccentricity: 2 percent of the footing width in the direction of misplacement but not more than 2 inches.

    c. Misplacement or Eccentricity of Footings Supporting Masonry Or Concrete: ½-inch.

    d. Reduction in Thickness: Minus 5 percent of specified thickness.

8. Variation in Steps

    a. In a Flight of Stairs: rise, 1/8-inch; tread, ¼-inch.

    b. In Consecutive Steps: rise, 1/16-inch; tread, 1/8-inch.

9. Variation from established lines and grades in sidewalks, plazas, outdoor concrete slabs, curb and gutter sections: in 10 feet, ¼-inch; in 1 foot, 1/8-inch.

H. Where tolerances are not met, the Owner's Representative may require removal and replacement at no cost to the Owner.

3.8 REINFORCEMENT

A. Design: The reinforcement design shown on drawings shows only the necessary information for detailing the reinforcement and preparing placing and bending details. Prior to starting concrete work, submitted detailed shop drawings shall be approved by the Engineer.

B. Bending: In accordance with CRSI Manual of Standard Practice, Chapter 7.

C. Placement: Place reinforcement accurately as shown. Adequately secure metal reinforcement in position by concrete or metal chairs and spacers, in accordance with CRSI Manual of Standard Practice, Chapter 8. Distance between the steel and the surface, as shown; otherwise, in accordance with Chapter 8.

D. Splices: Locate splices of reinforcement as shown. For any splices not shown, assume Class B splice. Stagger splice in adjacent horizontal bars, with 5-feet stagger distance. Lap adjacent sheets of wire mesh a minimum of 6 inches and wire securely.

E. Inspection: After reinforcement has been placed, it shall be inspected and approved before placing concrete.

F. Conditions of Surfaces: At time concrete is placed, notify Engineer 48 hours prior to placement of concrete. Concrete shall not be places until Engineer has reviewed and approved the placement of all reinforcing steel.

G. Welding Reinforcement: Do not weld reinforcing steel unless specifically approved by the Engineer. Welding to be in accordance with ASTM A706.

3.9 JOINTS AND EMBEDDED ITEMS

A. Construction Joint

1. Obtain approval for joints not shown and locate them where they least impair the strength of the structure. Unless otherwise shown on the drawings, joints in walls and columns shall be at the underside of floors, slabs or beams, and at the top of footings or floor slabs. Place beams at the same time as slabs. At least two hours shall elapse after depositing concrete in columns or walls before depositing concrete in supported beams or slabs. As the new concrete is placed, vibration in tops of columns and walls is desirable. Make joints perpendicular to the main reinforcement.

2. All horizontal construction joints in walls shall have a continuous wood screed strip at the outer face of joint to form a true line. Screeds shall be removed and the reglet thoroughly cleaned out before pouring the next portion of wall.

3. Continue all reinforcing steel and mesh across construction joints. Lap slices shall be located outside all construction joints.

4. Construction joints shall be made rough and all laitance removed from the surface by chipping the entire surface, sandblasting with coarse silica sand, or hosing the surface 4 to 6 hours after the pour with a fine spray, exposing solidly embedded clean aggregate.

5. Forms and reinforcing shall likewise be cleaned of drippings, debris, etc., by means of compressed air. Surfaces of the hardened concrete shall be cleaned to the satisfaction of the Engineer and wet as required before placing of new concrete. Just before starting the new pour, all free water shall be removed and the horizontal surfaces shall be covered with at least a 4-inch thickness of concrete composed of cement and fine aggregate, omitting the coarse aggregate.

B. Expansion Joints

1. Install expansion joint fillers to ½-inch below slab.

2. Where shown, load transfer dowels shall consist of plain bars with one half coated with an approved antibond coating. The coated half shall be sleeved. No other reinforcement or metal shall extend continuously through the joint.

C. Waterstops

1. The design and location of waterstops shall be as shown on the drawings and in these specifications. Each piece of premolded waterstop shall be of maximum practicable length to minimize the number of end joints.

2. PVC waterstops shall be properly heat spliced at the ends and intersections to ensure continuity. Construct forms for construction joints in such a manner as to prevent injury to waterstops. Allow at least 10 minutes before pulling or straining the new splice in any way. The finished splices shall provide a cross section that is dense and free of porosity with tensile strength of not less than 80% of the unspliced materials.

3. Install waterstops in strict conformance with manufacturers recommendations.

4. Hold PVC waterstops securely in position with continuous No. 3 rebar secured to waterstops and hog rings at 12" max on center. Secure continuous rebar to each mat of reinforcing with tie wire at 12" on center. Install waterstops in construction and expansion joints in hydraulic structures or where shown in the drawings.

5. If joint is not watertight after construction, one or both of the following shall be done to provide a watertight joint:

   a. Grouting of the joint by drilling grout holes to the center of the structure unit and forcing epoxy grout into the joint under pressure.

   b. Cutting of a bevel groove on the water side of the joint. The groove shall be ½ to ¾-inch in width and depth and shall be caulked with epoxy joint sealer in accordance with manufacturer's instructions.

D. Other Embedded Items

1. Prior to concreting, place all required sleeves, inserts, anchor bolts and embedded items.

2. Give all trades whose work is related to the concrete ample notice and opportunity to introduce embedded items before concrete is placed.

3. Position expansion joint material, waterstops, and embedded items accurately and support them against displacement. Fill voids in sleeves, inserts, and anchor slots temporarily with readily removable material to prevent the entry of concrete.

E. Pipes and Wall Spools Cast in Concrete

1. Install wall spools (i.e. bell ring inserts), wall flanges, and wall anchors before placing concrete. Do not weld, tie, or otherwise connect the wall spools or anchors to the reinforcing steel.

2. Support pipe and fabricated fittings to be encased in concrete on concrete piers or pedestals. Carry concrete supports to firm foundations so that no settlement will occur during construction.

3. Pipes or spools located below operating water level shall have waterstop ring collars and shall be cast in place. Do not block out such piping and grout after the concrete section is cast. Pipes fitted with thrust rings shall be cast in place.

F. Additional Reinforcement Around Openings: Place additional reinforcement around pipe or openings as indicated in the drawings

3.10 FORM REMOVAL

Carefully remove forms to ensure the complete safety of the structure. All supporting forms or shoring shall remain in place for a minimum of 10 days or until members have acquired the 28-days compressive strength to support their weight and imposed loads safely.

3.11 CONSTRUCTION LOADS ON STRUCTURAL SLABS

No construction materials and equipment shall be allowed on structural slabs until the concrete has reached the 28-day compressive strength.

3.12 REPAIRING AND PATCHING

A. Clean, thoroughly dampen and patch all tie holes and all repairable defects immediately after form removal.

B. All honeycombed and other defective concrete shall be removed to sound concrete with edges perpendicular to the surface. Surface imperfections greater than 3/8 inch in any dimension shall be removed and the affected areas neatly patched. Dampen the area to be patched and an area at least 6 inches wide surrounding it to prevent absorption of water from the patching mortar. Mix patching grout to the consistency of thick cream and brush it well into the surface.

C. Make the patching mortar of the same material and approximately the same proportions as used for the concrete, omitting the coarse aggregate. The resultant mortar shall consist of not more than 1 part cement to 2½ parts sand by damp loose volume.

D. Do not use more mixing water than necessary for handling and placing. Mix the patching mortar in advance and allow to stand with frequent manipulation with a trowel, without adding water, until it has reached the stiffest consistency that will permit placing.

E. After surface water has evaporated from the area to be patched, brush the patching grout well into the surface. When the patching grout begins to lose the water sheen, apply the premixed patching mortar. The mortar shall be thoroughly consolidated into place and struck off to leave the patch slightly higher than the surrounding surface. To permit initial shrinkage, leave the patch undisturbed for at least 1 hour before finishing it. Keep the patched area damp for 7 days. Do not use metal tools in finishing a patch in a formed wall which will be exposed.

F. Tie Holes: Clean thoroughly by mechanical abrading, dampen, then fill solid with patching mortar. Mortar shall match color of concrete. Fill tie holes prior to finishing.

3.13 FINISHES FOR SURFACES

A. Finish 1: Beams, columns, and exterior walls not exposed to water or view: Repair defective concrete, fill depressions deeper than ½ inch, and fill tie holes.

B. Finish 2: Exterior and interior walls, beams, and columns exposed to water, unless such items are to be coated: Repair defective concrete, remove fins, fill depressions ¼ inch or deeper, and fill tie holes.

C. Finish 3: Walls, beams, and columns of structures or buildings exposed to view and to 1 foot below water level or finished grade; underside of formed floors or slabs (EXCEPT - surfaces which are to be coated): In addition to Finish 2, fill depressions and airholes with mortar. Dampen surfaces and then spread a slurry consisting of one part cement and one and one-half parts sand by damp loose volume, over the surface with clean burlap pads or sponge rubber floats. Remove any surplus by scraping and then rubbing with clean burlap.

D. Finish 4: Exterior and interior surfaces to be coated: Repair defective concrete, remove fins, fill depressions 1/16 inch or deeper, fill tie holes, remove mortar spatter, and remove bulges higher than 1/16 inch. Surface shall be trowelled, sacked, and brush blasted.

E. Finish 5: Slabs and floors to be covered with concrete or grout: Screed to grade without special finish.

F. Finish 6: Slabs and floors not water bearing: Repair defective concrete, remove fins, fill depressions ¼ inch or deeper, and fill tie holes.

G. Finish 7: Slabs and floors which are water bearing; Slab surfaces on which mechanical equipment moves; Slab surfaces to receive hardener: Steel trowel finish, free from trowel marks and all irregularities.

H. Finish 8: Slabs and floors of structures or buildings exposed to view: Steel trowel finish without local depressions or high points and apply a light hair-broom finish. Do not use stiff bristle brooms or brushes. Leave hair-broom lines parallel to the direction of slab drainage.

I. Finish 9: Slabs and floors at slopes greater than 10% and stairs: Steel trowel finish without local depressions or high points. Apply a coarse broom finish. Leave broom lines parallel to the direction of slope drainage.

J. Finish 10: Exposed stairs and landings and slabs designated for non-slip finish: Areas to have non-slip finish shall incorporate 25 pounds per 100 square feet of aluminum oxide grains into the surface. Immediately before floating begins, sprinkle two-thirds of the abrasive evenly over the surface and float. After embedment, sprinkle the remaining one-third at right angles to the previous application. Apply more heavily in areas not sufficiently covered by the first application, and float again immediately. Complete finishing as specified under Trowelled Finish.

K. Finish 11: Exposed edges (EXCEPT – edges normally covered with earth): Provide chamfer or beveled edges per this Section.

L. Finish 12: Top of walls, beams, and similar unformed surfaces: Strike smooth and float in accordance with Finish 4.

3.14 SLAB FINISHING

A. Screeding: After concrete has been thoroughly consolidated, screed slabs to the desired elevation and contours by means of accurately placed edge forms and intermediate screed strips.

B. Floated Finish

1. Place, consolidate, strike off, and level concrete, but do not work it further until ready for floating. Begin floating when water sheen has disappeared and when the surface has stiffened sufficiently.

2. During or after the first floating, check planeness of surface with a 10-foot straightedge applied at not less than two different angles, and then cut down all high spots and fill all low spots to achieve a true plane within ¼-inch in 10 feet.

3. Refloat slab immediately to a uniform sandy texture.

C. Troweled Finish: Float finish slab as described above, then steel trowel by machine or by hand. Additional trowellings shall be done by hand after the surface has hardened sufficiently. Final trowelling shall produce a ringing sound from the trowel and the finished surface shall be free of trowel marks, uniform in texture, and appearance shall be planed to the tolerance specified under Floated Finish. Trowelled finish shall occur at tank floors (except where grout topping or fillets will follow), troughs, channels, clear wells, and all building floor slabs.

D. Coarse Broom Finish: Immediately after floating, give slabs for exterior walkways and exterior stoops a coarse transverse scored texture by drawing a broom across the surface.

3.15 FLOOR HARDENER

A. All building floors not scheduled for floor covering, Non-slip Floor Finish, or Broom finish shall receive hardener (Finish 7).

B. Apply hardener after floors have cured, in accordance with the manufacturer's recommendations.

C. Floors shall receive three applications of hardener, mixed and applied as specified for heavy duty floors as shown on contract drawings.

3.16 CURING AND PROTECTION

A. General: Beginning immediately after placement, protect concrete from drying, excessively hot and cold temperatures and mechanical injury. Keep moisture loss to a minimum until cement has hydrated and concrete is hard. Keep concrete constantly moist during the curing period. Follow color admixture manufacturer's recommendations for integrally colored concrete.

B. Curing

1. Formed Surfaces: Keep forms wet. Cool metal forms exposed to the sun with water. If curing compound is used, apply in accordance with manufacturer's instructions. Curing compound shall not be used on any wall/slab scheduled to be coated.

2. Slabs: Immediately after finishing, apply one of the materials specified in Section 2.22 entitled Curing Materials, but use membrane forming liquid only with Engineer's approval.

3. Duration of Curing: 7 days minimum.

C. Protection

1. In cold weather, maintain the moisture conditions but also, by heating or covering, maintain the temperature of the concrete between 50 degrees F and 70 degrees F for entire curing period.

2. In hot weather take immediate steps to protect newly finished concrete from drying effects of wind and sun, and maintain temperature of the air surrounding the concrete uniform within 5 degrees F in any one hour or 50 degrees F in any 24 hour period.

3. During curing period, protect concrete from mechanical damage, loading, shock and vibration.

3.17 CONSTRUCTION OF CONCRETE FILLETS, TOPPING, AND EQUIPMENT PADS

A. Concrete fillets, topping and equipment pads shall be placed as soon as possible after completion of the curing period of the tank walls and structural floors. Contact surfaces shall be thoroughly cleaned to the degree recommended by the bonding agent manufacturer.

B. Bonding agent shall be accurately and thoroughly mixed and applied at the manufacturer's recommended coverage rate. Mix only the amount which can be used prior to expiration of the pot life. Concrete shall be immediately placed over the fresh surface before setting of the agent. Bonding agent which sets up prior to placing concrete shall be recoated with a fresh coat.

C. Concrete fillets, topping, and equipment pads shall be accurately screeded to the slopes and elevations shown and steel trowel finished. Cure concrete as specified for slabs above. Set equipment anchor bolts in pad to accommodate equipment furnished.

3.18 BACKFILL AGAINST STRUCTURES

A. Backfill against concrete structures shall be allowed only when the concrete has reached the specified 28-day compressive strength or as approved by the Engineer. Where backfill is to be place on both sides of the wall, or against more than one wall of a structure, place the backfill uniformly on both sides of the wall or walls.

B. Do not backfill until structure has passed leakage testing.

C. Do not backfill the walls of structures that are laterally restrained or supported by suspended slabs or slabs on grade until the slab is poured and the concrete has reached the specified compressive strength.

3.19 NONSHRINK GROUT

Use nonshrink grout to fill sleeves and voids under equipment bases. Grout shall be mixed and used in accordance with manufacturer's recommendations. Exposed edges shall be smooth, straight and even.

3.20 EPOXY GROUT

See Section 03071 for requirements.

3.21 CONCRETE GROUT

Concrete grout shall be used as a filler material to form shapes and profiles over concrete surfaces as shown on the drawings.

3.22 ADHESIVE ANCHORS

Install in strict conformance to manufacturer's printed instructions. Do not cut or damage existing reinforcing bars. Where reinforcing bars are encountered, move anchor location or core hole as approved by the Engineer.

3.23 LEAKAGE TESTING OF HYDRAULIC STRUCTURES

A. General

1. Prior to backfilling the structure and the application of water-proofing coatings, hydrostatically test reinforced concrete structures which will contain water or fluid to determine that they conform to Section B herein and are free of detectable leaks. Do not start leak testing until all of the following conditions are met:

    a. Structure or structural materials have achieved their maximum specified design strength.

    b. Cure time, defined above within subsection 3.16, has elapsed

    c. Do not hydrostatically test walls which are to be restrained or laterally supported by slabs until slab concrete has obtained the specified compressive strength.

    d. If a water test is desired for sequencing purposes on an incomplete structure, the Contractor shall immediately notify the Engineer. Such a request may not be allowed and is at the discretion of the Engineer. If the request is approved by the Engineer, the test cannot take place until the following conditions are met:

1) a duration of 14 days minimum has elapsed or the cure time has been reached, whichever is greater

2) the structure or structural materials have achieved their maximum specified design strength

3) Engineer's defined site specific requirements, defined during request review.

2. Prior to testing, clean exposed surfaces by thoroughly hosing and removing surface laitance and loose matter from walls and slabs. Remove wash water and debris from the structures by means other than washing through plant piping.

B. Leakage Test Procedure

1. All liquid containing structures (new or modified existing) shall be leak tested. Fill hydraulic structures to be subjected to leakage tests with potable water to the normal operating liquid level line not less than 2 feet below top of walls. Filling shall be at a uniform rate over a 24-hour period with continuous monitoring. For structures with adjacent bays, fill all bays simultaneously. Empty adjacent bays alternately. Repair any running leaks which appear during filling before continuing.

2. After the structure has been kept full for 48 hours, it will be assumed for the purposes of the test that the absorption of moisture by the concrete in the structure is complete. Then close all valves and gates to the structure and measure the change in water surface each day for a five-day period.

3. During the test period, examine exposed portions of the structure, and mark visible leaks or damp spots. A damp spot is defined as an area which seeps sufficient moisture to dampen a paper towel when pressed against it. Repair visible leaks or damp spots after dewatering. Additionally, if the drop in water surface in the 24-hour period exceeds 1/10 of 1% of the normal volume of liquid contained in the structure, the leakage shall be considered excessive.

4. The determination of surface moisture evaporation shall be aided with a 24-inch deep, white colored, watertight container with not less than 10 square feet of surface area exposure. Position container to experience environmental conditions similar to the structure being tested. Subtract the water loss due to evaporation from the measured water loss in the structure to determine the water loss due to leakage.

5. If the leakage is excessive, drain the structure, repair leaks and damp spots, and refill the structure and again test for leakage. Continue this process until the drop in water surface in a 24-hour period meets the test requirements and visible leaks and damp spots are eliminated.

6. If an underdrain system is present, inspect the manholes of the underdrain system for evidence of leaks in the floor slabs. If leaking is indicated, locate and repair.

7. If the leakage is detected and location is unknown, use the following procedures. All water-bearing structures must be seeded. Seed the floor slab of each hydraulic structure with one sack of cement per 1,000 square foot surface area. Seeding shall take place after the test filling has reached 18 inches in depth. Detect leaks in

construction and expansion joints with the aid of a diver. Stir cementious deposits flowing toward leaks and repair where the defect is located.

8. Repair flowing leaks whether leakage exceeds the allowable leakage or not.

9. Repairs and additional filling and testing shall be made by the Contractor at no additional cost to the Owner.

10. Use Form A, attached to this specification.

C. Repair of Defects

1. Do not repair defects until concrete has been reviewed by the Owner's Representative.

2. Surface Defects: Repair surface defects that are smaller than 1 foot across in any direction and are less than ½ inch in depth. Repair by removing the honeycombed and other defective concrete down to sound concrete, make the edges perpendicular to the surface and at least 3/8 inch deep, thoroughly dampen the surface, work into the surface a bonding grout, fill the hole with mortar, match the finish on the adjacent concrete, and cure as specified.

3. Severe Defects: Repair severe defects that are larger than surface defects but do not appear to affect the structural integrity of the structure. Repair by removing the honeycombed and other defective concrete down to sound concrete, make the edges perpendicular to the surface, sandblast the surface, coat the sandblasted surface with an approved epoxy bonding compound, place nonshrink grout as specified herein, match the finish on the adjacent concrete, and cure as specified.

4. Major Defects: If the defects are serious or affect the structural integrity of the structure or if patching does not satisfactorily restore the quality and appearance to the surface, the Engineer may require the concrete to be removed and replaced, complete, in accordance with the provisions of this section at no additional cost to the Owner.

D. Repair of Cracks in Concrete

1. Repair leaking concrete cracks that are 1/10 inch or less in width by epoxy pressure injection.

a. Preparation: Insert and anchor a one-way polyethylene valve or pipe nipple in holes drilled into crack. Position them every 6- to 18-inches on center depending on the width of crack. Maintain a slow, steady pressure rather than a rapid buildup of pressure. When grouting material reaches the next tube, stop off the present position and follow the same procedure on the next position.

b. Upon completion of the epoxy grouting, remove the epoxy gel used to hold the valve or nipple by applying a direct flame to the epoxy and scraping it off. Fill the holes with the same material as used for patching the surface.

c. While the valves or nipples are installed first, the grouting operation shall not commence until after the patch work has been completed and has sufficiently cured.

2. Repair cracks in concrete structures that are wider than 1/10 inch in width by cutting out t square edged and uniformly aligned joining 3/8 inch wide by 3/4 inch deep, preparing exposed surfaces of the joining, priming the join, and applying polyurethane join sealant in accordance with this section.

3. If the cracks are serious or affect the structural integrity or function of the element, the Engineer may require the concrete to be removed and replaced, complete, in accordance with the provisions of this section at no additional cost to the Owner.

4. After repairing visible leaks, damp spots or leaking concrete cracks, retest the structure.

3.24 CONCRETE TESTING

Concrete testing shall be performed by the Owner, at Owner's expense, in accordance with the following:

A. Test reports shall be sent to the Engineer with copies to the Contractor.

B. Concrete which fails to meet strength, slump, air or shrinkage requirements may be rejected by the Engineer before, during, or after placement.

C. One set of four concrete test cylinders shall be taken for every 50 cubic yards or fraction thereof of each concrete mix design placed each day. The Engineer has the option to direct the required test specimens to be taken as he deems necessary to insure the concrete meets the specification.

D. Specimens shall be taken, cured, and tested for compressive strength in accordance with ASTM C31, ASTM C39, and ASTM C172, respectively.

E. Test one cylinder at 7 days for information; test two cylinders at 28 days for acceptance; and hold one cylinder for verification. Strength acceptance will be based on the average of the strengths of the two cylinders tested at 28 days. If one cylinder of a 28-day test manifests evidence of improper sampling, molding, or testing, other than low strength, discard it and use the fourth cylinder for the test result.

F. Determine the concrete slump by ASTM C143 with each strength test sampling and as required to establish consistency.

G. Determine air content of the concrete using ASTM C231 to verify the percentage of air in the concrete immediately prior to depositing in the forms.

H. Determine drying shrinkage in accordance with ASTM C157, as modified by SEAOC, at 7, 14, 21, and 28 days of drying after the wet cure period. A minimum of three sets of three shrinkage bars shall be fast over the project duration. The Engineer has the option to increase or decrease the testing frequency as he deems necessary to insure the concrete meets the specification. Shrinkage bars of 28 days drying age shall not exceed 0.045 percent for laboratory cast and 0.058 percent for field cast.

I. The average value of concrete strength tests shall be equal to or greater than the specified 28-day strength. No test shall be less than 90% of the specified 28-day strength.

J. If the 28-day strength tests fail to meet the specified minimum compressive strength, the concrete will be assumed to be defective and one set of three cores from each area may be taken as selected by the Owner and in accordance with ASTM C42. If the average compressive strength of the set of three concrete cores fails to equal 90% of the specified minimum compressive strength or if any single core is less than 75% of the minimum specified compressive strength, the concrete will be considered defective. The Owner may require additional coring, nondestructive load testing, or repair of defective concrete. Costs of coring, testing of cores, load testing, and required repairing pertaining thereto shall be paid by the Contractor at no extra cost to the Owner.

3.25 DAMAGED OR DEFECTIVE CONCRETE

Remove damaged or defective concrete before completion and acceptance of the work and replace with acceptable concrete, at no additional cost to the Owner.

3.26 SAMPLE HYDRAULIC STRUCTURE LEAKAGE LEAK TEST FORM A

Contractor _____Project_____

Structure: _____Test #_____

Work to be Performed	Date	Quantity Water (gal)	Visible Leaks (Y/N)	Water Level Height	Pan Evaporation Reading	% loss	Contractor Initial	Construct. Manager Initial

Notes:_____
_____
_____
_____
_____

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SECTION 03110

CONTROLLED LOW STRENGTH MATERIAL

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes: Controlled Low Strength Material (CLSM).

B. Related Sections:

1. Section 03100 - Concrete.

1.2 REFERENCES

American Society of Testing and Materials (ASTM):

A. C31 - Standard Practice for Making and Curing Concrete Test Specimens in the Field.

B. C33 - Standard Specification for Concrete Aggregates.

C. C39 - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.

D. C143 - Standard Test Method for Slump of Hydraulic Cement Concrete.

E. C231 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.

F. C260 - Standard Specification for Air-Entraining Admixtures for Concrete.

G. C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.

H. D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3(2,700 kN-m/m3))

1.3 SYSTEM DESCRIPTION

Performance Requirements:

A. Total Calculated Air Content: Not be less than 8.0 percent nor greater than 12.0 percent.

B. Minimum Unconfined Compressive Strength: Not less than 50 pounds per square inch measured at 28 days.

C. Maximum Unconfined Compressive Strength: Not greater than 150 pounds per square inch measured at 28 days.

D. Wet Density: No greater than 132 pounds per cubic foot.

1.4 SUBMITTALS

A. Product Data: Submit data completely describing products.

B. Sieve Analysis: Submit sieve analyses of fine and coarse aggregates being used in triplicate. Resubmit at any time there is a significant change in grading of materials.

C. Mix: Submit full details, including mix design calculations for mix proposed for use.

D. Trial Batch Test Data:

1. Submit data for each test cylinder.
2. Submit data that identifies mix and slump for each test cylinder.

E. Cement Mill Tests: Include alkali content, representative of each shipment of cement for verification of compliance with specified requirements.

F. Pozzolan Certificate of Compliance: Identify source of pozzolan and certify compliance with requirements of ASTM C 618.

PART 2 MATERIALS

2.1 MATERIALS

A. Portland Cement: Type II modified portland cement as specified in Section 03100.

B. Fly Ash: As specified in Section 03100.

C. Water: As specified in Section 03100.

D. Admixture: Air entraining admixture in accordance with ASTM C260.

E. Fine Aggregate: Concrete sand that does not need to be in accordance with ASTM C33. No more than 12 percent of fine aggregate shall pass a No. 200 sieve, and no plastic fines shall be present.

F. Coarse Aggregate: Pea gravel no larger than 3/8 inch.

2.2 MIXES

Suggested Design Mix

Material	Weight	Specific Gravity	Absolute Volume Cubic Foot
Cement	30 pounds	3.15	0.15
Fly Ash	300 pounds	2.30	2.09
Water	283 pounds	1.00	4.54
Coarse Aggregate	1,465 pounds	2.68	8.76
Fine Aggregate	1,465 pounds	2.68	8.76
Admixture	4-6 ounces		2.70
TOTAL	3,543 pounds		27.00

2.3 SOURCE QUALITY CONTROL

A. Trial Batch:

1. After mix design has been accepted by Engineer, have trial batch of the accepted mix design prepared by testing laboratory acceptable to Engineer.

2. Prepare trial batches using specified cementitious materials and aggregates proposed to be used for the Work.

3. Prepare trial batch with sufficient quantity to determine slump, workability, consistency, and to provide sufficient test cylinders.

B. Test Cylinders:

1. Prepare test cylinders in accordance with ASTM C31 with the following exceptions:

   a. Fill the concrete test cylinders to overflowing and tap sides lightly to settle the mix.

b. Do not rod the concrete mix.

c. Strike off the excess material.

2. Place test cylinders in a moist curing room. Exercise caution in moving and transporting the cylinders since they are fragile and will withstand only minimal bumping, banging, or jolting without damage. Do not remove the test cylinder from mold until the cylinder is to be capped and tested.

3. Do not remove the test cylinder from mold until the cylinder is to be capped and tested.

4. The test cylinders may be capped with standard sulfur compound or neoprene pads:

a. Perform the capping carefully to prevent premature fractures.

b. Use neoprene pads a minimum of 1/2 inch thick, and 1/2 inch larger in diameter than the test cylinders.

c. Do not perform initial compression test until the cylinders reach a minimum age of 3 days.

C. Compression Test 8 Test Cylinders: Test 4 test cylinders at 3 days and 4 at 28 days in accordance with ASTM C39 except as modified herein:

1. The compression strength of the 4 test cylinders tested at 28 days shall be equal to or greater than the minimum required compression strength, but shall not exceed maximum compression strength.

D. If the trial batch tests do not meet the Specifications for strength or density, revise and resubmit the mix design, and prepare additional trial batch and tests. Repeat until an acceptable trial batch is produced that meets the Specifications.

1. All the trial batches and acceptability of materials shall be paid by the Contractor.

2. After acceptance, do not change the mix design without submitting a new mix design, trail batches, and test information.

E. Determine Slump in Accordance with ASTM C143 with the Following Exceptions:

1. Do not rod the concrete material.

2. Place material in slump cone in one semi-continuous filling operation, slightly overfill, tap lightly, strike off, and then measure and record slump.

PART 3 EXECUTION

3.1 INSTALLATION

A. Prior to placement, soils located below controlled low strength material placement shall be scarified to a depth of 8 inches, uniform moisture conditioned to or above the optimum

moisture content, and compacted to a minimum of 95 percent relative compaction in accordance with ASTM D1557.

B. Place controlled low strength material by any method which preserves the quality of the material in terms of compressive strength and density:

1. Limit lift heights of CLSM placed against structures and other facilities that could be damaged due to the pressure from the CLSM, to the lesser of 3 feet or the lift height indicated on the Drawings. Do not place another lift of CLSM until the last lift of CLSM has set and gained sufficient strength to prevent lateral load due to the weight of the next lift of CLSM.

2. The basic requirement for placement equipment and placement methods is the maintenance of its fluid properties.

3. Transport and place material so that it flows easily around, beneath, or through walls, pipes, conduits, or other structures.

4. Use a slump of the placed material greater than 9 inches, and sufficient to allow the material to flow freely during placement:

   a. After trial batch testing and acceptance, maintain slump developed during testing during construction at all times within plus or minus 1 inch.

5. Use a slump, consistency, workability, flow characteristics, and pumpability (where required) such that when placed, the material is self-compacting, self densifying, and has sufficient plasticity that compaction or mechanical vibration is not required.

3.2 FIELD QUALITY CONTROL

A. General:

1. Make provisions for and furnish all material for the test specimens, and provide manual assistance to assist the Engineer in preparing said specimens.

2. Be responsible for the care of and providing curing condition for the test specimens.

B. Tests by Owner:

1. During the progress of construction, the Owner will have tests made to determine whether the controlled low strength material, as being produced, complies with the requirements specified hereinbefore. Test cylinders will be made and delivered to the laboratory by the Engineer and the testing expense will be borne by the Owner.

2. Test Cylinders:

   a. Prepare test cylinders in accordance with ASTM C31 with the following exceptions:

      1) Fill the concrete test cylinders to overflowing and tap sides lightly to settle the mix.

2) Do not rod the concrete mix.

3) Strike off the excess material.

b. Place the cylinders in a safe location away from the construction activities. Keep the cylinders moist by covering with wet burlap, or equivalent. Do not sprinkle water directly on the cylinders.

c. After 2 days, place the cylinders in a protective container for transport to the laboratory for testing. The concrete test cylinders are fragile and shall be handled carefully. The container may be a box with a Styrofoam or similar lining that will limit the jarring and bumping of the cylinders.

d. Place test cylinders in a moist curing room. Exercise caution in moving and transporting the cylinders since they are fragile and will withstand only minimal bumping, banging, or jolting without damage.

e. Do not remove the test cylinder from mold until the cylinder is to be capped and tested.

f. The test cylinders may be capped with standard sulfur compound or neoprene pads:

1) Perform the capping carefully to prevent premature fractures.

2) Use neoprene pads a minimum of 1/2 inch thick, and 1/2 inch larger in diameter than the test cylinders.

3) Do not perform initial compression test until the cylinders reach a minimum age of 3 days.

3. Not less than 3 cylinder specimens will be tested for each 150 cubic yards of controlled low strength material and not less than 3 specimens for each half day's placement:

a. Test 1 cylinder at 3 days and 2 at 28 days in accordance with ASTM C39 except as modified herein.

b. The compression strength of the cylinders tested at 28 days shall be equal to or greater than the minimum required compression strength, but shall not exceed maximum compression strength.

4. The Owner will test the air content of the controlled low strength material. Test will be made immediately after discharge from the mixer in accordance with ASTM C231.

C. Tests by Contractor:

1. Test the slump of controlled low strength material using a slump cone in accordance with ASTM C143 with the following exceptions:

a. Do not rod the concrete material.

b. Place material in slump cone in one semi-continuous filling operation, slightly overfill, tap lightly, strike off, and then measure and record slump.

2. Test the slump at the beginning of each placement, as often as necessary to keep the slump within the specified range, and when requested to do so by the Engineer

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SECTION 03480

PRECAST UTILITY VAULTS AND CATCH BASINS

PART 1 GENERAL

1.1 DESCRIPTION

The work of this section consists of furnishing and installing precast concrete utility vaults with covers for flow meters, process equipment and other shown services, and also catch basins, all as shown on the contract drawings or specified herein.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Section 01300: Submittals

B. Section 01610: Seismic Design Criteria

C. Section 01615: Wind Design Criteria

D. Section 02200: Earthwork

E. Section 02623: Filter Fabric

F. Section 08310: Access Hatches

1.3 SUBMITTALS

A. In accordance with Section 01300, submit manufacturer's literature and drawings showing complete layout, dimensions, design loadings, materials of construction, etc.

B. For all precast items which are manufactured, the Contractor shall also submit a list of the design criteria used by the manufacturer.

C. The Contractor shall submit approved ICBO reports for all lifting inserts, showing allowable design loads on the inserts.

D. Verification of compressive strength shall be submitted in accordance with Section 01300. Such verification may be laboratory trial batch test results with a minimum of three test cylinders or a series of production compression tests with a minimum of 20 sets of test data which fall within the evaluation and acceptance criteria specified herein. Such tests must have been made within the previous two years on the identical concrete mix submitted.

E. For vaults larger than 4'-0" in any dimension, drawings and calculations shall be signed by a Civil or Structural Engineer registered in California. Loads and design criteria shall be as shown on the contract drawings, specification sections 01610 and 01615, and project Geotechnical Reports. Calculations shall be based on the soil pressures provided in the Geotechnical Reports and specification section 01610.

1.4 QUALITY ASSURANCE

Test methods and criteria for evaluation and acceptance of concrete shall be as specified in Section 03100, "Concrete".

PART 2 MATERIALS

2.1 VAULT AND CATCH BASIN DESIGN AND MANUFACTURE

A. Design Loads: Design loads shall consist of live load, dead load, impact load, hydrostatic load, and other loads that may occur.

1. Live loads shall be for HS20-44, or as required per AASHTO Standard Specifications for Highway Bridges with revisions.
2. Design wheel loads shall be sixteen (16) kips.
3. Earth loads shall include a 2-foot soil surcharge.

B. Forms: All forms used in placing concrete shall be sufficiently designed and braced to maintain alignment under pressures of concrete placement.

C. Concrete:

1. Aggregates used in the concrete mix either coarse or fine, excluding light-weight aggregates, shall conform to specifications as outlined by ASTM C33.
2. All light-weight aggregates, fine or coarse, shall conform to specifications as outlined by ASTM C33.
3. Both types of aggregates shall be properly graded and free of any deleterious substances so as to produce a homogeneous concrete mix when blended with cement.

D. Cement: The cement shall be Type II low alkali portland cement and shall meet ASTM C150 Type II standards.

E. Compressive Strength: Sufficient cement content per Section 03100 shall be used per batch so as to produce a minimum strength of 4000 psi at 28 days or other strength by design when required.

F. Batching: A central batching facility shall be used to assure accurate weighing and mixing of materials to obtain a suitable concrete mix.

G. Placing: Concrete shall be made by properly proportioned parts of sand, aggregate and cement with sufficient water to produce a concrete mix of uniform quality and slump. Handling from the mixer or the transport vehicle to the forms for deposit will be in a continuous manner, as rapidly as practicable without segregation or loss of ingredients, until the unit or segment pouring is completed. Compaction by either external or internal mechanical vibration shall be used during the placement of the concrete mix.

H. Curing: Concrete while still in the forms may be steam cured after an initial set has taken place. Steam temperature shall not exceed 160°F, nor raised from normal ambient temperature at a rate exceeding 40°F per hour. Steam curing shall be considered complete after sufficient time has elapsed to produce adequate strength to withstand any structural strain that may be subjected during the form stripping operation. Additional curing may be applied by means of water spraying or membrane curing compound to reach the ultimate strength requirements.

I. Reinforcing Steel: All reinforcing steel, including welded wire mesh, shall be of the size and in the location required for design loads and conforming to ASTM A185. All reinforcing shall be sufficiently tied to withstand any displacement during the pouring operation. All bars shall be intermediate grade, or as specified, billet steel conforming to ASTM A615.

J. Preformed Joint Sealant: The joint sealing compound shall be Quik-Seal, a preformed, cold applied, ready to use plastic joint sealing compound as supplied by Quikset Utility Vaults, Santa Ana, California; Ram-Neck by K.T. Syder Company; or approved equal.

2.2 UTILITY VAULTS

A. Dimensions as shown on the drawings, minimum size shall be 24” x 30”. Open bottom or enclosed with drain or without, as shown or required for service intended.

B. Vault Cover: Designed for HS-20 traffic loading. Unless otherwise noted on the drawings or scheduled in Specification Section 08310, provide galvanized steel, bolt down, drag off, unless shown to be hinged with spring assist, on the drawings or specified.

1. Manufacturers: Brooks Products, Inc., Stockton, CA; Jensen Precast, Sparks, NV; Utility Vault Co.; or equal.

2. Hinged Spring Assist Vault Cover: Where shown on the drawings, vaults shall be provided with spring or torsion assisted two-piece galvanized steel or aluminum covers. Covers shall be designed for HS-20 traffic loading and equipped with heavy forged brass hinges with stainless steel pins including automatic hold open arm with release handle, compression spring operators for ease of operation and to act as a check in retarding downward motion covers. Hardware shall be zinc plated and chromate sealed. Factory finish shall be a "Mill finish with bituminous coating applied to exterior of the frame". Cover shall be Bilco Model JD-H-20, Halliday Products Series 2HW, or approved equal.

3. Identification: All covers shall have identification marker detailing the contents with 1" bead weld letters (i.e. "water", "sewer", "electrical", chemical").

C. Internal Ladder: The Utility Vault shall be furnished with an internal aluminum ladder to provide easy access. The ladder rungs shall have a non-slip traction surface and internal stainless steel safety bar. The ladder shall meet or exceed OSHA General Industry Standards, Part 1910.27 for "Fixed Ladders". If the ladder depth is over 15' (as shown on the drawings), install a safety rail with harness and pull up access pole. For ladders less than 15' depth, install a head hazard deflector plate. For ladders over 24', install a safety cage and safety rail with harness and pull up access pole. Ladders shall be compliant with OSHA §1910.27 and 1926.1053.

2.3 CATCH BASINS

A. Unless otherwise noted, catch basins shall be 3' x 3' x 6" wall thickness with bottom. Catch basins shall have progressive webbed knock-outs to provide maximum flexibility and permitting pipe of any size shall be neatly and quickly grouted at the job site. All reinforcing steel shall meet ASTM specifications.

B. Catch Basin Grating: Unless otherwise noted on the drawings provide cast iron or galvanized steel grating, HS-20 traffic loading.

C. Manufacturers: Christy Concrete Products, Inc.; Jensen; or equal.

PART 3 EXECUTION

3.1 INSTALLATION

Vaults shall be installed as shown on the Contract Drawings and as recommended by the Manufacturer. Catch basins shall be placed on 6-inch compacted class 2 aggregate base. Vaults deeper than 10 feet below grade shall be placed on 12-inches of crushed rock wrapped in an approved geotextile fabric. Vaults less than 10 feet below grade shall be placed on 12-inches of

compacted class 2 aggregate base. Install level with top at grade in roadways and two to three inches above grade outside of roadways.

3.2 PRECAST VAULT

The above-mentioned precast item shall be installed in accordance with the manufacturer's recommendations, unless otherwise required by the drawings. All joints shall be sealed by the use of preformed sealant and mortar or non-shrink grout so as to be water tight. Interior joints shall be tooled flush.

3.3 CONNECTIONS

Connections to manufactured precast items shall be made by casting sections of pipe into the items using non-shrink grout as shown on the drawings, and/or using an approved resilient connector. All such connections shall be water tight.

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SECTION 03700

CONCRETE SAW-CUTTING AND CORE-DRILLING

PART 1 GENERAL

1.1 DESCRIPTION

The work of this section consists of saw-cutting and/or core-drilling new openings in existing concrete.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Section 01300 - Submittals

B. Section 03100 - Concrete

1.3 QUALITY ASSURANCE

Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this section.

1.4 SUBMITTALS

A. Comply with pertinent provisions of Section 01300.

B. Submit drawings and commentary showing and describing the proposed cutting procedures and proposed equipment for each type of cut.

PART 2 MATERIALS

Not used.

PART 3 EXECUTION

3.1 SAFETY REGULATIONS

A. Comply with all applicable safety regulations including the requirements of “The Construction Safety Orders” of the State of California and OSHA.

B. Provide equipment in good and safe working order, adequate to perform the work.

C. Provide necessary scaffolding, lighting, access, debris removal equipment and devices, and appropriate safety measures.

3.2 CONCRETE CUTTING

A. Perform concrete cutting as shown on the drawings and as specified herein and in accordance with the approved submittals.

B. Openings shall be cut to the dimensions shown on the drawings and shall not be over-cut. In straight-cut openings, the face opposite the saw shall be chipped to achieve the opening dimension.

3.3 PATCHING

A. Where existing reinforcing bars are cut at new opening, burn back the reinforcing bars a minimum of 1-inch below adjacent concrete.

B. Patch the resulting void at existing reinforcing bars and the surface of chipped opening surfaces with an approved epoxy grout in accordance with Section 03100 - Concrete, to achieve a smooth, uniform surface.

C. Paint the patch exposed surfaces with System K - Epoxy Paint per Section 09900.

3.4 DISPOSAL

A. Remove cut material and dispose off-site in a safe and orderly manner. Do not allow debris to accumulate on the site exposed to view.

B. Inside structures, cuttings, chippings and patching grout droppings must be removed completely. No debris shall be washed into the plant's sediment drain system.

C. Upon completion of the work of this section, the surfaces of all structures shall be clean and free of cuttings, slurry and debris.

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SECTION 03906

CONCRETE REHABILITATION AND EPOXY POLYMER LINING SYSTEM

PART 1 GENERAL

1.1 DESCRIPTION

A. Scope:

1. An approved applicator (Applicator) shall provide all labor, materials, equipment and incidentals as shown, specified and required to furnish and install a concrete rehabilitation and protective lining system for the City.

2. The extent of the protective lining and concrete rehabilitation shall be all interior surfaces of the Headworks, including walls, floors, and ceilings. See contract drawings for dimensions of interior surfaces.

3. The protective lining system components for the concrete corrosion rehabilitation work shall include:

   a. Surface treatment prior to coating application

   b. Structural reinforcement (rebar) coating

   c. Cementitous resurfacing/underlayment compounds

   d. Epoxy formulation filler compound

   e. Corrosion-resistant, moisture tolerant, epoxy monolithic protective lining

   f. Miscellaneous materials

   g. Dewatering, environmental modifying heaters and/or fans, as necessary to install materials specified herein.

B. General: Specification is written around single manufacturer responsibility (Sauereisen) for entire rehabilitation and lining system components. If submitting on equivalent products, provide written evidence from the manufactures that verify compatibility and performance guarantee statements required, in accordance with this specification, for mixing multiple manufactures components. Owner reserves the right to deny approval of any materials that do not comply with the Specifications.

C. Coordination:

1. Coordinate surface preparation of substrates to avoid later difficulty or delay in performing the Work of this Section.

2. Review Specification Section 01020 for bypass pumping and drawings for equipment, miscellaneous metals, and piping appurtenances that must be removed or protected prior to restoration work begins and coordinate the installation of items that must be installed prior to application of the protective lining system.

3. Remove all chemicals, films, loose or deteriorated concrete, laitance, compounds and other materials from substrates to receive the Work of this Section.

4. All substrate surface preparation and lining application is to be completed by manufacturer's approved Applicator.

1.2 QUALITY ASSURANCE

A. Applicator Qualifications:

1. Engage a single surface preparation and coating installation applicator specialist (Applicator) with specific experience in the application of the type of protective lining system specified, and who is approved by the protective lining manufacturer and agrees to employ only tradesmen with specific skill and experience in this type of Work. Submit manufacturer certification to Engineer for approval.

2. The Applicator shall be trained and approved by the protective lining materials manufacturer. Provide written documentation from the materials supplier that the applicator is trained and approved to apply all products used to complete the Work prior to commencement of any site Work.

3. The Applicator shall have performed at least three (3) wastewater treatment plant projects with coating and concrete rehabilitation systems of similar or greater complexity in the last five (5) years of similar size that demonstrate the Applicator's experience and qualification to construct this project; of which, the Applicator must demonstrate the successful completion of at least two (2) wastewater projects each with a dollar value of at least 65% of the value bid for this project. Submit contact reference information and dollar value of projects completed.

B. Performance Criteria: The surfaces to receive the protective lining system shall be capable of withstanding, under constant exposure, raw wastewater and withstand attack from hydrogen sulfide, abrasive particles, and organic acids generated by microbial sources, with no adverse effects. Products capable of only intermittent exposure resistance are not acceptable.

C. Source Quality Control: Provide each component of protective lining system produced by a single manufacturer, including recommended underlayment, fillers, repair products, base coat, and top coat materials and ensure compatibility between all elements. If submitting

multiple manufacturers, provide verification from each manufacturer that all products are compatible and that mixing manufacturers will not void warranties.

D. Statement of Application: Upon completion of the Work under this Section submit a statement to Engineer, signed by the protective lining system Applicator stating that the installed protective lining system complies with the requirements of the Specifications, and that the installation and materials comply with the manufacturer's printed recommendations related to the condition of installation and use.

E. Manufacturer:

1. Single source protective lining system components specified are as manufactured by Sauereisen, Pittsburgh, PA (412) 963-0303. Request for material substitutions to the specified products shall be made in writing to the Engineer.

2. Alternative source for lining system components are Raven Lining Systems and Sika Corporation, with compatibility and performance guarantee statements required, in accordance with this specification, for mixing multiple manufactures components.

3. The naming of a manufacturer in this specification is not an indication that the manufacturer’s standard system is acceptable in lieu of the specified component features. Naming is only an indication that the manufacturer may have the capability of engineering and supplying a system as specified.

1.3 SUBMITTALS

A. Samples: Submit for approval the following:

1. Protective lining manufacturer’s standard size finished sample of protective lining system on ¼-inch board showing the installed lining system to be expected in the finished Work. Show the full thickness, or a typical thickness when underlayment requirements will vary, of system with all components in place. The protective epoxy lining must be at full thickness. Sample submittals shall be reviewed for color, texture, and pattern only. Compliance with all other requirements is the exclusive responsibility of Applicator.

B. Shop Drawings: Submit for approval the following:

1. Copies of manufacturer's technical data sheets complete with installation instructions for protective lining system required.

2. Maintenance Manual: Copies of manufacturer's written instructions for recommended maintenance practices. Include the following information:

a. Product name and number.

b. Name, address and telephone number of manufacturer and local distributor or representative.

c. Detailed procedures for routine maintenance and cleaning.

d. Detailed procedures for repairs.

3. Test Reports: Verification from protective lining system manufacturer that all testing for physical properties has been performed in strict accordance with referenced ASTM standards. Submit spark and adhesion testing data to Engineer for approval.

C. Certificates:

1. Submit manufacturer's certifications that materials have been approved for the installation in a municipal wastewater treatment plant, in the wetwell and inlet channel of a pump station with the following known conditions:

a. Pump station has continued exposure to high levels of sulfur/H_2S gas, abrasive materials, organic acids, and liquids pH range of 6.0-9.0

b. Pump station does not have exterior waterproof coating

c. Pump station is sitting in high groundwater that is above the structures bottom elevation

d. Coating is moisture tolerant and can withstand groundwater intrusion

2. Submit manufacturer’s Materials Warranty certificate.

3. Submit certificate of Applicator’s training and manufacturer’s approval to apply all materials.

D. Applicator’s successful project completion reference list.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Delivery of Materials:

1. Deliver material in manufacturer's original unopened and undamaged packages.

2. Clearly identify manufacturer, brand name, contents and stock number on each package.

3. Packages showing indications of damage that may affect condition of contents are not acceptable.

B. Storage of Materials

1. Store in original packaging under protective cover and protect from damage.

2. Store all materials at temperatures recommended by manufacturer.

3. Stack containers in accordance with manufacturer's recommendations.

C. Handling of Materials: Handle materials in such a manner as to prevent damage to products or finishes.

1.5 JOB CONDITIONS

A. Environmental Requirements: Maintain substrate temperature and air temperature before, during and after installation in accordance with protective lining manufacturer's written recommendations and instructions. If dewatering, heating, cooling, humidity control, or any other environmental modification is required for proper installation (according to manufacturer's literature), provide submittal on approach.

B. Provide adequate ventilation during application and curing periods.

1.6 WARRANTY

A. Protective Lining manufacturer shall warranty its products as free from material defects for a minimum period of three (3) year. Provide associated Warranty Certificate.

B. Applicator shall warranty the installed protective lining system as free from material and workmanship defects for a minimum period of three (3) year.

PART 2 MATERIALS

2.1 MATERIALS

A. The protective lining system shall be a multi-component protective lining system, including:

1. Concrete reinforcing steel bars (rebar) coating / primer shall be placed on all exposed rebar. Assume 700-lf of exposed bars, at no additional cost to the Owner.

2. Cementitous resurfacing/ underlayment compound that shall be placed all interior surfaces. Assume application depth is 3" across entire structure, at no additional cost to Owner.

3. Epoxy filler compound to fill all voids and bug holes in the concrete to provide a properly prepared and uniform surface for the epoxy lining.

4. 100% solids epoxy, moisture tolerant, polymer lining designed specifically for municipal wastewater exposure, at a thickness of 125 mils.

5. The applicator shall supply all accessory components such as sealers, infiltration control products or other compounds or products as recommended by the protective lining manufacturer for maximum protective lining adherence to substrate and long-term service performance.

B. Products:

1. Reinforcing steel bars (rebar) coating / primer:

Properties	Sauereisen ConoWeld No. 501
Components	2 part
Application Time at 70°F	
Working Time	20 minutes
Initial Set	6 hours
Material	100% solids epoxy
Minimum Thickness	10 mils

Rebar primer shall be applied to all exposed rebar to seal surface, prevent reinforcing steel corrosion, and promote adhesion of the subsequent resurfacing layer.

Alternative manufacturer is Sika Amatec 110 EpoCem, with compatibility and performance guarantee statements for mixing multiple manufactures components.

2. Cementitous Resurfacer:

Properties	Sauereisen F-121 Substrate Resurfacer
Components	1 part
Application Time at 70°F	
Working Time	30-45 minutes
Initial Set	7 hours
Compressive Strength (ASTM C109)	
@ 24 hours	3,900 psi
@ 7 days	5,000 psi
@ 14 days	5,500 psi
@ 28 days	7,000 psi
Shear Bond Strength (ASTM C882-91)	
@ 7 days	2,200 psi
@ 28 days	2,540 psi
Flexural Strength (ASTM C580)	1,500 psi
Tensile Strength (ASTM C307)	550 psi
Density (ASTM C905)	137 pcf
Mix Ratio (powder to water, by weight)	6.25/L
Minimum Thickness	1/8”
Assumed Average Thickness (for bidding purposes)	3”

Underlayment shall be a high strength, fast setting cement resurfacing material. Mortar shall be trowel or pump applied. Existing structures which are being rehabilitated shall receive the resurfacing compound cement within the entirety of the interior surface at a minimum 1/8" thickness (and an average thickness assumed to be 3") to fill all irregularities to provide uniform surface for the application of the epoxy corrosion resistant lining system. Ensure amount of resurfacing compound does not extend beyond the limits of the original designed floor elevations (to ensure the existing pump and pipes fit without alteration to the discharge manifold).

Alternative manufacturer is Sika Repair 224 with compatibility and performance guarantee statements for mixing multiple manufactures components. Allow Sika Repair 224 to dry for a minimum of 7 days (at 70-degrees Fahrenheit and less than 50% relative humidity) prior to applying epoxy lining.

3. Epoxy Filler Compound:

Properties	Sewergard No. 109
Color	Off White
Compressive Strength	10,000 psi
Density (ASTM C905)	87.2 pcf
Flexural Strength (ASTM C580)	4,000 psi
Modulus of Elasticity (ASTM C580)	5.2×10^4 psi
Tensile Strength (ASTM C307)	2,200 psi
Bond Strength to Concrete (ASTM D4541)	Concrete Failure
Moisture Absorption (ASTM C413)	<0.25%
Shrinkage (ASTM C531)	<0.2%
Working Time	15 minutes @ 70°F
Topcoat	3 hours @ 70°F

Filler Compound shall be an epoxy formulation specifically designed to fill small voids, irregularities and air pockets in concrete surfaces, structures. The filler compound shall provide a uniform surface for the application of epoxy monolithic protective linings. The Filler Compound shall be confirmed by the manufacturer as compatible with the protective lining.

4. Epoxy Base Coat and Sealer Coat Lining:

Properties	Sewergard No. 210X
Adhesion (ASTM D4541)	Concrete Failure
Application Time (ASTM C308 modified)	
Working Time @ 70°F	30 minutes
Bond Strength to Concrete (ASTM D7234)	Concrete Failure
Bond Strength by Slant Shear (ASTM C882 modified)	700 psi (49.2 kg/cm2)
Compressive Strength (ASTM D695)	15,500 psi (1089.9 kg/cm2)
Components	2 parts
Elongation (ASTM D638)	12.9%
Flexural Strength (ASTM D790) @ 28 days	8,000 psi (562.4 kg/cm2)
Maximum Service Temperature (dry)	150°F (65°C)
Mix Ration (by volume)	1 part A-(Hardener):3 parts b (Resin)
Modulus of Elasticity (ASTM D790)	5.1 x 104 psi
Permeability (ASTM E96)	1.32 x 10-10
Shore D (ASTM D2240)	95
Tensile Strength @ 7 Days (ASTM D638)	4,300 psi (302.3 kg/cm2)
Minimum Thickness	125 mils

Protective epoxy lining is to be moisture tolerant and capable of withstanding groundwater intrusion, as exterior of structure does not have waterproof coating and the entire structure sits below the groundwater table.

Sewergard Epoxy 210X lining is to be applied in one to two coats for a total system thickness of 125 mils dft.

Alternative manufacturer is Raven Lining Solution 405, with compatibility and performance guarantee statements for mixing multiple manufactures components.

C. Product and Manufacturer: Provide one of the following:

1. Sauereisen, Pittsburgh, PA (412) 963-0303.
2. Or equal, in accordance with this specification.

PART 3 EXECUTION

3.1 INSPECTION

The Applicator shall examine the areas and conditions under which protective lining Work is to be performed and notify Engineer in writing of conditions detrimental to the proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected in a manner acceptable to Engineer.

A. Commencement of the Work of this Section shall indicate that the substrate and other conditions of installation are acceptable to the Applicator and the Engineer and shall produce a finished product meeting the requirements of the Specifications. All defects resulting from such accepted conditions shall be corrected by Applicator at his own expense.

B. Contractor shall remove all piping, equipment and appurtenances as required to properly conduct the Work. Any piping, flap gates, slide gates, guide rails, pipe supports, grating, electronic instrumentation, or other appurtenances Contractor is unable to remove shall be protected from surface preparation and coating activities. Any damage to existing piping, equipment and appurtenances shall be repaired or replaced with new at the discretion of the Engineer. See Drawings for Notes and piping, equipment and appurtenances inside wetwell and influent channel.

C. Contractor shall provide cranes or lifting devices as required to conduct the Work. Use of the City davit crane will not be allowed.

3.2 SURFACE PREPARATION

A. Prior to rehabilitation, remove all existing pipe supports, pump guide brackets, anchors, gate frames, hatches, grating and appurtenances mounted to the structure, as shown in the Pump Station Drawings.

B. Existing Concrete Application - Existing concrete structures to receive protective lining system must be capable of withstanding imposed loads. All oil, grease and chemical contaminants must be removed from the surface of the concrete. All loose or deteriorated concrete shall be removed by mechanical means. All surfaces must be firm, free of damaged or contaminated concrete, laitance, form release agents, and standing water and they must be structurally sound as determined by Engineer. Suitable surface preparation methods include shot blasting, abrasive Blasting, or hydro-blasting. Surface preparation procedures shall be in accordance with ICRI Guideline No. 03732. Surface preparation requirement is to expose aggregate and obtain a uniform surface texture resembling an ICRI CSP # 4-6 comparators.

C. Use the following procedures where reinforcing steel with active corrosion is encountered: Sandblast reinforcing steel to remove all contaminants and rust. Abrasive blast to SSPC-SP5, white metal. Remove contaminants, the substrate must be neutralized. Determine section loss, splice new reinforcing steel where there is more than 15 percent loss as directed by the Engineer. If more than half the diameter of the reinforcing steel is exposed, chip out behind the reinforcing steel a minimum of 1/2 inch. The distance chipped behind the reinforcing steel must also equal or exceed the minimum placement depth of the

accepted material. Coat rebar with primer and allow to cure for 6 hours prior to resurfacing system is installed.

D. Use the following procedures where reinforcing steel is encountered without active corrosion: Abrasive blast to SSPC-SP5, white metal. Remove contaminants, the substrate must be neutralized. If more than half the diameter of the reinforcing steel is exposed, chip out behind the reinforcing steel a minimum of 1/2 inch. The distance chipped behind the reinforcing steel must also equal or exceed the minimum placement depth of the accepted material. Coat rebar with primer and allow to cure for 6 hours prior to resurfacing system is installed.

E. Concrete surfaces that have been resurfaced must be allowed to cure in accordance with protective lining manufacturer's recommendations prior to application of protective epoxy lining system, for a minimum of 7 hours, at conditions environmental required by manufacturer. If alternative manufacturer is selected, provide a minimum of 7-days cure time, at conditions environmental required by manufacturer.

F. Level or grind concrete substrates to protective lining system manufacturer's recommended tolerances to produce a uniform surface profile, including removal of all sharp edges, ridges or depressions.

G. Stopping Active Leaks: After surface cleaning and preparation, any visible leaks shall be reported to the Engineer. Any minor leaks not requiring other repairs by the Engineer must be sealed using Sauereisen InstaPlug No. F-180, No. F-370 Chemical Grout or approved equal prior to proceeding with protective lining system installation.

H. New Concrete (*no new concrete is used on this project*):

1. Allow any new concrete is to cure for 28 days before protective lining system is installed, unless otherwise recommended by the Applicator or protective lining systems manufacturer.
2. New Concrete Application – All voids, holes and depressions shall be filled with epoxy based filler compound material (section 2.1.B.1), re-establishing plan finished grades and surface profiles.
3. Moisture Testing:
    a. Floors - New concrete should be installed over a moisture barrier to eliminate moisture transmission through the concrete floor. Prior to the application of materials, the moisture content must be determined using a suitable Moisture Detection System per ASTM F-1869 - "Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride." One such manufacturer is Sealflex Industries, 2925 College Ave. #B4, Costa Mesa, CA (714-708-0850). An average value exceeding 3.0 lbs/1000 ft^2/24-hr period is unacceptable and shall require additional cure time, the application of a surface penetrating vapor barrier or other corrective measures. Re-test after taking corrective measure to ensure an average value below 3.0 lbs.

    b. Moisture testing for walls and overheads - Test new concrete pours/block for moisture after completing surface preparation. Utilize ASTM D-4263 "Standard

Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method." Any indication of moisture shall require additional cure time, the application of a surface penetrating vapor barrier or other corrective measures. Re-test after taking corrective measure to ensure the absence of moisture.

c. Consult protective lining system manufacturer regarding all questions and/or recommendations in reference to moisture problems or questions.

d. Expansion and construction joints shall be formed and filled as recommended by the protective lining system manufacturer.

3.3 APPLICATION

A. Protective lining systems shall be installed when ambient air and surface temperatures are between 50º and 85ºF. Store lining materials within the 60º to 85ºF range for 48 hours prior to use. Application and storage temperatures outside of this range shall require written instruction from the protective lining manufacturer.

B. Application in direct sunlight and/or with rising surface temperatures is not recommended, as this may result in blistering of the materials due to expansion of entrapped air or moisture (out-gassing) in the concrete/concrete block substrates. In such cases, it shall be necessary to postpone the application until later in the day when the temperature of the substrate is falling. Concrete surfaces that have been in direct sunlight must be shaded for at least 24 hours prior to application and remain shaded until the initial set has taken place. Consult protective lining system manufacturer for application schedule guidelines specific to temperature conditions and possible sealer application recommendations to reduce out-gassing.

C. Resurfacing/Epoxy Filler Compound Application - Cementitous resurfacing and epoxy filler compounds shall be used in accordance with this specification and in accordance with protective lining manufacturer's recommendations to provide a uniform and crack, void and bug hole free surface for epoxy lining application.

D. Epoxy Base Coat and Sealer Coat Lining –Epoxy base coat and sealer coat lining shall be applied and cured on the properly prepared surface in accordance with protective lining system manufacturer's written guidelines as outlined in product technical data sheets.

1. Epoxy base coat shall be applied to a total minimum thickness of 125 mils. Application method and equipment shall be approved by the Engineer and shall be in accordance with the protective lining system manufacturer's recommendations.

E. High Voltage Spark Testing. Contractor shall provide high voltage spark testing. Installed protective epoxy lining shall be tested for pinholes after a minimum 24-hour cure at a temperature of 70°F. Pinhole testing shall be accomplished in accordance with ASTM D-4787, using a Tinker Razor Holiday Detector, San Gabriel, CA, Model AP/W, or an approved equal device. Test voltage of 100 volts/mil of coating thickness shall be applied.

All pinholes shall be marked and repaired using manufacturer's approved Patch Kit, or other approved method. Submit spark testing data to Engineer for approval.

F. Adhesion Testing – Contractor to perform adhesion testing. Adhesion testing shall be conducted after the lining system has cured in accordance with manufacturer specification. Adhesion testing shall be in accordance with ASTM D4541-Modified herein. Affix one 3/4 inch dolly (to the host structure) on every concrete slab, wall, and ceiling with a maximum spacing of 500-sf (one on the wetwell floor, one in the influent/overflow channel floor, one on each of the four wetwell walls, one on each of the four influent/overflow channel walls, and one in the wetwell ceiling). Prior to the pull test, the tester shall utilize a scoring device to cut around the dolly and cut through the lining until the original concrete is reached. Failure due to improper adhesion of the dolly shall require retesting. The pull test in each area is to be a minimum of 200psi. Pull tests of a minimum 150psi to 200psi may be acceptable if more than 50 percent of the substrate is adhered to the back of the dolly. A test result may be disregarded by the Engineer if there is a valid non-statistical reason as specified in section 8.4 and 8.5 of ASTM D4541. If the host structure fails the minimum requirement then the Engineer and lining manufacturer shall be consulted. All voids caused by the adhesion testing are to be prepared and repaired per lining manufacturer recommendations. Submit adhesion testing data to Engineer for approval.

3.4 ADJUSTMENTS AND CLEANING

A. At the completion of the Work, Applicator shall remove all materials and debris associated with the Work of this Section.

B. Clean all surfaces not designated to receive protective coating. Restore all other work in a manner acceptable to Engineer. Re-install all removed equipment, piping supports, gates, and appurtenances.

C. All finished protective lining Work shall be protected from damage until Final Acceptance of the Work. Protective lining damaged in any manner shall be repaired or replaced at the discretion of Engineer at no additional cost to Owner.

D. Clean all protective lining as recommended by the manufacturer to provide finished Work acceptable to Owner, just prior to Final Acceptance.

END OF SECTION

SECTION 05500

METAL FABRICATIONS

PART 1 GENERAL

1.1 DESCRIPTION

The work of this section consists of providing miscellaneous metal work shown on the Drawings, as specified herein, and as needed for a complete and proper installation.

1.2 RELATED SECTIONS

A. Section 01300 - Submittals

B. Section 05120 -Structural Steel

C. Section 05140 – Structural Aluminum

D. Section 09900 - Painting

1.3 GOVERNING COVER AND STANDARDS

A. 2019 California Building Code (CBC)

B. AA - The Aluminum Association “Specifications and Guidelines for Aluminum Structures”

1.4 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this section.

B. Perform shop and/or field welding required in connection with the work of this section in strict accordance with pertinent recommendations of the American Welding Society.

1.5 SUBMITTALS

A. In accordance with Section 01300.

B. Product data to be submitted:

1. Materials list of items proposed to be provided under this Section;

2. Manufacturer's specifications and other data needed to prove compliance with the specified requirements;

3. Shop Drawings in sufficient detail to show fabrication, installation, anchorage, and interface of the work of this Section with the work of adjacent trades;

4. Manufacturer's recommended installation procedures which, when approved by the Engineer, will become the basis for accepting or rejecting actual installation procedures used on the work.

PART 2 MATERIALS

2.1 MATERIALS

A. In fabricating items which will be exposed to view, limit materials to those which are free from surface blemishes, pitting, rolled trade names, and roughness.

B. Unless noted otherwise, comply with the following standards, as pertinent.

1. Steel plates, shapes, and bars: ASTM A36.

2. Rolled W and WT shapes: ASTM A992, Grade 50

3. Steel plates to be bent or cold-formed: ASTM A283, grade C.

4. Steel tubing (hot-formed, welded, or seamless): ASTM A501.

5. Steel bars and bar-size shapes: ASTM A306, grade 65, or ASTM A36.

6. Cold-finished steel bars: ASTM A108.

7. Cold-rolled carbon steel sheets: ASTM A336.

8. Galvanized carbon steel sheets: ASTM A526, with G90 zinc coating in accordance with ASTM A525.

9. Stainless steel bars, plates, structural shapes, ASTM A276, Type 304.

10. Stainless steel sheets: AISI type 302 or 304, 24 gauge, with Number 4 finish.

11. Aluminum plates, shapes, and bars, 6061-T6 or 6063-T6 alloy, mill finish unless otherwise specified.

12. Grey iron castings: ASTM A48, Class 40.

13. Malleable iron castings: ASTM A47.

14. Steel pipe: ASTM A120, schedule 40, black finish unless otherwise noted.

15. Concrete inserts:

    a. Threaded or wedge type galvanized ferrous castings of malleable iron complying with ASTM A27.

    b. Provide required bolts, shims, and washers, hot-dip galvanized in accordance with ASTM A153.

2.2 FABRICATION

A. Except as otherwise shown on the Drawings or the approved Shop Drawings, use materials of size, thickness, and type in accordance with this Section.

B. Fabricate with accurate angles and surfaces which are true to the required lines and levels, grinding exposed welds smooth and flush, forming exposed connections with hairline joints, and using concealed fasteners wherever possible.

C. Prior to shop painting or priming, properly clean metal surfaces as required for the applied finish and for the proposed use of the item.

D. On surfaces inaccessible after assembly or erection, apply two coats of the specified primer. Change color of second coat to distinguish it from the first.

E. Properly mark and match-mark materials for field assembly and for identification as to location for which intended.

F. Fabricate for delivery sequence which will expedite erection and minimize field handling of materials.

G. Where finishing is required, complete the assembly, including welding of units, before start of finishing operations.

H. Provide finish surfaces of members exposed in the final structure free from markings, burrs, and other defects.

2.3 CASTINGS

A. All castings shall be sound and free from shrinkage crack, blow holes, and other defects. All fins and burnt sand must be removed. Excessive porosity and spongy surfaces will constitute causes for rejection. The Engineer shall be final judge as to whether the defects present are sufficient to cause rejection.

B. No welding or patching of defects in castings will be permitted unless authorized by the Engineer. Any such welding or patching done without the Engineer's consent shall be cause for rejection.

C. All castings shall be true to form and dimensions shown on the Drawings. After inspection and prior to shipping, all machined surfaces shall be coated with a blue rust inhibitive lacquer, or other approved material which can be easily removed, unless otherwise specified.

D. The dimensions of the finished castings shall not be less than the specified dimensions. Castings shall not be more than seven and one-half (7-1/2) percent overweight. Large castings shall be suspended and hammered over their entire area. No cracks, flaws, or other defects shall appear after such hammering.

E. Castings shall be provided with adequate continuous fillets cast in place in all re-entrant angles. The radius of curvature of the exposed surface of a fillet shall define the size of the fillet. The size of fillets shall not be less than one-half (1/2) of the thickness of the thinnest adjoined member nor less than one-half (1/2) inch.

F. Iron castings shall be dipped or painted with asphalt which will form a tough, tenacious, non-scaling coating which does not have a tendency to become brittle when cold or sticky when hot.

G. The covers and seats shall be machined so that the cover sits evenly and firmly in the frame.

2.4 CONNECTIONS

A. Provide bolts and washers of types and sizes required for completion of field erection.

B. Welded Construction: Comply with AWS Code for procedures, appearance, and quality of welds, and methods used in correcting welded work.

C. Assemble and weld built-up sections by methods which will produce true alignment of axes without warp.

2.5 FASTENERS

A. General:

1. For exterior use and where built into exterior walls, provide zinc-coated fasteners, for damp locations provide stainless steel fasteners.

2. Provide fasteners of type, grade, and class required for the particular use.

B. Comply with the following standards as pertinent:

1. Bolts and Nuts: Provide hexagon-head regular type complying with ASTM A307, Grade A (Steel); ASTM A320 and A194, Grade B8 (Stainless Steel).

2. Lag bolts: Provide square-head type complying with Fed. Spec. FF-B-561.

3. Machine Screws: Provide cadmium plated steel type complying with Fed. Spec. FF-S-111; except use stainless steel for damp locations or with aluminum.

4. Washers:

a. Plain washers: Comply with Fed Spec FF-W-92, round, carbon steel.

b. Lock washers: Comply with Fed. Spec FF-W-84, helical spring type carbon steel.

5. Toggle bolts: Provide type, class, and style needed but complying with Fed. Spec. FF-B-588.

6. Anchorage devices: Provide expansion shield complying with Fed Spec FF-S-325.

2.6 HOLES FOR OTHER WORK

A. Provide holes required for securing other work to metalwork and for passage of other work as shown on the approved Shop Drawings.

B. Provide threaded nuts welded to framing and other specialty items as shown, to receive other work.

C. Cut, drill, or punch holes perpendicular to metal surfaces.

D. Do not flame cut holes or enlarge holes by burning.

E. Drill holes in bearing plates.

2.7 OTHER MATERIALS

Provide other materials, not specifically described but required for a complete and proper installation, as selected by the Contractor subject to the approval of the Engineer.

2.8 GALVANIZING

A. Shall be double hot-dip processed after fabrication, ASTM A123, A153, A386, and A525. Double dip shall be required, if necessary, to achieve required coating weight.

B. For repair of galvanizing, use galvaloy stick applied as recommended by the manufacturer.

2.9 SHOP PRIMING and FINISHES

A. General:

1. Shop prime un-galvanized steel work, except those members or portions of members to be embedded in concrete or mortar.

2. Paint embedded steel which is partially exposed on the exposed portions, and the initial 2" of embedded areas only.

B. Surface Preparation:

1. After inspection and before shipping, clean steelwork to be painted.

2. Remove loose rust, loose mill scale, and spatter, slag, and flux deposits.

3. Prepare steel in accordance Section 09900. If not specified, prepare steel in accordance with Steel Structures Painting Council SP-3, "Power Tool Cleaning."

C. Primer Painting:

1. Immediately after surface preparation, apply structural steel primer paint in accordance with Section 09900 and the manufacturer's recommendations and at a rate to provide a uniform dry film thickness.

2. Use painting methods which will result in full coverage of joints, corners, edges, and exposed surfaces.

3. The Contractor shall be responsible for providing the required coating system per Section 09900. The Contractor shall remove shop coatings not in conformance with Section 09900. Additionally, the Contractor shall prepare any shop applied coating, which, while meeting the requirements of Section 09900, requires additional surface preparation in order to obtain a mechanical bond between coatings.

D. All stainless-steel parts, after its fabrication, shall undergo a passivation (pickling) process to ensure maximum resistance to corrosion. All stainless-steel components and structures shall be submersed in a chemical bath of nitric acid and hydrofluoric acid to remove any residues that may be present on the material as a result of forming, manufacture, or handling. After removal from the pickling bath, the equipment must be washed with a high-pressure wash of cold water to remove any remaining surface debris and promote the formation of an oxidized passive layer which is critical to the long life of the stainless steel. Submergence insures complete coverage. Spray on chemical treatments and glass bead blasting are specifically not acceptable due to their inability to provide complete and

uniform corrosion protection. All field welds shall be cleaned and passivated to remove iron (and prevent corrosion) in accordance with ASTM A380.

PART 3 EXECUTION

3.1 SURFACE CONDITIONS

Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the work. Do not proceed until unsatisfactory conditions are corrected.

3.2 COORDINATION

Coordinate as required with other trades to assure proper and adequate provision in the work of those trades for interface with the work of this Section.

3.3 INSTALLATION

A. General:

1. Set work accurately into position, plumb, level, true, and free from rack.
2. Anchor firmly into position.
3. Where field welding is required, comply with AWS recommended procedures of manual-shielded metal-arc-welding for appearance and quality of weld and for methods to be used in correcting welding work.
4. Grind exposed welds smooth, and touch-up shop prime coats.
5. Do not cut, weld, or abrade surfaces which have been hot-dip galvanized after fabrication and which are intended for bolted or screwed field connections.
6. Dissimilar Materials: Where dissimilar metals are in contact, or where aluminum is in contact with concrete, mortar, masonry, wet or pressure treated wood, or absorptive materials subject to wetting, the surfaces shall be protected with a coat of bituminous paint conforming to MIL-C-18480 or to TT-V-51 or a coat of zinc chromate primer conforming to TT-P-645 to prevent galvanic or corrosive action.
7. Materials and parts necessary to complete each item, even though such work is not definitely shown or specified, shall be included. All bolts, anchors, supports, braces, connection and other items necessary for completion of the miscellaneous metalwork shall be provided.

B. Immediately after erection, clean the field welds, bolted connections, and abraded areas of shop priming. Paint the exposed areas with same material used for shop priming.

END OF SECTION

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SECTION 05530

GRATINGS, STAIR TREADS, AND FLOOR PLATES

PART 1 GENERAL

1.1 DESCRIPTION

The work of this section consists of furnishing and installing gratings, stair treads and floor plates.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Section 01300 - Submittals

B. Section 03100 - Concrete

C. Section 05120 - Structural Steel

D. Section 05500 - Metal Fabrications

1.3 QUALITY ASSURANCE

Standards:

A. AA - Aluminum Association

B. AISC - American Institute of Steel Construction

C. ASTM - American Society for Testing and Materials

D. AWS - American Welding Society

E. NAAMM - National Association of Architectural Metal Manufacturers

1.4 SUBMITTALS

A. In accordance with Section 01300.

B. Submit shop drawings prior to fabrication. Include information necessary for fabrication and erection of component parts and arrangement of gratings, frames, stair treads and floor plates. Indicate size and weight of members, type and location of shop and field connections, type, size and extent of all welds and welding sequence. Use AWS welding symbols. Approval of shop drawings will be for size and arrangement of principal and auxiliary members and strength of connections. Any errors in dimensions and quantities shown will be the responsibility of the Contractor.

C. Certificate: Furnish manufacturer's certificate that grating materials meet or exceed the requirements of this specification.

1.5 HANDLING AND STORING MATERIALS

Material to be stored shall be placed on skids above the ground. It shall be kept clean and properly drained. To avoid delays, deliver timely all loose items to be built into the concrete.

PART 2 MATERIALS

2.1 ALUMINUM GRATING

A. Open Mesh Grating (Type A)

1. Swage locked rectangular design (spaced approximately 1-3/16 x 4-inches on center).

2. Main bars to be 3/16-inches thick, depth as indicated in the Schedule in Part 3.02A1 of these Specifications or as indicated on the Drawings. Cross bars shall be secured to the main bars by a swaging process to prevent turning, twisting or coming loose.

3. Banding strips of the same thickness and ¼ -inch less depth as main bars shall be welded to each main bar at ends of grating sections and at openings.

4. Grating shall be IKG Borden swaged lock type "BS", 31266 Avenue 12, Madera, CA 93639; Seidelhuber No. 19S4, or equal.

B. Unpunched Plank (Type B)

1. Anti-skid surface, continuous raised longitudinal ridges.

2. Integral I-beam ribs with welded banding strips at ends of grating sections and at openings.

3. Each panel shall be provided with a recessed handle for removal.

4. For grating size, see Schedule in Part 3.02A2 of these Specifications, or as indicated on the Drawings.

5. As manufactured by IKG Borden; Seidelhuber, or equal.

2.2 GALVANIZED STEEL (OPEN MESH) GRATING (TYPE C)

A. Weldforged rectangular design (spaced approximately 1-3/16 x 4-inches on center).

B. Main bars to be 3/16-inches thick, depth as indicated in the Schedule in Part 3.02A3 of these Specifications, or as indicated on the Drawings. Cross bars to be twisted square steel and resistance welded at right angles to the main bars. No notching or cutting of bearing bars before welding is permissible.

C. Banding strips of the same depth and thickness as main bars shall be welded to each main bar at ends of grating sections and at openings.

D. Grating shall be IKG Borden, weldforged type "WB", 31266 Avenue 12, Madera, CA 94623; Seidelhuber No. 19W4, or equal.

2.3 STAINLESS STEEL (OPEN MESH) GRATING (TYPE E)

A. Weld forged rectangular design (spaced approximately 1-3/16 x 4-inches on center).

B. Main bars to be 3/16-inches thick, depth as indicated in the schedule in Part 3.02.A.3 of these specifications or as indicated on the Drawings.

C. Banding strips of the same depth and thickness as main bars shall be welded to each main bar at ends of grating sections and at openings.

D. Grating shall be 1KG Borden, weld forged type stainless type 316 “WB”, 31266 Avenue 12, Madera, CA 94623 or equal.

E. Furnish with a clean welded stainless appearance by electropolish, chemical cleaning or beadblast the finished product as needed.

2.4 GRATING FRAMES

Type 304 Stainless Steel or Fiberglass in areas exposed to chemicals and corrosive materials.

A. Embedded by welding continuous vertical bar same height as grating, to edge of 2-inch horizontal leg of 2-inch x 1½-inch structural angle, thereby providing 1-5/8-inch wide bearing area. Thickness of frame shall be ¼ -inch minimum. Provide welded-on anchors at 18-inch centers, minimum two per side, as detailed on the Drawings. 1½ -inch vertical leg

of frame below grating shall have a 5/16-inch diameter hole 24-inches on center for temporary nailing to formwork.

B. Surface Mounted Frame shall be a 2½ x 2 x ¼ -inch structural angle. Frame shall be attached as shown on the Drawings with a 5/8-inch diameter Type 304 stainless steel bolts at 15-inch centers maximum, minimum two per side.

2.5 STAIR TREADS

A. Aluminum construction, 0.065-inch thick "I-bar" webs with ¼-inch wide grooved top and bottom flanges. Cross bars shall be secured to main bars by a swaging process to prevent turning, twisting, or coming loose. Main bearing bar size shall be 1½ x 3/16-inch "I-bar" for tread lengths up to 42-inches.

B. Nosing shall be extruded corrugated aluminum, 1¼-inches wide.

C. Carrier bar shall be 3 x 3/16-inch aluminum full width of tread with one round and one slotted 7/16 -inch opening for bolts. Bolts shall be 3/8-inch diameter, galvanized steel for dry locations, stainless steel for moist locations.

D. Irving Borden type "IB" Bar, Seidelhuber type 19SI4, or equal.

2.6 SAFETY NOSING FOR CONCRETE STAIRS

A. Cast aluminum with cross-hatched and non-slip abrasive surfaces, or IKG Borden MEBAC aluminum nosings.

B. Cast aluminum exposed wearing surface to contain not less than 2 oz. per square foot of abrasive granules embedded in the top metal surface not less than 1/16" while the matrix is in a molten state. Size of non-slip granules shall range from No. 16 to No. 24.

C. Nosing shall be 4-inches wide and 5/16-inches thick minimum, with ¼-inch diameter by 1-inch long cast-on bolt anchors. Length shall be as required to terminate not more than 4-inches from each end of treads and as indicated for platforms and landings. Nosing shall be flush with the top of the traffic surfaces.

D. IKG Borden MEBAC aluminum type C-4E; American Abrasive Metals Co. "Alumalun" Style A; Wooster Products Inc. "Alumogrit" Type 101, or equal.

2.7 CHECKER PLATES

A. Aluminum diamond tread, 6061-T4 or T6 alloy. Raised pattern on one-inch centers.

B. Galvanized steel angle frame as detailed on Drawings.

C. Checker plates as manufactured by Ryerson, Emeryville, CA 94608; Aluminum Co. of America, Pittsburgh, PA 15219, or equal.

PART 3 EXECUTION

3.1 FIELD MEASUREMENTS

Before fabrication or installation, verify all dimensions of areas, spaces, spans and configurations. Provide openings for passage of pipes or other penetrations.

3.2 GRATING INSTALLATION

A. Grating sizing (Unless otherwise called out on the drawings)

1. Open Mesh Aluminum Grating (Type A)

Span	Bearing Bar Size	Wt. Lbs. Sq. Ft.
2'-6" and less	1" x 3/16"	2.6
3'-0" to 3'-6"	1¼" x 3/16"	3.2
Over 3'-6" to 4'-0"	1½" x 3/16"	3.9
Over 4'-0" to 4'-6"	1¾" x 3/16"	4.5
Over 4'-6" to 5'-0"	2" x 3/16"	5.1

2. Unpunched Aluminum Plank (Type B)

Span	Bearing Bar Size	Wt. Lbs. Sq. Ft.
2'-6" and less	1"	2.65
3'-0" to 3'-6"	1¼"	3.25
Over 3'-6" to 4'-0"	1½"	3.95
Over 4'-0 to 4'-6"	1¾"	4.55
Over 4'-6" to 5'-0"	2"	5.55
Over 5'-0" to 5'-6"	2¼"	6.25

3. Open Mesh Galvanized Steel Grating (Type C)

Span	Bearing Bar Size	Wt. Lbs. Sq. Ft.
2'-6" and less	¾" x 3/16"	5.8
3'-0" to 3'-6"	1" x 3/16"	7.5
Over 3'-6" to 4'-6"	1¼" x 3/16"	9.1

Over 4'-6" to 5'-6"	1½" x 3/16"	10.8
Over 5'-6" to 6'-0"	1¾" x 3/16"	12.5

B. Grating Sections:

1. Overall physical size of grating sections may be shown or indicated on Drawings where ease of removing an individual section has been considered. Otherwise, if not indicated on Drawings specifically, size of sections shall be such that no panel weighs more than 60 pounds.

2. Provide ¼-inch space between grating sections and frame and adjacent grating sections. Edge of grating at openings shall be banded with same size bar as bearing bar.

C. Grating Fasteners:

1. Open mesh grating.

   a. Secure each grating section to frame with stainless steel saddle clips and stainless steel self-drilling fasteners; at least four per grating section. Saddle clips shall be placed over two main bearing bars.

   b. Use galvanized saddle clips for galvanized steel grating, aluminum saddle clips for aluminum grating, Type 316 stainless steel saddle clips for stainless and fiberglass grating.

2. Plank grating.

   a. As detailed on Drawings or as recommended by Manufacturer.

D. Grating Frames and Supports

1. All gratings shall be set into angle frames set and anchored into the concrete, supported by surface mounted frames, or as detailed on the Drawings.

2. The top surfaces of all bars and panels of gratings shall be flush with the adjacent surfacings, around perimeter of grating sections and at openings.

3. Provide supports for gratings at openings as detailed on the Drawings. If detailing on the drawings is not shown contractor shall design and provide support beams for gratings at openings as needed at no cost to the Owner. If additional support beams are needed due to geometrical constraints, they are designed and provided at no cost to the Owner.

4. Use galvanized steel frames for steel gratings, aluminum frames for aluminum gratings, type 304 stainless steel frames for fiberglass gratings and Type 304 stainless steel frame for stainless steel gratings.

3.3 WORKMANSHIP

A. All fabrication shall be done to the dimensions shown or as approved. All items shall be free from any defects which mar appearance or impair strength.

B. All panels shall be absolutely flat and true to provide even, uniform, non-rattling bearing on the supports. Supports for all grating shall be provided as shown on the Drawings.

END OF SECTION

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SECTION 05570

METAL SUPPORT FRAMING

PART 1 GENERAL

1.1 DESCRIPTION

The work of this section consists of furnishing and installing metal support framing for piping and other equipment as shown on the drawings.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Section 01300 - Submittals

B. Section 01610 - Seismic Design Criteria

C. Section 01615 - Wind Design Criteria

D. Section 05500 - Metal Fabrications

E. Section 15094 - Hangers and Supports

F. Division 16 - Electrical

1.3 QUALITY ASSURANCE

Standards

A. AA - Aluminum Association

B. AISC - American Institute of Steel Construction

C. ASTM - American Society for Testing and Materials

D. AWS - American Welding Society

1.4 SUBMITTALS

A. In accordance with Section 01300.

B. Provide structural calculation stamped and signed by a Structural or Civil engineer registered in the state of California for the metal support framing system. See specs 01610 and 01615 for additional information.

C. Submit shop drawings prior to fabrication. Include information necessary for fabrication and erection of component parts and arrangement of frames. Indicate size and weight of members; type and location of shop connections. Approval of shop drawings will be for size and arrangement of principal and auxiliary members and strength of members. Any errors in dimensions and quantities shown will be the responsibility of the Contractor.

D. Certificate: Furnish manufacturer's certificate that framing materials meet or exceed the requirements of this specification.

1.5 HANDLING AND STORAGE OF MATERIALS

Materials to be stored shall be placed on skids above the ground. It shall be kept clean and properly drained. To avoid delays, deliver all loose items to be built into the concrete in a timely fashion.

PART 2 MATERIALS

2.1 GENERAL

A. All parts shall be manufactured by Unistrut Corporation, Wayne, Michigan; B-Line Systems, Inc., Highland, Illinois, or equal.

B. All parts of the system shall be of one manufacturer. Parts shall be stamped with manufacturer's part number for identification.

C. The load capacities of parts, connections and assemblies shall meet or exceed those published in the latest framing manufacturer's engineering catalog and supplementary bulletins.

D. Dimensions, tolerances and physical design shall be so that the parts within the system will be interchangeable and conform to the designs set forth in the latest framing manufacturer's engineering catalog and supplementary bulletins.

E. Channels, continuous concrete inserts, and closure strips shall be 12-gauge, cold-formed from mild steel conforming to ASTM A1011, Grade C specifications.

F. Fittings shall be press formed from hot rolled, pickled and oiled steel plate conforming to ASTM A575 or steel strip conforming to ASTM A1011 Grade C specifications.

G. Gripping nuts shall be stainless steel spring mounted with serrated nuts.

H. Screws and bolts shall be stainless steel. All threads shall be Unified National Coarse, Class A.

I. Unless noted otherwise, framing channels shall be galvanized.

J. Use stainless steel or fiberglass materials in wet or corrosive areas, or as shown on the drawings.

PART 3 EXECUTION

3.1 GENERAL

See Contract Drawings for configuration and member model numbers (if shown). Supply all components to result in a complete system, whether shown, specified or not. The minimum design basis shall be Unistrut model P1000, or equal.

3.2 FIELD MEASUREMENTS

Before installation, verify all dimensions of areas, spaces, spans and configurations.

3.3 INSTALLATION

A. All frameworks and assemblies of the system shall be true, plumb, square and level and accurately located according to the Contract and Shop Drawings.

B. Cut ends of fiberglass channels shall be sealed per manufacturer's recommendations.

C. All installations shall be coordinated with other trades as required.

D. All bolted connections shall be tightened to the following torque values.

1. ¼-inch bolts 4 foot-pounds torque
2. 3/8-inch bolts 30 foot-pounds torque
3. ½-inch bolts 50 foot-pounds torque

3.4 WORKMANSHIP

All fabrication shall be done to the dimensions shown or as approved. All items shall be free from any defects which mar appearance or impair strength.

END OF SECTION

SECTION 07110

WATERPROOFING

PART 1 GENERAL

1.1 DESCRIPTION

The work of this Section consists of furnishing and installing below grade waterproofing required for this work as indicated on the Drawings or specified herein and includes, but is not necessarily limited to, below grade waterproofing.

1.2 RELATED WORK DESCRIBED ELSEWHERE

A. Section 01300: Submittals

B. Section 02225: Structure Excavation and Backfill

C. Section 09900: Painting

1.3 QUALITY ASSURANCE

A. Qualifications of Installers: Provide at least one person who shall be present at all times during execution of this portion of the work and who shall be thoroughly experienced in the application of the specified products and shall direct all work performed under this Section.

B. Manufacturer's Certification: Prior to start of installation of the work of this Section, secure a visit to the job site by a representative of the manufacturer of the waterproofing materials used, who shall inspect and shall certify that the surfaces to which waterproofing is to be applied are in a condition suitable for that application.

1.4 SUBMITTALS

Materials List: Before any waterproofing materials are delivered to the job site, submit a complete list of all materials proposed to be furnished and installed under this portion of the work, making the submittal in accordance with the provisions of Section 01300 of these Specifications.

1.5 PRODUCT HANDLING, STORAGE, AND DELIVERY

A. Use all means necessary to protect waterproofing materials before, during, and after installation and to protect the installed work and materials of all other trades.

B. In the event of damage, immediately make all repairs and replacements necessary at no additional cost to the Owner.

C. Deliver materials in manufacturer’s original, unopened containers and rolls with labels intact and legible.

D. Deliver materials in sufficient quantity to allow continuity of work.

E. Handle rolled goods so as to prevent damage to edge of ends.

F. Select and operate material handling equipment so as not to damage existing construction.

G. Store materials on clean raised platforms with weather protective covering when stored outdoors.

H. Provide continuous protection of materials against wetting and moisture absorption.

I. Protect materials against damage by construction traffic.

J. Remove wet materials for project site.

K. Comply with fire and safety regulations.

L. Store emulsions in temperature above 45°F.

PART 2 MATERIALS

2.1 WATERPROOFING

A. General: All waterproofing shall be the specified products of the W. R. Meadows Co., MEL-ROL LM, Karnak Corp., or equal.

B. Below Grade Waterproofing: All below grade waterproofing shall be non-solvent type waterproofing, or equal, applied to at least 60-mil thickness (2 coats of 30 mils each, DFT).

C. Primer: Per manufacturer's requirements.

2.2 PROTECTION

Protect all waterproofing, horizontal and vertical, with 8-mil thickness double wrapped polyethylene encasement. The thickness shall not be less than 10 percent of the nominal thickness and shall be in sheet form. Use 10 mil vinyl tape to secure and seal the polyethylene sheet.

2.3 OTHER MATERIALS

All other materials, not specifically described but required for a complete and proper installation of waterproofing, shall be as recommended by the material supplier.

PART 3 EXECUTION

3.1 SURFACE CONDITIONS

A. Inspection

1. Prior to all work of this section, carefully inspect the installed work of all other trades and verify that all such work is complete to the point where this installation may properly commence.
2. Verify that waterproofing may be installed in strict accordance with the original design and the manufacturer's recommendations.

B. Discrepancies

1. In the event of discrepancy, immediately notify the Engineer.
2. Do not proceed with installation in areas of discrepancy until all such discrepancies have been fully resolved.

3.2 INSTALLATION

A. Waterproof coating shall be applied below grade on outside of concrete structures listed in Section 09900 Finish Schedule and below.

B. Waterproof coating shall also be applied to the following:

1. Below grade unit masonry surfaces.
2. Backfilled side of retaining walls and planters, which occur above adjacent grade.
3. Backside of metal flashings.

C. Surface Preparation: Examine surfaces for foreign material, moisture, and unevenness, which would prevent the execution and quality of application of system as specified. Remove any paraffin or wax base non-bonding compounds. Fill all cracks, voids, joints, depressions and places around projections with cement grout to provide smooth and flush surface. Proceed with waterproofing application only after surface defects are corrected. Application of material will be considered as evidence of installer's acceptance of substrate as a proper base for waterproofing.

D. Application: Install materials in accordance with requirements of waterproofing system manufacturer. Maintain neat line at upper edge. Mask as required to prevent overrun of materials onto surfaces. Install the required protective covering over the waterproofing to prevent damage during backfill operation.

3.3 COORDINATION WITH SEALANTS

A. Where feasible, delay application of waterproof coatings until installation of sealants has been completed in joints adjoining surfaces to be coated.

B. Protect adjoining work, including sealant bond surfaces, from spillage or blow-over of waterproof coatings. Cover adjoining and nearby surfaces of aluminum and glass where there is possibility of waterproof coatings being deposited on surfaces. Cover live plant materials with drop cloths. Clean waterproof coatings from adjoining surfaces immediately after spillage. Comply with manufacturer's recommendations for cleaning.

3.4 CODES, ORDINANCES AND LAWS COMPLIANCE

In addition to the specific requirements described herein, the total scope of work required by this section includes all means, methods, labor and material required to conform to all applicable Federal, State and local codes, ordinances, laws and any other requirements applicable to the construction process, materials and the finished, completed work.

3.5 PROTECTION OF SYSTEM

Score the fiber board to mold around the round surface of the structure so that all voids are eliminated. Tape the joints with duct tape to prevent the entrance of stones and dirt during backfill operations.

END OF SECTION

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SECTION 08310

ACCESS HATCHES

PART 1 GENERAL

1.1 SUMMARY

Section includes furnishing and installing access hatches.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Section 01300 - Submittals

1.3 SUBMITTALS

A. Product Data

B. Shop Drawings:

1. Show profiles, accessories, and dimensions.
2. Show locations of access doors.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Identify type and size of each door in way not to damage finish prior to delivery.

B. Deliver products only after proper facilities are available.

C. Deliver and store packaged products in original containers with seals unbroken and labels intact until time of use.

D. Handle carefully to prevent damage and store on clean concrete surface or raised platform in safe, dry area. Do not dump onto ground.

E. Protect access doors during shipment and storage to prevent warping, bending, and corrosion.

1.5 QUALITY ASSURANCE

A. All hatches located over submersible pumps with guide rails shall be supplied by the same manufacturer as the submersible pump for coordination.

B. All hatches not located over a submersible pump shall be supplied by the same manufacturer and as specified herein.

PART 2 MATERIALS

2.1 FLOOR ACCESS HATCH (H-20 Loading)

A. Manufacturers:

1. One of the following or equal:

a. The Bilco Co., Type JD-AL-H20 or JAL-H20.

b. Babcock-Davis Associates, Inc.

c. US Foundry

d. Syracuse Castings

e. Halliday Products

B. Style: Single or double leaf, 316SST, capable of withstanding H20 loading, channel frame, with drainage couplings. Hatches with openings greater than 36-inches in the long dimension shall be double leaf type.

C. Door Leaf: Minimum ¼ -inch 316SST diamond pattern plate.

D. Frame: ¼ -inch extended 316SST channel with bend down anchor tabs around perimeter. A continuous EPDM gasket shall be mechanically attached to the frame.

E. Hardware:

1. Hinges: Equipped with 316SST hinges with 1/4-inch diameter stainless steel pins.

2. Lock: Snap lock with removable handle mounted on door leaf.

3. Grip Handle: Provide vinyl grip handle designed to release cover for closing.

4. Operating Mechanism: Compression spring tubes designed for ease of operation and automatic hold-open arm with release handle.

5. Provide 1 ½ -inch drainage coupling located in front right corner of channel frame where drainage is not allowed within structure as scheduled.

6. Provide fall protection as scheduled.

F. Minimum access hatch size and style are shown on the drawings (nominal clear opening shown, provide additional length/width as necessary to form a complete frame).

2.2 FALL PROTECTION

A. Saf-T-Grate (install grating style fall protection on all access hatches, unless shown otherwise):

1. Grating panel(s) shall be fiberglass, molded in one piece, with load bearing bars in both directions to allow for use without continuous side support.
2. Panel shall be designed to support a 300 PSF (1464 kg/m2) live load and be high visibility safety yellow in color.
3. Torsion rod lift assistance shall be provided for ease of operation and a hold open arm shall be included to automatically lock the panel in the fully open 90 degree position.
4. A release handle shall be provided to close the grating panel and there shall be a provision to lock the panel to prevent unauthorized access.
5. Hold open arm shall be 316SST with a stainless steel release handle.
6. All other hardware, including mounting brackets, hinges, torsion rod, padlock loop, and fasteners, shall be type 316 stainless steel.
7. Manufacturer shall provide a twenty-five year warranty against defects in material and workmanship.

2.3 WARRANTY

Hatch manufacturer shall provide 25-year warranty against defects in materials and workmanship.

2.4 FINISHES

Floor Access Door Types:

A. 316SST: pickle/passivate after fabrication.

B. All hardware shall be 316 stainless steel.

PART 3 EXECUTION

3.1 EXAMINATION

Examine construction to receive access door and verify correctness of dimensions and other supporting or adjoining conditions.

3.2 PREPARATION

A. Coordinate details with other work supporting, adjoining, or requiring access doors.

B. Verify dimensions, profiles, and fire-resistive rating for each opening.

Verify that location will serve portion of work to which access is required. Where proposed functional location conflicts with other work, notify the Engineer before installation.

3.3 INSTALLATION

A. Install access doors in accordance with manufacturer's instructions.

B. Ensure correct types and adequate sizes at proper locations.

C. Securely attach frames to supporting work and ensure doors, frames, and hardware operate smoothly and are free from warp, twist, and distortion.

3.4 ADJUSTING

Adjust doors, frames, and hardware to operate smoothly, freely, and properly, without binding.

3.5 CLEANING

Thoroughly clean surfaces of grease, oil, or other impurities, touch-up abraded prime coat.

3.6 HATCH SCHEDULE

Location	Loading	Material	Comments
Headworks	H20	Aluminum	(a) (b) (c)

(a) Fall Protection: Saf-T-Grate Style.

(b) Provide drainage collection coupling.

(c) Re-use existing frame, all else new.

END OF SECTION

SECTION 09900

PAINTING AND FINISH SCHEDULE

PART 1 GENERAL

1.1 DESCRIPTION

The work of this section consists of furnishing and applying paint for architectural, structural, mechanical and miscellaneous work.

The work comprises the painting of all exposed surfaces of concrete, sheet metal, iron and steel, process equipment, electrical equipment, process piping ducts and other miscellaneous items.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Section 01300: Submittals

B. Section 02601: Manholes and Cleanouts

C. Section 05500: Metal Fabrication

D. Section 07110: Waterproofing

E. Section 10400: Identifying Devices

1.3 SUBMITTALS

A materials list and samples shall be submitted as required by Section 01300 and as follows:

A. Materials list naming each product to be used identified by manufacturer and type number.

B. Volatile organic compound (VOC) level (gm/l) and manufacturer's certification of compliance with applicable air quality limits for each coating.

C. Manufacturer's application recommendations for each product submitted.

D. The Contractor shall submit a current chart of the Manufacturer's available colors for selection by the Engineer, forty five (45) days prior to the start of coating and painting.

Samples, when reviewed and accepted by the Engineer, shall establish the quality of the painted surface where these applications are indicated.

E. The owner shall select colors from the submittal information presented. Mechanical and piping systems may include multiple color selections in order to properly identify process facilities. The owner may choose up to two (2) colors for the exterior (field and trim) and two (2) colors for the interior (field and trim) at the Boiler Building. Submittals for architectural finishes at the Boiler Building shall be coordinated with the Submittals for the Metal Roofing System.

1.4 DEFINITION

The term "paint" as used herein includes enamels, paints, sealers, emulsions and other coatings used as prime intermediate or finish coats for protection or decoration.

1.5 COMPLIANCE WITH VOLATILE ORGANIC COMPOUND (VOC) LIMITS

All paint and coating products shall comply with the applicable limits on volatile organic compounds (VOC) as established by the United States Environmental Protection Agency and by State and local air quality regulating agencies. It shall be the Contractor's responsibility to verify compliance of all paints and coatings. In the event that any paint or coating listed herein is found to be non-compliant, the Contractor shall notify the Engineer and the Engineer will select a substitute coating or paint.

1.6 QUALITY ASSURANCE

A. General: Quality assurance procedures and practices shall be utilized to monitor all phases of surface preparation, application and inspection throughout the duration of the project. Procedures or practices not specifically defined herein may be utilized provided they meet recognized and accepted professional standards and are approved by the Engineer.

B. Workmen: Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

C. Paint Coordination:

1. Review other Sections of these Specifications as required, verifying the prime coats to be used and assuring compatibility of the total coating system for the various substrata.

2. Upon request, furnish information on the characteristics of the specific finish materials to assure that compatible prime coats are used.

3. Provide barrier coats over non-compatible primers or remove the primer and re-prime as required.

4. Notify the Engineer in writing of anticipated problems in using the specified coating systems over prime-coatings supplied under other Sections.

1.7 DELIVERY AND STORAGE

A. All materials shall be brought to the job site in original sealed containers. Each container shall bear the manufacturer's name, coating type, batch number, date of manufacture, storage life, and special directions. They shall not be used until the Engineer has inspected contents and obtained data from information on containers or label. Materials exceeding storage life recommended by the manufacturer shall be rejected.

B. All coatings and paints shall be stored in enclosed structures to protect them from weather and excessive heat or cold. Flammable coatings or paints must be stored to conform to City, County, State and Federal safety codes for flammable coatings or paint materials. At all times coatings or paints shall be protected from freezing.

1.8 REFERENCED SPECIFICATIONS AND STANDARDS

A. Without limiting the general aspects of other requirements of these specifications, all surface preparation, coating and painting of surfaces shall conform to the applicable requirements of the National Association of Corrosion Engineers, the Society for Protective Coatings, the American Concrete Institute, the Forest Products Research Society and the Manufacturer's printed instructions.

B. The Engineer's decision shall be final as to interpretation and/or conflict between any on the reference specifications and standards contained herein.

1.9 AS COATED SUMMARY SHEET

A. Contractor shall supply a list of all coating products used on the Project, including the exact stock number and the file numbers for the color tints added and amounts for each. The Summary Sheet should also list the local paint supply location for the particular brand of coating including the Name, address, phone number, and website for each product.

B. Contractor shall provide one unbroken gallon container or kit of each color and type of paint and each type of solvent and thinner required by the Specifications. These spare paint supplies shall be stored as required in paragraph 1.7, this section, until delivery is requested by the Engineer.

PART 2 MATERIALS

2.1 PAINT AND FINISH PRODUCTS

A. Paint and coating products shall be fresh and well ground; shall not settle readily, cake, or thicken in the container; shall be broken up readily with paddle to a smooth consistency; and shall have easy application properties. Other painting materials such as linseed oil, turpentine, mineral spirits, miscellaneous thinners, varnish, and shellac shall be of the highest quality.

B. All paints and coatings shall be specifically manufactured for use on projects of this type, and shall be used on surfaces intended by the paint manufacturer. Paints and coatings shall be Tnemec, Carboline or equal. All paint and coatings shall be delivered in original containers, with seals unbroken.

C. To establish a standard of quality, several specific paint and coating products are listed in the coating System Index under 2.5, this section.

2.2 COMPATIBILITY OF SHOP AND FIELD PAINTS

To ensure a satisfactory painting job it is essential that the paints applied in the shop and in the field be mutually compatible. Where prime coats are shop applied, the Contractor shall instruct suppliers to provide compatible primers with the finish coats selected by the Contractor. In no case will primers be allowed that are not manufactured by the suppliers of the finish coats unless approved by the Engineer.

2.3 COLORS

A. Color for the various surfaces to be painted shall be selected by the Engineer. Use of different colors for the various structures or for surfaces of a single structure may be directed by the Engineer.

B. Piping, ductwork and adjacent equipment colors shall be as specified in Section 10400, identifying devices.

C. Equipment/Piping colors shall be as scheduled below:

1. All exposed equipment and piping coated, as defined below, shall be tan for all process fluids, brown for all sludge lines, and blue for all potable water.

2. Provide color chart for engineers approval.

2.4 SYSTEMS INDEX

A. System A

1. Type of Coating: Polymidoamine or Amine Cured Epoxy

2. Surface: Ferrous metals and concrete submerged or subject to submersion in non-potable water.

3. Surface Preparation: Ferrous Metals: SSPC-SP-10 Concrete: SSPC-SP-13.

4. Coatings and Dry Film Thickness (DFT):

Minimum No. of Coats	DFT per Coat	Tnemec Series	Carboline
1	4.0 to 5.0 mils	66HS-1211 Red	Carboguard 890
2	6.0 mils	66HS	Carboguard 890

B. System B

1. Type of Coating: Protective Coal Tar

2. Surface: Buried ferrous metals and Concrete

3. Surface Preparation: Steel - SSPC-SP6; Concrete - SSPC-SP-13

4. Coatings and Dry Film Thickness (DFT):

Minimum No. of Coats	DFT per Coat	Tnemec Series	Carboline
2	10.0 mils	46H-413	Bitumastic 300M

C. System C

1. Type of Coating: 100% Solids Epoxy (Hydropox or Plasite 4500S - See Section 02601)

2. Surface: Concrete

3. Surface Preparation: SSPC-SP-7 (for new concrete) or SSPC-SP-13 (for existing modified structures)

4. Epoxy lining shall be manufactured by Con-Tech of California, Inc. and consist of a prime and finish coat. The prime coat shall be a two component, low viscosity 100% solids, deep penetrating primer. The prime coat shall be designed for use on properly prepared porous substrates, such as concrete. The finish coat shall be a non-polluting, solvent free, two-component, 100% solids epoxy system designed as a chemical coating barrier against potable water, salt water, and raw wastewater. The finish coat shall cure at a low minimum temperature of 40°F, have a potlife of 35 minutes at room temperature, be tack free in 4 hours and cured in 3 days.

   a. Prime coat (at 150 square feet per gallon), Hydro-Prime 251 + HYDROTHIX

   b. Finish coat (DFT = 80 mils), Hydro-Pox Ct. 04-204 UHB

5. Concrete curing compound is not allowed as specified in Section 03100. Forms shall remain for a minimum of 7 days or more depending on ambient temperatures as approved by the Engineer.

6. A wet cure method for a minimum of 7 days may also be allowed as approved by the Engineer.

7. Coating shall be applied during periods of stable to declining temperatures to minimize pin-holing.

8. If sacking and brush blast is required prior to the prime coat, only a grout consisting of sand and cement is allowed. Additives that may produce a surface film compromising adhesion are prohibited.

D. System D

1. Type of Coating: Polyamidoamine or Amine Cured Epoxy, Polyurethane

2. Surface: Exterior, non-submerged metals and plastic piping, mild or severe chemical or corrosion exposure.

3. Surface Preparation: Ferrous metals: SSPC-SP-6

4. Plastic Piping and Non-Ferrous Metals: SSPC-SP-1

5. Galvanized Metal: SSPC-SP-7 (Take care not to remove Galvanized Coating)

6. Coatings and Dry Film Thickness (DFT):

Minimum No. of Coats	DFT per Coat	Tnemec Series	Carboline
2	5.0 mils (metals) 3.0 mils (plastics)	66HS	Carboguard 890
1	4.0 mils(metals) 3.0 mils(plastics)	1074 or 1075	Carbothane 134VOC

E. System E

1. Type of Coating: Polyamidoamine or Amine Cured Epoxy

2. Surface: Interior non-submerged metals, plastic piping, concrete, mild or severe chemical or corrosion exposure.

3. Surface Preparation: Ferrous Metals: SSPC-SP-6

4. Plastic Piping and Nonferrous Metals: SSPC-SP-1

5. Galvanized Metal: SSPC-SP-7

6. Concrete: SSPC-SP-13

7. Coatings and Dry Film Thickness (DFT):

Minimum No. of Coats	DFT per Coat	Tnemec Series	Carboline
2	5.0 mils (metals and concrete)	66HS	Carboguard 890
2	3.0 mils (plastics)	66HS	Carboguard 890

F. System F

1. Type of Coating: Acrylic Epoxy
2. Surface: Interior plaster and gypsum wallboard.
3. Surface Preparation: In accordance with the general surface preparation specifications in this Section.
4. Coatings and Dry Film Thickness (DFT):

Minimum No. of Coats	DFT per Coat	Tnemec Series	Carboline
1	1.5 mils	151-1051	Sanitile 120
2	4.0 mils	113 or 114	Sanitile 255

G. System G

1. Type of Coating: Modified Aliphatic Amine Epoxy
2. Surface: Interior masonry and concrete walls.
3. Surface Preparation: SSPC-SP-13
4. Filler: Apply filler per manufacturer's requirements to provide a "pin-hole" free surface.
5. Coatings and Dry Film Thickness (DFT):

Minimum No. of Coats	DFT per Coat	Tnemec Series	Carboline
1	60 to 80 ft^2/gal.	130	Sanitile 600
2	8.0 mils	84	Carboguard 890

H. System H

1. Type of Coating: Aliphatic polyurethane.
2. Surface: Overhead rolling doors (both sides).
3. Surface Preparation: SSPC-SP-1.
4. Coatings and Dry Film Thickness (DFT):

Minimum No. of Coats	DFT per Coat	Tnemec Series	Carboline
1	3.0 mils	530	Carboguard 890

1	2.0 mils	1075	Carbothane 134VOC

I. System I

1. Type of Coating: Acrylic, Semi-Gloss.
2. Surface: Interior concrete, masonry, wood, plaster, gypsum drywall, and exterior wood surfaces.
3. Surface Preparation: Clean and Dry, see sections 3.02, 3.03, 3.04.
4. Coatings and Dry Film Thickness (DFT):

Minimum No. of Coats	DFT per Coat	Coating Type	Sherwin Williams (or equal)
1	2.0 mils (1.5 mils for wood)	Interior Primer	Preprite Problock
1	3.0	Interior Coating	Duration Interior
1	1.5 – 2.0	Exterior Primer	A-100 Latex Primer
2	2.5 – 3.0	Exterior Coating	Duration or Resilience Exterior

J. System J

1. Type of Coating: Resinous Flooring
2. Surface: Concrete subject to mild chemical service.
3. Surface Preparation: Acid etch or shot blast to create profile/anchor pattern.
4. Coatings And Dry Film Thickness (DFT):

Minimum No. of Coats	DFT per Coat	Tnemec Series	Carboline
1	4.0 mils	203	Carboseal 780
2	12.0 mils	280	Carboseal 745
1	3.0 mils	290*	Carboseal 835

* As noted on the drawings, areas of the deck floors of the UV system shall be coated with the above system except Tnemec Series 290 shall be replaced with Series 295.

NOTE: On floor surface, broadcast clean silica sand per paint manufacturer's recommendations to form non-slip surface.

K. System K

1. Type of Coating: Polyurea Elastomer
2. Surface: Exterior Concrete

3. Surface Preparation: SSPC-SP-13

4. Coatings and Dry Film Thickness (DFT):

Minimum No. of Coats	DFT per Coat	Tnemec Series	Carboline
1	4.0 mils	203	Carboguard 1340WB
2	40.0 mils	400	Reactamine ET

L. System L

1. Type of Coating: High build acrylic.

2. Surface: Exterior concrete block.

3. Surface Preparation: SSPC-SP7

4. Coatings and Dry Film Thickness (DFT):

Minimum No. of Coats	Total DFT	Tnemec Series	Carboline
2	8.0 mils	180	3359DTM Series

M. System M

1. Type of Coating: Heat resistant aluminum coatings.

2. Surface: High heat (to 750°F) equipment and piping.

3. Surface Preparation: SSPC-SP-10.

4. Coatings and Dry Film Thickness (DFT):

Minimum No. of Coats	DFT per Coat	Tnemec Series	Carboline
1	2.5 mils	90E92	Thermaline 4700VOC

N. System N: Emulsified Asphalt Coating (See Section 07110).

O. System O

1. Type of Coating: Aromatic elastomeric polyurethane, or epoxy.

2. Surface: Submerged ferrous metals subject to abrasion.

3. Surface Preparation: SSPC-SP-10

4. Coatings and Dry Film Thickness (DFT):

Minimum No. of Coats	DFT per Coat	Tnemec Series	Carboline

1	4.0 to 5.0 mils	66HS -1211	N/A
2	8.0 to 12.0 mils	164	Reactamine 760

P. System P

1. Type of Coating: Polyamide Epoxy / Acrylic
2. Surface: Exterior of steel structures and tanks previously coated with alkyd enamel.
3. Surface Preparation: All surfaces damaged by construction SSPC-SP-6; all other surfaces SSPC-SP-7.
4. Coatings and Dry Film Thickness (DFT):

Minimum No. of Coats	DFT per Coat	Tnemec Series	Carboline
1	4.0 to 6.0 mils	66HS	Rustbond
1	2.5 to 3.0 mils	30	Carbocrylic 3359DTM

Q. System Q

1. Type of Coating: Vinyl Ester
2. Surface: Concrete and masonry subject to severe chemical service (Chemical pump areas and secondary containment areas).
3. Surface Preparation: SSPC-SP-13.
4. Surface shall be smooth to obtain a “pin hole” free surface after coating. Block filler shall be used on masonry, trowel smooth. Concrete shall be trowelled or sacked prior to coating. Filler shall be Tnemec Series 201+ Carbosil, Semstone 800 Primer + Cabosil, or equal.
5. Coatings and Dry Film Thickness (DFT):

Minimum No. of Coats	DFT per Coat	Tnemec Series	Carboline
1	6.0 mils	201	Semstone 800
1	30 mils	275	Semstone 870
1	15 mils	120	Semstone 870

NOTE: On floor surface, broadcast clean silca sand into prime coat per paint manufacturer’s recommendations to form non-slip surface.

R. System R

1. Type of Lining: Epoxy.
2. Surface: Interior of welded steel potable water storage tanks. Lining shall be NSF-61 approved for potable water service.

3. Surface Preparation: Ferrous metals: SSPC-SP-10

4. Coatings and Dry Film Thickness (DFT):

Minimum No. of Coats	DFT per Coat	Tnemec Series	Carboline
1	6-8 mils (primer)	V140F	Carboguard 891VOC
1	6-8 mils	V140F	Carboguard 891VOC

NOTE: Field prime all remaining unprimed, abraded or rusted areas after re-blast cleaning per SSPC-SP-10.

S. System S

1. Type of Coating: Zinc-Rich Aromatic Urethane/Polyamidoamine Epoxy.

2. Surface: Exterior of welded steel potable water storage tanks.

3. Surface Preparation: Ferrous metals: SSPC-SP-10

4. Coatings and Dry Film Thickness (DFT):

Minimum No. of Coats	DFT per Coat	Tnemec Series	Carboline
1	2.5-3.5 mils (primer)	94-H2O	Carbozinc 859
1	4-6 mils	166	Carboguard 890
1	3-5 mils	1075	Carbothane 134VOC

NOTE: Field prime all remaining unprimed, abraded or rusted areas after re-blast cleaning per SSPC-SP-10.

T. System T

1. Type of Coating: Flexible Polyurethane

2. Surface: Concrete subject to mild chemical service.

3. Surface Preparation: SSPC-SP-13.

4. Surface shall be smooth to obtain a “pin hole” free surface after coating. Concrete shall be trowelled or sacked, and abrasive blasted prior to coating.

5. Coatings and Dry Film Thickness (DFT):

Minimum No. of Coats	DFT per Coat	Tnemec Series	Carboline
1	2.0-4.0 mils	203	N/A
1	50-60 mils	400	Reactamine 760

U. System U

1. Type of Coating: Fiber-reinforced modified polyamine epoxy.
2. Surface: Concrete and steel subject to hydrogen sulfide exposure.
3. Surface Preparation:
    a. Concrete: SSPC-SP-13 plus finish 4 to obtain a “pin hole” free surface after coating
    b. Steel: SSPC-SP-5
4. Coatings and Dry Film Thickness (DFT):

Minimum No. of Coats	Total DFT	Tnemec Series	Carboline
1	50 mils	436 (steel)	Plasite 4500S
1	8 mils	201 (concrete)	*
1	70 MILS	436 FR (concrete)	Plasite 4500S

* Engineer knows of no equal.

V. System V: Fusion Epoxy .

1. Type of Coating: Fusion Epoxy – Fluidized Bed Grade
2. Surface: Fabricated steel piping manifolds and above ground welded steel piping
3. Surface Preparation: SSPC-SP10
4. Coatings and Dry Film Thickness (DFT):

Minimum No. of Coats	Total DFT	3M Scotchkote
Shop Coat 1	16 mils	206N (steel)
Field Coat* 1	10 mils	312

* Field welds, connections and damaged areas

W. System W:

1. Type of Coating: Self-crosslinking Acrylic
2. Surface: Primed Structural Steel Members.
3. Surface Preparation: SSPC-SP-11
4. Coatings and Dry Film Thickness (DFT):

Minimum No. of Coats	DFT per Coat	Tnemec Series	Carboline
1	4 mil	115	Carbocrylic 3359DTM

X. System X:

1. Type of Coating: Semi Gloss Silicone Trim Enamel
2. Surface: Exterior Ferrous Metals.
3. Surface Preparation: SSPC-SP-6
4. Coatings and Dry Film Thickness (DFT):

Minimum No. of Coats	DFT per Coat	Coating Name	Manufacturers
1(Zinc primed metal)	4 mil	Zinc Oxide Dust Primer ("SW Galvanized Iron Primer")	ICI Paint Stores Deero-Frazee Pioneer Paint Co. PPG Industries Sherwin Williams Dunn Edwards
1 (unprimed metal)	4 mil	Zinc Chromate Alkyd Primer ("Zinc Chromate Primer")	ICI Paint Stores Deero-Frazee Pioneer Paint Co. PPG Industries Sherwin Williams Dunn Edwards
2	4 mil	Semi Gloss Silicone Alkyd Enamel	ICI Paint Stores Deero-Frazee Pioneer Paint Co. PPG Industries Sherwin Williams Dunn Edwards

NOTE: Delete Primer at Factory primed items. Provide painted finish to match adjacent surfaces at exposed roof top equipment as directed by architect. This system to cover painting of switchgear, and roof top HVAC equipment

Y. System Y:

1. Type of Coating: Semi Gloss Alkyd Enamel
2. Surface: Building Interior Including Toilet Area, Kitchens, and Paint Grade Doors.
3. Surface Preparation: In accordance with the general surface preparation specifications in this Section.
4. Coatings and Dry Film Thickness (DFT):

Minimum No. of Coats	DFT per Coat	Manufacturer
Per MFG	Per MFG	Devoe: 50801 Wonder –Tones Latex Primer and Sealer Glidden: Y-3416 Spred Primer Sealer Moore: Moore's Latex Quick Dry Prime Seal Pittsburg: 6-2 PPG Quick Drying Interior Latex Primer
Per MFG	Per MFG	Devoe: 26XX Velour Alkyd Semi-Gloss Enamel Glidden: Y-4600 Line – Spred Lustre Semi Gloss Moore: Moore's Satin Impervo Enamel

Z. System Z

1. Type of Coating: Low Solids Acrylic
2. Surface: Exterior concrete block.
3. Surface Preparation: SSPC-SP7
4. Coatings and Dry Film Thickness (DFT)

AA. System AA

1. Type of Coating: Polyamidoamine Epoxy
2. Surface: Ductile Iron Pipe
3. Surface Preparation: In accordance with the general surface preparation specifications in this Section.
4. Coatings and Dry Film Thickness (DFT)

PART 3 EXECUTION

3.1 GENERAL

A. During scheduled coating periods, daily whether reporting is required (including, but not limited to, air and surface temperature, dew point, relative humidity, rain, snow, mist, fog, and wind. Further, daily report shall include conditions that have the potential to cause dust, insects, or debris adhere to coating.) Contractor is required to obtain preauthorization from Owner's representative and Engineer prior to coating and painting; authorization shall be whether dependant. At all times, Contractor shall comply with paint manufacturer's published recommendation for environmental conditions in which paint materials can be applied and as approved by the Engineer. Additionally, see section 3.5.

B. All surface preparation, coating and painting shall conform to applicable standards of the National Association of Corrosion Engineers, the Steel Structures Painting Council, the American Concrete Institute, the Forest Products Research Society and the Manufacturer's printed instructions. Material applied prior to approval of surface by the Engineer shall be removed and re-applied to the satisfaction of the Engineer at the expense of the Contractor.

C. All work shall be performed by skilled craftsmen qualified to perform the required work in a manner comparable with the best standards of practice.

D. The Contractor shall provide a supervisor at the work site during cleaning and application operations. The supervisor shall have the authority to sign any change orders, coordinate work and make decisions pertaining to the fulfillment of the contract.

E. Dust, dirt, oil, grease or any foreign matter that will affect the adhesion or durability of the finish must be removed by washing with clean rags dipped in an approved cleaning solvent and wiped dry with clean rags.

F. Coatings and painting systems include surface preparation, prime coating and finish coatings. Unless otherwise specified, prime coatings shall be field applied. Where prime coatings are shop applied, the Contractor shall instruct suppliers to provide the prime coat compatible with the finish coat specified. Any off-site work which does not conform to the specification is subject to rejection by the Engineer.

Shop applied prime coatings which are damaged during transportation, construction or installation shall be thoroughly cleaned and touched up in the field as directed by the Engineer. The Contractor shall use repair procedures which insure the complete protection of all adjacent primer.

The specified repair method and equipment may include wire-brushing, hand or power tool cleaning or dry air blast cleaning. In order to prevent injury to surrounding painted areas blast cleaning may require use of lower air pressure, smaller nozzle and abrasive particle sizes, short blast nozzle distance from surface, shielding and masking. If damage is too extensive, the item shall be re-cleaned and coated or painted as directed by the Engineer.

G. Previously painted surfaces: Repair surface defects. Remove grease, oil and other contaminants as specified for steel surfaces. Scrape carefully to remove deteriorated coatings. Glossy or very hard coatings should be sanded lightly to promote maximum adhesion of the subsequent coating. Surface must be thoroughly dry before coating.

H. The Contractor's coating and painting equipment shall be designed for application of materials and shall be maintained in first class working condition. Compressors shall have suitable traps and filters to remove water and oils from the air. Contractor's equipment shall be subject to approval by the Engineer.

I. Application of the first coat shall follow immediately after surface preparation and cleaning and within an eight-hour working day. Any cleaned areas not receiving first coat within eight-hour period shall be re-cleaned prior to application of first coat. This may include re-blasting.

J. Prior to assembly, all surfaces made inaccessible after assembly shall be prepared as specified herein and shall receive the coating or paint system specified.

3.2 SURFACE PREPARATION, METALLIC SURFACES

A. Surface preparation will be based on comparison with: ASTM D2200 "Pictorial Surface Preparation Standards for Painting Steel Surfaces", SSPC-Vis 1,: ASTM D610 "Standard Methods of Evaluating Degree of Rusting on Painted Steel Surfaces", SSPC-Vis 2,; and as described below. Anchor profile for prepared surfaces shall be measured by use of a non-destructive instrument such as a Keane-Tator Surface Profile Comparator or Testex Press-O-Film System.

To facilitate inspection the Contractor shall, on the first day of abrasive blast cleaning operations, blast clean metal panels to the standard specified. These panels shall be equivalent to the supplied plate stock which is to be coated or painted and shall have minimum measurements of 8-½-inches by 11-inches. After agreeing a specific panel meets the requirements of the specification, it shall be initialed by the Contractor and Engineer and coated with a clear non-changing finish. Panels shall be utilized for inspection purposes throughout the duration of blast cleaning operations.

B. Heavy deposits of grease or oil shall be removed with solvent oil cleaner and any chemical contamination shall be neutralized and/or flushed off prior to any other surface preparation.

C. Surfaces scheduled for Near White or Commercial Blast Cleaning shall have all welds, edges, and sharp corners ground to a 1/16-inch radius and all weld splatter removed, and sandblasted in accordance with Steel Structures Painting Council Specifications, removing mill scale, rust, dirt, paint, or other foreign matter, and shall be slightly roughened to form a suitable anchor pattern for the coating application. Do not leave blasted surfaces overnight before coating. Remove all sand from the surface by brush or industrial vacuum.

D. All other steel not scheduled for blast cleaning shall have all weld splatter removed, and rough edges and rough welds ground, and shall be cleaned by means of hand or power tools, in accordance with Steel Structures Painting Council Specification No. 2 or No. 3, removing all loose mill scale rust, dirt, paint, or other contaminants. Blast cleaning may be used if practical. The remaining mill scale, rust, and paint must be sufficiently abraded to provide for good bonding of the coating.

E. Field blast cleaning for all surfaces shall be dry method unless otherwise directed.

F. Particle size of abrasives used in blast cleaning shall be that which will produce a 2 mil (50.0 microns) surface profile or in accordance with recommendations of the manufacturer of the specified coating or paint system to be applied.

G. Abrasive used in blast cleaning operations shall be new, washed, graded and free of contaminants that would interfere with adhesion of coating or paint and shall not be reused unless specifically approved by the Engineer.

H. During blast cleaning operations, caution shall be exercised to insure that existing coatings or paints are not exposed to abrasion from blast cleaning.

I. The Contractor shall keep the area of his work in a clean condition and shall not permit blasting materials to accumulate as to constitute a nuisance or hazard to performance of work or operation of existing facilities.

J. Blast cleaned surfaces shall be cleaned prior to application of specified coatings or paints by a combination of blowing with clean dry air, brushing/brooming and/or vacuuming as directed by the Engineer.

K. All welds shall be cleaned with a suitable chemical compatible with the specified coating materials.

L. Specific Surface Preparation: Surface preparation for the specific system shall be as designated in the Systems Index, Part 2.05 of these specifications.

M. Application SSPC specifications are as follows:

1. Solvent Cleaning (SSPC-SP1): Removal of oil, grease, soil and other contaminants by use of solvents, emulsions, cleaning compounds, steam cleaning or similar materials and methods which involve a solvent or cleaning action.

2. Hand Tool Cleaning (SSPC-SP2): Removal of loose rust, loose mill scale and other detrimental foreign matter to degree specified by hand chipping, scraping, sanding, and wire-brushing.

3. Power Tool Cleaning (SSPC-SP3): Removal of loose rust, loose mill scale and other detrimental foreign matter to degree specified by power wire-brushing, power impact tools or power sanders.

4. White Metal Blast Cleaning (SSPC-SP5): Blast cleaning to a gray-white uniform metallic color until each element of surface is free of all visible residues.

5. Commercial Blast Cleaning (SSPC-SP6): Blast cleaning until at least two-thirds of each element of surface area is free of all visible residues.

6. Brush-Off Blast Cleaning (SSPC-SP7): Blast cleaning to remove loose rust, loose mill scale and other detrimental foreign matter to degree specified.

7. Near White Blast Cleaning (SSPC-SP10): Blast cleaning to nearly white metal cleanliness, until at least 95 percent of each element of surface area is free of all visible residues.

3.3 SURFACE PREPARATION, CONCRETE AND MASONRY

A. Concrete and masonry shall cure at least 28 days and have a moisture content prior to coating or painting below 8 percent as measured by an instrument such as a Delmhorst Model DP, unless recommended otherwise by the paint manufacturer.

B. All surfaces shall be thoroughly cleaned by abrasive blasting, wire-brushing or other approved methods, removing all traces of foreign materials. Remove all loose concrete and masonry by chipping or other approved methods to leave only a sound, firmly bonded substrate. Cracks and voids shall be repaired or filled as directed by the Engineer with approved suitable materials, mixed and applied in strict accordance with the Manufacturer's printed instructions. In general, final surface shall be smooth and free of voids, cavities, dirt, dust, oils, grease, or other contaminants.

C. Where oil or grease deposits are present, prior to above surface preparation, clean surfaces by scrubbing with a solution of one and one-half ounces (44.4 ml) tri-sodium phosphate (TSP) and one and one-half ounces (44.4 ml) of non-sudsing detergent mixed into one gallon (3.785 liters) of warm water. Surfaces shall then be flushed clean with fresh water.

D. Specific Surface Preparation: Surface preparation for the specific system shall be as designated in the Systems Index, Part 2.05 of these specifications.

3.4 SURFACE PREPARATION, WOOD AND COMPOSITION MATERIALS

A. Wood and composite materials shall have a moisture content prior to coating or painting below 15 percent as measured by an instrument such as a Delmhorst Model BD-7, unless recommended otherwise by the paint manufacturer.

B. All surfaces shall be thoroughly cleaned by use of mineral spirits, scrapers, and sandpaper or wire brushes to remove all dirt, oil, grease or other foreign substances. Finished surfaces exposed to view shall, if necessary, be made smooth by planing or sandpapering. Small, dry, seasoned knots shall be scraped, sandpapered, and thoroughly cleaned, and shall be given a thin coat of WP-578 Western Pine Association knot sealer before application of the priming coat. Large, open unseasoned knots, and all beads or streaks of pitch shall be scraped off, or if the pitch is still soft, it shall be removed with mineral spirits and the resinous area shall be thinly coated with knot sealer. After priming, all holes and imperfections shall be filled with putty or plastic wood (colored to match the finish wood), allowed to dry, and sandpapered smooth. Painting of interior wood and composite materials shall proceed insofar as practicable, only after masonry work has dried. Existing surfaces shall be cleaned of all loose or flaking paint and sandpapered as required.

C. Specific Surface Preparation: Surface preparation for the specific system shall be as designated in the Systems Index, Part 2.5 of this section.

3.5 COATING APPLICATION

A. Coating and paint application shall conform to the requirements of the Steel Structures Painting Council Paint Application Specifications SSPC-PA1, latest revision, for "Shop, Field and Maintenance Painting", and recommended practices of the National

Association of Corrosion Engineers, the American Concrete Institute, the Forest Products Research Society and the Manufacturer of the paint and coating materials.

B. Before applying any paint or finish, all surfaces shall be thoroughly cleaned and prepared for painting as herein specified. All cleaned metal shall be primed or painted, as specified, immediately after cleaning to prevent new rusting or oxidation of cleaned surfaces.

C. Protective coverings or drop cloths shall be use to protect floors, fixtures, and equipment. Care shall be exercised to avoid lapping on glass or hardware. Coatings and paints shall be sharply cut to lines. Finished surfaces shall be free from defects or blemishes.

D. Application – Environmental Conditions

1. Do not paint surfaces that exceed manufacturer specified moisture contents or when none, the following moisture contents:

    a. Plaster and Gypsum Wallboard: 12 percent.

    b. Masonry, Concrete and Concrete Block: 8 percent.

    c. Interior Located Wood: 15 percent.

    d. Concrete Floors: 7 percent.

2. Do not paint or coat:

    a. Under dusty conditions.

    b. When light on surface measures less than 15 foot-candles.

    c. When ambient or surface temperature is less than 40 degrees Fahrenheit.

    d. When relative humidity is higher than 85 percent.

    e. When surface temperature is less than 5 degrees Fahrenheit above dew point.

    f. When surface temperature exceeds the manufacturer's recommendation.

    g. When ambient temperature exceeds 90 degrees Fahrenheit, unless manufacturer allows a higher temperature.

3. No coating work shall be done under unfavorable weather conditions to wet or damp surfaces or in rain, snow, fog or mist.

4. When it is expected the air temperature will drop below 40 degrees F or less than 5 degrees F above the dewpoint within eight hours after application of coating or paint.

    Dewpoint shall be measured by use of an instrument such as a Sling Psychrometer in conjunction with the US Department of Commerce Weather Bureau Psychometric Tables.

    If above conditions are prevalent, coating or painting shall be delayed or postponed

until conditions are favorable, unless conditions are acceptable to the paint manufacturer for any given coating. The days coating or painting shall be completed in time to permit the film sufficient drying time to prevent damage by atmospheric conditions.

5. Provide fans, heating devices, or other means recommended by coating manufacturer to prevent formation of condensation or dew on surface of substrate, coating between coats and within curing time following application of last coat.

6. Provide adequate continuous ventilation and sufficient heating facilities to maintain minimum 45 degrees Fahrenheit for 24 hours before, during and 48 hours after application of finishes.

E. All painting shall be well applied, leaving no sags, laps, brush, or other defects. Each coat must thoroughly dry before applying next coat, and all work must be carefully cut into a true line and left smooth and clean. Hardware trim and other items shall be removed as required for proper application of coatings.

All painting shall conform to the following general conditions:

1. Thickness of coating in mils shall mean the dry film thickness. The number of coats specified shall mean the minimum number of coats to be used. Additional coatings shall be required if necessary to obtain the specified film thickness.

2. No coating work shall be done under unfavorable weather conditions.

3. Prime coats shall be provided where called for as a part of the painting system. Shop prime coats shall conform to the specified painting system for the given item. It shall be the responsibility of the Contractor to coordinate work so that factory prime items are primed or painted with a coating compatible with the specified finish painting system.

4. Particular attention shall be given to all welds, edges, and corners so as to get full and adequate coverage. Damaged shop prime coats or field applied prime coats shall be carefully replaced before finish painting. Surface preparation for replacement of damaged coats shall be such as to give a clean surface for proper bonding of prime coat. Finish coatings shall not be applied until touch-up prime coat has completely dried.

5. Minimum between-coat drying items, as stated in the printed instructions of the coating manufacturer will be carefully observed.

6. Thinning shall be done only if necessary for workability of the coating material in accordance with the manufacturer's printed instructions. Use only the appropriate thinner.

7. Each coat shall be applied in a similar but different color from the preceding coat, the finish coat to be color selected by the Engineer.

3.6 SPECIAL REQUIREMENTS FOR GALVANIZED AND NON-FERROUS METALS

Where galvanized or non-ferrous metals are scheduled to be painted, the surface shall be brush blasted in accordance with SSPC-SP7 before finish is applied. Do not remove the galvanized coating. Damaged areas should be repaired with an appropriate zinc-rich primer, such as Tnemec Series 90-97.

3.7 INSPECTION

A. Inspection - General:

Concrete, plastic and wood surfaces shall be visually inspected to insure specified coverage has been attained. Where destructive testing is deemed necessary, an instrument such as a Tooke Gage shall be used. Thickness of coatings and paints on metal surfaces shall be checked with a non-destructive type thickness gauge. Coating integrity shall be tested with an approved inspection device. Holiday detection shall be performed prior to the application of aluminum or metallic finish coats. Holiday detectors shall not exceed the voltage recommended by the manufacturer of the coating system. For film thickness between 10 and 20 mils, a non-sudsing type wetting agent such as Kodak Photo-Flo shall be added to the water prior to wetting the detector sponge. All pinholes shall be marked, repaired in accordance with the manufacturer's recommendations and retested. No pinholes or other irregularities will be permitted in the final coating.

In cases of dispute concerning film thickness or holidays, the Engineer's calibrated instruments and measurements shall predominate. Wide film thickness discrepancies shall be measured and verified with a micrometer or other approved measuring instrument.

B. Inspection Devices:

The Contractor shall furnish, until final acceptance of coating and painting, inspection devices in good working condition for detection of holidays and measurement of dry-film thickness of coating and paint. The Contractor shall also furnish US Department of Commerce; National Bureau of Standards certified thickness calibration plates to test accuracy of dry-film thickness gauge and certified instrumentation to test accuracy of holiday detectors.

Dry-film thickness gauges and holiday detectors shall be made available for the Engineer's use at all times until final acceptance of application. Holiday detection devices shall be operated in the presence of the Engineer.

Acceptable devices for ferrous metal surfaces include, but are not limited to Tinker-Rasor Model M-1 holiday detector for coatings to 20 mils dry film thickness, Tinker-Rasor Models AP and AP-W holiday detectors for coatings in excess of 20 mils dry-film thickness, and Mikrotest or Positest unit for dry-film thickness gauging. Non-ferrous metal surfaces shall be checked with an instrument such as an Elcometer "Eddy Current" Tester or De Felsko Model 252. Inspection devices shall be operated in accordance with the manufacturer's instructions.

3.8 SAFETY AND HEALTH REQUIREMENTS

A. General: In accordance with requirements set forth by regulatory agencies applicable to the construction industry and Manufacturer's printed instructions and appropriate technical bulletins and manuals, the Contractor shall provide and require use of personnel protective lifesaving equipment for persons working in or about the project site.

B. Head and Face Protection and Respiratory Devices: Equipment shall include protective helmets which shall be worn by all persons in the vicinity of the work. In addition, workers engaged in or near the work during abrasive blasting shall wear eye and face protection devices and air purifying, half-mask or mouthpiece respirator with appropriate filter. Barrier creams shall be used on any exposed areas of skin.

C. Ventilation: Where ventilation is used to control hazardous exposure, all equipment shall be explosion-proof. Ventilation shall reduce the concentration of air contaminant to the degree a hazard does not exist. Air circulation and exhausting of solvent vapors shall be continued until coatings have fully cured.

D. Sound Levels: Whenever the occupational noise exposure exceeds maximum allowable sound levels, the Contractor shall provide and require the use of approved ear protective devices.

E. Illumination: Adequate illumination shall be provided while work is in progress, including explosion-proof lights and electrical equipment. Whenever required by the Engineer, the Contractor shall provide additional illumination and necessary supports to cover all areas to be inspected. The level of illumination for inspection purposes shall be determined by the Engineer.

F. Temporary Ladders and Scaffolding: All temporary ladders and scaffolding shall conform to applicable safety requirements. They shall be erected where requested by the Engineer to facilitate inspection and be removed by the Contractor to locations requested by the Engineer.

3.9 PRESERVATION

During construction, painter shall assume the preservation of all his work against damage by accident or otherwise, and shall leave the work clean and whole. The work will not be accepted until all of the work has been completed and all retouching has been done. All work which is rejected, or for any reason has to be done over, will be done by the Contractor at his expense.

3.10 CLEANING

During the progress of the work, all other work shall be covered and fully protected from injury or painter's finish, and care shall be exercised not to splatter paint, enamel, etc., on adjacent work. Upon completion of the work, all staging, scaffolding and containers shall be removed from the

site or destroyed in a manner approved by the Engineer. Name and data plates on equipment shall not be painted and shall be left clean and legible upon completion of the project. All damage to surfaces resulting from the work of this section shall be cleaned, repaired, or refinished to the satisfaction of the Engineer at no expense to the Agency.

3.11 SURFACES REQUIRING PAINTING

In general, the following surfaces are to be coated or painted:

A. All exposed metal surfaces and piping, interior and exterior.

B. All submerged or buried metal and some submerged concrete and masonry surfaces, as scheduled.

C. All structural and fabricated steel, including tanks and equipment and galvanized structural steel.

D. The interior of certain tanks and wet wells as specified in the schedule.

E. Exterior aboveground concrete and masonry, as scheduled.

F. The interior of certain structures as specified in the Schedule.

G. Equipment furnished without factory finish surfaces.

H. Doors, woodwork and architectural items.

I. Equipment furnished with factory finished surfaces to match pipe service color.

J. Fusion epoxy lined and coated steel piping and equipment to match pipe service color.

K. Dissimilar Materials: Where dissimilar metals are in contact, or where aluminum is in contact with concrete, mortar, masonry, wet or pressure treated wood, or absorptive materials subject to wetting, the surfaces shall be protected with a coat of bituminous paint conforming to MIL-C-18480 or to TT-V-51 or a coat of zinc chromate primer conforming to TT-P-645 to prevent galvanic or corrosive action.

3.12 SURFACES NOT REQUIRING PAINTING

A. Unless otherwise indicated, painting is not required on surfaces in concealed areas and inaccessible areas such as furred spaces, foundation spaces, utility tunnels, pipe spaces, and on buried piping.

B. Metal surfaces of anodized aluminum, stainless steel, chromium plate, copper, bronze, and similar finished materials will not require painting under this Section except as scheduled and defined below.

1. All stainless-steel parts/equipment, after its fabrication, shall undergo a passivation (pickling) process to ensure maximum resistance to corrosion. All stainless-steel components and structures shall be submersed in a chemical bath of nitric acid and hydrofluoric acid to remove any residues that may be present on the material as a result of forming, manufacture, or handling. After removal from the pickling bath, the equipment must be washed with a high-pressure wash of cold water to remove any remaining surface debris and promote the formation of an oxidized passive layer which is critical to the long life of the stainless steel. Submergence insures complete coverage. Spray on chemical treatments and glass bead blasting are specifically not acceptable due to their inability to provide complete and uniform corrosion protection. All field welds shall be cleaned and passivated to remove iron (and prevent corrosion) in accordance with ASTM A380.

C. Portions of metal embedded in concrete, except for aluminum surfaces.

D. Electrical equipment with factory applied finish.

E. Do not paint moving parts of operating units; mechanical or electrical parts such as valve operators; linkages; sensing devices; and motor shafts, unless otherwise indicated.

F. Do not paint over required labels or equipment identification, performance rating, name, or nomenclature plates.

3.13 FINISH SCHEDULE

The following is a partial schedule and does not include all surfaces that require coatings. Coat unlisted surfaces with the same coating system as similar listed surfaces. Color selection shall be made by the Owner and provided in returned Contractor's Paint Submittal.

A. System "A" Polymidoamine or Amine Cured Epoxy:

1. Exterior of all submerged piping and valves except for stainless steel piping.
2. Submerged pipe supports and hangers except for stainless steel.
3. Exterior of submerged pumps, mixers, motors and other equipment.
4. Bell rings and underside of manholes covers and frames.
5. Sump pumps including the underside of base plates.
6. Field priming of ferrous metals surfaces with defective shop prime coating or where no other prime coating is specified.
7. All other submerged iron and steel metal unless specified otherwise.

B. System “B” Protective Coal Tar: Underground pipe flanges, corrugated metal pipe couplings, flexible pipe couplings, and miscellaneous underground metals not specified to receive another protective coating system.

C. System “C” 100% Solids Epoxy: Coat all interior concrete surfaces below top of slab or wall of all structures including new flow metering manhole, and existing screenings channels and grit channels and grit basins. Fill construction joints of all structures with epoxy grout, per 03100, prior to applying System C. Apply coating prior to drilling and installing pipe and grating anchors and supports. All existing modified structures listed shall be sandblasted and cleaned prior to coating. Coat exterior of all below grade structures with System “N” to prevent excessive moisture in concrete to be coated.

D. System “D” Polyamidoamine or Amine Cured Epoxy, Polyurethane:

1. Exterior piping, valves, pipe hangers and supports, electrical conduit, and other supports except for stainless steel.
2. Valve and gate operators and stands.
3. Structural steel including galvanized steel.
4. Process equipment (not submerged) including pumps, motors, equipment guards, equipment supports and other miscellaneous metals at the Headworks except for stainless steel and aluminum.
5. Exposed PVC piping and valves.
6. Exterior electrical cabinets, boxes, and exposed conduits that are not factory painted.
7. All primed structural steel members
8. All other miscellaneous exposed metals and plastics unless specified otherwise.

E. System “E” Polyamidoamine Epoxy: Interior non-submerged piping, valves, pipe hangers and supports, and exposed interior electrical conduits, and other supports at all process areas except for stainless steel and aluminum.

F. System “F” Acrylic Epoxy: Not used.

G. System “G” Modified Aliphatic Amine Epoxy: Not used.

H. System “H” Aliphatic Polyurethane: Not used.

I. System “I” Acrylic, Semi-Gloss: Not used.

J. System “J” Resinous Flooring: Not used..

K. System “K” Polyurea Elastomer: Exterior concrete, not used unless noted on drawings.

L. System “L” High Build Acrylic: Not used..

M. System “M” Heat Resistant Aluminum Coatings: Not used..

N. System “N” Emulsified Asphalt Coating (see Section 07110): Exterior buried walls for waterproofing of all below grade structures that require coating as defined within this specification, including the influent metering manhole.

O. System “O” Aromatic Elastomeric Polyurethane, or Epoxy: Submerged ferrous metals subject to abrasion.

P. System “P” Polyamide Epoxy/Acrylic: Exterior of steel structures previously coated with alkyd enamel.

Q. System “Q” Vinyl Ester: Not used.

R. System “R” Epoxy (Interior): Not used..

S. System “S” Zinc-Rich Aromatic Urethane/Polyamidoamine Epoxy (Exterior): Not used..

T. System “T” Flexible Polyurethane: Not used..

U. System “U” Fiber-reinforced Modified Polyamine Epoxy: Not used.

V. System “V” Fusion Epoxy: Not used.

W. System “W” Self-Crosslinking Acrylic: Not used.

X. System “X” Semi Gloss Silicone Trim Enamel: Not used..

Y. System “Z” Low Solids Acrylic: Not used.

Z. System “AA” Polyamidoamine Epoxy: Ductile Iron Piping.

END OF SECTION

SECTION 10400

IDENTIFYING DEVICES

PART 1 GENERAL

1.1 SUMMARY

The work of this section consists of providing safety signs, identifying devices for buildings, structures, piping, valves, and underground warning tapes for buried utilities.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Section 01300 - Submittals

B. Section 02229 – Utility Line Marking

C. Section 15000 – Piping

D. Division 16 - Electrical

1.3 SUBMITTALS

A. In accordance with Section 01300.

B. Samples of sign materials, colors and exterior letters, along with manufacturer's literature and shop drawings.

C. Submit a complete schedule of all signs, including sign label, type, location and support.

PART 2 MATERIALS

2.1 SIGNS - GENERAL

A. Colors, legends, and layout shall conform to OSHA 1910.145 requirements.

B. Overall size of signs 10 inches x 14 inches.

C. Material: 1/8-inch-thick rigid Butyrate (BSR) or fiberglass with printed message and background sealed within a fiberglass resin, suitable for outdoor weather conditions. Seton Name Plate Corporation, New Haven, CT 06505; W.H. Brady Company, Milwaukee, WI 53201, or equal.

2.2 "DANGER" SIGNS

Two-inch high white letters "Danger" in red oval surrounded by a rectangular black field. Text wording 1½-inch high black capital letters on white field.

No. of Signs Required	Text Wording	Placement
Not Used		

2.3 "CAUTION" SIGNS

Two-inch high yellow letters “Caution” on black field. Text wording 1½-inch high black capital letters on yellow field.

No. of Signs Required	Text Wording	Placement
Not Used		

2.4 “SAFETY” SIGNS

Two-inch high red letters on white field. Text wording 1-½-inch high black capital letters on red field.

No. of Signs Required	Text Wording	Placement
Not Used		

2.5 NFPA HAZARD IDENTIFICATION SIGNS

A. Per 2010 CFC Section 2703.5 and NFPA 704.

B. 12-inches x 12-inches minimum size.

C. Letter Size: 4-3/4 inches. Letter Color: Black.

D. Sign: Aluminum for exterior application; color to comply with NFPA requirements with red, blue, yellow and white diamonds. Provide mounting spacers for uneven surfaces.

E. Contractor to verify NFPA Rating text with City of Merced Fire Department prior to submittal.

F. Provide the following signs: Hazard Identification Code per NFPA 704 Fire Diamond:

No. of Signs Required	Text Wording	Placement
Not Used		

2.6 IDENTIFICATION OF PIPING AND VALVES

A. All piping shall be properly identified per the pipe schedule in Section 15000.

1. Snap-on Markers:
   a. Brady Bradysnap-On B-915.
   b. Seton Setmark.
2. 3/4 inch high letters for 3/4 to 4 inch pipe or covering, or 5 inch high letters for 5 inch or larger pipe or cover:
3. Provide UV resistant nylon extension straps for pipes larger than are 4 inch.
4. Material: UV resistant Vinyl.
5. Provide Text and Flow Arrows.

B. All Valves shall be identified per the valve numbers on the P&ID drawings. Provide stainless steel tag with embossed text and stainless steel wire connection to valve body.

2.7 UNDERGROUND WARNING TAPE

A. Refer to Section 02229 for underground identification requirements.

PART 3 EXECUTION

3.1 MOUNTING DANGER, CAUTION, SAFETY AND CHEMICAL SIGNS

A. Install the signs at the locations designated by the Engineer.

B. Mount signs with top of the sign 5'-6" above the floor.

C. Secure with No. 10 stainless steel screws, providing expansion shields for concrete.

D. Plastic ties shall not be used for fastening.

E. Mounting holes in signs shall be oversized to allow signs to “float” free.

3.2 MOUNTING ROOM SIGNS

A. Where doors are present, mount on doors, centered between jambs, and top of signs 5'-6" above the floor.

B. Where signs can be attached to doors and walls, attach with 1/16" thick white vinyl foam tape.

3.3 IDENTIFYING DEVICES FOR PIPING AND VALVES

A. Piping and valves identification signage and markings shall be installed as specified in Section 2.6.

B. Installation of identification signage and markings shall be by Divisions 15 and 16 subcontractors.

3.4 UNDERGROUND WARNING TAPE

Underground warning tape shall be installed in accordance with the details provided in section 02229.

END OF SECTION

SECTION 11010

GENERAL MECHANICAL EQUIPMENT PROVISIONS

PART 1 GENERAL

1.1 DESCRIPTION

This section contains items that pertain to all mechanical work.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Section 01610 - Seismic Design Criteria

B. Section 01010 - General Construction Information and Requirements

C. Section 01020 - Modifications to Existing Facilities and Order of Work

D. Section 01300 - Submittals

E. Section 03100 - Concrete

F. Section 09900 - Painting

G. Section 15080 - Piping Accessories and Appurtenances

H. Division 16 - Electrical

1.3 WORK INCLUDED

The work consists of completely installing the mechanical systems as shown on the drawings and specified in other sections.

1.4 QUALITY ASSURANCE

A. Requirements of Regulatory Agencies: Comply with all applicable codes, rules, and regulations.

B. References: Comply with referenced standards as listed in the individual sections.

C. Fees and Permits: Obtain required permits necessary to execute the work under this division.

D. All pressure vessels, safety devices and appurtenances shall comply with standards of and bear stamp of ASME.

E. All electrical devices and wiring shall comply with standards of NEC. All devices shall be UL listed and so identified.

F. Testing: All mechanical equipment shall undergo the minimum factory and field testing as specified herein and Section 01010. Additional testing requirements over and above those specified herein may be included in the individual equipment specifications. These requirements shall be considered complimentary to the minimum requirements specified herein.

1.5 DRAWINGS

Drawings are diagrammatic and show the general design, arrangement and extent of the systems. Do not scale drawings for roughing in measurements, nor use as shop drawings. Make field measurements and prepare shop drawings as required. Coordinate work with shop drawings of other specification divisions.

1.6 SUBMITTALS: IN ACCORDANCE WITH SECTION 01300

A. Detailed submittal requirements are given in the individual sections.

B. Contractor shall investigate the capacity and space requirements of the proposed equipment before submitting shop drawings.

C. Factory test reports shall be submitted for acceptance prior to shipment of the equipment to the job site. Field test reports shall be submitted for acceptance prior to final acceptance of the equipment.

D. Factory test procedures shall be submitted to the engineer for approval prior to commencement of any factory testing.

E. Seismic and structural anchoring calculations shall be submitted to the engineer for approval prior to installation of equipment.

F. Operation and Maintenance manuals shall be submitted to the engineer for approval prior to acceptance of equipment, in accordance with specification section 01680.

1.7 WARRANTY

A supplier's written warranty shall be provided for the equipment specified in this section. The warranty shall be for a minimum period of one (1) year for start-up or 18 months from time of equipment shipment, whichever comes first.

1.8 PRODUCT HANDLING

Protect material, equipment, and apparatus provided under this section from damage, water and dust, both in storage and installed, until final acceptance. Provide temporary storage facilities for material and equipment. Material, equipment, or apparatus damaged because of improper storage or protection will be rejected. See Section 01640.

1.9 JOB CONDITIONS

A. Special Requirements:

1. Maintain emergency and service entrances usable to pedestrian and vehicle traffic at all times. Where trenches are cut, provide adequate bridging for traffic.

2. Coordinate shutdown of water, wastewater, or heating systems.

B. Schedule of Work: Arrange work to comply with schedule of construction. In scheduling, anticipate means of installing equipment through available openings in structure. See Section 01020.

C. Protection:

1. Completely cover motors and other moving machinery to protect from dirt, dust, and water during construction.

2. Cap all openings in pipe and ductwork to protect against entry of foreign matter.

3. Protect premises and work of other divisions from damage arising out of installation of work of this division.

4. Perform work in manner precluding unnecessary fire hazard.

1.10 SPECIAL TOOLS

At completion of project, provide one set of special tools required to operate, adjust, dismantle, or repair any equipment of this division, as specified in the individual sections for specific pieces of equipment. Special tools mean those not normally found in possession of mechanics or maintenance personnel.

PART 2 MATERIALS

2.1 GENERAL

A. All the mechanical equipment to be shipped disassembled shall be assembled in the manufacturer's shop to insure proper fitting of parts, then match-marked for erection, and disassembled for shipment.

B. Contractor shall be responsible for locating and installing sleeves, inserts, and supports as required during the stages of construction.

C. Contractor shall be responsible for making minor changes in the piping, and equipment locations due to structural obstructions or conflicts with work specified in other divisions.

2.2 FABRICATED STEEL

A. All steel members used in the fabrication of the equipment shall conform to the requirements or "Specifications for Structural Steel". ASTM A36. All stainless steel shall be Type 316 unless otherwise specified.

B. Design and fabrication of Structural Steel Members shall be in accordance with the latest edition of AISC "Specifications for the Design, Fabrication, and Erection of Structural Steel Plates, Bars and Strip," Designation A-123, or of the ASTM Standard Specifications for Zinc Coating (Hot Dip) or Iron and Steel Hardware, Designation A153067, as appropriate for Buildings. All welding shall conform to the latest standards of the American Welding Society.

C. All parts shall be amply proportioned for all stresses which may occur during fabrication, erection, and operation.

D. All stainless-steel parts/equipment, after its fabrication, shall undergo a passivation (pickling) process to ensure maximum resistance to corrosion. All stainless-steel components and structures shall be submersed in a chemical bath of nitric acid and hydrofluoric acid to remove any residues that may be present on the material as a result of forming, manufacture, or handling. After removal from the pickling bath, the equipment must be washed with a high-pressure wash of cold water to remove any remaining surface debris and promote the formation of an oxidized passive layer which is critical to the long life of the stainless steel. Submergence insures complete coverage. Spray on chemical treatments and glass bead blasting are specifically not acceptable due to their inability to provide complete and uniform corrosion protection.

2.3 BOLTS, NUTS, AND WASHERS

Bolts for the equipment assembly shall be hexagonal, refined bar iron, except where the equipment body is stainless steel, aluminum, or bronze alloy, the bolts shall be the same corrosion

resistant material. Nuts shall be hexagonal, of the same metal as the bolts. All threads shall be clean cut and shall conform to US Standard B1.1 for Unified Screw Threads.

2.4 NAMEPLATES

Equipment nameplates shall be engraved or stamped on stainless steel and fastened to the equipment in an accessible location with oval head stainless steel screws or drive pins. Nameplates to have ¼-inch letters with Equipment Name and number as shown on "I Series" Contract Drawings.

2.5 EQUIPMENT MOUNTS, GROUTING, AND VIBRATION ISOLATION

A. Where a steel or cast base is shown between the equipment and a concrete pedestal, it shall be painted after fabrication in conformance with applicable provisions of Section 09900. It also shall be equipped with drain pans and drain connections, where applicable.

B. All concrete plan dimensions for bases or pedestals shall be at least 6 inches larger in each dimension than the steel or cast base so that the distance between the anchor bolt and edge of concrete is at least 3 inches. Conduits, piping connections, drains, etc., shall be installed as shown on the Drawings, and/or standard mechanical details.

C. Where specified or noted in the Drawings, the equipment including the base, shall be mounted on or suspended from vibration isolators to prevent the transmission of vibration and mechanically transmitted sound to the supporting structure. Vibration isolation available internally in the equipment unit is not equivalent and shall not be provided when vibration isolation as specified herein is required. Normally provided internal vibration isolators need be replaced with rigid supports in such cases.

D. Details of the vibration isolators where required by certain units of mechanical equipment are included in the Specifications for furnishing and installing those units.

E. Furnish all necessary materials and construct suitable raised concrete foundations for all equipment installed, even though such foundations may not be indicated on the Drawings. The tops of foundations shall be at such elevations as will permit grouting as specified below.

F. In setting pumps, motors, and other items of equipment customarily grouted, make an allowance of at least one inch for grout under the equipment bases. All shims shall be removed. Unless otherwise approved, all grout shall be an approved non-shrink grout.

G. Grout shall be mixed and placed in accordance with the Manufacturer's installation instructions and/or Section 03100, whichever is more stringent. Where practicable, the grout shall be placed through the grout holes in the base and worked outward and under the edges of the base and across the rough top of the concrete foundation to a peripheral form

so constructed as to provide a suitable chamfer around the top edge of the finished foundation.

H. Where such procedure is impracticable, the method of placing grout shall be as approved. After the grout has hardened sufficiently, all forms, hoppers and excess grout shall be removed, and all exposed grout surfaces shall be patched in an approved manner, if necessary, given a burlap-rubbed finish, and painted with at least two coats of an approved paint.

2.6 ANCHOR BOLTS

A. Anchor bolts for all equipment and appurtenances shall be furnished and installed as specified herein and/or as shown on the Drawings. Anchor bolt holes in equipment support frames shall not exceed the bolt diameters by more than 25 percent, up to a limiting maximum over-sizing of ¼-inch. Minimum anchor bolt diameter shall be 1/2 inch. All anchor bolts shall be furnished with leveling nuts, the faces of which shall be tightened against flat surfaces as shown to not less than 10 percent of the bolt's safe tensile stress.

B. Equipment manufacturer shall provide structural calculations for all equipment weighing more than 400 pounds. In addition, any equipment weighing more than 50 pounds that is hung from the structure above or from a wall shall have structural calculations. Further, all equipment taller than 5-feet shall have structural calculations. Structural calculations and details shall conform to the requirements of the CBC including Section 1613 and in accordance with contract specification Section 01610. Calculations shall be signed and stamped by a California Registered Civil or Structural Engineer.

1. All equipment inside water bearing structures shall also be designed to withstand sloshing, in accordance with ACI 350.3 and Specification Section 01610. Contractor shall provide stamped and signed calculations to verify compliance.

C. It shall be the responsibility of the equipment manufacturer to determine the number, size, and location of all anchor bolts to be set in concrete. Unless indicated otherwise on the drawings, anchor bolts, nuts, and washers shall be galvanized steel, except in wet or corrosive locations they shall be Type 316 stainless steel.

D. Obtain anchor bolt templates from the equipment manufacturer to aid in locating anchor bolts in the concrete pad.

E. No equipment shall be anchored to vertical or overhead structural elements without written approval of the Engineer.

2.7 SEISMIC CONSIDERATIONS

A. Vibration-isolated equipment shall be provided with snubbers capable of retaining the equipment in its designated locations without any material failure or deformation of the snubbers when exposed to a vertical or horizontal force at the contact surface equal to 100 percent of the operating weight of the equipment. Air gaps between retainer and equipment base shall not exceed 1/4 inch.

B. Inasmuch as most anchorage of equipment is to be made of poured-in-place concrete elements, it is imperative that types of anchorage be coordinated with the Contractor so that anchorage may be installed at time of pouring. If calculations and anchorage details are not submitted prior to pouring of concrete, the Contractor will become responsible for any strengthening of concrete elements because of superimposed seismic loading.

C. All piping, raceways, ductwork, accessories, appurtenances, etc., furnished with equipment shall be anchored to resist a lateral seismic force of 40 percent of its operating weight without excessive deflection. This force shall be considered acting at the center of gravity of the piece under consideration.

D. Piping with flexible connection and/or expansion joints shall be anchored such that the intended uses of these joints are maintained in the piping system.

2.8 BELT DRIVES

A. V-belt with cast iron sheaves rated not less than 1-1/2 times motor horsepower.

B. Multiple V-belts shall be matched sets.

2.9 SHAFT COUPLINGS

A. Shaft couplings for direct connected electric motor driven equipment 1/2 horsepower or larger shall be non-lubricated type, designed for not less than 50,000 hours of operating life. Where requirements of the equipment dictate specialized features, the manufacturer may substitute the coupling normally supplied for the service.

B. Coupling sizes shall be as recommended by the manufacturer for the specific application, considering horsepower, speed of rotation, and type of service. The use of couplings as specified herein shall not relieve the Contractor of his responsibility for precision alignment of all driver-driven units as specified by the equipment manufacturer.

C. Couplings shall be of the pin and pre-loaded neoprene cylinder type, designed to accommodate shock loading, vibration and shaft misalignment or offset. Stub shafts shall be connected through collars or round flanges firmly keyed to their shafts, to neoprene cylinders held to individual flanges by through pins. Couplings with cylinders pinned to both coupling flanges will not be acceptable.

2.10 BEARINGS

A. Unless otherwise specified all equipment bearings shall be oil or grease lubricated, ball or roller anti-friction type of standard manufacturer. Bearings shall be conservatively designed to withstand all stresses of the service specified and shall be selected on the basis of a 60 degrees C ambient temperature. Each bearing, except when otherwise noted, shall be rated in accordance with the latest revisions of AFBMA Methods of Evaluating Load Ratings of Ball and Roller Bearings for one of the following classes of B-10 rating life:

Class M1	8,000 hours of operation
Class M2	20,000 hours of operation
Class M3	50,000 hours of operation
Class M4	100,000 hours of operation
Class M5	200,000 hours of operation

B. Unless otherwise noted, all process-associated equipment, including motors, drivers and driven units shall have, as a minimum, bearings for Class M3 life.

C. All grease lubricated bearings, except those specified to be factory sealed and lubricated, shall be fitted with easily accessible grease supply, flush drain and relief fittings. Extension tubes shall be used when necessary. Grease supply fittings shall be standard hydraulic type designed for use with quick hydraulic couplings attached to grease guns. All equipment shall be equipped with an identical type of grease fittings, Alemite, Zerk, or equal.

D. Oil lubricated bearings shall be equipped with either a pressure lubricating system or a separate oil reservoir type system. Each oil lubrication system shall be of sufficient size to safely absorb the heat energy normally generated in the bearing under a maximum ambient temperature of 60 degrees C and shall be equipped with a filler pipe and an external level indicator gauge. To avoid work hardening or "brinelling" damage from vibration, bearings shall be removed and shipped separately, or rotors shall be locked in place to prevent movement during transport.

2.11 GUARDS

A. All exposed moving parts shall be protected with guards in accordance with the requirements of the State Division of Safety Standards.

B. Belt guards shall be fabricated of 16 gauge, expanded metal or wire screen with 70 percent free area and steel frame, covered both sides. Provide visual inspection of moving parts and insertion of tachometer without removal of guard. Provide access door in guard to permit checking of belt tension. Guards shall be galvanized after fabrication and shall be designed to be readily removable to facilitate maintenance of moving parts.

C. Shaft guards shall be solid 16 gauge galvanized steel, inverted "U" shape trough cover over entire length of exposed horizontal shafts, and tubular shape for vertical shafts. Extend

cover to below bottom of shaft and couplings. Provide for lubrication of bearings without requiring removal of cover.

D. All equipment with exposed moving parts which operates automatically or by remote control shall be identified by signs reading "CAUTION - AUTOMATIC EQUIPMENT - MAY START AT ANY TIME". Signs shall be 10 inches by 14 inches in size and shall be constructed of corrosion-proof material with a heavy-duty porcelain enamel finish or 1/8" thick butyrate or fiberglass. Letters shall be white in a red oval on a black background. Signs shall be installed near exposed moving parts.

2.12 ELECTRIC MOTORS

A. Standards: Motors shall be built in accordance with IEEE Standards, NEMA Standard MGI, latest revision, and to the requirements specified herein. Where a conflict may exist, these specifications take precedence.

B. Type: Motors specified herein are three-phase squirrel cage for 1/2 HP and above; or single-phase types for less than 1/2 HP; or D.C. for D.C. Variable Speed Drives.

C. Rating: Each motor shall develop ample torque for its required service throughout its acceleration range at a voltage 10 percent below nameplate rating. Where detailed on the Electrical Drawings to be operated on a reduced voltage starters, the motor shall develop ample torque under the conditions imposed by the reduced voltage starting method. Each VFD shall be one horse power size larger than required motor size.

D. The motor shall not be required to deliver more than its rated nameplate horsepower, at unity (1.0) service factor, under any condition of mechanical or hydraulic loading.

E. All motors shall be continuous time rated suitable for operation in a 40 degrees C ambient unless noted otherwise.

F. Specific motor data such as HP, Service Factor, RPM, enclosure type etc., is specified under the detailed specification for the mechanical equipment with which the motor is supplied.

G. Single Phase Motors: Single phase 120, 208, or 230 volt motors shall have integral thermal overload protection or shall be inherently current limited.

H. Thermostats: Where indicated or specified, winding thermostats shall be snap action, bi-metallic, temperature-actuated switch. Thermostats shall be provided with one normally closed contact. The thermostat switch point shall be pre-calibrated by the manufacturer. All inverter duty motors shall be provided with winding thermostats, unless RTDs are specified. All explosion-proof motors shall be provided with winding thermostats.

I. See electrical specifications for additional details.

2.13 NAMEPLATES

The motor manufacturer's nameplates shall be engraved or stamped on stainless steel and fastened to the motor frame with stainless steel screws or drive pins. Nameplates shall indicate clearly all of the items of information enumerated in NEMA Standard MG1-10.38 or MG1-20.60, as applicable.

2.14 SUBMITTAL DATA

Submittal of motor data for acceptance shall include complete nameplate data in accordance with NEMA Standards cited above and, in addition, the following for motors 3 hp or larger:

A. Ambient temperature rating.

B. Service factor.

C. Efficiency at 1/2, 3/4 and full load.

D. Power factor at 1/2, 3/4 and full load.

E. Motor outline, dimensions and weight.

F. Descriptive bulletins, including full description of insulation system.

G. Bearing design data.

H. Special features (i.e., space heaters, temperature detectors, etc.).

I. Wiring diagrams for motor power leads, over-temperature switch, heater and moisture monitoring.

2.15 CONDENSATION HEATERS

Condensation heaters, where specified under the detailed mechanical specifications shall be of the cartridge or flexible wrap around type installed within the motor enclosure adjacent to core iron. Heaters shall be rated for 120 V, single phase with wattage as required. The heater wattage and voltage shall be embossed on the motor nameplate. Power leads for heaters shall be brought out at the motor lead junction box.

2.16 WINDING TEMPERATURE DETECTORS

Where specified under the detailed mechanical specifications for individual equipment or on all A.C. motors to be connected to a variable speed drive, there shall be a factory installed winding temperature detector consisting of 3 thermostats (1 per phase) wired in series, with leads terminating in the main conduit box. This device shall protect the motor against damage for overheating caused by single phase, over load, high ambient, abnormal voltage, locked rotor, frequent starts or ventilation failure. The protective device shall have normally closed contacts rated 120VAC, which opens on high motor temperature. Not less than two (2) sets of three (3) detectors shall be furnished with each motor requiring such detector with one left as a spare. Temperature detectors shall be TI Klixon 9700 series or equal.

2.17 SUBMERSIBLE TYPE1 PROTECTION DEVICES

Where specified under the detailed mechanical specifications for individual equipment, furnish and install at the motor control center (unless indicated otherwise) a solid state device that provides a warning signal when the motor oil reaches a certain level of contamination by water. The contamination level is determined by measuring the resistivity of the motor oil bath. The resistivity shall be measured using a probe (di-electrode). The probe is connected to a lead, which runs back through the motor cables to the sensing device. The sensing device shall trip an auxiliary relay at low resistance (100K ohms or lower), to provide an alarm. The submersible Type 1 protection device shall be ABS Pumps Inc., Sealminder or equal.

2.18 SUBMERSIBLE TYPE 2 PROTECTION DEVICES

Where specified under the detailed mechanical specifications for individual equipment, furnish and install at the motor control center (unless indicated otherwise) a solid state protection device for monitoring the temperature and leakage detectors installed at the equipment. The solid state device shall operate on the current sensing principal whereby a change in temperature or leakage condition shall change the resistance of the associated sensor and thus alter the current in the sensing circuit. The protection device shall contain two sets of dry contacts, one for over temperature and one for leakage. The dry contacts will change state upon occurrence of an over temperature or leakage condition so as to shutoff the equipment on over temperature and provide an alarm for leakage. The submersible Type 2 protection device shall be Flygt, ITT Industries MiniCAS or equal.

2.19 SUBMERSIBLE TYPE 3 PROTECTION DEVICES

A. Each pump shall be provided with its own self-contained control and status protection device module which shall be mounted within the motor control center (unless indicated otherwise). This module shall operate from a 24 VAC transformer furnished with module and shall provide a single point within the control system for pump sensor output processing. The protection device module shall have a manual reset so that the operator must locally restart the pump and thus be provided with local indication as to the cause of pump stoppage.

B. The protection device module shall interface for the direct connection of all pump/motor internal monitoring devices by furnishing the module with four (4) 24 VAC Relays for the following functions.

1. Stator winding over temperature protection (stops pump, local LED indication).

2. Stator leakage alarm (local LED indication and contacts for remote alarm indication).

3. Lower bearing temperature protection (adjustable, stops pump, local LED indication).

C. The submersible Type 3 protection device shall be Flygt, ITT Industries, CAS or equal.

2.20 SINGLE PHASE MOTORS

A. General: Unless otherwise specified, motors smaller than 143T (1/2 hp) frame shall be single phase, capacitor start. Small fan motors may be split-phase or shaded pole type if such are standard for the equipment. Wound rotor or commutator type single-phase motors are not acceptable unless their specific characteristics are necessary for the application.

B. Voltage: Motors shall be rated for operation at 115 volts, single phase, 60 Hz. Should unusual conditions require a three-phase motor on a frame smaller than 143T, it shall be designed for 200 volts, three phase, 60 Hz, but only after written approval has been received from the Engineer.

C. Enclosure: Motors shall be totally-enclosed in conformity with NEMA Standard MG1-10.35. Small fan motors may be open type if suitably protected from moisture, dripping water and lint accumulation.

1. Locked rotor current shall not be greater than specified in NEMA Standard MG1-12.32, Design "N".

D. Bearings: Motors shall be provided with sealed ball bearings lubricated for 10 years normal use.

2.21 THREE PHASE MOTORS - FRAMES 143T THROUGH 449T

A. General: All motors 1/2 HP and larger shall be on a NEMA frame 143T or larger. Motors shall be designed and connected for operation on a 240 or 480 volt, 3 phase, 60 hertz alternating current system, as applicable. Dual voltage (230/460) rated motors are acceptable.

B. All motors shall be NEMA Design B, normal starting torque unless noted otherwise, Starting KVA/HP (Locked rotor) shall not exceed the values given in NEMA Standard

MG1-10.37. Motors shall be manufactured by US Motors, General Electric, Westinghouse, Reliance, or equal.

C. Bearings: Anti-friction motor bearings shall be designed to be re-greasable and initially shall be filled with grease suitable for ambient temperatures to 40 degrees C. Bearings shall be AFBMA Types BC or RN, heavy duty, or shall otherwise be shown to be suitable for the intended application in terms of B-10 rating life, Class M3 or better.

1. All grease lubricated bearings, except those specified to be factory sealed and lubricated, shall be fitted with easily accessible grease supply, flush, drain and relief fittings. Extension tubes shall be used when necessary. Grease supply fittings shall be standard hydraulic type as manufactured by the Alemite Division of the Stewart-Warner Corporation.

D. Insulation: Insulation systems shall be Class B or F (except as modified below) and shall be the manufacturer's premium grade, resistant to attack by moisture, acids, alkalies, and mechanical or thermal shock.

E. Enclosures: Motors shall have a cast iron frame and cast iron or stamped steel conduit box. Conduit box shall be split from top to bottom and shall be capable of being rotated to four positions. Synthetic rubber like gaskets shall be provided between the frame and the conduit box and between the conduit box and its cover. Motor leads shall be sealed with a non-wicking non-hygroscopic insulating material. A pad with drilled and tapped hole, not less than 1/4-inch diameter, shall be provided inside the conduit box for a motor frame grounding stud.

Motors weighing more than 50 pounds shall be equipped with at least one lifting lug. All hardware shall be corrosion resistant. Motors shall be delivered with manufacturer's standard paint.

The following specific features are required in addition to the preceding general specifications for the motor enclosures noted:

1. Open Drip Proof - Manufacturer’s standard design with Class B insulation, stamped steel motor lead junction boxes and 1.15 service factor (@ 40 degrees C).

2. Totally Enclosed Fan Cooled - TEFC motors shall include Class B insulation, cast iron junction box, 1.15 service factor (@ 40 degrees C) tapped drain holes (corrosion resistant plugs for frames 286T and smaller and automatic breather/drain devices for frames 324T and larger), upgraded insulation by additional dips and bakes to increase moisture resistance.

3. Explosion Proof - Explosion proof motors shall include Class B insulation, 1.15 service factor (@ 40 degrees C). Tapped drain holes (corrosion resistant plugs for frames 286T and smaller and automatic breather/drain/drain devices for frames 324T and larger), UL label for Class 1, Division 1, Group D Hazardous areas.

4. Severe Duty - Motors shall be of the corrosion resistant type conforming to motors designated by the manufacturer as "Chemical Duty", "Mill and Chemical", "Custom Severe Duty", or similar applicable manufacturer's quality designation. Severe duty

motors shall include Class F insulation (applied at Class B rise), 1.15 service factor (@ 40 degrees C), tapped drain holes (corrosion resistant plug for frames 286T and smaller automatic breather/drain devices for frames 324T and larger), epoxy finish, upgraded insulation by additional dips and bakes to increase moisture resistance.

5. Submersible - Motors shall be housed in a watertight casing and shall have Class F insulated windings which shall be moisture resistant. Pump motors shall have cooling characteristics suitable to prevent continuous operation in a totally, partially, or non-submerged condition continuously without overheating or other damage. The power cable shall be of adequate length to allow the unit to be wired as detailed on the electrical drawings without splices.

6. Inverter Duty – Motors shall be premium efficient design with inverter grade (Class H) insulation. Each inverter duty motor shall meet NEMA MG-1, Part 31 specifications for variable frequency drive (VFD) inverter duty applications. Motors shall be US Motors 841 Plus or equal.

7. Efficiency - Unless otherwise specifically specified for a specific motor, all motors shall be high-energy efficient type. Efficiencies shall be as determined in accordance with IEEE Standard 112 and NEMA MG-1-12.59. Motors shall be US Electric Motors "Premium Efficiency"; Baldor "Super-E", or equal.

2.22 ELECTRICAL DEVICES FURNISHED WITH MECHANICAL EQUIPMENT

A. Control panels supplied with mechanical equipment shall have the control switches, indicating lights, relay logic, and dry contact SCADA interfaces as indicated for each panel on the P&ID Drawings. Unless otherwise specified or shown all electrical power, control or instrumentation devices furnished as a "package" with mechanical equipment shall conform to the latest issue and addenda to the Joint Industry Council Electrical Standards for Mass Production Equipment (EMP-1-67), applicable NEMA Standards, National Electric Code (NEC 1999), or as modified herein.

B. Panels housing electrical equipment shall be NEMA rated for area into which panel is to be installed as shown on Contract Electrical Drawings. NEMA 4X panels shall be stainless steel. NEMA 1, 12 or 3R panels shall be galvanized steel, electrostatic applied baked enamel, painted gray. Panels located in Class 1 locations shall be explosion proof.

C. Devices mounted in non-ventilated panels shall be rated for a 50 degrees C (122 °F) ambient. Panels with devices rated less than 50 degrees C shall have ventilation fans and louvers. Louver openings shall have removable metal filters. All outdoor panels shall have heaters with guards and thermostat. Fans and heaters shall be powered from panel internal 120VAC control power.

D. A main panel power disconnect device to disconnect all power within the panel shall be an integral part of the panel and shall be one of the following types:

1. A horsepower rated heavy-duty fused safety switch or circuit breaker for 480, 240, or 208 volt, 1 phase or 3 phase panels. An outer door mounted operator for each switch or breaker padlockable in the off position shall be provided.

2. Circuit breaker for 120 volt, 1 phase panels.

E. Individual motor circuit protector (magnetic only circuit breaker) or fused protection shall be provided for each motor feed from panel.

F. All panels supplied with a 480-volt power feeder shall be provided with an integrally mounted dual winding 120-volt secondary control power transformers with primary and secondary fusing. Control power transformers shall have the neutral grounded.

G. All door mounted devices shall be of a heavy-duty industrial type quality. Lights, switches and pushbuttons shall be standard 30mm diameter, NEMA 13, U.L. listed and water & oil tight. All outer door mounted devices shall have black phenolic nameplates with 3/16" (minimum) white letters fastened by device assembly or stainless steel screws.

H. All indicating lights shall be full voltage 120VAC, LED type with push to test switch and wiring. Light lens colors shall be as follows:

Open/On	Green
Closed/Off	Red
Alarm/Trouble	Amber
Power On	White

I. Control relays shall be plug-in type with clear see-through sealed housing. Provide relay energized neon lamp or LED inside relay housing.

J. Time delay relays shall be solid state, plug in type with LED timer energized indicator lights.

K. All fuse shall have visible blown fuse indicator lights.

L. Contacts for external status, alarms or equipment interlocking shall be of the isolated contact type and provided as required per individual equipment specifications or Process and Instrumentation "I-Series" Drawings. Contacts shall be rated 10 amps at 120VAC continuous pilot duty. Alarm contacts shall be of the maintained latching contact type, requiring manual reset. Reset pushbuttons shall be provided and located on outer door for latching alarms.

M. Motor starters shall be magnetic, 120VAC coil solenoid operated, NEMA rated for horsepower of supplied equipment, contactor type, with chatter-proof armatures. Each motor starter to have a normally open and a normally closed auxiliary contacts. Provide one bimetallic type thermal overload relay for each phase.

An outer door insulated mechanical reset mechanism shall be installed for each motor starter thermal overload reset.

N. Watertight gasketed conduit hubs shall be used for all conduit penetrations to outdoor panels. Conduit entries to outdoor panels shall not enter top of panels.

O. Auxiliary devices (pressure switches, flow switches, etc.) located remotely from panels but furnished under this Section shall have enclosures as specified in the individual mechanical sections, or in conformance with the NEMA area classification noted on Contract Electrical drawings.

P. Schematic (elementary) or connection wiring diagrams, and equipment material lists shall be furnished for all panels. For panels containing a complex control scheme, a written operational theory shall be cross-referenced to the schematic diagram. The wiring diagram in its "as built" form shall be fastened to the panel door when panel is delivered to jobsite. The equipment material list shall identify the actual manufacturer, manufacturer's part or model number and a cross-reference as to its location in the panel. Generic part or model numbers are not to be used in material lists.

2.23 WIRING

A. Conductors extending beyond a panel to other auxiliary equipment which is pre-wired on a skid type or package base shall be protected by galvanized rigid steel conduit. Where terminating at a motor or other similar device requiring frequent movement or which produces excessive vibration liquid tight type flexible conduit shall be used. Liquid tight conduit will be limited to three (3) feet maximum length at any termination. All pre-wired wiring shall be copper, #14 AWG minimum.

B. Input or output instrumentation level signals shall be 4-20 mA and provided as required per the individual equipment specification and Process & Instrumentation “I-Series” drawings. All signal wiring shall have copper twisted shield pairs with overall shield.

C. Separate power, control and instrumentation terminal strips shall be provided for all external panel connections. All terminal points shall have black machine printed identification numbers on white background.

D. All wires inside panels and on pre-wired packages and skids shall have wire labels at each end point. Wire labels shall be white shrink tubes with permanent ink black machine typed lettering.

2.24 PRESSURE GAUGES

Pressure gauges furnished with mechanical equipment shall be as specified in Section 15080.

2.25 TOOLS AND SPARE PARTS

A. All special tools required for exclusive operation and maintenance of respective items of equipment shall be furnished with those items of equipment by the manufacturer. This includes special tools, instruments, accessories required for proper "in-plant" adjustment, maintenance, overhaul, and operation. Tools shall be high-grade, smooth, forged, alloy tool steel.

B. All tools and spare parts shall be carefully packed in cartons, labeled with indelible markings, and shall be adequately treated for a long period of storage. Complete ordering information including manufacturer, part number, part name, and equipment name and number(s) for which the part is to be used shall be supplied with the required spare parts. The tools and spare parts shall be delivered and stored in a location as directed.

C. Spare parts for certain equipment provided under Divisions 11, 15, and 16 have been specified in the pertinent Sections of the Specifications. All spare parts shall be collected and stored in a designated area. In addition, an inventory listing all spare parts, the equipment they are associated with, the name and address of the supplier, and the delivered cost of each item shall be furnished. Copies of actual invoice for each item shall be furnished with inventory to substantiate the delivered.

2.26 LUBRICANTS

Provide all mechanical equipment with a sufficient supply of correct lubricant for starting, testing, and an initial 120-day operation period. All lubricants shall be of types recommended by the applicable equipment manufacturer. Subject to the approval of the equipment manufacturer's, lubricants shall be limited to the least number or types required for normal maintenance of all equipment. Not less than 90 days before the date scheduled for field testing of equipment three (3) copies of a listing indicating all lubricants for item of mechanical equipment shall be provided. Unless otherwise noted, all grease lubrication fittings shall be of an approved standard hydraulic type.

2.27 LIFTING LUGS

Lifting lugs shall be provided for all equipment weighing 50 pounds or more.

2.28 VIBRATION

A. This section specifies the maximum allowable vibration levels for all mechanical equipment over 20 horsepower. Additional requirements that may be more stringent may also be listed in individual equipment specifications. In that case, the more stringent of the two requirements shall apply. Testing of equipment at the factory and in the filed as identified in PART 3 of this specification shall demonstrate compliance with the specified vibration limits. All vibration tests shall be conducted under actual operating conditions:

1. Unfiltered readings at each unit shall have less than the following peak to peak amplitudes.

Operating Speed (revolutions per minute)	Centrifugal Blowers	Unfiltered (Overall) Peak-to-Peak Amplitude (mils)		
		Other Rotating Equipment	Non-Clog Mixed Flow Pumps	Clean Fluid Pumps
0 - 300	N/A	5.0	6.0	6.0
301 - 600	N/A	4.0	5.0	5.0
601 - 900	N/A	3.0	4.0	3.0
901 - 1,200	N/A	2.0	3.5	2.0
1,201 - 1,500	N/A	1.8	3.0	1.8
1,501 - 1,900	N/A	1.5	2.5	1.5
1,801 - 2,400	N/A	1.0	2.0	1.0
2,401 - 3,000	N/A	0.8	1.5	0.8
3,001 - 3,600	1.25	0.7	1.3	0.7
Above 3,600	1.0	0.6	1.2	0.6

2. Vibration Velocity Limits: Unless otherwise specified, equipment is not to exceed the following peak velocity limits:

Item	Unfiltered Overall Limit (inches per second)	Any Filtered Peak Limit (inches per second)
Non-Clog or Mixed Flow Pumps	0.35	0.25
Clean Fluid Pumps	0.25	0.20
Motors and Steady Bearings	0.25	0.20
Gear Reducers, Radial	Not to exceed AGMA 6000-A88 limits	
Other Reducers, Axial	0.10	0.10
Centrifugal Blowers	0.15	0.10

B. For all equipment, axial shaft vibration displacements (relative to casing) shall not exceed 50 percent of the maximum lateral shaft vibration displacements (relative to casing existing at any point along the shaft).

C. The above vibration responses are to include the range from 5.0 Hz to 5000 Hz and shall therefore encompass both low and high frequency responses of the subject equipment. The measurements shall be obtained with the equipment installed and operating at any capacity within the specified operating range. In addition to these maximum unfiltered readings, it is also stipulated that no narrow band spectral acceleration component, whether sub-rotational, higher harmonic or asynchronous multiple of running speed, shall exceed 40 percent of the synchronous displacement amplitude component without manufacturer's detailed verification of the origin and ultimate effect of said excitation.

Any equipment showing excessive vibration shall be corrected by the Contractor at his expense and the equipment retested.

D. The Contractor shall furnish a written report covering all the test values and data for each unit tested.

PART 3 EXECUTION

3.1 EQUIPMENT INSTALLATION

A. Belt Driven Equipment: Mount with motors on common steel base with adjustable motor mount.

B. Pumps: Align pump and motor. Completely fill steel and cast iron pump bases with concrete grout after properly set.

C. Install equipment so nameplates are visible.

D. Basis for equipment and material installation is the published recommendations of manufacturer. Submit such recommendations for review.

E. Pipelines and other connections to mechanical equipment shall be installed square and shall not put in strain or use the equipment for support unless it is specifically designed for it.

3.2 IDENTIFICATION

A. Provide manufacturers' nameplates on all equipment, identifying manufacturer's name, model number, size, capacity, and electrical characteristics.

B. Leave all manufacturers' nameplates clean and legible. Install all equipment so view of nameplates is not obstructed.

C. Identify all equipment with symbol number and service as shown. Identification shall be on 1-1/4 inch by 3 inch, or larger nameplates, securely fastened to equipment.

D. Provide engraved identification of function on switches and manually operable controls.

3.3 CLEANING

A. During progress of work, keep premises reasonably free of debris, cuttings, and waste material. Upon completion of work, and at other times as directed, remove all such debris from premises.

B. Clean equipment and materials. Remove foreign materials including dirt, grease, splashed paint, and plaster. Restore to original condition any finish damaged.

3.4 FACTORY QUALITY CONTROL TESTING

A. All pumps and mechanical equipment shall receive the following minimum factory testing. Additional testing requirements may be specified in the individual equipment specification sections.

B. All pumps shall be provided with manufacturer's standard factory quality control testing as modified herein.

C. All pumps greater than 5 horsepower shall receive a hydrostatic test of the pump casing at 1.5 times the pump shut off head.

D. All pumps shall be statically and dynamically balanced and shall have a certified balancing report.

E. All pumps 5 horsepower and above shall receive a standard manufacturers bench test that shall include a minimum of 5 test points defining the pump curve. Test points shall correspond to the design points given in the individual pump specification.

The remaining test points shall define the pump curve above and below the specified design conditions. In addition, pump shut off conditions shall also be tested. Test procedures shall follow appropriate sections of the Hydraulic Institute Standards in addition to the requirements in this and other Sections.

1. As a minimum, pump head, flow, power, speed, efficiency and NPSH shall be determined and recorded.

F. All pumps scheduled to be driven by variable frequency drives shall be factory tested with a minimum of 5 test points at full speed and 5 test points at each speed specified under the design conditions in the individual pump specifications. If no alternate speed conditions are specified, 5 test points shall be provided at the minimum operating speed of the pump as recommended by the Manufacturer.

G. Vertical turbine pumps shall have bowl tests only.

H. Pump Test Tolerances: In accordance with appropriate Hydraulic Institute Standards, except the following modified tolerances apply:

1. From 0 to plus 5 percent of head at the rated design point flow.

2. 0 to plus 5 percent of flow at the rated design point head.

3. No negative tolerance for the efficiency at the rated design point.

4. No positive tolerance for vibration limits. Vibration limits in Hydraulic Institute Standards do not apply, use limits specified in this Section of the Specifications.

I. All non-submersible pumps greater than 10 horsepower shall also be tested for vibration in each plane at each exposed bearing location, on the pump, and on the motor. Vibration limits shall meet the requirements specified in Section 2.28 or more stringent requirements if specified in the individual equipment specifications.

J. All non-submersible pumps and non-vertical turbine pumps greater than 15 horsepower shall also receive a noise test. Measure the unfiltered overall A-weighted sound pressure level in dBA at 3 feet horizontally from the surface of the equipment on four sides at the mid point of the equipment height (set up temporary facilities to replicate field conditions, as shown on the contract drawings, including surrounding piping and walls). Pump and driver shall not exceed 85 dBA or lower noise level if specified in the individual equipment specifications. Pumps will need to pass the same noise test in the field, using actual installed conditions (including surrounding facilities), as described in the below the field performance testing section. If the pump does not meet noise limitations in the factory or installed field condition, manufacturer shall take immediate steps to correct the issue and limit the noise below allowable limits.

K. For all pumps, except vertical turbine pumps, the actual job motor shall be used unless an alternate means of driving the equipment is agreed to by the Engineer prior to testing.

L. All mechanical equipment shall be provided with the manufacturer's standard factory quality control tests, which shall clearly demonstrate conformance with the specifications and the specified manufactured equipment is free from defects. Standard tests shall be as modified herein.

M. All blowers for aeration or channel air systems shall be provided with a standard ASME PTC-13 (wire to air) test at the blower rated speed. Blower airflow shall be adjusted based on inlet throttling or blower speed to match the blower service specified. All blowers for aeration or channel air systems shall be provided with a hydrostatic test to 15 psig.

N. All blowers over 40 horsepower shall also be tested for vibration in each plane at each exposed bearing location, on the blower, and on the motor. Vibration limits shall meet the requirements specified in Section 2.28 or more stringent requirements if specified in the individual equipment specifications.

O. All blowers and Fans over 10 horsepower shall receive a noise test. Measure the unfiltered overall A-weighted sound pressure level in dBA at 3 feet horizontally from the surface of the equipment on four sides at the mid point of the equipment height (set up temporary facilities to replicate field conditions, as shown on the contract drawings, including

surrounding piping and walls). Blower and driver shall not exceed 85 dBA or lower noise level if specified in the individual equipment specifications. Blowers and fans will need to pass the same noise test in the field, using actual installed conditions (including surrounding facilities), as described in the below the field performance testing section. If the blower/fan does not meet noise limitations in the factory or installed field condition, manufacturer shall take immediate steps to correct the issue and limit the noise below allowable limits.

P. All other rotating equipment greater than 40 horsepower shall be tested for vibration in each plane at each exposed bearing location, on the blower, and on the motor. Vibration limits shall meet the requirements specified in Section 2.28 or more stringent requirements if specified in the individual equipment specifications.

Q. All other rotating equipment greater than 40 horsepower shall receive a noise test. Measure the unfiltered overall A-weighted sound pressure level in dBA at 3 feet horizontally from the surface of the equipment on four sides at the mid point of the equipment height (set up temporary facilities to replicate field conditions, as shown on the contract drawings, including surrounding piping and walls). Blower and driver shall not exceed 85 dBA or lower noise level if specified in the individual equipment specifications. Equipment will need to pass the same noise test in the field, using actual installed conditions (including surrounding facilities), as described in the below the field performance testing section. If the equipment does not meet noise limitations in the factory or installed field condition, manufacturer shall take immediate steps to correct the issue and limit the noise below allowable limits.

R. For all mechanical equipment, the actual job motor shall be used unless an alternate means of driving the equipment is agreed to by the Engineer prior to testing.

3.5 TEST WITNESSING

Factory tests shall be non-witnessed unless specified in the individual equipment specifications. When factory tests are indicated as witnessed, the costs for witnessing the tests by the Engineer, travel, and lodging costs shall be born by the Owner for the first test. All such costs for any subsequent factory re-testing required shall be born by the Contractor. The Contractor shall notify the Owner in writing a minimum of 21 calendar days prior to commencement of witnessed factory tests.

3.6 FIELD REPORTS

Submit reports for Field and Factory testing. Report features:

A. Report results in a bound document in generally accepted engineering format with title page, written summary of results compared to specified requirements, and appropriate curves or plots of significant variables in English units.

B. Include appendix with a copy of raw, unmodified test data sheets indicating test value, date and time of reading, and initials of person taking the data.

C. Include appendix with sample calculations for adjustments to raw test data and for calculated results.

D. Include appendix with the make, model and last calibration date of instrumentation used for test measurements.

E. Include in body of report a drawing or sketch of the test system layout showing location and orientation of the test instruments relative to the tested equipment features.

3.7 FIELD QUALITY CONTROL TESTING

A. Temporary Facilities and Labor: Provide all necessary fluids, utilities, temporary piping, temporary supports, temporary access platforms or access means and other temporary facilities and labor necessary to safely operate the equipment and accomplish the specified testing. With Owner's permission, some utilities may be provided by fully tested permanently installed utilities that are part of the Work.

B. Instrumentation: Provide all necessary test instrumentation, which has been calibrated within one year from date of test to recognized test standards traceable to the National Institute of Standards and Technology, Washington, D.C. or approved source. Properly calibrated field instrumentation permanently installed as a part of the Work may be utilized for Field Quality Control Tests.

C. Field Quality Control Tests: Schedule test date and notify Engineer at least 7 days prior to start of test. Test Measurement and Result Accuracy:

D. Use test instruments with accuracies as recommended in the appropriate referenced standards. When no accuracy is recommended in the referenced standard, use 1 percent or better accuracy test instruments.

E. Do not adjust results of tests for instrumentation accuracy. Measured values and values directly calculated from measured values shall be the basis for comparing actual equipment performance to specified requirements.

3.8 FIELD TESTING

A. All pumps and mechanical equipment shall receive the following minimum field testing. Additional field testing requirements may be specified in the individual equipment specification sections.

B. Submit test plan indicating test start time and duration, equipment to be tested, other equipment involved or required; temporary facilities required, number and skill or trade of personnel involved; safety issues and planned safety contingencies; anticipated effect on Owner's existing equipment and other information relevant to the test.

C. Perform general start-up and testing procedures for the equipment as recommended by the Manufacturer's written start up instructions.

D. Prior to testing, verify equipment protective devices and safety devices have been installed, calibrated, and tested and that the manufacturer's representative has certified proper installation of the equipment.

E. All mechanical pumps and equipment shall be given an 8-hour performance test and a 5-day facility startup/operational test in accordance with Section 01670. Equipment shall be operated continuously under normal operation as intended by the Contract Documents. Operational testing shall include automatic control and instrumentation systems. Any equipment or control systems that fail to perform properly shall be corrected and retested by the Contractor. Upon completion of a satisfactory operational test, a certificate of completion shall be prepared and signed by the Owner.

F. In addition to an operational test, certain mechanical equipment and pumps shall be given a field performance test as specified herein to demonstrate the complete system as installed meets the specified performance requirements.

G. All operational and performance testing shall be completed and accepted prior to acceptance of the equipment by the Owner. Equipment warranty periods shall not begin until final acceptance of the equipment by the Owner.

3.9 FIELD PERFORMANCE TESTS FOR PUMPS

A. All pumps shall be provided with a field performance test in accordance with applicable Hydraulic Institute Standards in addition to the requirements in this and other Sections.

B. All pumps 5 horsepower and smaller shall receive a field test that shall include testing the pump at the specified design condition. Pump Flow, head, and horsepower shall be recorded.

C. All pumps greater than 5 horsepower shall receive a field test that shall include a minimum of 5 test points defining the pump curve. Test points shall correspond to the design points given in the individual pump specification. The remaining test points shall define the pump curve above and below the specified design conditions. In addition, pump shut off conditions shall also be tested. Test procedures shall follow appropriate sections of the Hydraulic Institute Standards in addition to the requirements in this and other Sections. As a minimum, pump head, flow, power, speed, efficiency and NPSH shall be determined and recorded.

D. All pumps scheduled to be driven by variable frequency drives shall be tested with a minimum of 5 test points at full speed and 5 test points at each speed specified under the design conditions in the individual pump specifications. If no alternate speed conditions are specified, 5 test points shall be provided at the minimum operating speed of the pump as recommended by the Manufacturer.

E. Vertical turbine pumps shall be tested as a complete system after assembly.

F. Pump Test Tolerances: In accordance with appropriate Hydraulic Institute Standards, except the following modified tolerances apply:

1. From 0 to plus 5 percent of head at the rated design point flow.
2. 0 to plus 5 percent of flow at the rated design point head.
3. No negative tolerance for the efficiency at the rated design point.
4. No positive tolerance for vibration limits. Vibration limits and test methods in Hydraulic Institute Standards do not apply, use limits and methods specified in this or other Sections of the Specifications.

G. All non-submersible pumps greater than 10 horsepower shall also be tested for vibration in each plane at each exposed bearing location, on the pump, and on the motor. Vibration limits shall meet the requirements specified in Section 2.28 or more stringent requirements if specified in the individual equipment specifications.

H. All non-submersible pumps greater than 15 horsepower shall also receive a noise test. Measure the unfiltered overall A-weighted sound pressure level in dBA at 3 feet horizontally from the surface of the equipment on four sides at the mid point of the equipment height. Pump and driver shall not exceed 85 dBA or lower noise level if specified in the individual equipment specifications.

I. For all pumps, the actual job motor or driver shall be used.

J. Submit for engineering approval an alternative plan or waiver to the above listed field testing in cases where a certified pump curve has been provided by the manufacturer (as specified in the technical specifications) and there is insufficient water or appurtenances available to perform the field test. Submittal of alternative plan does not guarantee engineering acceptance.

3.10 FIELD PERFORMANCE TEST FOR MECHANICAL EQUIPMENT

A. All mechanical equipment shall be provided with a field performance tests.

B. Test all mechanical equipment at rated design conditions. Record equipment horsepower, speed, and other process performance parameters. Demonstrate compliance with the specified design conditions.

C. All equipment over 20 horsepower and shall also be tested for vibration in each plane at each exposed bearing location, on the machine, and on the motor. Vibration limits shall meet the requirements specified in Section 2.28 or more stringent requirements if specified in the individual equipment specifications.

D. All blowers and Fans over 2 horsepower and all other equipment over 20 horsepower shall receive a noise test. Measure the unfiltered overall A-weighted sound pressure level in dBA at 3 feet horizontally from the surface of the equipment on four sides at the mid point of the equipment height. Blower and driver shall not exceed 85 dBA or lower noise level if specified in the individual equipment specifications.

E. For all mechanical equipment, the actual job motor or driver shall be used.

3.11 FIELD REPORTS

A. Submit reports for field performance testing. Report features:

B. Report results in a bound document in generally accepted engineering format with title page, written summary of results compared to specified requirements, and appropriate curves or plots of significant variables in English units.

C. Include appendix with a copy of raw, unmodified test data sheets indicating test value, date and time of reading, and initials of person taking the data.

D. Include appendix with sample calculations for adjustments to raw test data and for calculated results.

E. Include appendix with the make, model and last calibration date of instrumentation used for test measurements.

F. Include in body of report a drawing or sketch of the test system layout showing location and orientation of the test instruments relative to the tested equipment features.

3.12 PRELIMINARY OPERATION

Operate any portion of installation if requested. Such operation does not constitute acceptance of the work as complete.

3.13 STARTUP SERVICE

A. Prior to startup, check auxiliary connections, lubrication, venting, controls, wiring, equipment for proper rotation, and install and properly set relief and safety valves to insure readiness of systems.

B. Start and operate all systems. All mechanical equipment and systems shall be placed in service by qualified factory authorized technicians who shall provide a written statement that the equipment has been installed and placed in service as recommended by the manufacturer. If, in the opinion of the Engineer, a start-up technician is not qualified or competent to work on a particular piece of equipment, the Contractor shall replace that person with one who is qualified and competent.

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SECTION 11334

PERFORATED PLATE SCREEN AND WASHER COMPACTOR

PART 1 GENERAL

1.1 DESCRIPTION

Scope: The work of this section consists of furnishing and installing two (2) fine screens with perforated filter panels, two (2) screenings washer/compactors and associated controls. The screening mechanism will be installed into the existing headworks. The screens and washer/compactor shall be provided by the same manufacturer. All equipment supplied shall be rated for a Class I, Division 1, Group C and D hazardous environment.

1.2 EQUIPMENT TAG NUMBER

Tag Number	Equipment Name
SCR A3111	Headworks Screen No. 1
WSH/CMP A3121	Headworks Washer/Compactor No. 1
SCR A3211	Headworks Screen No. 2
CMP A3211	Headworks Washer/Compactor No. 2

1.3 RELATED WORK SPECIFIED ELSEWHERE

A. Section 01300 – Submittals

B. Section 01680 – Operating and Maintenance Manuals

C. Section 09900 – Painting and Finish Schedule

D. Section 11010 – General Mechanical Equipment Provisions

E. Division 16 – Electrical

1.4 SUBMITTALS

A. In accordance with Specification Section 01300, the Manufacturer shall furnish shop drawings, parts lists, complete descriptive literature, catalog cut sheets, engineering and physical data, etc. as necessary to fully describe and define all items to be furnished under this specification. The submittals shall include:

1. Certified general arrangement drawings showing all important details including materials of construction, dimensions, loads on supporting structures, and anchor bolt locations.
2. A list of all deviations from drawings and specifications.
3. Descriptive literature, bulletins and/or catalogs of the equipment.
4. Complete data on motors and gear reducers.
5. Wiring diagrams and electrical schematics for all control equipment to be furnished.
6. Describe the automatic adjusting cleaner brush and secondary deflector roller.
7. Describe method of checking and adjusting drive chain tension.
8. Provide details of the area at the bottom of the screen to show how the screen will pick up large objects off the channel floor.
9. Provide details of the bottom of the screen that shows the method employed to prevent buildup of grit and small stones beneath the screen and to prevent wear on the screen elements.
10. Provide independent certified test data confirming screen capture efficiency (or SCR value) with perforated panels of the same size as specified herewith. Testing shall confirm the percentage of all material captured by the screen as documented by an independent third party laboratory (the National screen evaluation facility at Chester Lee Street in England by TRPM and Northumbrian Water). The documented report of the test which shows the result of screenings capture rate (SCR) must be provided with submittals.
11. Submit hydraulic calculations verifying each screen can handle 24.7 MGD with 34-inches of downstream water elevation and 30% blinding that results in less than 12-inches head loss, stamped and signed by a California registered professional engineer.
12. Submit seismic calculations, stamped and signed by a California registered professional engineer, in accordance with Specification Section 01610 and 01615.
13. Manufacturer's installation instructions, parts list, and operating and maintenance instructions. Provide operation and maintenance manuals in accordance with Specification Section 01680.
14. Provide startup services and training in accordance with Specification Section 01670 and 01675.

15. Electrical Information:

    a. Electrical Drawings including, but not limited to:

        1) Three line or one drawings detailing all devices associated with the power distribution system.

        2) Elementary diagrams for all relay logic, power supplies, PLC I/O and other wiring. Include ladder rung numbers and coil and contact cross referencing numbers.

        3) PLC analog and digital I/O wiring diagrams showing the wiring requirements for each instrument loop.

        4) Enclosure and elevation layout diagrams showing deadfront, front panel and backpan devices drawn to scale. Show fabrication methods and details; including material of construction, paint color, support and latching mechanisms, fans and ventilation system, and conduit entrance areas.

        5) Nameplate drawing showing dimension of nameplate lettering & format of text, color of nameplate & lettering, materials, and location.

    b. Complete catalog cuts with full description of equipment. The part or model number with options to be provided shall be clearly identified. Where more than one item or catalog number appears on a catalog cut, the specific item(s) or catalog numbers(s) proposed shall be clearly identified

    c. Bill of Material list.

    d. Programmable Logic Controller (PLC) and Operator Interface (OI). In addition to above requirements submit:

        1) PLC ladder logic program and narrative of functional description.

        2) OI graphic screen color print outs for proposed graphic screens.

        3) Electronic files of proposed PLC and OI program

1.5 QUALITY ASSURANCE

A. All equipment furnished under this Section shall:

1. Be of a manufacturer who has been regularly engaged in the design and manufacture of the equipment;

2. Be of latest design; and,

3. Be demonstrated to the satisfaction of the owner that the quality is equal to the equipment specified herein.

4. Have a minimum of five (5) installations, of perforated plate fine screens meeting these specifications, in the United States.

5. Equipment manufacturer shall be ISO 9001 certified

6. The perforated plate screens and washer/compactors will be shipped to the site fully assembled, if possible, and dependent upon the height of the screens and washer/compactors. Some ancillary components may be removed in order to prevent damage during shipment.

7. All stainless-steel parts/equipment, after its fabrication, shall undergo a passivation (pickling) process to ensure maximum resistance to corrosion and to remove all embedded iron and heat tint.

    a. All stainless-steel components shall be submersed in a chemical bath of nitric acid and hydrofluoric acid to remove any residues that may be present on the material as a result of forming, manufacture, or handling.

    b. After removal from the pickling bath, the equipment must be washed with a high-pressure wash of cold water to remove any remaining surface debris and promote the formation of an oxidized passive layer which is critical to the long life of the stainless steel.

    c. Submergence insures complete coverage. Spray on chemical treatments and glass bead blasting are specifically not acceptable due to their inability to provide complete and uniform corrosion protection.

    d. Surfaces shall be subjected to a 24-hour water test or ferroxyl test to detect the presence of residual embedded iron and shall be re-treated, as needed, to remove all traces of iron contamination.

    e. All field welds shall be cleaned and passivated to remove iron (and prevent corrosion) in accordance with ASTM A380.

    f. Surfaces shall be adequately protected during shipping and handling to prevent contact with iron or steel objects or surfaces.

8. Definitions

    a. Screen Height: The height between the operating floor and the top of the perforated plate screens.

    b. Discharge Height: The height between the operating floor and the screenings discharge.

    c. Head Loss: Total difference in elevation of the water level upstream of the upstream screening elements and downstream of the downstream return elements.

    d. Percent Blinded: Percentage of submerged area of partially blinded perforations relative to total area of non-blinded perforations.

e. Maximum Differential Head: Maximum difference in elevation of the water level upstream and downstream of the upstream screening elements that the screen will experience during emergency conditions (i.e. screen fully plugged).

f. Screenings Capture Rate (SCR) or Capture Efficiency: Percentage of all material captured by the screen as documented by the National screen evaluation facility at Chester Lee Street in England by TRPM and Northumbrian Water. The documented report of the test which shows the result of screenings capture rate (SCR) must be provided with submittals.

g. Screen Angle: Angle of screen frame incline from horizontal plane parallel with mounting floor.

B. Factory Assembly and Testing: The perforated plate screen and the washer/compactor shall be factory assembled and factory tested at the point of manufacture. A second test shall be conducted on-site after the screen and washer/compactor installation, to ensure that the screenings/washing system is installed properly and performs according to the specification. The test shall be conducted by a service representative, which is employed by the equipment manufacturer, and shall include a complete mechanical check during a 4 hour minimum test run. The U.S. testing shall be videotaped and a copy of the videotape shall be provided to the Engineer. The combined unit shall be shipped assembled for erection by the Contractor excluding the discharge piping.

1.6 DESIGN CRITERIA

A. Perforated Plate Screen:

1. Each perforated plate screen will consist of perforated filter panels, drive chain, sprockets and bearings, primary rotating self-adjusting cleaner brush, secondary deflector roller, spray wash water system, drive motors, gear reducers, anchor bolts, controls and all accessories and appurtenances specified or otherwise required for a complete and properly operating installation.

2. Solids will collect on a continuous belt of perforated panels perpendicular to the flow, elevating solids to the discharge point. The perforated filter panels shall be cleaned by means of an automatic adjusting rotating cleaner brush. Screens that do not have an automatic adjusting rotating cleaner brush shall not be allowed.

3. The perforated filter panels shall be driven by drive sprockets secured to the main drive shaft.

4. The screen shall be suitable for installation and operation in a channel with the following measurements:

   a. All channel dimensions: 42-inches wide and 108-inches deep

   b. The angle of inclination shall be 30° (lower section) and 75° (upper section) from horizontal.

5. The screen shall be capable of passing a maximum of 24.7 MGD of wastewater with a downstream water level of 34 inches. The total maximum headloss across the screen will be approximately 12 inches, based on a 30% screen blinding factor and steady state flow.

6. The screen shall be capable of operation under the following configurations and/or conditions:

Parameter	Quantity
Service:	Pumped Raw Wastewater
Channel width (inches)	42
Channel depth (inches)	108
Discharge Height (feet)	4.5 (from top of channel)
Perforated Screen opening (mm)	6
Minimum Screen Capture Ratio	85%
Spray water flow (gpm)	20
Spray water pressure (psi)	45
Peak Design Condition	
Peak hydraulic flow per screen (MGD)	24.7
Maximum design headloss (inch)[1]	12

Notes 1 Headloss based on 30% screen blinding factor and 34-inch water level downstream

B. Washer/Compactor

1. Each washer/compactor shall consist of a flange mounted gearmotor, spiral with separate thrust bearing, wash water spray system, stainless steel trough, wash zone, press zone, discharge piping, electrical controls, and all other appurtenances required or shown on the drawings.

2. Each screen shall have a coupled washer/compactor.

3. All designs shall ensure that maintenance to the mechanisms such as motors, drives and bearings are accomplished at the operating floor level without need to remove the units from their anchorage.

4. Operation: Washer/compactor is designed to be continuously run without requiring an operator.

5. The washer/compactor unit shall be furnished in type 304 stainless steel for wetted parts and all structural pieces.

6. The washer/compactor shall be capable of operation under the following configurations and/or conditions:

Parameter	Quantity
Max Capacity	177 cfh
Screenings Volume Reduction	60-85%
Weight Reduction	60-85%
Inlet Length	31.5 inches
Solid Matter of Debris	>40%
Fecal Reduction	90% (<20 mg/g BOD_5)
Wash Water	16 gpm @ 20-40 psi
Motor HP	5

1.7 ENVIRONMENTAL CONDITIONS

A. The equipment will be continuously and intermittently exposed to the following environmental conditions

1. Ambient air temperature may range from 15°F to 115°F. Relative humidity may fluctuate between 10 and 100 percent. All equipment supplied shall be rated for a Class I, Division 2, Group C and D hazardous environment.

2. The screened media will be domestic raw sewage, wastewater treatment plant mixed liquor and plant drain flows.

3. Exposures: The equipment will be subject to rainfall, wind (including dust and dirt), direct sunlight and a corrosive environment due to wastewater, splashing, hydrogen sulfide and hydrocarbon gases.

1.8 WARRANTY

A supplier's written warranty shall be provided for the equipment specified in this section. The warranty shall be for a minimum period of five (5) years from start-up or 66-months from time of equipment shipment, whichever comes first.

PART 2 MATERIALS

2.1 ACCEPTABLE PRODUCTS

The screening equipment shall be: SAVECO North America, Inc. FSM Perforated Filter Screen Model FRSIII 800 x 3075/6HF. The screenings washer/compactor equipment shall be: SAVECO Screw Wash Press Model SPW. All equipment shall be supplied by the screening manufacturer to ensure coordination between screen and washer/compactor. The screen and washer/compactor controls shall be fully integrated by the screen manufacturer and operate as a single unit.

2.2 MATERIALS – PERFORATED PLATE SCREENS

A. All moving wetted parts, all wetted parts on which moving parts ride, all filter belt components under guiding, bearing, or driving loads shall be 304 stainless steel, wear resistant heat treated, high tensile, wear resistant steel, or UHMW-PE as noted below:

1. The frame shall be minimum 4mm thick type 304 stainless steel.
2. The discharge chute, and all covers shall be type 304 stainless steel.
3. The primary screen and brush drive shafts shall be type 304 stainless steel.
4. The secondary rotating deflector shall be from type 304 stainless steel.
5. The lower sprocket stub shafts shall be from type 304 stainless steel.
6. The upper and lower sprockets shall be type 304 stainless steel with only the wear area hardened.
7. The middle guide transitioning the filter panels from 30 degrees to 75 degrees is a non-revolving guide from UHMW-PE.
8. The screening elements shall be one piece curved from type 304 stainless steel and will not require upstream protection using coarse bar screens. Screens that require upstream protection shall not be permitted.
9. The heavy duty roller chain will be from type 304 stainless steel with PA6 rollers.
10. The side and bottom seals shall be replaceable contoured UHMW-PE with 304 stainless steel fasteners.
11. The bottom seal between the lower end of the screen frame and the width of the filter panels shall be from Buna-N rubber and shall include a triple layer polyester brush with a 304L stainless steel adjustable holder.
12. The screening element support rails shall be 304 stainless steel with UHMW-PE wear surface or equivalent.
13. Spray bars from shall be 304 stainless steel.
14. All fasteners shall be 304 stainless steel.
15. All other appurtenances shall be of manufacturer’s standard coated material.

2.3 EQUIPMENT DESIGN FEATURES – PERFORATED PLATE SCREENS

A. General

1. The screen shall be designed to provide maximum solids filtration and thus maximize capture of debris and minimize rate of head loss increase through the screen. This shall be achieved by means of one piece perforated curved filter elements. The maximum openings shall be 6 mm. The screen will be operated intermittently by means of differential head measurement.
2. The screen shall be mounted by fastening to the top of the channel. The screen mounting system shall be constructed of 304 stainless steel and complete as required to function in accordance with the specification. Routine service, repair or replacement of damaged parts, shall be possible with the screen in the channel.
3. Unit shall be designed so that maintenance of the drive mechanism can be accomplished at operating floor level. Screen elements shall be capable of removal at the operating level without taking the screens out of the channel or effecting the continuous or intermittent rotation of the screen.
4. The screen shall be factory assembled and tested for a minimum of four hours prior to delivery and shall be delivered to the site fully assembled (other than the motor/reducer unit, discharge chute, and support legs). It shall be capable of being set in place and field erected by the contractor with minimal field assembly.
5. The influent screening system shall include a perforated plate screen and a washer/compactor system. The perforated plate screens shall be a self-contained screening system used to capture and transport wastewater debris to the washer/compactor system.
6. Influent screening system shall be designed for continuous and intermittent operation. The perforated plate screens shall be installed in the channel as shown on the Contract Drawings.
7. All components shall be amply proportioned for all stresses that may occur during manufacturing, transportation, erection, and operation.

B. Filter Screen

1. The one-piece curved screening elements shall be nominal 1/8" thick and fixed by four fasteners to the heavy-duty roller chain drive links having 7.87" pitch x 1.38" x 0.2" thick section which shall ride on 0.2-inch thick 304 stainless steel supports located on the upstream and downstream sides of the screen.
    a. Chain shall have an average ultimate design strength of 20,232 lbf (90kN).
    b. On every tenth screen panel a set of static, non-engaging 'finger' type lifters shall be attached to the lower edge of the panel, designed specifically to lift spherical and large size solids (stones, square lumber cans, bottles, rag clumps, etc.) from the bottom of the channel.

c. Screens that use lifting ledge on top of the panel thereby preventing the removal of solids from the bottom of the channel floor will not be permitted. Screens which do not support the drive chains on the downstream side will not be approved.

2. A submerged curved stainless steel plate shall be provided at the base of the screen. The base of the screen shall be fitted with a rubber seal 10mm thick directly followed by a polyester brush along the full length of the filter panel to prevent ingress of stones and grit and to prevent solids bypass.

3. Two (2) upper sprockets from ¾-inch thick type 304 stainless steel with 7.87 inch pitch. Upper sprockets shall be split to allow removal without having to remove the drive shaft.

4. Two (2) revolving ¾-inch thick lower guides with 7.87 inch pitch. Lower revolving guide bearings shall be slide bushing from bronze with a 316 stainless steel 3.15 inch stub shaft. Complete unit sealed with stainless steel cover, o-rings and v-rings seals. Grease line from stainless steel brought to operating level. Ball or roller bearings or slide bushings made of plastic or ceramic shall not be accepted as a lower sprocket bearing.

5. The middle guide shall be stationary between the 30 and 75-degree transition section. The use of rotating sprockets/guides in this area shall not be allowed.

6. To prevent deflection, the one-piece filter elements shall have a minimum thickness of 1/8" and shall be made of curved stainless steel. This is required to insure structural integrity and smooth operation. Engaging tines, fingers or engaging elements, which can bind or jam, will not be acceptable. Filter panels that are not curved shall not be acceptable. Filter panels with a flat face inclined and a horizontal ledge shall not be allowed.

7. The screening elements are to be of the engineered curved shaped so that they can be cleaned with optimum efficiency with an automatic adjusting rotating cleaner brush. Minimum diameter of rotating cleaner brush is 450 mm. The rotation direction of the brush drive must be in the opposite direction of the belt drive.

8. The rotating cleaner brush shall be nylon and have a minimum diameter of 450 mm and be self-adjusting with no manual or motorized adjuster mechanism. The motorized cleaner brush will automatically adjust as the brush wears during use. The automatic adjustment will maintain consistent cleaning efficiency at a SCR value of 85%. The distance between the cleaner brush and filter panels will be automatically controlled to ensure the distribution and magnitude of pressure is equal across the entire filter panel surface. Systems that use gas springs or struts to adjust brush shall not be permitted. Screens with rotating cleaner brushes requiring manual adjustment or adjustment with gas cylinders or a motor shall not be permitted.

9. The lifting fingers are located on each tenth filter plate. The lifting fingers must be located on the lower area of the filter element. Systems where these fingers are near the middle or top of the element are not permitted. They will be designed to remove spherical solids from the bottom of the channel, which may otherwise roll back off

the screen face and accumulate thus creating a wear problem as the screen elements are moving thru the solids as they ascend on the upstream side of the screen.

10. The screening elements must be sealed against the chain by means of special knuckle joint side plates attached to each perforated plate filter element. Maximum gaps between the screen panels and side frame is 1 mm. These side plates must be made in Stainless steel. Simple brush systems are not permitted. This is to ensure that small items are not floated past the sides of the screening elements.

11. A rotating deflector consisting of a 304 stainless steel tube roller wiper fabricated from 3.5 inches O.D. complete with 1.75 inches diameter stainless drive steel shafts at each end supported by two-hole flange bearings and auxiliary driven by screen drive unit. The roller wiper shall turn at max 20 rpm and function to seal the gap between the filter panels and discharge chute and to direct the heavier solids removed from the screen by the revolving brush cleaner into the screenings wash press inlet hopper. The rotating deflector prevents bypassing of solids into the downstream channel. Screens supplied with a brush scraper and/or a static deflector that is not self-cleaning shall not be permitted.

C. Filter Screen Panels

1. The screen filtration belt shall be provided with one piece perforated curved elements, which limits the maximum opening in any direction to the perforated opening size detailed in Paragraph 1.6.A.6. This restricted opening profile prevents long thin materials from passing through the openings. Filter panels that are not curved shall not be acceptable. Filter panels with a flat face inclined and a horizontal ledge shall not be allowed.

2. No cleaning devices which cause trash to be pushed or dropped into the interior of the filtration belt will not be allowed.

3. The individual screening elements must not exert stresses on one another and the load transmission must be exclusively via chains. Systems which involve connecting the screen elements together with other or additional attachments are therefore not permissible because of stressing. Furthermore, the elements must not be able to overlap one another, which would create spaces in which material could collect.

4. Due to the risk of high differential levels on the screen, in the event of a power failure, excess solids load condition, mechanical breakdown etc. the screen shall be designed to withstand a maximum differential head of 3.3 ft. measured from the upstream water level to the downstream water level.

5. The manufacturer shall provide calculations showing that it will meet this requirement. A test will be conducted at site, before the screen or screens are accepted, during which time the screen will be tested for a minimum period of two hours at the specified maximum differential head condition.

    a. Should the screen fail this test, for example there is bending, bowing, buckling or other significant signs of mechanical damage then the screen shall be removed at the manufacturers cost.

6. The horizontal space between each adjoining screen panels will not exceed 1 mm +/- 10% at any point between any adjacent panels. The screen manufacturer shall make a witnessed measurement of the screen panel adjoining spaces before acceptance at site and if more than 10% are greater than the dimension of the specified screen perforation the screen will not be accepted until the manufacturer has corrected the problem and a re-measurement as above confirms the specification has been met.

7. To control the buildup of biological slimes behind the screen panels, a 1-inch diameter internal spray water wash spray bar will be provided, manufactured from stainless steel with PVDF spray nozzles. The spray bar will be attached in the internal space between the rotating screen panels and the spray water will be directed to wash each screen panel as the panel moves past the spray nozzles. The spray bar will supply approximately 9 gpm per ft. width of screen panel at a pressure of 40 - 45 psi. The spray orifices will be non-plugging and suitable for use with treated effluent water. A minimum 1" NPT connection will be located on one side of the screen frame above the operating floor level and the water supply connection will include an inline strainer, manual operated ball valve, and solenoid valve suitable for attaching to the 1" NPT connection. Systems that require spray bars to assist with removing screenings from the filter panels shall not be allowed. The nozzle system for cleaning the belt must be located after the cleaning by the brush. Systems with a spray bar prior to the brush are not permitted.

D. Chain and Sprockets

1. The filter panel drive chains shall be equal in pitch to the upper and lower drive sprockets.

2. The chain for the perforated filter panels shall be roller type chain and be from material as per Paragraph 2.2.A.9. Chain shall have a maximum design operating force of 20,232 lbf. Chain shall not require lubrication.

3. Each screen shall be provided with two identical drive sprockets from material as per Paragraph 2.2.A.6. Sprocket pitch and width shall match the roller chain – 7.87-inches. The sprockets shall be mounted on a drive shaft from material as per Paragraph 2.2.A.3 mounted between grease-able bearings mounted on the external side of the frame.

4. Each screen shall be provided with a middle transition guide from material as per Paragraph 2.2.A.7. This guide shall be located on the tension side between the 30 and 75-degree transition section.

5. Chain drive shaft bearings shall be four-hole flange mounted to a stainless steel plate. The bearings shall be grease lubricated. Chain tension adjustment is achieved via the take up screws attached to the flanged mounting plate. The take screw shall be an acme thread type from type 18-8 stainless steel. The bearing casing shall be made of paint coated cast iron. Units using threaded rod shall not be allowed.

6. Chain guides shall be secured to the screen frame for the full height of travel. A guide track shall also be located at the bottom of screen to allow the chain to travel

from a downward to an upward direction. The chain guides shall accurately guide the chain and filter panels. The chain guide tracks shall be stainless steel.

E. Screen Drive Mechanism

1. Motor: 1.5 HP, 1760 rpm TEFC geardrive inverter duty motor suitable for 460/3/60 electrical supply. Overload protection shall be provided by a true power monitor electrical overload device that senses the motor power factor.
2. Gear Reducer:
    a. Helical Worm type from SEW.
    b. Hollow, shaft type.
    c. Anti-friction bearings.
    d. AGMA I rating.
3. All drive components shall be designed to operate the screen continuously under a calculated load resulting from the differential water level between the upstream and downstream sides of the screen.
4. Minimum filter panel speed shall be 13 fpm.

F. Brush Drive Mechanism

1. Motor: 2.0 HP, 1760 rpm TEFC geared motor suitable for 460/3/60 electrical supply.
2. Gear Reducer:
    a. Helical Worm type from SEW.
    b. Hollow, shaft type.
    c. Anti-friction bearings.
    d. AGMA I rating.

G. Rotating Deflector Drive Mechanism:

1. Auxiliary driven from Screen drive. Screens that require a third motor for the rotary deflector shall not be allowed.

H. Discharge Chute/Hood:

1. A discharge chute/hood shall be provided that fully encloses the discharge section of the screen. The upper section of the discharge chute/hood shall be hinged to allow complete access the screen cleaner brush. The hinged hood shall be secured with quick closing clamps and supplied with two (2) gas cylinders to aid opening and closing
2. Discharge chute shall be from type 304 stainless steel

3. Each screen discharge chute/hood shall direct screenings directly to the washer/compactor. Outlet shall extend down to the inlet of the washer/compactor and shall be designed to match the screenings washer/compactor inlet hopper with no water leaking or screenings dropping to the floor.

I. Frame Enclosures / Covers

1. The screen shall be provided with easily removable, sufficiently stiffened covers made of 18-gauge 304 stainless steel plates with edges on all sides.

2. Covers shall be provided on the upstream and downstream portion of the screen above the operating floor.

3. Covers shall be secured in place using quarter turn tool operated stainless steel cam latches.

2.4 EQUIPMENT DESIGN FEATURES – WASHER/COMPACTORS

A. General

1. The shafted screw type screenings wash press shall be a complete assembly consisting of an inlet hopper between the filter screen and wash press. The shafted screw wash press shall be designed to receive and wash screenings, then reduce the volume and water content by means of a pressing zone. The unit's washing and compacting performance will be as documented in Paragraph 1.6.B.6. After the compacting and dewatering process, the screenings shall be conveyed through the discharge transportation tube to the existing transport screw conveyor.

2. Screenings washers that use impellers and/or grinders to tear and shred fibrous screenings at the inlet to the compactor and therefore increase the amount of inert material returned to the plant shall not be allowed.

3. The screw wash press shall be designed and built to withstand maximum possible forces exerted. All structural and functional parts shall be sized to prevent deflections or vibrations that may impair the screw wash press operations. All components of the screw wash press shall be made of type 304 stainless steel except the shaft screw which shall be from high strength steel with Hardox™ 400 flights throughout. Bearings, electrical devices, sprockets, motor, and gear reducer shall be of the manufacturer's standard materials.

4. Shop Surface Preparation/Coating: All weldments shall be cleaned and passivated using a full dip passivation process to remove weld spatter, slag, and discoloration. Bearings, electrical devices, drive and wiper chains and sprockets, motor and gear reducer shall be provided with the manufacturer's standard coating system. Screen weldments not full dipped passivated, using spray on cleaning solutions, passivating welds only or bead blasting shall not be allowed.

5. The screw wash press shall discharge dewatered screenings capable of passing the EPA Paint Filter Test as described in method 9095 of the EPA publication SW-486.

B. Screw Housing

1. The screw housing shall be constructed from 8mm (0.31 inches) thick type 304 stainless steel. The screw housing shall have support beams with U-profile, thickness of 5mm on each side. The screw housing shall be designed to support all required loads.

2. The interior of the screw housing shall incorporate with minimum of six (6) anti-rotation wear bars each fabricated from Hardox® 400 special high strength alloy steel with minimum Brinnel Hardness of 400.

3. The bottom of the housing shall be provided with perforated drainage sections. Perforations shall be countersunk with maximum 6 mm in diameter. Units supplied with slotted or wedgewire drainage or compaction sections shall not be allowed. Perforations not countersunk shall not be allowed.

4. An inlet area length as specified in Paragraph 1.6.B, will receive incoming materials. A hopper constructed from type 304 stainless steel shall be provided by the manufacturer to direct solids to the inlet area of the screenings washer.

C. Shafted Screw

1. The screw will be constructed of high strength low alloy carbon steel and Hardox® 400 flights (minimum 400 Brinell), prime coated for protection during shipment. Screw OD shall be 300 mm (11.8 inches) with 12 mm (0.47 inches) thick flights welded to a minimum 100 mm (4 inches) diameter shaft. The final flight of the screw shall be supplied dual thickness 24 mm (0.94 inches) for increased wear life. Screws that do not have the final flight from dual thickness (24 mm) and all flights from Hardox® 400 will not be allowed.

2. A replaceable nylon brush reinforced with a stainless steel backer shall be attached to the screw flights in the drainage area with stainless steel clips and hardware. To reduce wear on the brush the design shall be such that the screw shall not be allowed to rest in the press housing. The screw shall be fully supported and cantilevered off the thrust bearing.

D. Thrust Bearing

1. An independent thrust bearing housing shall be flanged mounted to the drive and flanged mounted to the press body. The independent thrust bearing assembly shall be protected from the environment and located in a separately sealed area located inside the press body. The flange portion of the thrust bearing shall have a grease fitting centrally located for ease of maintenance.

2. The thrust bearing shall fully support the screw and handle the load created during compaction and reversal of the screw. The thrust bearing shall utilize an SKF roller bearing complete with double lip grease seals and O-rings. The mounting flange shall have an O-ring seal mounted in a machined groove to seal the housing against the press body. Designs that utilize the thrust bearing inside the gear reducer housing will not be acceptable.

E. Drain Pan

1. A drain pan shall be mounted to the bottom of the screw housing along the full length of the housing. The pan shall be sloped to the drain, and it shall be provided with a flushing water connection. Drain connection shall be minimum 6-inch plain ended pipe. Flush connection shall be minimum 1-inch NPT connection.

2. The pan shall be secured in place with hardware and allow for easy removal. Drain pan shall be constructed of minimum 14-gauge 304 stainless steel.

F. Wash Water Manifold

1. The screenings washer shall be provided with a minimum of two (2) separate connections for injecting wash water into the screenings.

2. Wash water spray nozzles shall be capable of utilizing the screened plant effluent without clogging or fouling.

3. The wash zone shall include a spray wash system to wash organic residue from the screenings. The wash zone spray will consist of one (1) spray header with two (2) wash water injection points at 3 o'clock and 9 o'clock, two (2) brass spray nozzles, two (2) PRV's, one (1) ball valve and one (1) solenoid valve. The system will have an output of 16 gpm at 20-40 psi. The spray connection will be 1 inch NPT.

G. Inlet Hopper

1. The inlet hopper shall be designed to accept discharge screenings from the perforated plate filter screen discharge chute. The hopper shall directly interface with the filter screen discharge with no solids or water bypass.

2. The inlet hopper shall be fabricated from minimum 12-gauge type 304 stainless steel.

H. Discharge Pipe

1. The discharge pipe shall be flanged and mounted to the press body by a minimum 17-inch diameter flange.

2. The discharge pipe shall be designed to transport the washed, dewatered, and compacted screenings to the discharge point without plugging.

3. The diameter of the discharge pipe shall increase in size to ease the transportation of the screenings.

4. For increased washing and compaction performance the discharge pipe will include a manually controlled back pressure device. The back pressure is manually generated by a stainless steel plate positioned by operating personnel. Access to the back pressure device is through a stainless steel access box fitted with a bolt in place hatch with handle. The access box is integral to the discharge pipe. Material of construction 304 stainless steel.

5. The discharge pipe elbow shall be fabricated from minimum 11-gauge type 304 stainless steel.

6. The discharge piping following the elbow shall be fabricated from minimum 12-gauge type 304 stainless steel.

7. Discharge chute shall connect to the existing transport screw conveyor. Coordinate discharge point with existing conveyor inlet points.

    a. Provide extensions as needed to accommodate discharge at 4'-2" above floor and 6'-6" from center of channel.

    b. Provide flexible rubber connection and SST band for connection between compactor discharge and existing transport screw conveyor inlet connection point.

    c. Contractor to field verify connection point dimensions prior to equipment submittal.

I. Drive Assembly

1. The gear reducer shall be a flanged mounted directly to the thrust bearing housing and the compactor frame. Gear reducer shall be a helical gear type with hollow input shaft. The unit will be provided with a cast iron frame and be designed in accordance with AGMA recommendations for Class I service based on the horsepower required to operate the wash press. Units that do not bolt the gear reducer directly to the unit's frame will not be allowed.

2. The motor shall be TEFC, 5.0 HP, 460 Volt, 3 phase, 60 Hz. The motor shall be NEMA design code B and be direct coupled to the reducer.

3. Chain drives, belt drives, and hydraulic drives will not be accepted.

2.5 PERFORATED PLATE SCREEN AND WASHER/COMPACTOR SURFACE FINISH

A. Surface Treatment of Stainless Steel Components: All stainless steel subassemblies will be pickled in an acid bath or Starblast.

1. Shop Surface Preparation/Coating: All stainless steel subassemblies will be acid passivated after welding for corrosion resistance and to provide a superior surface finish. This will be done by full dipping of weldments. After passivation, the weldments will be thoroughly rinsed with clean water and allowed to air dry.

2. Sandblasting, acid paste passivation of welds and heat affected areas only, spray-on acid solutions in lieu of dipping, glass bead blasting or grit blasting of stainless steel surfaces will not be allowed in lieu of fully submerged acid passivation.

3. See part 1.5, above, for additional information.

B. The screw and drive shaft will be finished with an enamel coating.

C. Motors and gear reducer will be manufacturer's standard finish and shall be painted the same color. The drive shaft, sprockets and gear reducers will be epoxy painted.

2.6 ELECTRICAL DEVICES– PERFORATED PLATE SCREENS and WASHER/COMPACTORS

A. Electrical Devices For Screens: All interconnecting conduit and wiring will be the responsibility of the installing contractor. In addition to the drive motors, the following electrical devices will be supplied with each perforated plate screen unit:

1. Ultrasonic Level Controller: A 120V differential level controller shall be provided in a windowed NEMA 4X polycarbonate enclosure suitable for floor mounting, to receive and interpret a 4-20mA scaled signal from an upstream and downstream transducer. The controller shall have 5 internal relays and provide an LCD display.

2. Ultrasonic Level Transducer: Two (2) ultrasonic level transducers shall be provided with type 304 stainless steel mounting brackets and expansion anchors. Each sensor shall have an PBT housing, have a range of 1-33 ft, and be supplied with a 33 ft integral cable. Sensor shall be suitable for installation in a Class 1, Division 1, Group D area.

3. Emergency Stop Local Push Button Station: A NEMA 7 emergency stop push button station will be mounted on a support stand and will have a ½-inch NPT conduit connections (electrical connection by others).

4. Motor Cut-out Switch: One (1) safety microswitch will be provided, suitable for the area classification and mounted to the hinged hood.

5. Solenoid Valve: One (1) solenoid valve shall be provided to control flow to the spray wash assembly. The brass body valve shall be 120 Volt, single phase, 60 Hz with a NEMA 4X housing.

B. Electrical Devises for Washer/Compactors: In addition to the drive motors, the following electrical devices will be supplied with each unit:

1. Intrinsically Safe Torque Switch. The washer and compactor will be equipped with a limit switches to detect over-torque conditions by sensing relative movement of the motors. The switches will have a 3.2-foot long integral cable. An intrinsically safe barrier relay will be mounted in the main control panel.

2. Alternatively, overload protection may be supplied electronically in the control panel by measuring current draw.

3. Explosion-Proof Emergency Stop Local Push Button Station. A NEMA 4X emergency stop push button, suitable for outdoor use, station will be mounted to the support stand and will have a ¾-inch NPT conduit connection to control both the washer and compactor.

4. Explosion-Proof Solenoid Valves. 120 volt, single phase, 60 HZ solenoid valves for the wash zone and flush spray washes housed in NEMA 4X enclosures will have 18-inch-long integral leads and will have 1/2 inch NPT conduit connections.

C. Control Panel

1. Each Screen and Washer/Compactor train shall have a single control panel (this project will have two control panels total to operate the two screening system trains). The panel shall be 480-volt primary U.L. listed and labeled control panel in a NEMA 4X, 316 stainless steel enclosure. Panel shall be supplied with control switches, indicating lights, relay logic, and dry contact SCADA interfaces as indicated for each panel on the Process and Instrumentation Diagrams (P&ID) contract drawings and as specified under Division 16 and 17 of the specifications. In addition, panel shall be suitable for floor mounting with the following electrical components to provide proper operation of the equipment.

    a. Main disconnect with through door interlock handle.

    b. Step down control transformer.

    c. Branch circuit protection.

    d. Screen drive motor VFD.

    e. Brush motor starter (IEC) with overloads.

    f. Compactor motor starter (IEC) with overloads.

    g. Emergency stop pushbuttons (for screen and washer/compactor).

    h. Hand-Off-Auto selector switches for screen and brush drive.

    i. Hand-Off-Auto selector switches for the screw drive, wash and flush water sprays.

    j. Open–Close–Auto switch for screen wash water solenoid valve.

    k. Power monitor shall provide overload protection for screen drive by sensing motor power factor.

    l. Hour meter for each motor.

    m. Control power on, run and fault indicating lights.

    n. Alarm reset pushbuttons.

    o. Programmable logic controller to control the equipment.

    p. Indicating lights shall be push-to-test.

    q. UL label.

    r. Communicate with SCADA (for alarms, status, and control)

2. The manufacturer shall provide a programmable logic controller (PLC) with local operator interface (OI) to monitor and control the Screen and Washer/Compactor System. The PLC shall be Allen-Bradley (AB) Compact Logix 5380 family (5069-L306ER processor or larger) with Ethernet port. The OI shall be Allen Bradley (AB) Panelview 7 with color LCD touch screen and Ethernet. The PLC

shall be provided with a 4-port hub to allow direct interface and communication with the OI and plant's SCADA system, which will operate on an "Ethernet Data Network"

a. The PLC shall be fully programmable to reflect the specifics of the Screening system (screen and washer/compactor). Setup shall provide a user-friendly graphic interface to display information

b. The Screenings System Supplier shall provide the PLC ladder logic programs and OI graphic configuration on electronic files to the City, along with all relevant PLC addresses to enable the future SCADA system to monitor the Screening system remotely.

c. The PLC shall be sized with all I/0 points necessary for a complete operating system, with an additional 20 percent I/O points of each type of I/O as spares.

d. All PLC software, including graphics, configuration and applications ladder logic programming software shall be licensed directly to and become the sole property of the City for their use on this and future City projects. Software listed as proprietary will be rejected.

e. Operator Interface shall have screens developed to allow full manual or automatic monitoring and control of the equipment supplied, including:

   1) All Alarm conditions.

   2) Timers, and setpoints.

   3) Status of all equipment

   4) Differential level.

   5) Trends for all analog inputs..

f. No passwords shall be enabled on PLC or OI software or hardware developed for this project. All electronic copies provided to Owner shall not have any password protection enabled on them or the software.

g. PLC with OI shall be mounted inside the control panel.

3. The manufacturer shall coordinate the function of the control panel with all related equipment, including screens and washer/compactors, all of which shall be controlled from the screen control panel.

4. The Contractor shall provide all wiring, conduit, disconnects, and accessory items between the control panel and the screen.

5. Manufacturer shall work with SCADA team to configure vendor provided PLC code for data transfer between vendor provided PLC and Plant SCADA system, as required for fully function system and as shown on the P&ID Contract Drawings.

6. Control panel shall have an adjustable thermostat switch to run the equipment continuously at ambient temperatures below 30^{o}F.

D. Operation, Monitoring, and Control for Each Screen

1. Screen and Brush Hand Operation: In Hand position the operator shall be able to run the screen or brush assembly by selecting the respective Hand-Off-Auto selector switch. Turning the screen selector switch to Off will stop the unit. Screen drive motor is interlocked with the brush motor. Brush motor must be on if the screen is in operation.

2. Screen Automatic Operation: When the Screen and Brush are in Auto position the screen shall be controlled by the water level sensors. Screen operation shall be started when the water level sensors monitor a certain water level difference, when the sensor senses high upstream water level, high differential, or when a certain time has passed since the last operation of the screen. When the upstream water level reaches its high-level setting or when the high differential setpoint is reached, the Screen will run in high speed. When both the high level and high differential drop below their setpoints, the screen will decrease to low speed after the high speed off delay timer has expired. Screen operation shall be stopped with an adjustable delay time after the water difference is below a certain value and after the sensor reads the correct water level, or after a certain run time has expired (if operation was started by timer).

    a. When Unit is in AUTO, and Screen, Drive and Washer/Compactor are not running, allow Plant SCADA System to initiate start operation of Unit without Unit requiring a high differential level start setpoint to be reached. Unit will then stop/start as programmed.

3. Controls shall operate the washer and compactor on a timed, liquid level control signal or continuous basis.

4. Wash Water Solenoid Valve Operation: In Hand position the wash water solenoid valve will open. In the Close position the wash water solenoid valve will close.

5. Wash Water Automatic Operation. The wash water solenoid valve will open and close via a repeat cycle timer whenever the screen is in operation.

6. Fault Conditions:

    a. Excessive motor power will trip the starter overload relays, immediately stop the drive or brush motor, and illuminate the alarm indicating light. This fault must be reset by depressing the associated motor starter overload reset internal to the control panel.

    b. Momentary drive high torque will trip the screen motor load monitor, immediately stopping the screen drive motor, and illuminate the alarm indicating light. Pushing the reset pushbutton will reset this fault.

E. Operation, Monitoring, and Control for Each Washer/Compactor

1. Hand Operation: When Hand mode is selected, the spiral will run continuously. When spray wash Hand mode is selected, the spray wash will run continuously.

2. Intermittent Automatic Operation: The control panel will be equipped to control the wash cycle and screw movement. The wash cycle and the screw movement will be controlled independently using timers and counters. The drive motor and spray wash will be controlled automatically when the selector switches are placed in the Auto position.

    a. The press motor starts after an adjustable accumulated run time from the interlocked feeding equipment.

    b. The wash water solenoid is open whenever the screw is in operation.

    c. The washing solenoid closes, and the press motor runs for an adjustable length of time, typically set at 30 seconds, to dewater and discharge the screenings.

3. Emergency Stop: The unit can be deactivated at any time by pressing either the control panel mounted or unit mounted Emergency Stop push buttons.

4. Fault Conditions: Motor overload, high motor torque, or high motor current conditions will stop the motor and illuminate the fault light.

2.7 WASHER COMPACTOR DIMENSIONS

As shown on the contract drawings.

2.8 ANCHOR BOLTS

A. Anchor Bolts: All anchor bolts shall be a type 304 stainless steel. The equipment supplier shall furnish all anchor bolts, nuts, and washers required for the equipment. Seismic calculations shall be required, as specified in Specification Section 01610 and 01615.

B. Fasteners: All fasteners shall be type 304 stainless steel. The equipment supplier shall furnish all fasteners required for the assembly of the equipment.

C. The General Contractor shall set the anchors in accordance with the Manufacturer's instructions.

2.9 SPARE PARTS

A. The following spare parts shall be provided as the total amount of spare parts for each perforated plate screen:

1. Two (2) perforated screen panels with side sealing and without lifting fingers.

2. One (1) perforated screen panel with side sealing and with lifting fingers.

3. One (1) complete set of replacement cleaner brush elements.

4. Five (5) feet of chain with one (1) master link.

B. The following minimum spare parts shall be provided for each washer/compactor:

1. One (1) brush with mounting clips and hardware for screw.

C. Manufacturer shall recommend any additional spare parts deemed necessary based on experience with the screen in similar applications.

2.10 FACTORY ASSEMBLY, TESTING AND INSPECTION

The screen shall be factory assembled and tested for a minimum of four (4) hours prior to delivery and shall be delivered to the site fully assembled (other than the motor/reducer unit, discharge chute and supports). It shall be capable of being set in place and field erected by the Contractor with minimal field assembly.

2.11 INSTALLATION, OPERATION AND MAINTENANCE MANUAL

In addition to the normal Installation, Operation and Maintenance manuals required by contract, a spare manual will be shipped with the unit in order to allow for proper operation of equipment prior to release of all final Installation, Operation and Maintenance Manuals to the end user. Provide, in accordance with Specification Section 01680.

2.12 PAINTING

Non-stainless steel parts shall be cleaned, primed and coated in accordance with Specification Section 09900. Motors and gear reducers shall be painted the same color. Stainless steel shall be passivated after fabrication. Factory coated equipment shall be repainted in the field as specified in Specification Section 09900.

PART 3 EXECUTION

3.1 PREPARATION

A. The mounting points of the channel shall be level and parallel and of proper size.

B. Contractor shall verify all dimensions in the field to ensure compliance of equipment dimensions with the drawings.

3.2 LIFTING AND MOVING EQUIPMENT

A. Lifting points shall be identified on all SAVECO North America equipment. A crane of sufficient capacity must be onsite for unloading the equipment from the truck and placing in the channel for installation.

3.3 INSTALLATION

A. The equipment shall be installed in conformance with the manufacturer's instructions. The manufacturer's service technician shall thoroughly check and inspect equipment after installation, initiate testing, make necessary adjustments, and instruct owner's personnel in proper operating and maintenance procedures.

B. Equipment shall demonstrate compliance with the specifications and shall operate to the satisfaction of the Owner under actual operating conditions.

3.4 STARTUP, TRAINING, AND QUALITY CONTROL

A. The initial start-up of SAVÉCO North America equipment will be performed by an authorized SAVÉCO North America representative. The SAVÉCO North America authorized representative will verify the proper operation and installation and provide training to the equipment operators. One (1) trip for a total of two (2) days is allotted. Additional days, if required, will be paid by the Owner for a nominal rate. Sales representatives will not be deemed acceptable in lieu of a factory-employed service technician. See Specification Section 01670, 01675, and 01680.

END OF SECTION

SECTION 11343

VORTEX GRIT REMOVAL SYSTEM (BAFFLE PLATES)

PART 1 GENERAL

1.1 DESCRIPTION

Scope: The work of this section consists of furnishing and installing four (4) V-Force baffle plates into two existing vortex grit removal tanks. Each existing tank shall be fitted with both inlet and outlet baffles. The existing vortex grit removal system is complete with vortex grit removal tanks, vortex grit drives, grit pumps, grit classifier and auxiliary equipment.

1.2 EXISTING EQUIPMENT TAG NUMBERS

Tag Numbers	Equipment Name
DRV A4112	Vortex Grit Drive 1
DRV A4212	Vortex Grit Drive 2
PMP A4111	Grit Pump 1
PMP A4211	Grit Pump 1
DRV A4310	Grit Classifier

1.3 RELATED WORK SPECIFIED ELSEWHERE

A. Section 01300 - Submittals

B. Section 05500 - Metal Fabrications

C. Section 09900 - Painting

D. Section 11010 - General Mechanical Equipment Provisions

E. Division 16 - Electrical

1.4 SUBMITTALS

A. In accordance with Section 01300:

1. Submit shop drawings, parts lists, complete descriptive literature, catalog cut sheets, engineering and physical data, etc. as necessary to fully describe and define all items to be furnished under this specification.
2. Provide complete design calculations shall be submitted to show compliance with design and seismic criteria, in accordance with Section 01610.
3. Provide operation and maintenance manuals in accordance with Specification Section 01680.

1.5 QUALITY ASSURANCE

A. All equipment furnished under this Section shall:

1. Be of a manufacturer who has been regularly engaged in the design and manufacture of the equipment;

2. Be supplied by a single manufacturer or supplier.

3. Be of the latest design; and,

4. Be demonstrated to the satisfaction of the owner that the quality is equal to the equipment specified herein.

B. Material Standards: All materials and workmanship shall meet the following referenced standards.

1. American Iron and Steel Institute (AISI): Steel Products Manual.

2. American Society for Testing and Materials (ASTM):

a. A36, Standard Specification for Carbon Structural Steel.

b. A536, Standard Specification for Ductile Iron Castings

c. F593, Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.

1.6 DESCRIPTION

A. Inlet and outlet baffles shall be provided in each existing vortex grit removal tank to enhance the coanda effect and direct the grit downward to the bottom of the separation chamber as well as enhance chamber flow patterns.

1.7 WARRANTY

A. A supplier's written warranty shall be provided for the equipment specified in this section. The warranty shall be for a minimum period of one (1) year for start-up or 18 months from time of equipment shipment, whichever comes first.

1.8 ENVIRONMENTAL CONDITIONS

A. Exposures: The equipment will be subject to rainfall, wind (including dust and dirt), direct sunlight and a corrosive environment due to wastewater, splashing, hydrogen sulfide and hydrocarbon gases. Ambient air temperatures may range from 15°F to 115°F. Relative humidity may fluctuate between 10 and 100 percent.

PART 2 MATERIALS

2.1 MANUFACTURERS

A. The baffle plates shall be V-Force Baffles as manufactured by Smith and Loveless to match the existing Pista 360 vortex grit removal system.

B. The naming of a manufacturer in this specification is not an indication that the manufacturer's standard equipment is acceptable in lieu of the specified component features. Naming is only an indication that the manufacturer may have the capability of engineering and supplying a system as specified.

2.2 EQUIPMENT

A. V-Force Baffle: The vortex grit removal tanks shall be fitted with the V-Force Baffle, which is an integral flow control baffle for both the inlet and outlet of each tank. The V-Force Baffle shall be designed to direct the inlet flow into the main chamber of the tank in a manner ensuring the proper vortex flow and to prevent short-circuiting. The V-Force Baffle on the outlet shall direct the flow out of the tank, and to act as a "slice weir" to control the water level in the main chamber and in the inlet chamber. No additional downstream flow control device shall be required to keep the velocity between 3.5 feet per second (fps) at peak flow and 1.6 fps at minimum flow with a 10:1 turn down. The V-Force Baffle shall be constructed of 316 stainless steel. The installing Contractor shall attach the V-Force Baffle to the existing concrete structure using 5/8" anchor bolts, as shown on the drawings.

PART 3 EXECUTION

3.1 INSTALLATION

A. The equipment shall be installed in conformance with the manufacturer's instructions.

B. Equipment shall demonstrate compliance with the specifications and shall operate to the satisfaction of the Owner under actual operation conditions.

END OF SECTION

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Contract Documents and Specifications for

CITY OF MERCED
DEPARTMENT OF PUBLIC WORKS
PROJECT NUMBER 230035
MERCED WWTF PHASE VI PROJECT – HEADWORKS IMPROVEMENTS

Volume 1B

March 2023

Stantec

PROJECT NUMBER 230035

CITY OF MERCED WWTF PHASE VI PROJECT – HEADWORKS IMPROVEMENTS

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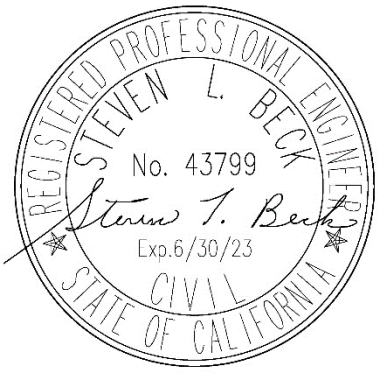

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CITY OF MERCED
DEPARTMENT OF PUBLIC WORKS

PROJECT NUMBER 230035

MERCED WWTF PHASE VI PROJECT – HEADWORKS IMPROVEMENTS

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SECTION 15000

MECHANICAL AND PLUMBING

PART 1 GENERAL

1.1 RELATED SECTIONS

A. Section 01300 - Submittals

B. Section 01666 - Testing of Pipelines

C. Section 02223 - Trenching, Backfilling, and Compacting

D. Section 10400 - Identifying Devices

E. Section 15052 – Stainless Steel Piping

F. Section 15080 – Pipe Appurtenances

G. Section 15094 - Hangers and Supports

1.2 DRAWINGS

Drawings are diagrammatic and show the general design, arrangement and extent of the systems. Do not scale drawings for roughing in measurements, nor use as shop drawings. Make field measurements and prepare shop drawings as required. Coordinate work with shop drawings of other specification divisions.

1.3 WORK INCLUDED

Perform all labor for installation and furnish all materials and equipment necessary for the installation of Air Conditioning and Plumbing Systems as indicated on the drawings and any incidental work to provide a complete and workable system, including the following related work:

A. The contractor shall provide a qualified job superintendent who shall manage and coordinate the activities of the trades and maintain the progress of the work to the satisfaction of the Architect.

B. Before beginning work, verify all dimensions at the building site and check existing conditions. Make changes which are necessary to install the work in harmony with other trades; they shall be first approved by the Engineer.

C. Follow as closely as possible, the locations of pipe, duct, and equipment indicated on the drawings. Changes which may be necessary on account of building obstructions shall be made at no extra cost to Owner. Indicated pipe sizes are a minimum and shall not be decreased in size without permission from the Engineer. No holes will be allowed in any structural members without written consent of the Engineer.

1.4 REQUIREMENTS OF REGULATORY AGENCIES

A. Provide all work and materials in full accordance with the latest Rules and Regulations of the following:

1. California Code of Regulations, Title 21, Title 22, & Title 24
2. Building Standards
3. The State Fire Marshal
4. National Fire Code
5. National Fire Protection Association
6. Safety Orders of the Division of Industrial Safety
7. The California Electric Code, Latest Edition
8. The California Building Code, Latest Edition
9. California Mechanical Code, Latest Edition
10. California Plumbing Code, Latest Edition
11. Other Applicable State Laws and Regulations

B. Nothing in these plans or specifications is to be construed to permit work not conforming to these Codes.

C. Furnish without extra charge any additional material and labor required to comply with these Rules and Regulations.

1.5 FEES, PERMITS, AND UTILITY SERVICES

A. Obtain all permits and pay all fees and charges of any kind required in connection with this work.

B. Arrange for utility connections and pay charges incurred, including excess service charges if any.

C. All temporary connections required to maintain services including adequate heat and cooling during the course of this contract shall be made without additional cost to the Owner. The normal function of the building must not be interrupted. Notify the Owner seven (7) days in advance before disturbing any service.

1.6 SUBMITTAL

In accordance with Section 01300.

A. Submittals shall be provided for the following items plus any additional items required in the specifications for the particular types of pipe:

1. Piping and jointing materials
2. Fittings
3. Specialties
4. Fabrication drawings of all major runs of pipe and all pipe which cannot be fabricated in the field.
5. The arrangement of piping and appurtenances proposed to serve equipment of other than the first named manufacturer.

B. Contractor shall investigate the space requirements of the proposed piping before submitting shop drawings.

1.7 PLACEMENT OF EQUIPMENT AND WORK

A. The placement of all equipment, piping, valves, etc. installed in accordance with manufacturer’s instructions.

B. Install equipment, piping, valves, etc. to provide sufficient clearance for maintenance and clearance from electrical panels whether shown on drawings or not.

C. Move equipment and/or work into spaces through openings provided or located in the spaces during construction, as required. Do disassembling and reassembling of equipment or other work necessary to accomplish this requirement without extra cost to the Owner.

1.8 SPECIAL FRAMING AND PIPE ISOLATION

Special framing, recesses, chases, and backing for work of this section is covered under other sections. Be responsible for proper placement of all pipe sleeves, hangers and supports, and location of openings for work of this section.

1.9 PAINTING

Painting in accordance with Section 09900.

1.10 MAINTENANCE AND OPERATING INSTRUCTIONS

A. Furnish 5 complete copies of operating and maintenance instructions for all equipment including typed instructions for lubrication of specific equipment, in accordance with Specification Section 01680. Provide the air balance report, as defined below. Provide in durable binder.

1.11 SYSTEM OPERATIONS

Operate the system for a period of at least one day of eight (8) hours to demonstrate fulfillment of the specifications. During this time all adjustments shall be made to the equipment so that it is placed in first-class operating condition. Instruct Owner in operating and maintenance procedures. Lubricate all equipment including motors before operation. In accordance with Specification Section 01670 and 01675.

1.12 GUARANTEE

The Contractor shall guarantee to repair or replace at his expense any defective work or material within a period of one (1) year after the acceptance of the work. This includes repair of any damage caused by leaks.

PART 2 MATERIALS

2.1 GENERAL

Provide pipe and tube, joint type, grade, size and weight indicated for service, and comply with governing regulations and industry standards.

Pipe sizes are minimum nominal inside diameter unless otherwise noted. All sizes of pipe shall be as called out on the drawings and specified herein. All pipe and fittings delivered to the job site shall be clearly marked to identify the material, class, thickness, and manufacturer. All material shall be new and free of blemishes.

Provide dielectric (insulated) fittings at all pipes of dissimilar metals, all buried valves, and all locations where buried pipeline connects to aboveground piping.

2.2 PIPES AND PIPE FITTINGS

A. Drain (D) piping above the floor (exposed):

1. Mechanical-Joint, Ductile-Iron Pipe: Thickness Class 50, cement mortar lined, and shall conform to the provisions of AWWA C151-81 and C140-80 and shall have "Tyton" type joints. Standard bituminous coating shall be applied to the outside surface of the pipe by the manufacturer. All fire hydrants shall be connected to the distribution main with ductile iron pipe running from the main to the hydrant.

    a. Mechanical-Joint, Ductile-Iron Fittings: Class 250 conforming to the requirements of ANSI A21.10 (AWWA C110-77). Fittings shall be cement mortar lined in accordance with AWWA C104-80. The inside and outside of the fittings shall be bituminous coated.

    b. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts. Nuts and bolts shall conform to the provisions of ANSI Specifications B18.2.

B. Vent (V) pipe shall be stainless steel piping, in accordance with Specification Section 15052.

C. Reclaimed Water (3W):

1. For piping that is less than 4" diameter, PVC Sch.40 and fittings. PVC schedule 40 piping shall not be allowed on site for pipes that are 4" diameter or larger.

    a. PVC (less than 4" diameter): Schedule 40 Rigid polyvinyl chloride (PVC) compound, Type I Grade I, with a Cell Classification of 12454 as defined in ASTM D1784. This compound shall be white in color, and shall be approved by NSF International for use with potable water (NSF Std 61).

    b. PVC is only allowed below grade, no exposed PVC piping shall be allowed on site.

2. For all piping that is less than 4-inches diameter and above ground, use schedule 40 galvanized steel.

   a. For 2.5-inches and smaller: ASTM A53 with threaded couplings. Pipe thread dimensions and size limits shall conform to ANSI B2.1. Fittings shall be malleable iron, ASTM A197, ANSI B16.3, Class 150.

   b. For 3-inches and larger: ASTM A53, butt-welded, grooved couplings, or flanges. Fittings shall be Steel, ASTM A234, ANSI B16.9, Sch. 40, or ductile iron in accordance with Section 15062; ends to match pipe.

   c. Screwed Joint Seal: Teflon tape.

   d. Flanges: steel flanges shall be ANSI B16.5, minimum Class 150, plain face or AWWA C207, Class D. Plain faced flanges shall not be bolted to raised face flanges. Gaskets shall be full face 1/16 inch thick Garlock Multi-swell Style 3760, or approved equal. Bolts shall be 316 SST.

   e. Grooved joints: in accordance with AWWA C606. Bolts shall be 316 SST.

   f. Pipe and fittings shall be lined with liquid epoxy as specified in AWWA C210 to a minimum thickness of 16 mils in not less than two coats.

   g. Insulate as scheduled below.

D. Copper and steel pipe connection: Provide Epco dielectric unions at connections of copper pipe and steel pipe of materials.

2.3 PIPE INSULATION

A. All exposed piping 2-inches or smaller shall be insulated with insulation and jacket, as defined below.

B. Insulation Thicknesses: Provide insulation thickness in inches in accordance with the following table:

	Nominal Pipe Diameters				
Temperature Service	**1 inch and less**	**1.25 to 2 inch**	**2.5 to 4 inch**	**5 to 10 inch**	**Over 10 inch**
Above 200 degrees Fahrenheit	2.0	2.5	3.0	3.5	3.5
105 to 200 degrees Fahrenheit	1.5	1.5	1.5	2.0	2.5
40 to 60 degrees Fahrenheit	0.5	1.0	1.0	1.5	2.0
Refrigerant and Fluids Below 40 degrees Fahrenheit	1.0	1.0	1.5	2.0	2.0
Heat Traced Lines	1.0	1.0	1.0	1.5	2.0

C. Insulation

1. Insulation Material: Closed cell elastomeric insulation in tubular form.
2. Temperature Range: Minus 40 degrees Fahrenheit to plus 180 degrees Fahrenheit.
3. K Factor at 75 Degrees Fahrenheit: 0.27.
4. Fire Rating: 25 or less flame spread, smoke developed 50 or less per ASTM E84.
5. Maximum Moisture Absorption, Weight Percent: 5.0.
6. Moisture Permeability: 0.10 perm-inch.
7. Joints: Seal with adhesive to form continuous water barrier.
8. Manufacturers: One of the following or equal:
    a. Armstrong World Industries, AP Armaflex.

D. Jacket

1. Material: Aluminum, Alloy 5005; 0.016 inch (26 gauge) minimum thickness.
2. Overlap: Overlap circumferential joints 4 inches minimum; overlap longitudinal joints 1 inch minimum; longitudinal joints oriented to minimize water entry.
3. Bands: 0.5 inch wide, 0.0508 inch (16 gauge) thick Aluminum, same alloy as jacket or 0.0179 inch thick Type 304 stainless steel; install on 18 inch centers, uniformly spaced and at all fitting joints.
4. Joint Seal: Apply waterproof adhesive at joints and overlaps.
5. Fittings: Custom fit of same materials.
6. Manufacturers: One of the following or equal:
    a. Childers Products.
    b. Premetco International.

2.4 VALVES

A. Ball Valves

1. Stainless steel Ball Valves (BV) - sizes 2” and smaller: shall have full ports and screwed ends.Stainless Steel body. TFE seats and seals. Type 316 stainless steel trim. Jamesbury; Hills-McCanna “McCannaflo”, Worcester, or equal.
2. Stainless steel Ball Valves (BV) Larger than 2”:
    a. Ball: Full port, single piece, solid. Solid 316, or 17-4 PH stainless steel conforming to requirements of ASTM A 351 Grade CF8M, or ASTM A 351 Grade CB7CU.

b. Stem: Blow-out proof (when assembled) using T-shaped configuration for positive retention. 304, 316, or 17-4 PH stainless steel.

c. Body: Three-piece, vertically split, end entry. Cast 316 stainless steel conforming to requirements of ASTM A 351 Grade CF8M

d. Seat: Cartridge design consisting of a seat ring with reinforced teflon or PEEK seat insert, and body seal. Spring loaded seats to assure ball/seat contact at low pressure.

e. Stem Seat: Thrust washer packing ring, two-rings for tight seal.

f. Jamesbury; Hills-McCanna "McCannaflo", Worcester, or equal.

B. SOLENOID VALVES (SOV, SOL V)

1. ¾ inches and smaller.

2. Forged brass body, Buna "N" seals and disc or diaphragm.

3. Orifice diameter equal to or greater than pipe size.

4. Epoxy resin encapsulated, waterproof, high temperature coil, 120 volt or as indicated on the drawings, single phase, 60 cycle, explosion-proof enclosure, normally-closed design, continuous duty rated.

5. Jackes-Evans Mfg. Co. Series J; Asco No. 8210, or equal.

PART 3 EXECUTION

3.1 GENERAL REQUIREMENTS

A. Dewater in accordance with Section 02140.

B. During loading, transportation and unloading, every precaution shall be taken to prevent injury to the pipe, coating, and lining. No pipe shall be dropped from cars or trucks, or allowed to roll down slides without proper retaining ropes. Each pipe shall rest on suitable pads, strips, skids or blocks securely wedged or tied in place. Padding shall be used on car or truck stakes, skids, etc., to prevent damage to the pipe during transportation and handling. Any pipe damaged shall be replaced or repaired as approved by the Engineer at no additional cost to the Owner.

C. Each section of pipe shall be delivered in the field as near as practicable to the place where it is to be installed. Pipes shall be distributed along the side of trench opposite to the spoil bank within easy reach of the installing crew.

D. Where it is necessary to move the pipe longitudinally along the trench, it shall be done in such a manner as not to injure the pipe. Pipe shall not be rolled or dragged on the ground. Where pipe is placed on stockpiles, it shall be neatly piled and blocked with strips between tiers.

3.2 EXCAVATING, TRENCHING, AND BACKFILL

A. Trenching and Backfill:

1. Except as otherwise noted on the plans or specified herein, all excavation and backfilling for piping shall be as specified in Section 02223, "Trenching, Backfilling, and Compacting".

2. Pipelines located in or under fill areas shall not be placed until the fill has been constructed and compacted to an elevation at least one (1) foot above the elevation of the top of the pipe.

3. All backfill other than where concrete encasement is required, for pipe lines installed under structures, slabs, footings, and paving shall be made with sand and fine gravel, thoroughly compacted in place to not less than 95% of maximum density.

B. Grades and Elevations:

1. All piping and appurtenances shall be installed in the position and to accurate lines, elevations, and grades as shown on the plans or specified herein. Where possible, piping shall be sloped to permit complete drainage. All pipelines shall be rigidly supported and braced by approved hangers, brackets, or other devices. When temporary supports are used, they shall be sufficiently rigid to prevent any shifting or distortion of the piping or related work. See Specification Section 15094.

2. Furnish all fittings necessary for the satisfactory alignment and arrangement of piping and all necessary unions and cleanouts.

3. An invert grade rod shall be used in laying all lines below ground.

3.3 INSTALLATION OF PIPING AND FITTINGS

A. Flexible Couplings:

1. Flexible couplings shall be installed where shown on the drawings and at such other points as may be required for ease of installation or removal of the pipe, subject to approval of the Engineer. Where necessary to prevent separation of pipe due to internal pressures, flexible couplings shall be of the type with set screws in the retainer gland or shall be provided with tie rods as approved by the Engineer. Where permanent flexibility is required, however, such as at connections to pumps or other equipment, and elsewhere as called for on the drawings, tie rods shall be the only acceptable restraining devices and shall be installed through separate mounting plates or lugs and not through flange bolt holes, in order to retain flexibility.

2. Where rubber or similar flexible couplings are called for on the Drawings, tie rods shall be provided if recommended by the manufacturer to prevent excessive elongation.

B. Flexible Joints: For pipelines extending from a concrete structure into earth, at least two flexible joints shall be provided in the earth within 3 feet of the structure face, one of which may be cast in structure with end flush with structure face. Piping beyond structure shall adequately supported by proper compaction under pipe or by supporting on firm undisturbed soil if necessary.

C. Union and Flanges:

1. In erecting the pipe, a sufficient number of screwed unions or flanged joints shall be used to allow any sections or runs of pipe to be disconnected without taking down adjacent runs. Screwed unions shall be used on pipelines two and one-half (2-1/2) inches in diameter and smaller. Flanged joints shall be employed in pipelines three (3) inches in diameter and larger.

2. All exposed piping shall be provided with rigid joints as necessary to prevent shifting or separation due to internal pressures, seismic forces, or the weight of the pipe and it's contents. Rigid joints shall include flanges, grooved couplings, screwed joints, welded joints, soldered joints, etc., unless otherwise noted on the drawings.

D. Concrete Thrust Blocks: Unless noted otherwise, concrete thrust blocks shall not be allowed, except at specific locations shown on the drawings or specifically approved by Engineer. Thrust blocks shall be poured between the pipe or fitting and undisturbed earth.

E. Concrete Wall and Slab Penetrations:

1. Hydraulic Conditions - Piping passing through concrete walls normally below liquid level shall be installed with one of the following:

a. Cut-off collar cast on ductile iron fittings or pipe, ¼-inch thick, 3-inches wide.

b. Cut-off collar welded to steel fittings or pipe, ¼-inch thick, 3-inches wide.

c. Cored, canned or sleeved hole 3-inches to 7-inches larger diameter than pipe; pack with non-shrink grout.

d. Cored, canned, or sleeved hole of suitable size to be sealed with a modular mechanical interlocking EPDM synthetic rubber links shaped to continuously fill the annular space between pipe and opening, equal to "Link-Seal" by Thunderline Corp., Wayne, MI.

2. Non-Hydraulic Conditions -

a. Piping passing through concrete walls, slabs, or footings from earth to earth shall have provision for reasonable relative movement by wrapping pipe with one-inch fiberglass entire thickness of concrete.

b. Horizontal or vertical piping passing through concrete walls, sidewalks, slabs, or footings from earth to air shall be wrapped with 3/8-inch thick, 60 durometer, rubber sheeting, secured with banding.

F. Connections to Equipment:

1. The pipework of all pumps and equipment shall be adequately supported throughout and the weight thereof shall be carried independently of the pump casings or the equipment. All pipework shall be mounted parallel with vertical and horizontal axes of reference. All sections of pipe shall be rigidly bolted or joined together after being cut accurately to length in such a manner as to relieve any and all parts of equipment of undue strain resulting from closure of flanged or other joints or connections.

2. Equipment shall be so positioned and aligned that no strain shall be induced within the equipment during or subsequent to the installation of pipework.

G. Pipe Joints:

1. Pipe shall be cleaned of dirt and scale prior to installation and all joints swabbed clean before jointing. Ends of all pipe shall be closed or plugged at the end of each day's work or otherwise as necessary to prevent the entrance of foreign materials.

2. The Contractor shall perform all work of cutting pipe and special castings necessary to the assembly, erection and completion of the work. All pipe shall be cut and reamed to fit accurately with smooth edges.

H. Coatings for Buried Valves and Piping Accessories: All buried valves, flange assemblies, flexible connections, flange coupling adapters and similar fittings shall be coated with petrolatum wax tape. All buried nuts, bolts, washers, tie rods, and other threaded fasteners shall be Type 316 stainless steel.

3.4 DISINFECTION AND TESTING OF PIPING

Disinfect all piping in accordance with Section 01656. Test all piping to 5 psi above operating pressures, in accordance with Section 01666.

3.5 IDENTIFICATION

See Section 10400.

3.6 PIPE CLEANOUTS

Cleanouts shall be "T" or "Y" branches or trap hubs of same material as pipe in which they are placed; locate as required by code.

3.7 INSTALLATION OF PIPING

A. Upon installation of piping, close ends of pipe immediately after installation. Leave closure in place until removal is necessary for completion of installation.

B. Flush each piping thoroughly and proved clean before connection to equipment.

3.8 PIPE HANGERS

In accordance with Section 15094.

END OF SECTION

SECTION 15052

STAINLESS STEEL PIPE

PART 1 GENERAL

1.1 DESCRIPTION

The work of this section consists of furnishing materials and constructing therewith new stainless-steel pipe, tubing, and fittings 30-inches in diameter and smaller.

A. Pipe shall conform to ASTM A312.

B. Stainless steel tubing shall be as specified in Part 2.15.

1.2 RELATED WORK ELSEWHERE

A. Section 01300 - Submittals

B. Section 01666 - Testing of Pipelines

C. Section 02223 - Trenching, Backfilling, and Compacting

D. Section 09900 - Painting

E. Section 11010 - General Mechanical Equipment Provisions

F. Section 15010 - General Process and Onsite Utility Piping Provisions

G. Section 15080 - Piping Accessories and Appurtenances

H. Section 15094 - Hangers and Supports

1.3 QUALITY ASSURANCE

Standards, American Society for Testing and Materials (ASTM), American Water Works Association (AWWA), American National Standards Institute (ANSI), American Iron and Steel Institute (AISI), and American Welding Society (AWS).

1.4 SUBMITTALS

A. Submit shop drawings in accordance with Section 01300.

B. Show materials of construction, with ASTM reference and grade. Submit manufacturer's certificates of compliance with referenced pipe standards, e.g., ASTM A312, A403, A774, A778. Show wall thickness of steel cylinder and fittings.

C. Submit piping layout drawings showing the location and dimensions of the pipe and fittings larger than 2.5 inches nominal diameter. Include layout lengths of valves, meters, blowers, and other equipment determining piping dimensions. Label or number each fitting or piece of pipe.

D. Submit manufacturer's data for flange and coupling gaskets.

E. Submit certifications that welders are qualified in accordance with ANSI B31.1, Paragraph 127.5 for shop and project site welding of pipe work.

PART 2 MATERIALS

2.1 PIPE

Pipe shall conform to ASTM A312 or A778, Grade 304L or Grade 316 as indicated in the Drawings and/or Specifications. If not indicated, use Grade 304L. Pipe sizes and wall thickness shall conform to ANSI B36.19. Pipe 2.5 inches nominal diameter and smaller shall be Schedule 40S. Pipe 3 inches nominal diameter and larger shall be Schedule 10S.

2.2 FITTINGS

A. Fittings 2.5 inches and smaller shall be threaded conforming to ANSI B16.11, 3,000-pound CWP. Material for threaded fittings shall conform to ASTM A403, Class WP, same material as connecting pipe.

B. Fittings for buried or submerged pipe larger than 2.5 inches shall be butt-welded, conforming to ASTM 403, Class WP same material and wall thickness as the connecting piping, conforming to ANSI B16.9. Elbows shall be short radius.

C. Fittings for aboveground or exposed pipe larger than 2.5 inches shall be butt-welded, grooved, or flanged, conforming to ASTM A403, Class WP same material and wall thickness as the connecting piping, conforming to ANSI B16.9. Elbows shall be short radius.

2.3 JOINTS

A. Joints for pipes 2.5 inches and smaller shall be threaded, same material as specified for fittings, 3,000-pound WOG, conforming to ANSI B16.11.

B. Joints for buried pipe larger than 2.5 inches shall be butt-welded or flexible grooved, unless noted otherwise on drawings.

C. Joints for aboveground or exposed pipe larger than 2.5 inches shall be flanged or welded.

D. Stainless steel pipe fabricated into spool pieces shall have shop-welded circumferential butt-weld joints or flanges.

2.4 THREAD LUBRICANT

Use Teflon thread lubricating compound or Teflon tape.

2.5 FLANGES

Provide stainless steel weld-neck flanges conforming to ANSI B16.5 for piping 2.5 inches and smaller to connect to flanged valves, fittings, or equipment. Provide weld-neck or slip-on flanges for piping larger than 2.5 inches. Flanges shall be Class 150 per ANSI B16.5. Material for weld-neck and slip-on flanges shall conform to ASTM A182, Grade F304 or F316 to match pipe type. Flanges shall match the connecting flanges on the adjacent fitting, valve, or piece of equipment. Flange shall be flat face.

2.6 BOLTS AND NUTS FOR FLANGES

A. Bolts and nuts for flanges shall be stainless steel conforming to ASTM A193, Grade B8M, for bolts and ASTM A194, Grade 8M, for nuts.

B. Bolts for flange insulation kits shall be stainless steel and conform to ASTM A 193, Grade B7. Nuts shall conform to ASTM A194, Grade 2H.

C. Provide stainless teel washer for each nut. Washers shall be of the same material as the nuts.

2.7 LUBRICANT FOR STAINLESS-STEEL BOLTS AND NUTS

Lubrication shall be TRX-Synlube by Ramco, Anti-Seize by Ramco, Jusk IT Husky Lube O'Seal, or equal.

2.8 GASKETS FOR FLANGES

Gaskets shall be fullface, 1/16 inch thick. Gaskets shall be acrylic or aramid fiber bound with nitrile. Gaskets shall be Garlock “Bluegard”, Klinger “Klingersill C4400”, or equal. Gaskets shall be suitable for a water pressure of 500 psi at a temperature of 400 degrees Fahrenheit.

2.9 WELDING:

A. Ensure that weld seams have full penetration and be free of oxidation, crevices, pits, cracks, and protrusions.

1. Weld seams without undercuts.
2. Provide weld crowns of 1/16 inch with tolerance of plus 1/16 inch and minus 1/32 inch.

B. Accomplish longitudinal welds on fittings, except elbows by the same procedures as for pipe.

C. Manually Weld Pipe Spools with Type 304L Filler Metal:

1. Where internal weld seams are not accessible, use gas tungsten-arc procedures with internal gas purge.
2. Where internal weld seams are accessible, weld seams inside and outside using manual shielded metal-arc procedures.

2.10 OUTLETS

A. Outlets 2.5 inches and smaller in piping 3 inches and larger shall be of the stainless steel Thredolet type, per AWWA Manual M11 (1998 edition), Figure 13-23. Outlets shall be 3,000-pound WOG stainless steel per ASTM A182, Grade F304 or F316, or ASTM A403, Grade WP304 or WP316, to match pipe. Threads shall comply with ANSI B2.1. Outlets shall be Bonney Forge Co. “Thredolet”, “Allied Piping Products Co. “Branchlet”, or equal.

B. For outlets 2.53 inches and smaller in piping smaller than 3 inches, use a stainless steel tee with a threaded outlet.

C. For outlets larger than 3 inches, use a stainless steel tee. Tees, crosses, laterals and wyes shall be shop fabricated from pipe, and in addition, stainless steel reinforcement collars shall be fully welded to the branch and run of the pipe as necessary to maintain the specified pressure rating.

2.11 WALL PENETRATIONS

Wall pipes shall have integral shop welded wall stops, circumferentially welded to the pipe run.

2.12 EXPANSION AND FLEXIBLE COUPLING ASSEMBLIES

Expansion and Flexible Coupling shall be provided at a minimum in the locations shown on the Contract Drawings. Couplings shall comply with the requirements of Section 15080, except that all metal parts in contact with the stainless steel piping and fitting shall also be stainless steel. Gasket material for hot air piping shall be able to withstand sustained operating temperatures up to 350°F. Flexible Coupling shall be held in place by means of an internal centering ring or centering lugs.

2.13 FINISH

After all shop operations have been completed, pipe and fittings shall be pickled and passivated in manufacturer's plant, and scrubbed and washed until discoloration and possible iron picked up from manufacturing process are removed. The standard finish for 16-gage through 8-gage material shall be No. 1 or 2B per ASTM A480; 3/16-inch and heavier plate material shall be No. 1 mill finish or better per ASTM A480.

2.14 STAINLESS STEEL TUBING

A. General

1. Provide stainless steel tubing in sizes indicated on the Drawings.
2. Where not indicated on the Drawings, provide stainless steel tubing of the size required to perform the function intended.

B. Tubing

1. Stainless Steel Tubing: Seamless tubing made of Type 316 L or 304L stainless steel and conforming to ASTM A269.
2. Wall thickness adequate for test pressure specified, but not less than 0.065 inch for run tubing. Connections to actuators may be ¼-inch as required for flexibility.

C. Fittings

1. Fittings for Use with Stainless Steel Tubing: Swage ferrule design, with components made of Type 316 stainless steel.
    a. Fittings: Double acting ferrule design, providing both a primary seal and a secondary bearing force.
    b. Flare, bite, or compression type fittings are not acceptable.
2. Fittings: Manufacturers: One of the following or equal:
    a. Crawford Fitting Company, Swagelok.
    b. Hoke, Gyrolok.

c. Parker, CPI.

D. Valves: Valves for Use with Stainless Steel Tubing: Air cocks of Type 316 stainless steel.

PART 3 EXECUTION

3.1 FABRICATION/INSTALLATION REQUIREMENTS

The piping supplier during manufacturing, fabricating and handling stages, and the Contractor during handling and installation stages, shall use extreme care to avoid the contact of any ferrous materials with the stainless steel piping. All saws, drills, files, wire brushes, etc. shall be used for stainless steel piping only. Pipe storage and fabrication racks shall be nonferrous or stainless steel or rubber-lines. Nylon slings or straps shall be used for handling stainless steel piping. Contact with ferrous items may cause rusting of iron particles embedded in the piping walls. After installation, the Contractor shall wash and rinse all foreign matter from the piping surface. All welded joints shall be treated with a pickling solution, brushed with stainless steel wire brushes and rinsed clean. If rusting of embedded iron occurs, the Contractor shall pickle the affected surface with Oakite Deoxidizer SS or equal, scrub with stainless steel brushes, and rinse clean.

3.2 MARKING, SHIPPING, AND STORAGE

All pipe, fittings, and fabrications shall be properly marked with type, gage, and heat number. All fabricated piping shall have openings plugged and flanges secured for storage and/or transport after fabrication. All fabricated piping shall be piece-marked with identifying numbers or codes which correspond to the Contractor's layout and installation drawings. The marks will be located on the spools at opposite ends and 180 degrees apart. Pipe spools shall be loaded and blocked and lagged as necessary to ensure protection from damage during shipping. Stainless steel pipe and fittings shall be stored per manufacturer's recommendation. Dents, gouges, and scratches in stainless steel pipe and fittings are not acceptable and are reason for rejecting pipe and fittings.

3.3 INSTALLING THREADED PIPING

Ream, clean, and remove burrs from threaded piping before making up joints. Apply thread lubricant to threaded ends before installing fittings, couplings, unions, or joints.

3.4 INSTALLING FLANGED PIPING

A. Set pipe with the flange bolt holes straddling the pipe horizontal and vertical centerline. Install pipe without springing, forcing, or stressing the pipe or any adjacent connecting valves or equipment.

B. Lubricate bolts prior to installation.

3.5 INSTALLING GROOVED-END PIPING

Install grooved-end pipe and fittings in accordance with the coupling manufacturer's recommendations and the following:

A. Clean loose scale, rust, oil, grease, and dirt from the pipe or fitting groove before installing coupling. Apply the coupling manufacturer's gasket lubricant to the gasket exterior including lips, pipe ends, and housing interiors.

B. Fasten coupling alternately and evenly until coupling halves are seated.

3.6 FABRICATION, ASSEMBLY, AND ERECTION

A. Beveled ends for butt-welding shall conform to ANSI B16.25. Remove slag by chipping or grinding. Surfaces shall be clean of paint, oil, rust, scale, slag, and other material detrimental to welding.

B. Fabrication shall comply with ANSI B31.3, Chapter V.

C. Welds shall be full circumferential. The minimum number of passes for welded joints shall be as follows:

Steel Cylinder Thickness (inch)	Minimum Number of Passes for Welds
Less than 0.1875	1
0.1875 through 0.25	2
Greater than 0.25	3

D. Use the shielded metal arc welding (SMAW) or the tungsten inert gas (TIG) process for welding. Use the SMAW process for any pipe. Use the TIG process only on pipe having a maximum thickness of Schedule 10S.

E. Welding preparation shall comply with ANSI B31.3, paragraph 328.4. Limitations on imperfections in welds shall conform to the requirements in ANSI B31.3, Tables 341.3.2A and 341.3.2B, and paragraph 341.4 for visual examination.

F. Identify welds in accordance with ANSI B31.3, paragraph 328.5.

G. Major piping assemblies shall be shop fabricated. Field welding of above ground piping shall be permitted only where indicated on the Contract Drawings or deemed necessary by the Engineer.

3.7 INSTALLING BURIED PIPE

Install in accordance with Section 02223, except as modified herewith. Pipe installed underground shall not deviate more than 1 inch from line or ¼ inch from grade. Measure for grade at the pipe invert.

3.8 INSTALLING ABOVEGROUND PIPE AND TUBING

A. Install pipe without springing, forcing, or stressing the pipe or any adjacent connecting valves or equipment.

B. Provide pipe hangars and supports as identified in the drawings.

C. Install tubing fittings in strict conformance with manufacturer's recommendations.

3.9 SUBMERGED PIPE

Install submerged aeration piping as shown on the drawings.

3.10 COATINGS

After installation, the Contractor shall paint all steel or iron flanges, couplings, and appurtenances in accordance with Section 09900. Painting of the stainless steel pipe is not required. However, the Contractor shall be responsible for supplying and installing the stainless steel piping with a consistently clean surface. Identifying spool piece marks shall be removed with paint thinner or solvents and the entire stainless steel surface shall be washed with detergent and hot water and rinsed clean.

3.11 TESTING

Test air piping in accordance with Section 01666.

END OF SECTION

SECTION 15080

PIPING ACCESSORIES AND APPURTENANCES

PART 1 GENERAL

1.1 DESCRIPTION

The work of this section consists of providing piping accessories and appurtenances.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Section 01300: Submittal

B. Division 15: Mechanical

1.3 QUALITY ASSURANCE

A. Reference, American Society for Testing and Materials (ASTM).

B. All grooved joint couplings, fittings, valves, and specialties shall be the products of a single manufacturer. Grooving tools shall be of the same manufacturer as the grooved components.

C. All castings used for coupling housings, fittings, valve bodies, etc., shall be date stamped for quality assurance and traceability.

1.4 SUBMITTALS

A. Materials list and catalog data sheets naming each product to be used identified by manufacturer and type number.

B. Grooved joint couplings and fittings shall be shown on drawings and product submittals, and shall be specifically identified with the applicable style or series designation.

PART 2 MATERIALS

2.1 FLEXIBLE COUPLINGS

A. Application

	Baker	Rockwell	Dresser
Iron pipe size O.D. pipe	200	411,521	38,90
Ductile iron	228	411, 431, 441	38, 53, 138, 153
Transition	212, 236	413, 433	162
Reducing	220, 240	415, 435	62
Flanged coupling adapter	601, 602, 603, 604	912, 913, 914, 916	127, 128

1. Rockwell International, 400 North Lexington, Pittsburg, PA 15208
2. Dresser Mfg., 41 Fisher Ave., Bradford, PA 16701
3. R.H. Baker & Co., 2929 Santa Fe Ave., Los Angeles, CA 90058, or equal.

B. Materials: Cast couplings shall be used wherever possible. Steel couplings with a minimum sleeve thickness of the connecting pipe wall or ¼-inch, whichever is greater, shall be used where cast couplings are not available.

1. Sleeve: Grey iron or steel.
2. Flanges: Malleable or ductile iron or high strength steel.
3. Bolts and Nuts: Low alloy, high strength, zinc coated when exposed, 304 stainless steel when buried, 316 stainless steel or below top of wall in water bearing structures.
4. Finish of Coupling: fusion epoxy coating.
5. Gaskets:
    a. Synthetic rubber (Rockwell grade 60, Dresser 42) High-temperature, non-asbestos gasket for service above 212°F.
    b. High Temperature Service – Gaskets on air piping or hot water piping shall be suitable for temperatures up to 300°F.

C. Wrap couplings, two feet beyond on either side, with geotextile fabric suitable to temperatures stated above.

D. Split-Sleeve couplings, with double-arched housing and O-ring gaskets may be used in lieu of sleeve-type. Couplings shall be restrained (FxF), expansion (ExE), or a combination (FxE) as required, manufactured by Victaulic Depend-O-Lok, Doraville, GA 30362.

2.2 FLANGED RUBBER FLEXIBLE CONNECTIONS

A. Rubber Expansion Hot Water, Sludge, and Air Service:

1. Manufacturers: One of the following or equal:

a. Mercer Rubber Company, Style 500.

2. Provide rubber expansion joints complete with control rods and split retaining rings.

3. Design:

a. Material: EPDM, reinforced with embedded steel rings, and a strong synthetic fabric.

b. Single Arch Expansion Joints for Air and Sludge Service,

1) Pressure Rating: Suitable for continuous operation at a pressure of at least 250 Pounds per square inch gauge.

2) Vacuum Rating: Suitable for a vacuum of 30 inches of mercury

3) Temperature Rating: Minimum continuous operation at 250°F.

4) Axial Extension: 1/2"

5) Axial Compression: 3/4"

6) Split retaining rings, stainless steel.

7) Ends of expansion joints, stainless steel 150 pound ANSI flanges with drilling to match that of the piping.

c. Dual Arch Expansion Joints for Hot Water service,

1) Pressure Rating: Suitable for continuous operation at a pressure of at least 180 Pounds per square inch gauge.

2) Vacuum Rating: Suitable for a vacuum of 30 inches of mercury

3) Temperature Rating: Minimum continuous operation at 250°F.

4) Axial Extension: 1"

5) Axial Compression: 1-1/2""

6) Split retaining rings, stainless steel.

7) Ends of expansion joints, stainless steel 150 pound ANSI flanges with drilling to match that of the piping.

B. Rubber Expansion Digester Gas and Chemical Service:

1. Manufacturers: One of the following or equal:

a. Mercer Rubber Company, Style 700.

2. Provide rubber expansion joints complete with control rods and split retaining rings.

3. Design:

   a. Material: EPDM with Teflon liner etched and permanently bonded to the expansion joint body and flange faces, reinforced with embedded steel rings, and a strong synthetic fabric.

   b. Coating: Hypalon paint to provide protection against ozone, weathering, and chemical exposure.

   c. Single Arch Expansion Joints for Digester Gas and Chemical service,

      1) Pressure Rating: Suitable for continuous operation at a pressure of at least 150 Pounds per square inch gauge.

      2) Vacuum Rating: Suitable for a vacuum of 30 inches of mercury

      3) Temperature Rating: Minimum continuous operation at 250°F.

      4) Split retaining rings, stainless steel.

      5) Ends of expansion joints, stainless steel 150 pound ANSI flanges with drilling to match that of the piping.

2.3 GROOVED COUPLINGS AND FITTINGS

A. Couplings

1. Housing shall be ductile iron conforming to ASTM A536, grade 65-45-12.

2. Gasket: ASTM D2000, one of the following, for the appropriate application:

   a. Ethylene Propylene Diene (EPDM) - Grade “E”

   b. Nitrile (Buna-N) - Grade “T”

   c. Halogenated Butyl - Grade “M”

3. Bolts and nuts: heat treated carbon steel, ASTM A449 and A183.

4. Coating:

   a. Exposed: enamel

   b. Buried: two coats Koppers, Bitumastic 50, or equal, after assembly.

5. Application:

   a. Grooved Steel Pipe (non-rigid connection): Victaulic 77 and W77, or engineer approved equal.

      1) For rigid connections through 12”, coupling housings shall be cast with offsetting angle-pattern bolt pads to provide rigidity and system support and hanging in accordance with ANSI B31.1 and B31.9.

a) 2” through 6”: Installation-Ready, for direct stab installation without field disassembly. Victaulic Style 107.

b) Victaulic Zero-Flex Style 07.

2) For sizes 14” through 24”, Victaulic Style W07.

b. Grooved Cast Pipe (nonrigid connection): Victaulic 31 or engineer approved equal.

B. Flange Adapters for Grooved Pipe

1. Class 125 standard drilling.

2. Housing shall be ductile iron conforming to ASTM A536, grade 65-45-12.

3. Gasket, ASTM D2000, one of the following, for the appropriate application:

a. Ethylene Propylene Diene (EPDM) - Grade “E”

b. Nitrile (Buna-N) - Grade “S” or “T”

c. Halogenated Butyl - Grade “M”

4. Coating:

a. Exposed: enamel.

b. Buried: Two coats Bitumastic 50, Koppers, or equal, after assembly.

5. Application:

a. Grooved Steel Pipe: Victaulic 741, W741, and 743 or engineer approved equal.

b. Grooved Cast Pipe: Victaulic 341 or engineer approved equal.

C. Cut and Rolled Grooves

1. Pipe sized ¾ through 24-inch may be cut grooved.

2. Roll groove pipe if wall thickness is less than minimum recommended by the manufacturer for cut-grooving.

3. Cast pipe shall have rigid radius cut grooves.

D. Collared and Shouldered Pipe

1. In accordance with manufacturer’s recommendations, Vic-Rings with Style 41 or 44 couplings as required for the application.

2. Victaulic Co., 4901 Kesslersville Road, Easton, PA 18042

2.4 TRANSITION COUPLING ADAPTOR

A. For piping connections with dissimilar outside diameter (for example, SDR to DIP), provide transition coupling.

B. The coupling shall have follower flanges and a sleeve made of cast ductile iron per ASTM A-536.

C. Flanges shall be color coded to identify general type of pipe (red for IPS size, Blue for ductile iron sizes, and gray for Cement sizes).

D. Gasket shall be Buna N and NSF 61 rated with temperature range from -20 to 180 degrees F.

E. The nuts and bolts shall be 304 SST.

F. Coat fitting with fusion epoxy.

G. Manufactured by Smith Blair Inc, model 441 Omni cast coupling, or equal.

2.5 PRESSURE GAUGES (PG)

A. Liquid filled, glycerine or silicone.

B. 2½- to 3½-inch dial, scale 20-50% greater than normal operating pressure, 270 degree movement.

C. Stainless steel case and polycarbonate window.

D. Provide gauges with Type 316 stainless steel socket and bellows or bourdon tube, depending on pressure range.

1. Where the maximum pressure is less than or equal to 15 pounds per square inch the gauge shall use bellows as the measuring element.

2. Where the maximum pressure is greater than 15 pounds per square inch, the measuring element shall be a bourdon tube.

E. 2½ percent accuracy.

F. ¼-inch NPT bottom connection.

G. Mount gauges on diaphragm seals where indicated on the Drawings.

1. Provide diaphragm seals with Type 316 stainless steel top housing, bottom housing, and bolt assemblies.

    a. Bottom housing shall be fitted with a ¼-inch flushing connection.

    b. This flushing connection shall be fitted with a Type 316 stainless steel close nipple and a brass shutoff cock.

    c. Diaphragm Seal: Removable.

        1) For pressure less than or equal to 15 pounds per square inch, provide a diaphragm seal.

        2) For pressures greater than 15 pounds per square inch, provide Type 316 stainless steel diaphragm seal.

    d. Fit diaphragm seal gauge assembly with a snubber.

    e. Snubber shall have porous metal disc sized to dampen pressure fluctuations in the filled system.

    f. Snubber shall be Stainless Steel.

    g. Snubber filter disc shall be sized to prevent the gauge from pulsating.

    h.

    i. Provide diaphragm seal gauge assemblies filled with silicone. Gauges used for chemical service shall utilize PTFE diaphragm seals and PVC gauge guard housings.

2. Pressure gauges, except gauges with diaphragm seals, shall have pulsation dampeners installed between the gauge and the shut-off valve.

3. Pulsation Dampeners shall be Stainless Steel.

H. Annular Seal Pressure Sensors

1. Pressure Sensors are to be of the full flange design, to be retained between standard ANSI B16.1 Class 125/6.5 Class 150 pipeline flanges.

2. The outside diameter of the sensor shall match the outside diameter of the mating flange.

3. Sensor shall be flow through design with flexible elastomer sensing ring around the full circumference. The elastomer sensing ring shall be rigidly clamped between metal end cover flanges, and no part of the elastomeric sensing ring shall be exposed to the external face of the sensor. There shall be no dead ends or crevices and flow passage shall make the sensor self-cleaning.

4. The pressure sensing ring shall measure pressure for 360° around the full inside circumference of the pipeline. Flexible sensing ring shall have a cavity behind the ring filled with fluid to transfer pressure to the gauge.

I. Manufacturers

1. Pressure Gauges: One of the following or equal:

   a. U.S. Gauge Division of Ametek, Inc. Solfrunt Gauges, Figure Number 1931T.

   b. Dresser Industries, Inc., Ashcroft Figure Number 1379.

2. Diaphragm Seal: One of the following or equal:

   a. For pressure less than or equal to 15 pounds per square inch:

      1) Ashcroft, Type 301.

      2) Mansfield and Green, Type LG.

      3) For chemical service, Plast-O-Matic Series GGMT.

   b. For pressures greater than 15 pounds per square inch:

      1) Ashcroft, Type 101.

      2) Mansfield and Green, Type RG.

      3) For chemical service, Plast-O-Matic Series GGMT.

3. Snubber: One of the following or equal:

   a. Chemiquip, Ashcroft

4. Pulsation Dampeners: One of the following or equal:

   a. Dresser Industries, Inc., Ashcroft Figure Number 1106S.

   b. Operation and Maintenance Specialties, Charlotte, N. C., Ray Pressure Snubbers.

5. ¼-inch stainless steel cross handle cock, Ashcroft 7004; Marsh MFG, or equal.

6. Pressure Annual Seal

   a. Red Valve Series 40.

   b. Ashcroft ISO-Ring.

   c. Approved equal.

2.6 THERMOMETERS

A. Tube Type Thermometers:

1. 9 inch size with adjustable angle from temperature well.

2. Type 316 stainless steel separable sockets with extension necks on insulated pipes and where indicated on the Drawings.

3. Range indicated on the Drawings.

4. Manufacturers: One of the following or equal:

   a. H.O. Trerice Company, Series BX9.

   b. Jay Instruments Company.

2.7 LINE SIZE PRESSURE SENSORS

A. Full line size with flanged or threaded ends.

B. Carbon steel body with flexible neoprene tube and liquid cavity.

C. Rated at 200 psi with 2 percent accuracy.

D. Gauge and liquid as specified in subsection 2.11 above.

E. Red Valve Series 30 or 40, 500 No. Bell Ave., Carnegie, PA 15106; Ronningen-Petter "Iso-Spool" or "Iso-Ring", Portage, MI 49081, or equal.

2.8 FLUSHING CONNECTION

A. Cast bronze swivel inlet adapter, rocker lugs.

B. 1-inch NPT inlet, hose thread outlet.

C. DeSanno Foundry & Machine Co. No. 73, 1933 Peralta, Oakland, CA 94607; Champion No. 10, 1460 No. Naud St., Los Angeles, CA 90012, or equal.\

2.9 INDUSTRIAL HOSE

A. Each hose valve shall be supplied with a coupled 50-foot long industrial hose.

B. Hose shall be the same size (full line size) of hose valve, 1" or 1.5" diameter.

1. Hose shall be oil resistant, reinforced two ply, modified nitrile tube and cover.

2. Versigard synthetic rubber, RMA Class C. Reinforced with spiral synthetic yarn. Rated between -40 oF and 190 oF. Minimum pressure rating of 150 psi.

3. Provided with threaded end connections and spray nozzle.

4. GoodYear, Model 569-049 Sureline, or equal.

2.10 MECHANICAL RUBBER SEAL

A. Modular, mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe and the wall opening.

B. EPDM seal element suitable for service to 250 degrees F, except seal element shall be silicone or viton suitable for 300 degrees F for aeration piping.

C. Composite pressure plates.

D. 316 stainless steel nuts and bolts.

E. Thunderline Link-Seal, or equal.

2.11 Tapping Sleeve

A. Manufacturers: One of the following or equal.

1. BTR Inc./Smith-Blair, Inc., Style 622 or 662.
2. Romac Industries, Inc., Style FTS 420.
3. Ford Metering Company, Model FTSC

B. Material

1. Tapping Sleeves: Steel construction, fusion bonded epoxy coating.
2. Bolts and Nuts: Type 304 stainless steel.
3. Nuts: Teflon coated.
4. Gaskets: EPDM.
5. Size of Tapped Boss: As indicated on the Drawings.

2.12 Tapping Valves

Tapping valve shall conform to AWWA C500. Tapping valves shall be manufactured by Mueller, or approved equal. Tapping valves shall have a Class 125, ANSI B16.1 inlet flange and a two inch (2”) square wrench nut.

2.13 PIPE SADDLES

A. Manufacturers: One of the following or equal.

1. BTR Inc./Smith-Blair, Inc., Style 317

2. Romac Industries, Inc., Style 202S

3. Ford Metering Company, Model FC202

B. Materials:

1. Pipe Saddles: Ductile iron.

2. Straps, Bolts, and Nuts: Type 304 stainless steel with Teflon coating on nuts.

3. Gaskets: EPDM

2.14 Line Stopping

Where indicated on the drawings, provide tapping sleeve, tapping valve, and line stopping equipment to temporarily stop flow in pipe.

2.15 CORPORATION STOPS

In accordance with AWWA C 800.

A. Manufacturers: One of the following or equal.

1. Ford

2. Mueller Company

2.16 CURB STOPS

A. Manufacturers: One of the following or equal.

1. Ford

2. Mueller Company

B. Description: Round way solid tee head stops.

2.17 COCKS

A. Gauge Cock:

1. Manufacturers: One of the following or equal.

2. Lunkenheimer Company, Figure 1178 or Figure 1180

B. Air Cock:

1. Manufacturers: One of the following or equal.

    a. Whitey Research Tool Company, Model B-42S4

    b. Hoke Inc., 7122G4B

C. Plug Cock Manufacturers:

1. One of the following or equal.

    a. Lunkenheimer Company, Figure 454

D. Plug Cock Design:

1. Bronze, straightway pattern complete with lever.

2.18 FLOOR DRAIN

A. Floor Drains and Equipment Drains in Process Areas or Buildings:

1. Equipment and Floor Drains: Provide with adjustable strainer head, floor level grate, 4-inch diameter funnel extension and provided with no-hub outlet and nickel bronze top.

    a. Manufacturers (one of the following or equal):

        1) Josam Company, 30000-A, combination drip drain, less clamping collar.

        2) Zurn Industries Inc., ZN-415 strainer.

2. Funnel Extension:

    a. Manufacturers (one of the following or equal):

        1) Josam Company, E-2.

        2) Zurn Industries Inc., Zn-238.

2.19 CLEANOUTS

A. Floor Cleanouts (FCO) in Finished Floor Areas: Provide complete including cast-iron ferrule, countersunk plug, gas tight and watertight seal, adjustable cleanout head extension, scoriated nickel-bronze top, and securing screw.

1. Manufacturers: One of the following or equal:

    a. Josam Company, 56070.

    b. Zurn Industries, Inc., ZN-1400.

B. Floor Cleanouts (FCO) in Unfinished Floor Areas: Same as floor cleanouts specified for finished floor areas, except heavy duty scoriated cast-iron top suitable for heavy traffic conditions.

1. Manufacturers: One of the following or equal:
   a. Josam Company, 56040-5.
   b. Zurn Industries, Inc., Z-1400-HD.

C. Yard Cleanouts (YCO) in Asphalt or Ground Areas: Floor cleanouts in unfinished floor areas specified before, for encasement in a concrete pad as indicated on the Drawings and flush with grade.

2.20 ROOF DRAINS

A. Main Roof Drains:

1. Main Roof Drains: Provide complete, including coated cast-iron body, combined flashing collar and gravel stop, bronze dome strainer, underdeck clamp where required, and pipe of size indicated on the Drawings.
2. Manufacturers: One of the following or equal:
   a. Josam Company, Series 21520-23.
   b. Zurn Industries, Inc., ZRB-100.

B. Overflow Roof Drains: Provide same as main roof drains but with a 2 inch water dam.

1. Manufacturers: One of the following or equal:
   a. Josam Company, 26010-23.
   b. Zurn Industries, Inc., ZRB-100-89.

C. Scupper Roof Drains: Provide complete, including coated cast-iron body, coated cast-iron or bronze angle strainer, 90 degree or 45 degree threaded outlet where required, and pipe of size indicated on the Drawings.

1. Manufacturers: One of the following or equal:
   a. Josam Company, 24700.
   b. Zurn Industries, Inc., Z-187.

D. Downspout Nozzles: Provide complete, including nickel-bronze body and wall flange.

1. Pipe Size: As indicated on the Drawings.
2. Manufacturers: One of the following or equal:
   a. Josam Company, 25010-50-SF.

b. Zurn Industries, Inc., ZANB-199.

2.21 POLYETHYLENE ENCASEMENT

All buried metallic piping, specials, and fittings shall be polyethylene encased, double wrapped. 8 mils thickness, sized to pipe diameter, ANSI/AWWA-C105/A21.5. Ends taped off with vinyl pipe wrap tape 10-mil vinyl tape manufactured by Calpico Inc. (Calpico VI-10) or equal.

Polyethylene Encasement- "Clear" non-colored polyethylene film, in either tubular or sheet form. The polyethylene film shall have a minimum thickness of 8 mils and at no point shall not be less than 10 percent of the nominal thickness. Polyethylene film shall be manufactured from a Type 1, Class A raw polyethylene material conforming to "Polyethylene Encasement for Ductile-Iron Piping for Water and Other Liquids" (ANSI/AWWA C-105/A21.5). Manufactured by Fee Spec's-LP378D Northtown, Fulton Enterprise Inc., Global Polymer Tech, Unisource, or equal.

PART 3 EXECUTION

3.1 FLEXIBLE COUPLINGS

A. Install where shown on Drawings and where required for ease of installation or removal of pipe, subject to approval of Engineer.

B. Pipelines 4 inches and larger extending from a concrete structure into earth shall have at least two flexible joints within 3 feet of the structure face.

C. Provide tension assemblies as specified in subsection 2.05 of this Specification where necessary to prevent separation of pipe due to internal pressures.

3.2 GROOVED COUPLINGS AND FITTINGS

A. Grooved systems may be used in lieu of flanged, welded or screwed joints for steel or cast pipe (grey or ductile) at Contractor's option, except for chemical service.

B. Install per manufacturer's directions.

C. The grooved coupling manufacturer's factory trained representative shall provide on-site training for contractor's field personnel in the use of grooving tools and installation of grooved joint products. The representative shall periodically visit the jobsite and review contractor is following best recommended practices in grooved product installation. (A distributor's representative is not considered qualified to conduct the training or jobsite visit(s).)

3.3 Hot Tapping

A. Hot tapping piping is not permissible, unless approved by Engineer. If approved, tapping shall be done in accordance with American Petroleum Institute (API) recommended practice 2201.

END OF SECTION

SECTION 15094

HANGERS AND SUPPORTS

PART 1 GENERAL

1.1 DESCRIPTION

The work of this section consists of providing necessary materials and installation to properly support all pipe, electrical conduit, ductwork and miscellaneous hardware.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Section 01300 – Submittals

B. Section 01610 – Seismic Design Criteria

C. Section 01615- Wind Design Criteria

D. Section 09900 – Painting and Finish Schedule

E. Section 11010 - General Mechanical Equipment Provisions

F. Section 15010 - General Process and Onsite Piping Provisions

1.3 QUALITY ASSURANCE

Standards:

A. AA - Aluminum Association

B. AISC - American Institute of Steel Construction

C. ASTM - American Society for Testing and Materials

D. AWS - American Welding Society.

1.4 SUBMITTALS

A. In accordance with Section 01300.

B. Shop Drawings: Submit certified drawings showing all details of pipe, electrical conduit, ductwork and miscellaneous support devices. Shop drawings shall include all details of construction, anchor size, hanger rod sizes, bar sizes, weld sizes, mounting dimensions and overall space requirements.

1. Submit manufacturer's literature to verify support of 5 times the weight or thrust of the piping without failure. Where standard tables are not available, provide calculations signed and stamped by a Civil or Structural Professional Engineer licensed to practice in the state where the project is located. All calculations shall be provided in English units.

2. All exposed and above grade piping shall be vibrationally isolated and restrained by a Seismic Restraint System. Provide calculations in accordance with specification sections 01610 and 01615.

a. The Typical Details provided in the construction documents for supporting mechanical equipment, electrical equipment and distributed systems (i.e. piping, conduit, ducting, other) are to be used for general guidance, minimum requirements, and layout for support systems. Design for these support systems shall be provided in the submittal. The design shall include details and calculations stamped and signed by a Civil or Structural engineer registered in the State of California.

b. Submit layout drawing(s) showing where submitted supports will be used. Layout drawings shall document how the pipe support will be used to resist lateral loads, perpendicular and parallel to the pipe, the specific height and spacing in that area, where the support will connect to flanges (e.g. pipe friction cannot be used to resist lateral loads)- to ensure the calculated maximum loads/spacing provided are appropriate (and to ensure contractor is installing correct detail in appropriate location).

3. Submit documents supporting manufacturer's published values (load capacities, max design loads, deflection from stress, etc.) in terms of how the values were obtained (independent testing laboratory, testing agency, or government agency).

C. Manufacturer's Literature: Submit manufacturer's literature for all channels, clevis hooks, straps, hanger rod, anchors, fasteners, and related material used in the utility support systems.

PART 2 MATERIALS

2.1 HANGERS AND SUPPORTS

A. Hangers and supports shall be factory fabricated units with published load limits and meet Manufacturer's Standardization Society of the Valve and Fittings Industry Standard Practice SP58.

B. Provide hanger or support as indicated on drawings, or select an appropriate hanger or support as shown on the "PIPE SUPPORT DETAILS" Drawing.

C. Hangers or supports shall be B-Line Systems, Inc.; Grinnell Corp., or equal.

2.2 FRAMING SUPPORT SYSTEMS

A. As called out on the drawings and as required to provide adequate support, use framing systems as manufactured by B-Line Systems, Highland, IL 62249; Unistrut Corporation of Wayne, MI 48184; or equal.

B. The load capacities of parts, connections and assemblies shall meet or exceed those published in the latest framing manufacturer's engineering catalog and supplementary bulletins.

C. Unless otherwise noted on the drawings, all framing members and fittings in non-corrosive or dry areas shall be hot-dipped galvanized steel. Paint entire framing support system in accordance with specification section 09900. Nuts and screws shall be electro-galvanized. All painted channels and fittings shall be carefully cleaned and phosphated. Immediately after phosphating, a uniform coat of highly effective rust inhibiting acrylic enamel paint shall be applied by the electro-deposition process and thoroughly baked. Color shall be Unistrut "Perma-Green", B-Line "Dura-Green per Federal Standard 595a, color number 14109 (dark limit V-). The resulting finish will withstand 400 hours salt spray when tested in accordance with ASTM designation B-117.

D. All framing members and fittings for humid, wet or corrosive areas shall be stainless steel or fiberglass. Cut ends of fiberglass shall be sealed per manufacturer’s recommendations. Nuts and screws shall be stainless steel, fiberglass or nylon as approved by the Engineer.

E. Continuous insert embedment channel shall be B-Line B52I; Unistrut P-3300 Series, Caine Strut No. C-3450/70, or equal.

F. For stainless steel pipe, all pipe support materials, framing members, and fittings shall be stainless steel.

2.3 CABLE TRAYS

Shall be B-Line Series 444; Unistrut tray system 3L2 Series, Globetray HDS Series, in widths as shown on the Drawings and with 18-inch rung spacing. Tray shall be supported on six-foot

maximum centers and designed to support a safe uniform allowable load of 200 pounds per lineal foot. Side rails shall be 3- or 4-inch high, 0.0747" (14 gauge) galvanized steel.

2.4 MISCELLANEOUS METAL FABRICATIONS

As specified in Section 05500, all miscellaneous metals used for hangers and supports (in non-corrosive areas) shall be hot-dip galvanized in accordance with ASTM A123 and 304 stainless steel passivated (for corrosive and wet areas). Vent holes shall be provided in closed tube type members in an unobtrusive location as required to prevent any danger of explosion during the galvanizing process.

PART 3 EXECUTION

3.1 PIPE SUPPORTS AND HANGERS

A. General

1. Pipes and ductwork shall be supported as shown on the Drawings, otherwise use appropriate type of support.

    a. The Typical Details provided in the construction documents for supporting mechanical equipment, electrical equipment and distributed systems (i.e. piping, conduit, ducting, other) are to be used for general guidance, minimum requirements, and layout for support systems. Design for these support systems shall be provided in the submittal. The design shall include details and calculations stamped and signed by a Civil or Structural engineer registered in the State of California.

2. Supports shall be used to meet all criteria herein, regardless of whether or not indicated on the drawings. No pipe shall be left unsupported whenever a change in direction of line or flow takes place. At least one support shall be provided between every two couplings. Supports shall be provided for all valves, meters, or other metallic appurtenances.

3. Securely fasten all piping to building construction with approved hangers, supports, guides, anchors and sway braces to maintain pipe alignment and prevent sagging, noise and excessive strain due to uncontrolled movement under operating conditions.

4. Relocate any hangers as necessary to correct unsatisfactory conditions that may become evident when system is put into operation.

5. Supporting of piping by wire, rope, wood or other makeshift devices will not be permitted.

6. Burning of holes in beam flanges or narrow members will not be permitted.

7. All exposed and above grade piping shall be vibrationally isolated and restrained by a Seismic Restraint System. Provide calculations in accordance with specification sections 01610 and 01615.

    a. In addition to the above listed specification requirements, sway bracing of non-resiliently supported piping shall also be designed to ensure compliance with SMACNA Guidelines for Seismic Restraint of Mechanical Systems and fire protection piping per NFPA requirements.

    b. Where supported by pipe hangers from the ceiling or where lateral displacement of pipe is probable, pipelines shall be seismically braced laterally at every 20 feet (minimum), and braced longitudinally and laterally every 40 feet (minimum) and at 90 degree bends. The minimum seismic bracing shall consist of 3/8-inch steel plate welded to pipe hanger, ½-inch diameter all threaded rod, ½-inch diameter flexible connector and eye rod inserted in the ceiling. Design shall be based on most restrictive requirement.

8. Fasten hanger rods to structural steel members with suitable beam clamps.

9. Protect pipe insulation at every hanger, support or guide of insulated piping with inserts and shields.

B. Manifolding

1. Parallel runs of piping, except for fire protection piping may be supported on trapeze hangers, spaced as required for the smallest pipe carried.

2. Piping in chases shall be supported on channel framing.

3. Channel framing shall be selected to support 5 times the weight or thrust of the piping without failure in accordance with the manufacturer's standard ratings. Submit details for approval.

    a. Where standard tables are not available, provide calculations signed and stamped by a Civil or Structural Professional Engineer licensed to practice in the state where the project is located. All calculations shall be provided in English units.

C. Support Hanger Spacing

1. Maximum spacing for horizontal piping supports shall be as follows:

Material	Size	Spacing
Steel Pipe and Stainless Steel Pipe	1” and smaller	5 feet
	1-1/4” to 2”	7 feet
	Larger than 2”	10 feet
Copper Pipe	1" and smaller	5 feet
	1-1/4" and larger	8 feet

PVC Pipe	1" and smaller	4 feet
	1-1/4" to 2"	4-1/2 feet
	2-1/2" to 3-1/2"	5 feet
	4" to 5"	6 feet
	6" and larger	7 feet
Ductile iron pipe	All sizes	8 feet
Fiberglass pipe	Less than 3"	8 feet
	3" and larger	10 feet

2. Where building structure does not permit the specified spacing the Contractor shall provide additional adequate support. Location and details shall be submitted for approval.

3.2 ELECTRICAL CONDUIT SUPPORT

See Division 16 for additional requirements, the most stringent of the listed spacing shall apply.

3.3 MISCELLANEOUS HARDWARE

Support as shown. When not shown, support as required to form a solid, rigid, strong installation satisfactory to the Engineer.

3.4 GALVANIZING TOUCH-UP

Cold Galvanize all field cut bare metal not designated to be painted.

END OF SECTION

SECTION 15110

SST FLAP GATES

1.1 GENERAL

A. This Section Covers Stainless Steel Pump Discharge Flap Gates. The equipment provided under this section shall be fabricated, assembled, erected, and placed in proper operating condition in full conformity with the drawings, specifications, engineering data, instructions and recommendations of the equipment manufacturer.

B. Gates shall be supplied with all the necessary parts and accessories indicated on the drawings, specified, or otherwise required for a complete, properly operating installation, and shall be the latest standard product of a manufacturer regularly engaged in the production of fabricated water control gates.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Section 01300 – Submittals

1.3 REFERENCE STANDARDS

A. ASTM - American Society for Testing and Materials.

B. AWWA - American Water Works Association.

1.4 SUBMITTALS

A. In accordance with Section 01300, submit materials list naming each product to be used identified by manufacturer and model number. Provide catalog cuts, shop drawings, or other information to fully describe and define the equipment being supplied including materials of construction.

B. Provide a structural design for seismic loads in accordance with criteria in the UBC Standards and Section 01610.

C. Provide operation and maintenance manuals in accordance with Specification Section 01680.

1.5 QUALITY ASSURANCE

All materials and equipment shall be the latest standard product of a manufacturer regularly engaged in the design and manufacturer for a period of at least five years. Gates shall be furnished with all necessary accessories for a complete installation, including hydraulic control systems. All gates shall be provided by one manufacturer.

1.6 WARRANTY

The gate manufacturer shall guarantee the equipment supplied to be free of design deficiencies and manufacturing defects for a period of Five (5) years following its being placed into service. If any design deficiencies and/or manufacturing defects are defined during the warranty period, the Manufacturer shall, at their discretion, repair or replace the "failed component(s)". If repair or replacement of a component is needed to correct a problem, the Manufacturer shall be responsible for the cost of parts and labor with no cost to the Owner. If repair or replacement of a component is needed to correct a problem, it shall be made on-site (whenever possible) and in a manner, which minimizes the time the unit is out of service and the inconvenience to the Owner. All warranty repairs are required to be completed within 30 days.

1.7 MANUFACTURERS

Gates supplied under this section shall be Model GH-39SP Stainless Steel Pump Discharge Flap Gates as manufactured by Golden Harvest Inc. or equal.

1.8 QUALITY ASSURANCE

A. The manufacturer shall have 10 years experience in the production of hydraulic control gates and have a licensed engineering staff with a minimum of 10 years of experience in the design of hydraulic control gates. The manufacturer’s shop welds, welding procedures and welders shall be qualified and certified in accordance with the requirement of the latest edition of AWS Sections D1.1, 1.2 & 1.6.

B. The fully assembled gates shall be shop inspected, tested for operation and adjusted before shipping. There shall be no assembling or adjusting on the job site.

C. All stainless steel equipment shall be passivated after fabrication.

1.9 PERFORMANCE

A. Flap gates shall be substantially watertight under the design head conditions. Under the design seating head, the leakage shall not exceed 0.10 US gallons per minute per foot of seating perimeter.

B. Flap gate is designed for use on pump discharge lines where violent slamming action will occur. A Leaf spring damper is provided to restrict over-rotation. The flap cover, body and hinge system shall be of extra heavy-duty construction. The compression seal shall be designed to act as a cushion and help dampen the slamming action of the flap cover that occurs when the pump is turned off or fails to operate.

PART 2 MATERIALS

2.1 GENERAL

A. Anchor bolts for gates shall not conflict with the concrete reinforcing bars. Contractor shall not be allowed to drill through the reinforcing steel. The gate manufacturer shall modify the gate frame as required to prevent a conflict with the bolts and reinforcing steel. All gates are rising stem unless noted otherwise.

B. All gates shall be of one manufacturer.

C. The naming of a manufacturer in this specification is not an indication that the manufacturer's standard equipment is acceptable in lieu of the specified component features. Naming is only an indication that the manufacturer may have the capability of engineering and supplying a system as specified

2.2 MATERIALS AND CONSTRUCTION

General Design. Flap gates shall be stainless steel designed to mount direct to a concrete wall, wall thimble or spigot style mounted around a pipe. Gates shall be designed and constructed to withstand the maximum seating head as shown in the gate schedule. The flap gate shall pivot from a single hinge point to allow free flow on the unseating head side.

MATERIALS TABLE:

Part	**Material**
Frame, Flap, Hinge Arms, Pins	Stainless Steel Type 304L, 316L ASTM A-240 & 276
Seals	Neoprene ASTM D-2000
Seal Retainer	UHMW-PE ASTM D4020 or Stainless-Steel T-304 / 316 ASTM 276
Hinge Bushing	Self-Lubricating Fiberglass Reinforced DIN ISO 4379
Fasteners & Hardware	Stainless Steel Type 304, 316 ASTM F593 / F594
Anchor Bolts	Stainless Steel Type 304, 316 ASTM A276
Leaf Spring	HI carbon 5160 steel or stainless-steel

2.3 FRAME SPIGOT AND FLANGE

A. The gate spigot and flange shall be constructed of stainless-steel members to form a one-piece rigid frame.

B. The spigot shall be design in such a way to place the flap at an approximate 2.5°-degree taper to allow for positive closure.

2.4 FLAP

The gate cover shall consist of stainless-steel plate reinforced to limit its deflection to L/360 of the gates span under the design head condition.

2.5 HINGES & HINGE ARMS

A. Flap gates shall be hinged at the top with a minimum two [2] hinge arms construction stainless steel plate or shapes.

B. Flap gates required to open with low differential head pressure shall be supplied dual hinge/pivot system. The upper hinge shall provide opening sensitivity adjustment.

2.6 HINGE MECHANISMS

Hinge pin and fasteners shall be machined of stainless-steel round bar. Hinge bushings shall be self-lubricating fiberglass, Gar-Max or approved equal.

2.7 RESILIENT SEAL:

Seals shall be of resilient neoprene and be attached to body with a UHMW-PE or stainless-steel retainer strip.

2.8 MOUNTING GASKET:

When required, flap gate shall be mounted with a minimum of 3/8 in. (10mm) thick neoprene gasket and sealant. Sealant shall be Bostic 915 industrial sealant or approved equal.

2.9 LEAF SPRING

Shall form 1/4” minimum material and may be a single or multiple leaf. Leaf size and number depend on the size of the flap gate.

2.10 PASSIVATION

All stainless-steel parts/equipment, after its fabrication, shall undergo a passivation (pickling) process to ensure maximum resistance to corrosion and to remove all embedded iron and heat tint. All stainless-steel components and structures shall be submersed in a chemical bath of nitric acid and hydrofluoric acid to remove any residues that may be present on the material as a result of forming, manufacture, or handling. After removal from the pickling bath, the equipment must be washed with a high-pressure wash of cold water to remove any remaining surface debris and promote the formation of an oxidized passive layer which is critical to the long life of the stainless steel. Submergence insures complete coverage. Spray on chemical treatments and glass bead blasting are specifically not acceptable due to their inability to provide complete and uniform corrosion protection. Surfaces shall be subjected to a 24-hour water test or ferroxyl test to detect the presence of residual embedded iron and shall be re-treated, as needed, to remove all traces of iron contamination. All field welds shall be cleaned and passivated to remove iron (and prevent corrosion) in accordance with ASTM A380. Surfaces shall be adequately protected during shipping and handling to prevent contact with iron or steel objects or surfaces.

PART 3 EXECUTION

3.1 GATE HANDLING, TRANSPORTATION AND STORAGE

A. Contractor shall exercise the following precautions with Flap Gates.

B. Handling: Avoid bending, scraping or overstressing the gates.

C. Transportation: Loading, transporting and unloading of the gates shall be conducted such that the gates are kept clean and free from damage.

D. Protection: Provide sheltered onsite storage. Provide blocking, platforms, or skids to protect the gates from contact with the ground. Protect the gates from damage from construction activities or equipment.

E. Surfaces shall be adequately protected during shipping and handling to prevent contact with iron or steel objects or surfaces.

3.2 FIELD QUALITY CONTROL

A. Testing

1. After the gate installation and checking, run gates through at least 2 full cycles from the closed position to full open position and back to the closed position. Also operate gates with intermediate stops.

2. Provide certificate of proper installation.

B. Manufacturer's Field Services

1. Coordinate field service work with the manufacturer's representative, Owner, and Engineer prior to initiating such work.

2. Manufacturer's Representative: Furnish services of a representative experienced in installation and operation of the gates.

3. Manufacturer's representative shall perform the following services in three separate trips (minimum) as described below:

   a. Installation assistance and inspection: One man-day.

      1) Advise/observe the Contractor on the installation of the gates.

      2) Check and verify the installation of the gates is in accordance with the Drawings and manufacturer's installation instructions.

   b. Certification of installation, field testing, and start-up assistance: One man-day.

   c. Operator Training: One man-day.

   d. Each man-day consists of 8 working hours.

   e. The specified durations are the minimum required time on the job site and do not include travel time.

SECTION 15142

WALL PIPES, SEEP RINGS, AND PENETRATIONS

PART 1 GENERAL

1.1 DESCRIPTION

This section includes materials, installation, and testing of steel and cast-iron wall pipes and sleeves (including wall collars and seepage rings), and penetrations.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Section 01300 - Submittals

B. Section 03100 - Concrete

C. Section 09900 - Painting and Finish Schedule

D. Section 15010 - General Process Piping Provisions

1.3 SUBMITTALS

A. Submit shop drawings in accordance with Section 01300.

B. Submit detail drawings for fabricated steel or cast-iron wall and floor pipes and sleeves, wall flanges, seep rings, and sealing materials. Show dimensions and wall thicknesses.

C. Show flange sizes and the appropriate ANSI or AWWA flange dimensional standard where flanged end wall pipes or penetrations are used.

D. List coating systems to be applied, manufacturer, and dry thickness of coatings. Call out coatings where coatings are to be applied.

E. List materials of construction, with ASTM material reference and grade.

F. Submit manufacturer's instructions for installing rubber annular hydrostatic sealing devices.

G. Submit six copies of the results of the leakage test for cast-iron sleeves having shrink-fit steel collars or collar halves bottomed in a groove and steel sleeves having welded steel collars.

PART 2 MATERIALS

2.1 GENERAL

A. Use either cast-iron or fabricated steel wall sleeves when containing rubber annular hydrostatic sealing devices through which piping passes. Use only cast-iron penetrations and anchors when connecting to cast-iron and ductile-iron pipe. Use only fabricated steel penetrations and anchors when connecting to steel pipe.

B. Cast-iron flanges shall conform to ANSI B16.l, Class 125 or 250, to match the flange on the connecting pipe.

C. Steel flanges shall conform to AWWA C207, Class D. Flanges shall be flat face. Flanges shall match the flange on the connecting pipe.

D. Gaskets for flanges shall be as specified in the detail piping specification.

E. Bolts and nuts for flanges shall be as specified in the detail piping specifications with the following additions: buried or submerged service shall be 316 stainless steel, exposed service shall be galvanized.

2.2 CAST-IRON WALL FLANGES, ANCHORS, AND SLEEVES

A. Provide cast- or ductile-iron wall pipes with ends as shown in the drawings for connection to adjacent PVC and ductile-iron pipe, or for containing pipes where they pass through concrete walls, ceilings, and floor slabs. Provide seepage ring on wall pipes and sleeves passing through concrete walls and slabs which are to be watertight. Locate collars such that the collar is at the center of the wall or floor slab, unless otherwise shown in the drawings.

B. Wall pipes and sleeves shall be of the following types:

1. Pipe or sleeve with integrally cast seep ring.
2. Pipe or sleeve with steel collar halves bottomed in a groove provided in the pipe or sleeve.

3. Minimum wall thickness for pipes and sleeves having integrally cast seep rings shall be as shown in the following table:

Pipe of Sleeve Size (inches)	Minimum Wall Thickness (inches)
3	0.48
4	0.52
6	0.55
8	0.60
10	0.68
12	0.75
14	0.66
16	0.70
18	0.75
20	0.80
24 or greater	0.89

C. Minimum wall thickness of pipes or sleeves having shrink-fit collars shall be Class 52. Cut shrink-fit collars from a 1/4-inch-thick steel ring. Attach the collar to a cast-iron pipe or sleeve by heating the steel collar and allowing it to shrink over the pipe at the necessary location. Provide an epoxy bond (Keysite 740 or 742 or Scotchkote 302) between the pipe and collar. Sandblast the area of the pipe to be epoxy coated per SSPC SP-l0.

D. Wall pipes or sleeves having steel collar halves bottomed in a groove shall be ductile iron Class 54 minimum unless otherwise shown. Wall flanges shall consist of ¼-inch-thick steel seep ring halves for pipes through 24-inch and 3/8-inch-thick halves for pipe 30 inches and larger, bottomed in a groove provided on the pipe. The pipe groove shall be machine cut to a depth of 1/16 to 5/64 inch to provide a press fit for the seep ring. Seep ring halves shall be welded together after fit into groove but shall not be welded to pipe. Seep rings shall be sealed completely around the pipe with silicon sealant manufactured by Dow-Corning No. 790, General Electric Silpruf, or equal.

E. The material used in cast- or ductile-iron wall flanges, wall sleeves, and wall penetrations shall conform to ASTM A 395, A 436, A 536, A 48 (Class 35), or A 126 (Class B).

F. Pressure test at least one of each size of cast-iron pipes or sleeves having shrink-fit steel collars or collar halves installed in a groove in the pipe at the place of fabrication to demonstrate watertightness of the seal between the collar and the sleeve. The test shall be at a pressure of 20 psig for four hours duration and shall show zero leakage.

2.3 FABRICATED STEEL WALL FLANGES, ANCHORS, AND SLEEVES

A. Provide fabricated steel wall pipes and sleeves with ends as shown in the drawings for connection to adjacent steel or concrete pipes, or for containing pipes, where they pass through concrete walls. Provide seepage ring or wall flange on wall pipes and sleeves passing through concrete walls and slabs which are to be watertight. Wall thickness shall be the same as the pipe wall thickness when connecting to steel pipe. Minimum wall thickness for sleeves containing pipes shall be standard weight per ANSI B36.10 for sleeves 72 inches and smaller and ½-inch for sleeves greater than 72 inches through 96 inches.

B. Wall flanges shall be in the form of a steel wall collar welded to the steel sleeve or penetration. Cut welded wall collars from a ¼-inch steel ring. Attach the collar to a steel wall pipe or sleeve with full circle, 3/16-inch fillet welds. Welding procedures shall be in accordance with ANSI B31.3, Chapter V.

C. Steel pipe used in fabricating wall sleeves containing pipes shall comply with ASTI4 53 (Type E or 5), Grade B; ASTI4 A 135, Grade B; ASTM A139, Grade B; or API 5L or 5LX. Wall pipes connecting to steel pipe shall be of the same material as the connecting pipe. Wall collar material shall comply with ASTM A105, A181, or A182.

D. Pressure test at least one of each size of fabricated steel wall sleeve or penetration and collar assemblies at the place of fabrication to demonstrate watertightness of the seal between the collar and the sleeve. The test shall be at a pressure of 20 psig for four hours duration and shall show zero leakage.

2.4 RUBBER ANNULAR HYDROSTATIC SEALING DEVICES

A. Rubber annular hydrostatic sealing devices shall be of the modular mechanical type, utilizing interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe sleeve and the passing pipe. Assemble links to form a continuous rubber belt around the pipe, with a pressure plate under each bolthead and nut.

B. Materials of construction shall be as follows:

Compound	Material
Pressure Plate	Carbon
Bolts and Nuts for Links	Zinc Phosphated Carbon Steel (exposed service) 316 Stainless Steel (submerged or buried)
Sealing Element	EPDM Rubber

C. The size of the wall sleeve needed to accommodate the passing pipe shall be as recommended by the rubber annular seal manufacturer.

D. Provide centering blocks in 25% of the sealing elements on pipelines larger than 12 inches in diameter.

E. The rubber annular hydrostatic sealing devices shall be Link Seal as manufactured by Thunderline Corporation or equal.

2.5 BOLTS AND NUTS FOR FLANGED-END WALL PIPES

Use bolts and nuts as specified for the piping connected to the wall pipe. See Section 15010.

2.6 POLYETHYLENE FOAM FILLER FOR PIPE PENETRATIONS

Packing foam shall be an extruded closed-cell polyethylene foam rod, such as Minicel backer rod, manufactured by Industrial Systems Department, Plastic Products Group of Hercules, Inc., Middletown, Delaware; Ethafoam, as manufactured by Dow Chemical Company, Midland, Michigan; or equal. The rod shall be 1/2 inch larger in diameter than the annular space.

2.7 PAINTING AND COATING

A. Coat penetrations and sleeves exposed, above ground, or in vaults and structures in accordance with Section 09900, Systems A or D unless fusion-bonded epoxy coatings are shown in the drawings or specified elsewhere.

B. Coat submerged sleeves and penetrations per Section 09900, System A unless fusion-bonded epoxy coatings are shown in the drawings or specified elsewhere.

C. Coat buried sleeves and penetrations with fusion-bonded epoxy in accordance with Section 09900.

PART 3 EXECUTION

3.1 LOCATION OF PIPES AND SLEEVES

A. Provide a wall or floor pipe where shown in the drawings and wherever piping passes through walls or floors of tanks or channels in which the water surface is above the pipe penetration.

B. Provide a floor sleeve where shown in the drawings and wherever plastic pipe, steel, or stainless-steel pipe 3 inches and smaller or stainless steel or copper tubing passes through a floor or slab. Provide a rubber annular sealing device in the annular space between the sleeve and the passing pipe or tubing.

C. Provide wall sleeves where shown in the drawings and wherever plastic pipe, steel or stainless-steel pipe 3 inches and smaller, or stainless-steel or copper tubing passes through

a wall. Provide a single rubber annular seal when the wall is 8 inches thick or less. Provide two rubber annular seals (one at each end of the sleeve) when the wall is more than 8 inches thick. Pack the annular space with polyethylene foam filler and fill the ends of the penetration with 2 inches of elastomeric sealant on both sides of the structure.

D. Where sleeves are installed in which water or soil is on one or both sides of the channel or wall, provide two rubber annular seals (one at each end of the sleeve).

E. Where pipes pass through walls or slabs and no sleeves or wall or floor pipe with seep ring is provided, pack the annular space with polyethylene foam filler and fill the ends of the penetration with 2 inches of elastomeric sealant on both sides of the structure.

3.2 INSTALLATION IN EXISTING CONCRETE WALLS AND SLABS

Core drill holes 2 inches larger in diameter than the diameter of the wall flange or collar. Install wall pipe and collar assembly axially aligned with the piping to which it will be connected or will contain. Pack the void space between the sleeve and concrete with grout. See Section 03100 for grouting specification.

3.3 INSTALLATION IN NEW CONCRETE WALLS AND SLABS

Install wall pipes and sleeves in walls before placing concrete. Do not allow any portion of the pipe or sleeve to touch any of the reinforcing steel. Install wall pipe or sleeve and collar assembly axially aligned with the piping to which it will be attached or will contain. Provide supports to prevent the pipe or sleeve from displacing or deforming while the concrete is being poured and is curing.

3.4 INSTALLATION IN DRY FLOORS AND SLABS

Install pipe sleeves and spools in concrete floors and slabs which do not have water over them such that the sleeve or pipe extends from the bottom of the floor or slab to 2 inches above the floor or slab unless shown otherwise in the drawings.

3.5 INSTALLATION OF WALL PIPES HAVING FLANGED END CONNECTIONS

A. Check alignment before grouting in place or pouring concrete. Realign if the sleeve is not properly aligned.

B. Install flanged end wall sleeves or penetrations with bolt holes of the end flanges straddling the horizontal and vertical centerlines of the sleeve.

C. Lubricate flange bolts with oil and graphite prior to installation.

3.6 QUALIFICATIONS OF WELDERS

Welder qualifications shall be in accordance with AWS B2.1.

3.7 INSTALLATION OF RUBBER ANNULAR HYDROSTATIC SEALING DEVICES

Install in accordance with the manufacturer's instructions.

3.8 FIELD TESTING

Check each wall penetration for leakage at the time the hydraulic structure is tested for leakage; see Section 03100. Penetrations shall show zero visible leakage.

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SECTION 16010

ELECTRICAL

PART 1 GENERAL

1.1 SCOPE OF WORK

A. The Contractor shall install, ready for use, the electrical system as specified in Division 16 and shown on the Contract Drawings. This document describes the function and operation of the system and particular components, but does not necessarily describe all necessary devices. All components and devices shall be furnished and installed as required to provide a complete operable and reliable system for accomplishing the functions and meeting the performance set forth hereinafter.

B. If an “or equal” manufacturer is proposed by the Bidder, the cost of any required engineering redesign, and the cost of any electrical, mechanical or structural modifications to adjacent and interfacing equipment necessary to make the several parts fit together, licensing fees and additional construction and other costs resulting from the proposed “or equal” equipment shall be included in the Bid. If the proposed “or-equal” manufacturer is not accepted by the Owner after the Award of Contract, the Bidder shall furnish and install the named equipment at no additional cost to the Owner. See specification section 01300 for further information on submitting equal products.

C. Furnish all required labor, materials, project equipment, tools, construction equipment, safety equipment, transportation, test equipment, incidentals, and services to provide a complete and operational electrical system as shown on the Drawings, included in these Specifications, or required for fully operating facilities. See Section 16940 Appendix "A" for Device Index for mounting detail requirements to be provided for equipment listed.

D. Examine the Specification and Drawings for mechanical equipment and provide all starters, circuit breakers, switches, pushbuttons and appurtenances which are not specified to be with the mechanical equipment. Erect all electrical equipment not definitely stated to be erected by others, furnish and install conduit, wire, cable, and make connections required to place all equipment in complete operation.

E. Contract Elementary Drawings do <u>not</u> show all electrical interfaces, lockouts, etc. required for motor control. These Drawings show general layout and have made provisions for interlocks, solenoid valve control, etc. and are only typical. Contractor is responsible for examining the Contract P- Series Drawings for all motor control interfaces, temperature switches, solenoid valves, float switches and device lockout, requirements. The

Contractor's submitted elementary diagrams shall show all motor controls and interlocks for the specific piece of equipment. Provide a separate set of elementary diagrams for each similar group of equipment. It is within the Contractor's scope of work to submit elementary diagrams that not only show the MCC bucket wiring, but also include the field interlocks, motor heaters, protective devices, valve controls, etc. The Contractor's Elementary submittal Drawings shall also show field terminal block numbers for each of the field interlocks and valve controls.

F. The major areas in the Division scope of work are shown on the E & P series drawings and are designated on the Division 16 Index Specifications which include both the furnishing and installation of:

1. Replace existing Headworks Screening Unit 1 and 2. Modify existing Headworks Screening Unit 3. Add new Plant Meter Manhole Flowmeter.
2. PLC programming shall be by Contractor. OI & SCADA system configuration shall be by Contractor.
3. Conduits, and the field interconnection wiring between the equipment, pumps, MCCs, main switchboard, control panels, panelboards, field devices, etc. as shown on plans for both sites.
4. All necessary miscellaneous shut off, sample, and calibration valves to sensors.
5. Trenching, backfilling, compaction, and resurfacing for all new underground conduit routes.
6. Grounding system and equipment grounding.
7. Supply concrete pads and supports for electrical and instrumentation equipment.
8. Installation of primary devices, equipment and instruments, are not completely detailed on Contract drawing plan sheets. Contract Drawing typical installation details for installation and mounting requirements for equipment and instruments are called out in the following Division 16 indexes:
    a. 16970 – Flow Instrument Index
9. Removal and disposal of excess materials from excavation, pavement removal and demolition work.
10. Drawings EA--series are referenced as E-series.
11. Drawings PA-, and PT - series are referenced as P-series.

G. No items for panels or MCCs shall be shipped loose for later field installation in MCC, control panel, enclosures, etc. without prior written approval of the Owner. Incomplete panels or MCC arriving at the jobsite shall be returned by the Contractor to the shop to complete fabrication at no additional cost to the Owner when directed by the Owner. Panels that were shipped to site without a factory test will be returned by the Contractor to the shop to complete factory test no additional cost to the Owner.

H. Provide all necessary hardware, conduit, wiring, fittings, and devices to connect the electrical equipment provided under other Sections. The following shall be done by the Contractor at no additional cost to the Owner:

1. Provide additional devices, wiring, conduits, relays, and isolators to complete interfaces of the electrical and instrumentation system.

2. Changing normally open contacts to normally closed contacts or vice versa.

3. Adding additional relays to provide more contacts as necessary to carry out work specified.

4. Other work implied by the Contract documents.

5. Provide larger circuit breakers, starter, conduit and wire as required for the horsepower of the supplied equipment when the supplied equipment is larger than that specified, at no additional cost to the Owner or lug adapters as necessary when connecting to the wires listed in the Conduit and Wire routing schedule.

I. The following Specifications incorporate specific equipment and devices that are preferred by the Owner because of their serviceability, because of the local availability of labor, parts and materials, or because of the ability of the Owner to umbrella the equipment under existing maintenance Contracts; however, favorable alternatives proposed in writing during the submittal process will be reviewed by the Owner as to whether they are acceptable as approved equals.

J. The decision of the Engineer governs what is acceptable as a substitution or approved equal. If the Engineer considers it necessary, tests to determine equality of the proposed substitution shall be made, at the Contractor's expense, by an unbiased laboratory that is satisfactory to the Engineer. No reason will be released on why a substitution was not acceptable. No Contract extension will be granted due to the substitution being rejected.

K. All electrical equipment and materials, including installation and testing, shall conform to the applicable codes and standards listed in this and other Sections. All electrical work shall conform with the National Electric Code (NEC) 2020 issue. Nothing on the Drawings or in the Specifications shall be construed to permit work or materials not conforming to these codes and standards.

L. Electrical Contractor is encouraged to attend the pre-bid job walk and it is highly recommended Contractor shall have accomplished the following:

1. Thoroughly examine existing conditions before submitting his bid proposal to perform any work. He shall compare site conditions with data given on the plans or in these Specifications. No allowance shall be made for any additional costs incurred by the Electrical Contractor due to his failure to have examined the site or to have failed to report any discrepancies to the Owner prior to bid.

2. Verify all measurements and conditions and shall be responsible for the correctness of same. No extra compensation will be allowed because of differences between work shown on the Drawings and measurements at the site.

M. It is the Electrical Contractor's responsibility to be fully familiar with the existing conditions and local requirements and regulations. New MCCs may be installed in areas with limited space. MCC and other equipment footprints were developed based on best available information. Contractor is responsible for any additional conduits, wires, construction costs, engineering design requirements, and appurtenances to accommodate MCCs that are larger than that shown on Contract Documents.

N. Any major deviations in location and conduit routing that the Electrical Contractor makes without the express written review or direction of the Engineer, shall be considered to have been made at the Electrical Contractor's sole responsibility. Such deviations made by the Electrical Contractor shall be reflected on the Electrical Contractor supplied "Record Drawings" and Conduit Schedule. The Owner will reimburse the Electrical Engineer and the Owner and then will deduct an amount equal to this reimbursement from the Electrical Contractor's contract for all engineering, drafting, and clerical expenses associated with updating the Record Drawings and Conduit Schedule due to any major unauthorized changes.

O. The term "Engineer" used throughout this Division 16 is the "City of Merced Engineer or their designated Engineer representative." The term "Owner" in Division 16 is the City of Merced. When "Contractor" is listed in these documents without further definition, such as "Electrical Contractor," it is to mean the "Prime or General Contractor."

P. All control panels, control stations and instrument enclosures shall be a listed approved assembly and labeled by an approved testing shop. This is to be an entire assembly (a complete unit) to include all components and enclosures as an assembly, controls. etc.

Q. The Contractor shall field verify all existing conditions, equipment, wires, conduit, etc., as required to complete the project.

1.2 CODES AND STANDARDS

A. All electrical/instrumentation equipment and materials, including installation and testing, shall conform to the following applicable codes and standards:

1.	ANSI	American National Standards Institute, Inc.
2.	EIA	Electronics Industries Association
3.	ETL	Electrical Testing Laboratories
4.	FM	Factory Mutual
5.	GO128	General Order No. 128, Rules for Construction of Underground Electrical Supply and Communication Systems, Public Utilities Commission of the State of California
6.	IEEE	Institute of Electrical and Electronics Engineers
7.	ICEA	Insulated Power Cable Engineers' Association

8.	ISA	International Society for Measurements & Control Standards (formerly Instrument Society of America)
9.	NEC	National Electric Code, 2020 Edition
10.	NEMA	National Electrical Manufacturers Association
11.	NETA	Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems, International Electrical Testing Association
12.	NESC	National Electrical Safety Code
13.	NFPA 820	National Fire Protection Agency, Standard for Fire Protection in Wastewater and Collection Facilities
14.	OSHA	Occupational Safety and Health Act Standards
15.	UL	Underwriter's Laboratories, Inc.

B. The revisions of these codes and standards in effect on the date of issuance of the Contract Documents shall apply.

C. Codes and standards referenced shall be considered minimum acceptable work.

D. In instances where two or more codes are at variance, the most restrictive requirements shall apply.

E. Nothing on the Drawings or in the Specifications shall be construed to permit work or materials not conforming to the preceding codes and standards.

F. All work shall also be performed in accordance with the State, County or City standards, and local Utility codes.

G. The Contractor shall furnish without extra charge any additional material and labor which may be required for compliance with these codes and standards, even though the work is not explicitly mentioned in the Specifications or shown on the Contract E- Series Drawings.

H. Amperage listed on the single-line Drawings for motors are per NEC Table 430.250 and may not necessarily match that of the equipment supplied. It is the electrical system supplier and Contractor's responsibility to furnish equipment sized for the motors supplied for this project at no additional cost.

1.3 RELATED WORK SPECIFIED IN OTHER SECTIONS

A. The following are covered in other sections in the Contract documents and are part of Division 16:

1. Section 16010 – Electrical.
2. Section 16011 – Electrical and Instrumentation Submittals and Drawing Requirements.
3. Section 16012 – Electrical and Instrumentation Operations and Maintenance Data.
4. Section 16013 – Electrical and Instrumentation Spare Parts.
5. Section 16020 – Seismic Restraint for Electrical Equipment.
6. Section 16110 – Conduits.
7. Section 16115 – Duct Banks, Vaults, and Pull Boxes.
8. Section 16120 – Wire, Fuses, and Terminal Blocks.
9. Section 16140 – Wiring Devices.
10. Section 16144 – Nameplates.
11. Section 16190 – Supporting Devices.
12. Section 16450 – Grounding.
13. Section 16605 – Electrical System Analysis.
14. Section 16620 – Electrical and Instrumentation Field Tests.
15. Section 16900 – Electrical and Instrumentation Training.
16. Section 16912 – PLC Firmware and Programming Software.
17. Section 16913 – PLC Applications Programming.
18. Section 16914 – PLC I/O List.
19. Section 16915 – PLC Control Strategies
20. Section 16940 – Instrumentation.
21. Section 16970 – Flow Instruments.

B. The contents of this Section apply to all "electrical and instrumentation" equipment suppliers and manufacturers doing work listed in following sections:

1. Section 01300 - Submittal Procedure.
2. Division 11.
3. Division 15.

1.4 ELECTRICAL CONTRACTOR QUALIFICATIONS

A. It is the intent of this Division that the complete responsibility for management and installation of the electrical and instrumentation required for this project be by the Electrical Contractor. This responsibility includes, but is not limited to, supervision and coordination of work performed by the System Supplier. Uncertified electricians shall not perform electrical work for which certification is required.

B. Contractor shall submit the proposed Electrical Sub-Contractor and System Supplier with bid documents that will be used on this project.

C. The Electrical Contractor shall meet the following minimum qualifications:

1. Has a current C-10 Electrical Contractor's License.
2. Has regularly engaged in similar electrical Contracting for the municipal water and wastewater industry.
3. Has performed work of similar or greater complexity on at least five previous projects under one company name which is the present company name.
4. Has all persons performing work as electricians certified by the California Apprenticeship Council per California Labor Code Section 3099.
5. The Electrical Contractor certification per Section 01012 – Certification of Electrical Sub-Contractor Experiences and Qualifications.

1.5 SYSTEM SUPPLIER QUALIFICATIONS

A. General:

1. All switchboards, panels, MCCs, panelboards, panelboard transformers and PLC hardware, shall be supplied by one system supplier. All panels and instrumentation listed for Division 16 in all Division 16 appendix Indexes shall be supplied by the same System Supplier. This includes, but not limited to, all work necessary to select, furnish, supervise installation, calibrate, program, and place into operation all transmitters, instruments, controllers, alarm equipment, monitoring equipment, and accessories as specified herein. The system supplier shall not subcontract any portions of the equipment provisioning with the exception of fire and security alarm systems without written approval of Owner.

2. The system supplier shall have an on-staff project engineer with prior experience on similar sized projects. This project engineer shall coordinate the technical aspects of this project and prepare the submittals and drawings. This project engineer's name, address, and phone number shall be provided within the first week after notice to proceed. The system supplier project engineer shall attend all coordination meetings and be on-site when requested by the Owner's Resident Engineer.

B. The System Supplier certification per Section 01013 – Certification of System Supplier Experiences and Qualifications.

1.6 CONTRACT DOCUMENTS

A. The Contract Drawings and Specifications are intended to be descriptive of the type of electrical system to be provided; any minor details missing in either shall not relieve the Contractor from the obligations there under to install in correct detail any and all materials necessary for a complete operational system at no additional cost.

B. The Contract Drawings are generally diagrammatic; exact locations of electrical products shall be verified in the field with the Owner's Resident Engineer. Except where special details on Drawings are used to illustrate the method of installation of a particular piece or type of equipment or materials, the more restrictive of the two shall take precedence in the event of conflict.

C. The Contract Electrical elementary, elevation and one-line diagrams are the basis of the electrical system to be provided and are for reference only. It is the Contractor's responsibility to adjust and make minor revisions to the diagrams as necessary for an operational system at no additional cost to the Owner. Additional isolators, relays, wiring, terminal blocks, etc., shall be provided for an operational system at no additional cost to the Owner. Contractor shall also modify starter size, breaker size, etc. at no additional cost to the Owner, if such changes are the direct result of the equipment selected by the Contractor.

D. Location at facilities of new equipment, inserts, anchors, panels, pull boxes, conduits, stub-ups, and fittings for the electrical system are to be determined by the Contractor and Engineer at time of installation. Contractor shall make minor adjustments to locations of electrical equipment required by conditions and coordination with other trades at no additional cost. Minor adjustments are defined as those adjustments required due to equipment size changes or variations between different equipment suppliers.

E. The Conduit and Wire Routing Schedule, wire fill, and number of conduits are based on the best information available. It is the Contractor's responsibility to modify the conduit schedule based upon Shop Drawings for the actual equipment. Such modifications in conduit sizes and numbers of conductors shall be at no additional cost to the Owner and shall be approved by Owner, if such changes are the direct result of the equipment selected by the Contractor. A copy of the Conduit and Wire Routing Schedule and Electrical plans showing conduit routing shall be updated weekly by the Contractor. Progress payments will be withheld if during monthly checks it is found that the contractor fails to maintain the Conduit Schedule updates.

F. Electrical and instrumentation, conduit and wire lengths shown on circuit Drawings are approximate and do not show changes in elevation or vertical risers. The Contractor is responsible for determining actual lengths for bidding and installation purposes.

G. All equipment shall be installed and located so that it can be readily accessed for operation and maintenance. The Engineer reserves the right to require minor changes in location of equipment, without incurring any additional costs. These minor changes are changes which would provide adequate clearance and work areas in front of and around equipment.

H. Where conduits are shown as "home runs" on the Contract Drawings or stated to be furnished, but not explicitly shown as part of the scope of work, the Contractor shall provide all fittings, boxes, wiring, etc., as required for completion of the raceway system in compliance with the NEC and the applicable Specifications in this Section.

I. No changes from the Contract Drawings or Specifications shall be made without written approval of the Engineer. Should there be a need to deviate from the Contract documents, submit written details and reasons for all changes to the Engineer for review within thirty days after the award of the contract.

J. The resolution of conflicting interpretation of the Contract documents shall be as determined by the Engineer.

K. The Electrical Contractor shall maintain a separate set of neatly hand-printed or typed and accurately marked set of Record Documents, consisting of spreadsheets, specifications and full size blue-line Electrical (E-Series) and Instrumentation (P-Series) Contract Drawings. These documents are to be used specifically for recording the as built locations and layout of all electrical and instrumentation equipment, routing of raceways, vaults, junction and pull boxes, and other diagram or document changes. These Record documents shall be kept up-to-date during the progress of the job, with all "change orders," submittal modifications, and construction changes shown and stamped with "As-Built" at end of job. These Record documents shall not be used for daily construction use and shall not contain any mark-ups that are unrelated to as-built corrections. Updated drawings are to be submitted with pay estimates to show progress of revisions, changes which affects pay request.

1. The following lists the record documents that shall be submitted as "as-built" by the Electrical Contractor:

    a. E-Series Drawings.

    b. Panelboard schedules.

    c. Conduit and Wire Routing Schedule.

        1) A copy of the Conduit and Wire Routing Schedule and Electrical Contract Drawings showing conduit routing shall be updated weekly by the Contractor.

        2) Progress payments will be withheld if during monthly checks it is found that the Contractor fails to maintain the Conduit Schedule updates.

    d. Lighting and Fixture Schedule.

    e. Duct banks and their routing with offset measurement and indicated changes in depths.

2. The following lists the record documents that shall be submitted as "as-built" by System Supplier to be maintained by Electrical Contractor:

    a. P-Series Drawings

    b. Section 16914 PLC I/O List

    c. Instrumentation Indexes

3. Record documents shall be kept current weekly with all change orders, submittal modifications, and construction changes shown. Record Documents shall be subject to the inspection by the Engineer at all times, progress payments or portions thereof may be withheld if Record Documents are not accurate or current.

4. When documents are changed, they shall be marked with erasable colored pencils using the following coloring scheme:

    a. Additions – red

    b. Deletions – green

    c. Comments - blue

    d. Dimensions – black

5. Show the following on the Electrical (E-Series) Record Contract Drawings by dimension from readily obtained base lines:

    a. Exact location, type and function of electrical and instrumentation equipment and devices.

    b. Precise routing and locations of underground conduits, ductbanks, vaults, pullboxes, junction boxes, etc. that make-up the raceway system.

c. Show the dimensions, location and routing of electrical work which will become permanently concealed.

d. Show complete routing and size of any significant revisions to the systems shown.

6. Prior to acceptance of the work, the Contractor shall deliver to the Engineer one set of record full-size Electrical and Instrumentation series Record Contract Drawings and spreadsheets neatly marked and accurately showing the information required above.

1.7 SUBMITTAL AND DRAWING REQUIREMENTS

Provide electrical and instrumentation submittals per Section 16011 - Electrical and Instrumentation Submittal Requirements and Section 01300 - Submittal Procedure.

1.8 COORDINATION

A. The Contractor shall coordinate the electrical work with the other trades, code authorities, utilities, and the Engineer, with due regard to their work, towards promotion of rapid completion of the project. If any cooperative work must be altered due to lack of proper supervision of such, or failure to make proper provisions, then the Contractor shall bear expense of such changes as necessary to be made in the work of others.

B. The Contractor shall examine the architectural, mechanical, structural, electrical, and instrumentation equipment provided under other Sections of this Contract in order to determine the exact routing and final terminations for all conduits and cables. The exact locations and routing of cables and conduits shall be governed by structural conditions, physical interferences, and the physical location of wire terminations on equipment. Conduits shall be stubbed up as close as possible to equipment terminals.

C. Manufacturer's directions and instructions shall be followed in all cases when they have more restrictive requirements than that shown on the Contract Drawings or have stipulations in order to meet warranty requirements.

D. The Contractor shall schedule a minimum of two (2) mandatory coordination meetings during the initial and submittal phase of the project. The meetings shall be held at the jobsite and include, as a minimum, attendance by the Owner's Resident Engineer, Prime Contractor, Electrical Contractor, System Supplier Engineer, and Design Engineer.

1. The first meeting shall be held in advance of the first comprehensive submittal and no later than 21 days after Contract award. The purpose of the meeting shall be for the Electrical Contractor and System Supplier to summarize their understanding of the project, discuss any proposed substitutions or alternatives, review the project schedule, explain format of Drawings, and discuss any other topics deemed necessary for project coordination.

2. The second meeting shall be held after the review of the first comprehensive System Supplier submittal has been completed by the Owner. The purpose of the meeting is to discuss comments made on the submittal package, to update the project schedule, and coordinate the testing, training, and installation phases of the project.

E. The electrical and instrumentation modifications and additions are to be made after parts of the Plant are operational. The Contractor shall schedule all the required work with the City, including each shutdown period. Each shutdown shall be implemented to minimize disruption of the existing operations. The work to be provided under this Contract shall not disrupt any of the Plant operations without prior approval.

1. The Contractor shall limit all unscheduled shutdown periods to less than 1 hour and only with prior approval of the City.

2. Carry out scheduled shut downs only after the time, date, and sequence of work proposed to be accomplished during shutdown has been favorably reviewed by the City. Submit shutdown plans at least 2 days in advance of when the scheduled shutdown is to occur.

3. The City reserves the right to delay, change, or modify any shutdown at any time, at no additional cost to the City, when the risk of such a shutdown would jeopardize the operation of the system.

F. The Contractor shall cease work at any particular point, temporarily, and transfer his operations to such portions of work as directed, when in the judgment of the Owner it is necessary to do so.

G. Prior to commencing construction, the Electrical Contractor shall arrange a conference with the Prime Contractor, System Supplier and Owner's Resident Engineer as well as all major equipment suppliers, and shall verify types, sizes, locations, controls and installation requirements of all proposed equipment. He shall, in writing, inform the Owner's Resident Engineer that all phases of coordination of this equipment have been covered and if there are any unusual conditions, they shall be enumerated at this time.

1.9 SUPERVISION

A. The Contractor shall schedule all activities, manage all technical aspects of the project, coordinate submittal and Drawings, and attend all project meetings associated with this Section.

B. The Contractor shall supervise all work in this Section, including the Electrical Contractor's general construction work, and System Supplier's work, from the beginning to completion and final acceptance.

C. The Contractor shall supervise and coordinate all work in this Section to ensure that each phase of the project, submittal, delivery, installation, and acceptance testing, warranty, etc., is completed within the allowable scheduled time frame.

D. The Contractor shall be responsible for obtaining, preparing, completing, and furnishing all paper work for this Section including that of the Electrical Contractor and the System Supplier, which shall include transmittals, submittals, forms, documents, manuals, instructions, and procedures.

1.10 INSPECTIONS

A. All work or materials covered by the Contract documents shall be subject to inspection at any and all times by the Engineer. If any material does not conform to the Contract documents, or does not have an "approved" or "approved as noted" submittal status; then the Contractor shall, within three days after being notified by the Engineer, remove the unacceptable material from the premises; and if said material has been installed, the entire expense of removing and replacing same, including any cutting and patching that may be necessary, shall be done by the Contractor.

B. The Contractor shall give the Owner 10 working days' notice of the dates and time for inspection. Date of inspection shall be as agreed upon by both the Contractor and Owner

C. Work shall not be closed in or covered over before inspection and approval by the Owner's Resident Engineer. All costs associated with uncovering and making repairs where non-inspected work has been performed shall be borne by the Contractor.

D. The Contractor shall cooperate with the Owner and provide assistance for the inspection of the electrical system under this Contract. The Contractor shall remove covers, provide access, operate equipment, and perform other reasonable work which, in the opinion of the Engineer, will be necessary to determine the quality and adequacy of the work.

E. Before request for final inspection is made, the Contractor shall submit to the Owner in writing, a statement that the Contractor has made his own thorough inspection of the entire project enumerating punch list items not complete and that the installation and testing is complete and in conformance with the requirements of this Division.

F. The Owner may arrange for a facility inspection by Cal-OSHA Consultation Service at any time. The Contractor shall make the necessary corrections to bring all work in conformance with Cal-OSHA requirements, all at no additional cost to the Owner.

G. Contractor will be responsible for any additional cost for overtime, weekend overtime or differential time expenses for inspection of defective work that has to be re-inspected.

1.11 JOB CONDITIONS

A. The Contractor shall make all arrangements and pay the costs thereof for temporary services required during construction of the project, such as temporary electrical power and

telephone service. Upon completion of the project, remove all temporary services, equipment, material, and wiring from the site as the property of the Contractor.

B. The Contractor shall provide adequate protection for all equipment and materials during shipment, storage, and construction. Equipment and materials shall be completely covered with two layers of plastic and set on cribbing six inches above grade so that they are protected from weather, wind, dust, water, or construction operations. Equipment shall not be stored outdoors without the approval of the Owner. Where equipment is stored or installed in moist areas, such as unheated buildings, provide an acceptable means to prevent moisture damage, such as a uniformly distributed heat source to prevent condensation.

C. The elevation of the project site is approximately 150 feet above sea level. All equipment shall be derated as recommended by the manufacturer or in accordance with ANSI C37.30.

D. The normal, unconditioned ambient temperature range of the job site will vary between 10° to 110 °F. All equipment shall be rated to operate at continuous full load under these temperature ranges. Any additional provisions for cooling or heating shall be provided to meet these requirements at no additional cost.

E. Corrosion Protection:

1. The Contractor is specifically cautioned that the treatment plant ambient air contains airborne contaminants, including but not limited to, the corrosive gasses: hydrogen sulfide, chlorine and ammonia. The corrosion severity level will vary according to specific locations, temperature, relative humidity, ratio of change of relative humidity, wind speed and wind direction, and may also be subject to seasonal variation.

2. Unless otherwise specified, equipment shall be installed such that no significant or detrimental corrosion shall occur over a 20 year period. Installation of 316 stainless steel NEMA 4X enclosures is acceptable to meet this requirement.

3. Class 1 Areas:

a. Areas noted as Class 1, Div 1 or 2 areas may contain gases or vapors that are hazardous. The Contractor shall take all precautions to maintain personnel safety by always having working gas monitors present in Class 1 areas or by other methods.

b. All Electrical construction in Class 1, Div 1 or 2 areas shall be installed as follows:

1) Explosion proof.

2) Intrinsically safe.

1.12 OPERATION AND MAINTENANCE MANUALS

Operation and maintenance manuals covering instructions and maintenance for each type of equipment shall be furnished per Section 16012 – Electrical and Instrumentation Operations and Maintenance Data.

1.13 AREA CLASSIFICATION

Where equipment ratings are not specifically called out on the drawings or schedules, they shall be supplied with the following ratings:

A. Wet environments requiring NEMA 4X enclosures and construction:

1. Indoors in water corrosive or chemical exposed areas.
2. All equipment mounted outdoors.

B. Dry heated areas requiring NEMA 12 enclosures and construction:

1. Indoor equipment not in water corrosive or chemical exposed areas.

C. Seismic Classification:

1. The site is within Seismic Zone 3. All electrical equipment and construction techniques must be designed and braced per Section 16020 Seismic Restraint for Electrical Equipment.

D. Locations requiring Class 1, Division 1 rating:

1. Septage receiving station.
2. Headworks screening area.
3. All wetwells of submersible sewage or wastewater pumps.

E. Locations requiring Class 1, Division 2 rating:

1. Grit pumps, basins and classifier.
2. Aerobic Digesters.
3. Influent pump station.

1.14 CHANGE ORDER PRICING

A. All change order pricing by Contractor or System Supplier shall be broken out into the following minimum categories:

1. Labor per hour, listed per discipline, i.e. Engineer, Drafter, Estimator, Programmer, Secretarial, Electrician, etc.
2. Materials and equipment itemized per component and quantity.
3. Conduit and wiring size, lengths and costs per foot for material only.
4. Rentals, travel, per diem, etc.
5. Tax.
6. Shipping.
7. Insurance.
8. Overhead and profit.

B. Lump sum change order pricing is not acceptable.

C. If Contractor or System Supplier refuses to provide a change order with broken out pricing, the Engineer reserves the right to obtain independent estimates from other Contractors or System Suppliers. The Contractor or System Supplier, who refused to provide the change order with broken out pricing, will be charged for the preparation of the independent estimates.

PART 2 MATERIALS

2.1 QUALITY

A. It is the intent of the Contract Specifications and Drawings to secure the highest quality of all materials and equipment in order to facilitate operation and maintenance of the facility. All equipment and materials shall be new and the products of reputable suppliers having adequate experience in the manufacture of these particular items. For uniformity, only one manufacturer will be accepted for each type of product. Provide the manufacturer's latest design that conforms to these Specifications.

B. All equipment shall be designed for the service intended and shall be of rugged construction, of ample strength for all stresses which may occur during fabrication, transportation, erection, and continuous or intermittent operation. All equipment shall be adequately stayed, braced, and anchored, and shall be installed in a neat and workmanlike manner. Appearance and safety, as well as utility, shall be given consideration in the design of details. All components and devices installed shall be standard items of industrial grade, unless otherwise noted, and shall be of sturdy and durable construction suitable for

long, trouble-free service. Light duty, fragile, and competitive grade devices which in the opinion of the Engineer are of doubtful durability shall not be used.

C. Products that are specified by manufacturer, trade name, or catalog number, establish a standard of quality and do not prohibit the use of approved equal of other manufacturers. However, all provided products specified or not, must be favorably reviewed and approved by the Engineer prior to installation.

D. Underwriter's Laboratories (UL) listing is required for any installed equipment; this includes substituted equipment when such a listing is available for any named equipment.

E. When required by the Contract Specifications or requested by the Engineer, the Contractor shall submit equipment or material samples for test or evaluation. The samples shall be furnished with information as to their source and prepared in such quantities and sizes as may be required for proper examination and testing, with all freight and charges prepaid. All samples shall be submitted before shipment of the equipment or material to the job site and in ample time to permit the making of proper tests, analyses, examinations, rejections, and resubmissions before incorporated into the work.

F. It is the System Supplier's responsibility to visit the jobsite to collect and document existing equipment and MCC device part numbers in order for all similar new equipment to match existing.

2.2 COMPONENTS

A. Switches and Lights

1. General:

a. Water and oil tight as defined by NEMA 13, UL listed.

b. Standard 30 mm diameter, with round plastic clamp ring.

c. Manufacturers:

1) Switches shall be Allen Bradley 800T.

2) Cutler-Hammer E34 Series.

3) Approved equal.

4) Devices to be mounted or supplied for existing MCCs, switchgear, and control panels shall match the style of existing devices.

2. Hand Switch (HS):

a. Selector switches for hand-off-auto (HOA) applications shall have the hand position to the left, off in center, and auto in the right position.

b. On/Off selector switches shall have the On position to the right.

3. Hand Control (HC):

    a. Pushbutton caps shall be colors shown on Contract Drawings or approved in submittals.

4. Indicating Lights:

    a. Full voltage LED type.

    b. Round plastic lens and miniature bayonet lamp base.

    c. Manufacturer's standard legend plates shall be provided.

    d. Indicating light type and color of lens shall be as shown on the Drawings or specified in the Contract documents.

    e. Indicating lights designated "PTT" shall be provided with a push-to-test switch and wiring.

B. Relays and Timers:

1. General: Relays and timers shall be provided with N.O. or N.C. contacts as shown on the Contract Drawings. All spare contacts shown shall be provided. A minimum of two isolated form C contacts shall be provided on each timer or relay. Contacts shall be rated 10 amps minimum at 120 VAC, 60 Hz unless otherwise stated. Supply power or coil voltage shall be 120 VAC unless otherwise shown on the Contract Drawings or when relay is utilized in 24VDC control circuits. Relays and timers shall be designed for continuous duty. All relays shall be UL listed. The following is a summary of abbreviations associated with relays and timers:

    a. CR - control relay.

    b. PFR - power fail relay.

    c. TR - time delay relay.

    d. TDOE - time delay on energization.

    e. TDOD - time delay on de-energization.

2. Control relays (CR) shall be plug-in type with clear see-through sealed or enclosed housing to exclude dust. Sockets for plug-in relays shall be standard industrial type blade 8 or 11 pin with barrier pressure screw terminals. Provide IDEC Type RH, Potter and Brumfield, or approved equal. Provide relay energized neon lamp or LED (inside relay case).

3. The power fail relay (PFR) shall continuously monitor the three phases for power loss, low voltage, phase loss, and phase reversal. The power fail monitor shall have a drop-out voltage adjustment, an adjustable delay on make time delay (0.2 to 8.0 minutes) and a status indicating LED. Power fail relays shall be Diversified SLJ, Time Mark, or approved equal.

4. Time delay relays (TR) shall be solid state plug-in relays with a timer adjustable over the multi-time range 1 second to 10 minutes and from 1 minute to 10 hours unless

other ranges are indicated or required. Provide LED timer energized indicator lamp. Sockets for plug-in timers shall be standard industrial type blade 8 or 11 pin with barriered pressure screw terminals. Time delay relays shall be IDEC RTE, Potter and Brumfield, or approved equal.

5. Provide and install all moisture or temperature protection relays when required for equipment or motor/pump warranty conditions including any additional conduits for low voltage signal wiring. Submitted drawings shall include the wiring and terminations for all of these relays.

6. The motor controls shall be controlled by an Allan-Bradley 1760 Pico controller or approved equal. Provide additional modules to meet intent of Contract Drawings. The Pico controller I/O shall be wired to match wiring shown on Contract drawings. Pico controller shall have built in keypad, LCD display and real-time clock. Contractor shall be responsible for programming PICO and obtaining software required to program PICO.

2.3 ELECTRICAL ENCLOSURES AND BOXES

A. Enclosures to be NEMA rated per Indexes with fast access door latches. Enclosure construction shall be 14 gauge (minimum) with continuously welded seams. Outer door shall have provisions for locking enclosure with standard padlock. Provide full height white backpan in each box. Provide larger enclosure as required to accommodate the supplied equipment at no additional cost to the Owner.

B. Provide accessories consisting of breaker to disconnect incoming power, heater, fan, louvers, and thermostats. Provide metal data pocket within each enclosure and box to hold as-built drawings.

C. Panels listed as stainless steel shall be 316 stainless steel.

D. Provide copper ground bus per Section 16450.

E. All metal panel doors shall be installed with ground straps.

F. Panels shall be provided with engraved nameplate identifying name of panel, voltage and location of power source feeding it (i.e. MCC-100, Panelboard LP-1, etc.).

G. Enclosure shall be Hoffman, Rittal or approved equal.

PART 3 EXECUTION

3.1 WORKMANSHIP

A. All work in this Section shall conform to the codes and standards outlined in Division 16 or in these plans and specifications.

B. The Contractor shall employ personnel that are skilled and experienced in the installation and connection of all elements, equipment, devices, instruments, accessories, and assemblies. All installation labor shall be performed by qualified personnel who have had experience on similar projects. Provide first class workmanship for all installations.

C. The Contractor shall ensure that all equipment and materials fit properly in his installations.

D. The Contractor shall perform any required work to correct that in the opinion of the Engineer are improper installations at no additional expense to the Owner.

E. The Engineer reserves the right to halt any work that is found to be substandard or being installed by unqualified personnel.

F. All cutting and notching shall be laid out carefully in advance. Do not notch any structural member or building surface without specific approval in writing from the Engineer. Carefully carry out any cutting, channeling, chasing, or drilling of floors, walls, partitions, ceilings, paving, or other surfaces required for the installation, support, or anchorage of conduit, raceways, or other electrical materials and equipment. Following such work, restore surfaces neatly to new condition using skilled craftsmen of the trades involved, at no additional cost to the Owner.

G. Keep the premises free from accumulation of waste material or rubbish on a daily basis. Upon daily completion of work, remove waste materials, scraps, and debris from the premises and from the interior and exterior of all devices and equipment.

H. All equipment installed by the Contractor shall be in accordance with the Drawings and the manufacturer's recommendations and instructions and shall operate to the Engineer's satisfaction. Follow all manufacturers' instructions for handling, receiving, installation, and pre-check requirements prior to energization. After energization, follow manufacturer's instructions for programming, set-up and calibration of equipment. The Contractor shall be responsible for and shall correct by repair or replacement, at his own expense, equipment which in the opinion of the Engineer, has been caused by faulty mechanical or electrical assembly by the Contractor. Necessary tests to demonstrate that the electrical and mechanical operation of the equipment is satisfactory and meets the requirements of these Specifications shall be made by the Contractor at no additional cost to the Owner.

I. The Contractor shall vacuum clean the interior of all motor control centers, panelboards, junction boxes and other enclosures supplied under this project containing electrical

equipment to remove all dirt, metal chips, stripped insulation, etc., from the enclosure. This cleaning shall be done prior to energizing the device initially and a second time immediately prior to the final acceptance inspection.

3.2 CONSTRUCTION METHODS, GENERAL

A. All wiring shall be neatly bundled and laced with plastic tie-wraps, anchored in place by screw attached retainer. Where space is available, such as in electrical cabinets, all wiring shall be run in slotted plastic wireways or channels with dust covers. Wireways or channels shall be sized such that the wire fill does not exceed 50%. Wires carrying 100 volts and above shall be physically separated from lower voltage wiring by using separate bundles or wireways with sufficient distance to minimize the introduction of noise, crossing only at 90 degree angles. Retainers shall be Panduit High Bond Adhesive back mounts SGABM series, or approved equal.

B. Where wiring crosses hinged surfaces, provide a "U" shaped hinge loop protected by plastic spiral wrap. The hinge loop shall be of sufficient length to permit opening and closing the door without stressing any of the terminations or connections.

C. Wireways, retainers, and other devices shall be screw-mounted with round-head 316 stainless steel screws. Glue or sticky back attachment of any type or style shall not be used.

D. All devices and wiring shall be installed and permanently labeled and secured in accordance with Section 16144 and Section 16120.

E. All components associated with a particular compartment's or enclosure's function shall be mounted in that compartment or enclosure.

F. Spacing and clearance of components shall be in accordance with UL, JIC, and NEC standards.

G. Wires shall not be spliced except where shown. Devices with pigtails, except lighting fixtures, shall be connected at terminal blocks. Equipment delivered with spliced wires shall be rejected and the Contractor required to replace all such wiring, at no additional cost to the Owner.

H. Where splices are allowed or approved by the Engineer they shall conform with the following:

1. Splices of #10 and smaller, including fixture taps, shall be made with nylon self-insulated twist on wire joints; T & B, or approved equal.

2. Splices of #8 and larger shall be double crimped splices, or approved equal, insulated with heat shrink tubing, or approved equal.

3. Splices in underground pullboxes shall be insulated and moisture sealed with 3M "Scotchcast" cast resin splice kits. Kits used shall have a date marking for shelf life that is not expired.

4. Wire splicing devices shall be sized according to manufacturer's recommendations.

5. Tape on splices shall not be allowed.

6. Splices for motor leads shall be made with 3M DB series splice kit, or approved equal.

I. Tapes shall conform to the requirements of UL 510 and be rated: 105 °C, 600V, flame retardant, hot and cold weather resistant. Vinyl plastic electrical tape shall be 7 mil black. Phase tape shall be 7 mil vinyl plastic, color coded as specified; 3M 33 + or equal. Electrical insulation putty shall be rubber based, elastic putty in tape form; 3M or equal. Varnished cambric shall not be used.

J. Connections to terminals shall be as follows:

1. Use connector or socket type terminals furnished with component.

2. Connections to binding post screw, stud, or bolt use:

a. For #10 and smaller wire, T & B "Sta-Kon," Buchanan "Termend" or approved equal, self-insulated locking forked tongue lug.

b. For #8 to #4/0 wire, T & B "Locktite," Burndy QA, or approved equal, lug of shape best suited.

3. Use ratchet type crimping tool which does not release until proper crimp pressure has been applied.

4. Connections for all terminals shall be made with insulation stripped per manufacturer's instructions.

K. Equipment shall be wired and piped by the manufacturer or supplier. Major field modifications or changes are not allowed without the written "change order" authority by the Engineer. When field changes are made, the components, materials, wiring, labeling, and construction methods shall be identical to that of the original supplied equipment. Contractor's cost to replace or rework the equipment to match original manufacturer or supplier methods shall be done at no additional cost to the Owner.

L. Mating fittings, bulkhead fittings, plugs, connectors, etc., required to field interface to the equipment and panels shall be provided by the supplier when the equipment is delivered.

M. All electrical and instrumentation Drawings associated with the equipment shall be provided with the equipment when it is delivered to the job site. Drawings for each piece of equipment shall be placed in clear plastic packets of sufficient strength that will not tear or stretch from drawing removal and insertion. All Drawings shall also be provided in a digital electronic format.

N. Vertical motors, horizontal motors and all motors shall have make-up connections per Contract Drawings.

O. All wire and cable lugs shall be copper; aluminum or aluminum alloy lugs shall not be allowed. The Electrical Contractor shall supply all lugs to match the quantity and size of wire listed in the Conduit and Wire Routing Schedule.

3.3 EQUIPMENT FABRICATION, GENERAL

A. Panel cutouts for devices (i.e., indicating lights, switches) shall be cut, punched, or drilled and smoothly finished with rounded edges. Exposed metal from cutouts that are made after the final paint finish has been applied shall be touched up with a matching paint prior to installing device. Do not paint nameplates, labels, tags, switches, receptacles, conductors, etc.

B. All doors shall be fully gasketed with non-shrinkable, water and flame resistant material.

C. Bolts and screws for mounting devices on doors shall be as specified by the manufacturer; otherwise they shall have a flush head which blends into the device or door surface. No bolt or screw holding nuts shall be used on the external surface of the door.

D. No fastening devices shall project through the outer surfaces of equipment except as designated by the manufacturer and approved by the Engineer.

E. Each component within the equipment shall be securely mounted on an interior subpanel or backpan and arranged for easy servicing, such that all adjustments and component removal can be accomplished without removing or disturbing other components. Mounting bolts and screws shall be front located for easy access and removal without special tools. Access behind the sub panel or backpan shall not be required for removing any component.

F. A copper ground bus shall be provided in each enclosure or cabinet. It shall have provisions for connecting a minimum of ten grounding conductors. Screw type lugs shall be provided for connection of grounding conductors. All grounding conductors shall be sized as shown on plans or in accordance with NEC Table 250.120, whichever is larger.

G. Minimum wire bending space at terminals and minimum width of wiring gutters shall comply with NEC Tables 312.6 (a) and (b).

H. Wire shall not be installed with smaller sizes than those shown in NEC Article 310 for each circuit amperage rating.

I. Future device and component mounting space shall be provided on the door, backpan, and subpanel where detailed on the Drawings. Where no detail is shown, provide a minimum of 15 percent usable future space.

J. Doors shall swing freely to a minimum of 90° and close with proper alignment.

K. All control, power, and signal wires inside enclosures shall be run in separate plastic wireways. Wireways shall not be filled over 50% capacity.

L. All electrical panels shall be labeled with the KAIC rating and meet the minimum Contract Document design rating; SSCR labeling is not accepted as an equivalent.

M. All vents shall be provided with removable metal filter.

N. A ground bus shall be provided in each enclosure or cabinet. It shall have provisions for connecting a minimum of ten grounding conductors. Screw type lugs shall be provided for connection of grounding conductors. All grounding conductors shall be sized as shown on plans or in accordance with NEC Table 250.122, whichever is larger.

3.4 DELIVERY

A. Contractor shall inspect each electrical and instrumentation item delivered to the jobsite and ensure that it is undamaged, meets specification and submittal.

B. Contractor shall unpack each item for inspection within two (2) days of arrival.

C. Complete written inventory shall be produced by Contractor and submitted to Owner within (2) days after arrival on jobsite for record keeping prior to any payment for the item.

3.5 DAMAGED PRODUCTS

Damage products will not be accepted. All damaged products shall be replaced with new products.

3.6 FASTENERS

A. Fasteners for securing equipment to walls, floors, and the like shall be 316 stainless steel. The minimum size fastener shall be 1/2-inch diameter. Layout to maintain headroom, neat mechanical appearance, and to support equipment loads required.

B. Concrete pad with stainless steel anchor bolts shall be provided for each Field Control Station and instrument support.

C. Anchor Methods:

1. Hollow Masonry: Sleeve type anchors.

2. Solid Masonry: Sleeve type anchors or epoxy anchors bolts.

3. Metal Surfaces: Machine screws, bolts, or welded studs.

4. Concrete Surfaces: Wedge or expansion anchors.

5. Structural Steel: Right angle, parallel and edge type rigid metal clamps. Do not weld or drill structural steel.

D. Equipment Mounting:

1. The Contractor shall be responsible for furnishing and setting all anchor bolts required to install his equipment.

2. Electrical equipment shall be unistrut "stand off" mounted a minimum of ½ - inch from the wall in a manner so that the rear of the equipment is freely exposed to air circulation.

3. Unistrut material shall be 316 stainless steel in NEMA 4X areas and galvanized in non-NEMA 4X areas unless called out specifically in details. Provide and install all unistrut face and bracing for secure mounting with a maximum ¼" deflection.

4. All equipment enclosures shall be of the NEMA classification noted on the electrical plan Drawings for the area in which the device will be mounted.

5. Reinforced concrete pad with 316 stainless steel anchor bolts shall be provided for each electrical freestanding equipment.

E. Dissimilar metals such as aluminum, stainless steel, steel, galvanized steel between enclosures, devices, etc. and mounting surfaces shall be isolated from each other using insulated tape or nonmetal spacers. Tape and spacers used shall be specifically manufactured for this application.

3.7 INSTALLATION, GENERAL

A. System:

1. Install all products per manufacturer's recommendations and the Drawings.

2. Provide relays, signal converters, isolators, boosters, and other miscellaneous devices as required.

3. Change normally open contacts to normally closed contacts or vice versa.

4. Add additional relays to provide more contacts as necessary.

5. Keep a copy of the manufacturer's installation instructions on the jobsite available for review at all times prior to and during the installation of the associated equipment.

B. Panels and Enclosures:

1. Install panels and enclosures at the location shown on the Drawings or approved by the Engineer.

2. Install level and plumb.

3. Seal all enclosure openings to prevent entrance of insects and rodents.

4. All conduits entering outdoor panels and enclosures shall use watertight hubs. These hubs shall be located on sides or bottom only. Top entry of outdoor panels or enclosures is not allowed unless specifically shown on plans.

5. Provide larger motor termination boxes as required to accommodate conduit and wires.

6. Additional condulets with terminal blocks shall be supplied for wire termination to devices with leads instead of terminals (i.e. solenoid valves, level probe, etc.).

7. Terminate all status, control, and analog I/O wiring on terminal blocks, including spares. Provide additional relay, DIN rails, terminal blocks and side panels as required.

8. Seal around bottom edge of all pad mounted enclosures to prevent entrance of insects, rodents, dirt, debris, etc.

9. Clearance about electrical equipment shall meet the minimum requirements of NEC 110.26.

10. Provide supporting devices per Section 16190.

11. All panels and enclosures shall be delivered with as-built drawings in clear plastic packets within each panel and enclosure.

C. Conduits and Ducts:

1. Install all conduits and ducts per Section 16110, Section 16115 and Section 16190.

2. Special “Soft–Jaw” type pipe clamps shall be used to prevent damage to PVC-coated conduit while field threading and cutting to length.

D. Wiring, Grounding, and Shielding:

1. Wiring inside and outside equipment shall be installed per Section 16120.

2. It is important to observe good grounding and shielding practices in the generally noisy environment in this application. The shield of shielded cables shall be terminated to ground at one end only, the originating panel end. The shield at the other end shall be encased in an insulated material to isolate it from ground.

3. Special cables shall be provided when required by manufacturer or necessary to correct noise or distortion interference at no additional cost to Owner.

4. Field wiring shall not begin until interconnection drawings have been submitted by the Contractor and approved by the Engineer, per Section 16011.

E. Cutting and Patching:

1. The Contractor shall do all cutting and patching required to install their work. Any cutting which may impair the structure shall require prior approval by the Engineer. Cutting and patching shall be done only by skilled labor of the respective trades. All surfaces shall be restored to their original condition after cutting and patching.

F. Seals:

1. Seal around all conduits, wires, and cables penetrating between walls, ceilings, and floors in all buildings with a fire stop material. Seal shall be made at both ends of the conduit with a fire stop putty. Seal shall have a minimum two hour rating. Fire stop sealing shall be International Protective Coatings Flamesafe, or approved equal.

2. Seal around conduits entering outside to inside structures and around bottom of free standing enclosures to maintain watertight integrity of structure.

3. Place conduit type seal in each underground conduit riser into panels and enclosures to prevent entrance of insects and rodents.

4. Seal around bottom edge of all pad mounted enclosures to prevent entrance of insects, rodents, dirt, debris, etc.

G. Housekeeping Pads:

1. Concrete housekeeping pads are required for all free standing electrical equipment. Housekeeping pads shall be 3-1/2" inches above surrounding finished floor or grade unless otherwise shown and shall be 4 (minimum) inches larger in width and depth around equipment.

2. Housekeeping pads shall be installed for future units as shown on the Contract Drawings.

3. Housekeeping pad shall be high quality Class "A" concrete with rebar crossway network per Contract Drawings. The minimum size rebar allowed is #3. Concrete shall be precisely leveled so that equipment set in place will not require shimming.

H. Cleaning and Touch up:

1. Prior to start-up and the completion of the work, all parts of the installation, including all equipment, exposed conduit, and fittings shall be cleaned and given touch up by Contractor as follows:

   a. Remove all grease and metal cuttings.

   b. Any discoloration or other damage to parts of the building, the finish, or the furnishings, shall be repaired.

   c. Thoroughly clean any of his exposed work requiring same.

d. Vacuum and clean the inside of all MCC and electrical and instrumentation enclosures prior to applying power and at end of project before final acceptance.

e. Clean all above and below ground pull boxes, junction boxes, and vaults from all foreign debris prior to final acceptance.

f. Paint all scratched or blemished surfaces with the necessary coats of quick drying paint to match existing color, texture, and thickness. This shall include all prime painted electrical equipment, including but not limited to enclosures, panels, poles, boxes, devices, etc.

g. Remove all decals and lettering from both sides of support plates.

h. Repair damage to factory finishes with repair products recommended by Manufacturer.

i. Repair damage to PVC or paint finishes with matching touchup coating recommended by Manufacturer.

3.8 SAFETY LOCKOUTS

A. Contractor shall provide safety lockout tags on the breakers for all MCCs and Panelboards and other electrical enclosures. Safety tags shall not be the same as those used by the Owner. All padlocks used for this purpose shall be keyed differently from any of the Owner's padlocks. Padlocks shall remain in place by the Contractor until operation of the portion of work is turned over to the Owner with the responsibilities noted on the acceptance form.

B. The following is the procedure for transferring each portion of work over to the Owner prior to completion of the entire project:

1. Contractor shall inform the Owner when a portion of the work is complete, ready for inspection and available to be placed into operation.

2. The Owner will schedule the inspection and substantiate that the work is complete and operational.

3. The Contractor will correct any deficiencies.

4. The Owner will prepare a Partial Utilization form in which that portion of the project will be turned over the Owner with the responsibilities noted on the acceptance form. The Contractor then shall remove his safety lockouts and tags.

C. Safety lockout tags shall be rigid vinyl with write-on surface and brass grommet. Safety tags shall be secured in place with material of sufficient strength to prevent accidental removal or displacement. Safety lockout tags shall be Panduit Write-on Safety Tags, model PVT-98 or approved equal

3.9 TESTING

A. Factory testing shall be as specified in Section 16610.

B. Field Tests shall be as specified in Section 16620.

3.10 TRAINING

Training shall be as specified in Section 16900.

3.11 SPARE PARTS

Spare parts shall be provided as specified in Section 16013.

3.12 WARRANTY

A. The Contractor shall warrant all electrical and instrumentation equipment and software supplied under this scope of work for a period of one (1) year from date of final acceptance. Standard published warranties of equipment which exceed the preceding specified length of time shall be honored by the manufacturer or supplier.

B. The Contractor shall provide all labor and material to troubleshoot, replace, or repair any hardware or software that fails or operates improperly during the warranty period, at no additional cost to the Owner.

C. The System Supplier shall have a staff of experienced personnel available to provide service on a two (2) working day notice during the warranty period. Such personnel shall be capable of fully testing, programming and diagnosing the hardware and software delivered; and of implementing corrective measures.

D. If the System Supplier fails to respond in two (2) working days, the Owner at its option will proceed to have the warranty work completed by other resources; the total cost for these other resources shall be reimbursed in full by the Contractor. The use of other resources, as stated above, shall not change or relieve the Contractor or supplier from fulfilling the remainder of the warranty requirements.

E. Each time the Supplier's repair person responds to a system malfunction during the warranty period, he or she must contact the designated Owner maintenance supervisor for scheduling of the work, access to the jobsite, and permission to make repairs. Operation of facilities necessary to test equipment shall only be performed by or under the direction of the Owner Staff. The Owner reserves the right at its sole discretion to deny operations requested by the Supplier. A written description of all warranty work performed shall be documented on a field service report to be given to Owner prior to the repair person leaving job site each day. This field service report shall detail and clearly state problem, corrective

actions taken, additional work that needs to be done, data, repair person name and company.

F. Prior to "final acceptance," the Contractor shall furnish to the Engineer a listing of warranty information for all manufacturers of materials, instruments, and equipment used on the project. The listing shall include the following:

1. Manufacturer's name, service contact person, phone number, and address.

2. Material and equipment description, equipment number, part number, serial number, and model number.

3. Manufacturer's warranty expiration date.

4. Copies of receipts/proof of purchase.

3.13 FINAL ACCEPTANCE

A. Final acceptance will be given by the Owner after the equipment has passed the "final acceptance trial period," each deficiency has been corrected, final documentation has been provided, and all the requirements of design documents have been fulfilled.

B. At the end of the project, following the completion of all of the field tests, and prior to final acceptance, the Supplier shall:

1. Remove all temporary services, equipment, material, and wiring from the site.

2. Verify Service equipment has been legibly marked in field with the maximum available fault current per NEC 110.24 (A). Field marking shall include date the fault current calculation was performed and be weather & UV rated. Service equipment shall not be hand labeled.

3. Two sets of all keys for locks supplied on this project. Submit each key with matching duplicate. Wire all keys for each lock securely together. Tag and plainly mark with lock number or equipment identification, and indicate physical location, such as panel or switch number.

4. Verify that as-installed drawings, in reinforced clear plastic pockets, have been placed in all new or modified panels.

5. Resubmit all Electrical System Analysis studies with all calculations rerun, data and graphs updated to reflect as-left conditions. Provide new Arc Flash labels to reflect as-constructed equipment and as-left circuit breaker settings.

6. Provide the following final documentation to the Owner:

a. A listing of warranty information.

b. Operations and Maintenance Manual – Each "operation and maintenance" manual shall be modified or supplemented by the Supplier to reflect all field changes and as-built conditions.

c. Full size record drawings, neatly marked and accurately showing the information required herein.

d. Two (2) disk copies of all final documentation to reflect as-built conditions.

e. Four (4) USB drives with copies of all final documentation to reflect as-built conditions. USB to include drawings in both PDF & DWG Format; SCADA Program for PLC and associated equipment; all configuration files for radios, instrumentation, etc.

f. At least one set of manuals, all software, disks and required programming cables shall be turned over to the Owner's SCADA/Electrical division.

END OF SECTION

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SECTION 16011

ELECTRICAL AND INSTRUMENTATION SUBMITTALS AND DRAWING REQUIREMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

Work specified under Section 01300.

1.2 RELATED SECTIONS

These Electrical Submittals and Drawing Requirements apply to all Sections of Division 16.

1.3 SUBMITTAL AND DRAWING REQUIREMENTS

General:

A. The Contractor shall ensure all equipment suppliers provide the submittal documentation required in Section 01300 and this Section. Submittals shall be complete, neat, orderly, and indexed. The Contractor shall check all submittals required under this Division for the correct number of copies, adequate identification, correctness, and compliance with the Contract Specifications and Drawings, and initial all copies certifying compliance.

B. Submittals shall also include all other information as may reasonably be required, in the opinion of the Engineer, to demonstrate fully that the materials and equipment to be furnished and the methods of work comply with the provisions and intent of the Contract Documents. Additional submittal requirements are specified in each individual Section of the Specifications.

C. The Contractor shall coordinate each submittal with the work so that the project will not be delayed. This coordination shall include scheduling the different categories of submittals, so that one will not be delayed for lack of coordination of another. No extension of time will be allowed because of failure to properly schedule submittals.

D. The Contractor shall provide a Submittal Check List, as shown in Appendix "A," for each submittal item. Note, submittal checklist in Appendix is typical and does not limit the extent of the submittals required.

E. No submittal documents shall be labeled as proprietary. Labeling documents as proprietary will be sufficient cause for rejection of entire submittal. The Owner reserves the right to copy or duplicate any and all portions of the documents provided for the project including copyrighted documents as desired.

F. Submittals shall be provided in binders as specified herein. The Owner reserves the right to reject submittals that fail to be organized as described herein.

G. Identify all submittals by submittal number on letter of transmittal. Submittals shall be numbered consecutively and resubmittals shall have a letter suffix. For example:

1. 1st submittal: 1
2. 1st resubmittal: 1A
3. 2nd resubmittal: 1B, etc.

H. All submittals required for Division 16 shall be submitted in quantity specified per Section 01300.

I. Submit a "Submittal Organization Plan and Schedule" for approval prior to the submission of any other submittals. This organization plan and schedule shall list all the submittals required under Division 16 and have a column filled in for proposed submittal date; and additional columns for entry of actual submittal date and date submittal approved. Submittal dates shall be spread out in a sequence meeting approval of Engineer to provide adequate review time and follow sequence of work. If contents of proposed schedule and submittal organization would not provide for a complete and timely review, compile submittal organization and schedule as directed by the Engineer. The schedule shall be updated and resubmitted as requested by the Engineer.

J. All catalog cuts and drawings for Division 16 listed materials for a major piece of equipment such as an MCC, shall be in one submittal package regardless of supplier of the various components. Catalog cuts shall be submitted grouped together by material and not scattered throughout the submittal intermingled with other material cut sheets (i.e. do not submit cut sheet for specific size conduit followed by cut sheet for specific size wire, and then cut sheet for different size conduit and different size wire. Group conduits together, group wires together, etc.).

K. Each submittal page shall be sequentially numbered and stamped with the date prepared. New pages added or pages replaced in any resubmittal shall have a later revised date than those used in original submittal and page numbering.

L. The decision of the Owner governs what is acceptable as a substitution. If the Owner considers it necessary, tests to determine equality of the proposed substitution shall be made, at the Contractor's expense, by an unbiased laboratory satisfactory to the Owner. Equality will be judged on the basis of the following:

1. Conformance with description or performance required.
2. Equal in quality.
3. Comparable in operation and maintenance.
4. Equal in longevity and service under conditions of climate and usage for given application.
5. Conformance with space allocations.
6. Comparable in appearance and artistic effect.
7. Compatible with mechanical and electrical construction of related work without necessitating changes in detail.

M. For each resubmittal, provide a copy of submittal comments and a separate letter, on Company letterhead, identifying how each submittal comment has been addressed in the resubmittal.

1.4 ELECTRICAL CONTRACTOR SUBMITTALS

A. Submittals include, but are not limited to, product data, samples, requests for substitutions, descriptive data, certificates, methods, schedules, marked-up Record Contract Drawings manufacturer's installation and other instructions, operations and maintenance manuals, and miscellaneous work related items.

B. Shop documents and Drawings shall be submitted for all devices and components in the electrical system provided by Electrical Contractor. The following items shall be submitted for approval under separate submittals:

1. Electrical components such as:
    a. Wire, cable and conduit labels.
    b. Nameplates and tags.
    c. Terminal blocks.
    d. Connectors and tapes.
    e. Conduit, raceways, wireways, and fittings.
    f. Ground system components.
    g. Pull, junction, and device boxes.

h. Enclosures and panels.

i. Miscellaneous wiring devices such as receptacles, switches, cover plates, etc.

j. Support and mounting methods.

k. Vaults.

2. Lighting and Fixtures, per Section 16500.

3. Conduit layout diagrams drawn to scale utilizing AutoCAD, with all conduit tags and size listed, shall be submitted and approved prior to underground conduits being installed. Conduits, duct bank and enclosure entries shall be drawn to scale. The following conduit layout diagrams shall be prepared and submitted by Electrical Contractor for approval.

   a. Diagrams for conduit stub-up locations into the bottom of:

      1) All Panels and Enclosures with 10 or more conduit entries.

      2) All new MCCs.

      3) Power Transformers.

   b. Diagrams for conduit cross sections for:

      1) All concrete duct banks.

      2) Each conduit run between all vaults and pull boxes shown on Contract Drawings.

      3) Pullbox and Vault side entries.

      4) Power Transformers.

4. Device and panel supports as specified in Section 16190.

5. Nameplates for equipment supplied by Electrical Contractor per Section 16144.

6. Seismic calculations per Section 16020.

7. Electrical system analysis per Section 16605.

8. Factory Test procedures per Section 16610.

9. Field Test procedures per Section 16620.

10. Training manuals per Section 16900.

11. Operation and maintenance manuals per Section 16012.

12. Record as-built Contract documents at end of project.

1.5 SYSTEM SUPPLIER SUBMITTALS

A. Submittals include, but are not limited to, product data, shop Drawings, test procedures, test results, annotated software program listings, disk copies of CAD generated Drawings, samples, requests for substitutions, descriptive data, certificates, methods, schedules, marked-up Contract Drawings and Specifications, manufacturer's installation and other instructions, operations and maintenance manuals, and other miscellaneous work related items.

B. Drawings shall be drawn using AutoCAD in a professional manner provided both on paper hardcopy and electronic form of CD or with each submittal. Each Drawing title shall contain an English Title, equipment number, and Drawing type to which Drawing pertains (i.e. Influent Pump No. 1 P1001 Elementary Diagram). Standard preprinted Drawings simply marked to indicate applicability to the Contract will not be acceptable. Drawings shall be prepared in a professional manner and shall have borders and a title block identifying the project, system, Drawing Number, AutoCAD file name, project engineer, date, revisions, and type of Drawing. Drawings shall be no smaller than 11" x 17" and printed with a laser jet printer or plotted in ink on vellum. The lettering shall be legible and no smaller than 0.075 inch in height. Drawings shall be prepared in the electrical diagram drafting format and detail as shown on the Contract "E" and "P" Series Drawings.

C. Drawings that are "B" sized shall be submitted in a folder that securely holds 11" x 17" Drawings. Drawings shall not be folded. Folder shall be clearly marked with System Supplier Company name, Submittal number, Specification Section reference, project name, and Electrical Contractor. "C" or "D" sized shall be folded and inserted into a clear plastic pocket with the title block visible. Drawings reduced from 11" x 17" to 8-1/2" x 11" or 8-1/2" x 14" in size shall not be acceptable.

D. Documents and Drawings shall be submitted for all devices and components in the electrical and instrumentation system. The following items shall be submitted for approval under separate submittals:

1. Motor control centers with all associated components.
2. PLC hardware.
3. Transformers and Panelboards.
4. Miscellaneous material:
    a. Wire, cable, and wire labels.
    b. Nameplates and tags.
    c. Terminal blocks and fuses.
    d. Miscellaneous devices.
5. Control panels and Enclosures with all associated components.
6. Instrumentation.

7. Instrument and vendor software and program documentation.
8. Operation and maintenance manuals.
9. Electrical System Analysis
10. Factory Test procedures.
11. Field Test procedures.
12. Training manuals.

E. System Supplier to submit Record as-built documents at end of project.

1.6 TESTING SUBMITTALS

A. The Contractor shall provide separate typed procedures and test forms detailing all of the factory and field tests. Test forms shall be setup to allow record entry of the results of each test. Each test procedure shall detail the requirements of Owner personnel to assist in operation of the site in order to conduct the tests. The Contractor shall provide sign-off forms for each test similar to those shown in Section 16610 and 16620 appendices. Each form shall include space for recording the following:

1. Test Procedure.
2. Test date.
3. Equipment tag number and description.
4. Test acceptance criteria.
5. Results of test.
6. Calibration test equipment description, part number and calibration date.
7. Check-off/sign-off for pass/fail including telephone numbers:
    a. Contractor.
    b. Engineer's Representative.
    c. Manufacturer's Representative.

B. Submit for approval the test procedures and test forms to the Owner at least three weeks prior to the start of testing. Testing shall not commence until the test procedures have been reviewed and approved by the Owner.

C. Along with each test procedure submittal, the Contractor shall state the name of the person to perform the test, qualification of person, company affiliation, resume listing past similar testing experience. If the Owner determines the person submitted is not qualified, then the Contractor shall resubmit an alternate. Test shall only be performed by the testing person approved by the Owner for the specific test.

D. Submit testing, start-up and operational testing schedule at the request of the Owner/Owner's Representative.

PART 2 MATERIALS

2.1 GENERAL

A. Submittals shall be neatly and orderly placed in binders. All copies shall be clear and legible. Provide originals when copies are not legible.

B. Each submittal shall include a copy of the appropriate Division specification sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (√) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated and, therefore, requested by the Contractor, each deviation shall be underlined and denoted by a unique number in the margin to the right of the identified paragraph. The remaining portions of the paragraph not underlined will signify compliance on the part of the Contractor with the Specifications. The submittal shall be accompanied by a detailed, written justification for each numbered item explaining variance or non-compliance with specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations from the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no review.

C. Each submittal for major equipment, such as MCCs shall be complete with all related drawings, catalog cuts, and other related submittal requirements in one package. Submittal deemed incomplete by Owner will be returned without review.

D. A copy of the Contract Document elementary diagrams and process and instrumentation (P & ID) diagrams relating to the submitted equipment, with require conformed plans and specifications that apply to the equipment in this Section, marked to show specific changes necessary for the equipment proposed in the submittal. If no changes are required, the Drawing or Drawings shall be marked "No Changes Required". Failure to include copies of the relevant Drawings with the submittal shall be cause for rejection of the entire submittal with no review being done.

E. All interconnects, loop, one-line and elementary diagrams shall be prepared by one System Supplier (except where noted otherwise). The Contractor shall submit for approval the proposed Drawing format for each type of Drawing or diagram specified. The Contractor shall not go into production with the Drawings or diagrams for this project until the Engineer has given written approval of the submitted proposed drawing format submittal.

2.2 ELECTRICAL CONTRACTOR SUBMITTAL DOCUMENTS

A. Each submittal shall be bound in a three hole-punched binder, which is sized such that when all material is inserted, the binder is not over 3/4 full. Spiral ring type binders are not acceptable.

B. Each binder shall be appropriately labeled on the front cover with the project name, Contract number, equipment supplier's name, Specification Section(s), and major material contained therein.

C. An index shall be provided on the inside front cover. This index shall itemize the contents of each tab and subtab section. Also list the project name, Contract number, and equipment supplier's name, address, phone number, and contact person on the index page.

D. Complete Material's list shall be provided as the first tabbed section. The Contractor shall provide Material list providing name of project, location of equipment, Specification Section, quantity, description, manufacturer, and full part number.

E. Shop documents, Drawings, and bill of materials shall be grouped under separate tabs. Shop documents shall be ordered in the same sequence as their corresponding Contract specification subsection. Dividers for each section shall be heavy duty with reinforced binding holes and permanent plastic labeled index tabs.

F. Failure to provide submittals with heavy duty permanent plastic labeled index tabs may be grounds for immediate rejection without review.

2.3 SYSTEM SUPPLIER SUBMITTAL DOCUMENTS

A. Each submittal shall be bound in a three ring binder, which is sized such that when all material is inserted the binder is not over 3/4 full. Binder construction shall allow easy removal of any page without complete manual disassembly. Spiral ring type binders are not acceptable.

1. Each binder shall be appropriately labeled on the outside spine and front cover with the project name, Contract number, equipment supplier's name, Specification Section(s), and major material contained therein.

2. An index shall be provided on the inside front cover. This index shall itemize the contents of each tab and subtab section. Also list the project name, Contract number and equipment supplier's name, address, phone number, and contact person on the index page.

3. The order of tabbed section in shop document submittal shall be as follows:

Tab	Contents
I	EXCEPTIONS/CLARIFICATIONS
II	BILL OF MATERIALS
III	PANEL EQUIPMENT SHOP DOCUMENTS
IV	FIELD EQUIPMENT SHOP DOCUMENTS
V	CONTRACT SPECIFICATIONS AND DRAWINGS
VI	NAMEPLATES

4. Dividers for each section shall be heavy duty with reinforced binding holes and permanent plastic labeled index tabs.

5. The following shall be submitted as separate submittal binders:

   a. PLC software program and documentation.

      1) Listing of all setpoints with proposed initial numeric entry values and corresponding Engineering Units for control strategies.

      2) Listing of all digital and analog registers, bits, timers etc., their respective description and full addresses.

      3) Complete commented ladder logic program.

      4) See Sections 16911 and 16915 for further submittal requirements.

   b. Drawings:

      1) A Drawing Index shall be provided that lists each Drawing title and drawing number. Each Drawing title and number shall be unique. The index shall not include drawings listed as "This Page Intentionally Left Blank."

      2) Drawings shall be submitted in a separate hole-punched binder that covers the entire 11 inch by 17 inch length of the Drawing:

         a) Shop Drawings with less than 15 sheets total in the submittal, shall be provided in an 11½-inch by 17½-inch reinforced folder.

         b) All Interconnection Drawings or Shop Drawings of 15 sheets or more shall be provided in separate three-ring binder to allow drawings to be easily removed. Binder shall be Cardinal D-Ring Easy Open Ledger Binder with locking D-Rings or approved equal.

         c) Failure to provide drawing submittal in correct binder format may be grounds for immediate rejection without review.

      3) Drawings shall not be folded. Blank pages shall not be placed in drawings set.

4) Drawings shall be hard tabbed into separate sections as follows:

a) One-line or three-line diagrams.

b) Loop diagrams.

c) Elementary diagrams.

d) Elevation diagrams.

e) Fabrication diagrams.

f) Interconnect diagrams (PDF version is not acceptable).

g) PLC I/O card wiring diagrams.

6. The following shall be submitted as a separate submittal binders:

a. Drawings:

1) The index shall not include drawings listed as "This Page Intentionally Left Blank." A Drawing Index shall be provided that lists each Drawing title and drawing number. Each Drawing title and number shall be unique.

2) Drawings shall be submitted in a separate hole-punched binder that covers the entire 11" X 17" length of the Drawing

a) Shop Drawings with less than 20 sheets total in the submittal, shall be provided in an 11½-inch by 17½-inch reinforced folder.

b) All Interconnection Drawings or Shop Drawings of 20 sheets or more shall be provided in separate three-ring binder to allow drawings to be easily removed. Binder shall be Cardinal D-Ring Easy Open Ledger Binder with locking D-Rings or approved equal.

c) Failure to provide drawing submittal in correct binder format may be grounds for immediate rejection without review.

3) Drawings shall not be folded. Blank pages shall not be placed in drawings set.

4) Drawings shall be tabbed into separate sections as follows:

a) One line or three line diagrams

b) Loop diagrams

c) Elementary diagrams

d) Elevation diagrams

e) Fabrication diagrams

f) Interconnect diagrams

g) PLC I/O card primary diagrams

B. The System Supplier submittals shall include but not be limited to data sheets and Drawings for each product together with the technical bulletin or brochure. The instrumentation submittals shall be clearly copied from originals. No FAX copies of documents are allowed. Color copies shall be provided when black and white copies do not show adequate clarity. The system supplier submittals shall include:

1. Catalog Cuts: Complete catalog cuts with full description of equipment. General sales literature will not be acceptable. The part or model number with options to be provided shall be clearly identified. Where more than one item or catalog number appears on a catalog cut, the specific item(s) or catalog numbers(s) proposed shall be clearly identified. Each catalog cut sheet shall be identified with the applicable Section and subsection numbers. The catalog cuts shall be placed in numerical Specification Subsection and paragraph order in the submittal for easy reference. (i.e. Section 16950-2.03 devices before Section 16950-2.04, etc.) Catalog cuts shall include:

    a. Product (item) name used herein and on the Contract Drawings.

    b. The manufacturer's model or other designation.

    c. Tag name/number per the P & ID Drawings, schedules and indexes.

    d. Complete documentation with full description of operation.

    e. Equipment technical specifications, ratings, and listings.

    f. Location of assembly at which it is installed.

    g. Input/output characteristics.

    h. Range, size, and graduations as required.

    i. Physical size with dimensions and mounting details.

    j. Quantity and quality requirements for electric power, air, and/or water supply.

    k. Materials of components in contact with or otherwise exposed to the process.

    l. Calibration, performance, or accuracy curves.

    m. Specifications

2. Equipment Record Sheets shall be provided to subtab all shop documents for each individual piece of equipment. Equipment Record or Instrument Sheets shall be bright yellow or blue for easy identification. Equipment Record Sheets shall be similar in format to the one shown in Appendix "A". Instrument Data Sheets shall be standard ISA 20 forms.

    a. The Equipment Record Sheets or Instrument Data shall have the following information preceding their corresponding catalog cuts:

        1) Product identification; name used herein and on the Contract Drawings.

        2) The Manufacturer's model number, part number, or other designation. This shall include the specific numbers of all proposed options.

3) Tag name/number per the P & ID Drawings or schedules.

4) Location of assembly at which it is installed.

5) Range, span, engineering units, input, and output characteristics.

6) Contract Specification Subsection number.

3. Tab I: Exceptions/Clarifications:

a. Itemize all exceptions and clarifications.

b. All exceptions taken from the Drawings and specifications shall be documented with justifications. When noting the exception, list which Drawings or which Specification Subsection number the exception is taken.

c. All exceptions taken from the Drawings and specifications shall be documented with justifications. When noting the exception, list which Drawings or which Specification Subsection number the exception is taken.

d. Clarification requests shall list which Drawing or Specification Subsection number the clarification is required for.

e. Requests for information (RFIs) shall not be included in submittals. RFIs shall be submitted separately, with its individual submittal number.

4. Tab II: Bill Of Materials:

a. Bill of Materials: Complete Materials list shall be provided similar in format to the Bill of Material shown in Appendix "A". Generic names or part numbers used by a distributor or Systems House are not acceptable; originating manufacturer's name and part number shall be listed. In addition the "Material Listing Form" shown in Appendix "A" shall be filled in and submitted for all Control Panels. A separate Bill of Material Listings shall be provided for:

1) MCCs

2) Switchgear, Switchboard, Panelboards, and Transformers

3) Control Panel

4) Power Transformer

5) Miscellaneous Devices

6) Disconnect Enclosure

7) Type of Field Instrumentation (i.e. 16950 series level instruments only in one submittal)

8) Spare Parts

5. Tab III and IV: Equipment:

a. Include catalog cuts and Equipment Record Sheet for each submittal item as specified herein.

b. Field equipment shop documents, panel equipment shop documents, and Bill of Materials shall be grouped under separate tabs. Shop documents shall be ordered in the same sequence as their corresponding Contract Specification Subsection.

6. Tab V: Contract Specifications and Drawings:

   a. The following Contract documents shall be provided in submittal.

   b. Copy of checked (✓) specifications as specified herein.

   c. Copy of P & ID and elementary diagrams marked to show changes requested.

7. Tab VI: Nameplates

   a. Submit full-size Drawing of all nameplates and tags, per Section 16144 - Nameplates, to be used on project. The Engineer has the right to adjust nameplate engraving titles during submittals at no additional cost to the Owner. Submittal to include the following:

      1) Dimensions of nameplate.

      2) Exact lettering and font for each nameplate.

      3) Color of nameplate.

      4) Color of lettering.

      5) Materials of construction.

      6) Method and materials for attachment.

      7) Drawing showing location and mounting arrangements of nameplates on each MCC, Switchboard, panel and enclosure.

8. Drawings:

   a. Drawings shall be provided with minimum drafting details as illustrated on Contract Drawings. Diagrams shall carry a uniform and coordinated set of wire colors, wire numbers, and terminal block numbers. Provide a symbol list identifying symbols used. The Drawings shall include:

      1) Electrical one line or three line diagrams detailing all devices associated with the power distribution system. The following applicable information or data shall be shown on the one-line diagram: location, size, interrupt KAIC. and amperage rating of bus; size and amperage rating of wire or cable; breaker ratings, number of poles, and frame sizes; auto-transfer switch; utility metering, voltage, amperage, number of wires and phases; ground size and connections; neutral size and connections; protective devices; fuse size and type; distribution transformers; panelboards; starters; contactor size and overload range; motor full load amperage of submitted motor and horsepower; rating for miscellaneous loads; etc. Submit a list of all equipment motor voltage, phase and full load amps provided for this project for verification of accuracy of submitted one line Drawings.

2) Analog and digital I/O loop diagrams showing the wiring requirements for each instrument loop. Graphic symbols shall conform with ISA S5.4 Drawing standards. A loop diagram shall be furnished for each analog and digital I/O process. Loop diagrams shall include the following as a minimum:

a) The loop diagram shall be drawn with sufficient detail to express control philosophy. The diagram shall show all components and accessories of the instrument loop, highlighting special safety and other requirements. These diagrams shall be arranged to emphasize device elements and their functions as an aid to understanding the operation of a system and for maintaining or troubleshooting that system.

b) A separate Drawing shall be prepared for each analog card. Each analog input and output shall be arranged on the diagram in the same order as the physical arrangement of the card terminations. Example format is shown on "E"-Series Contract Drawing.

c) Each digital input and output shall be arranged on the diagram in the same order as the physical arrangement of the card terminations. All termination points on the diagram shall be shown with the actual equipment identification, device, and relay terminal number or letter. A separate Drawing shall be prepared for each digital input and digital output card. Example format is shown on "E"-Series Contract Drawing.

d) All devices or items on the diagram shall have clear labeling and identification.

e) All termination points on the diagram shall be shown with the actual equipment identification terminal number or letter. This identification of termination includes terminal blocks, junction boxes, field devices, panel devices, computer I/O points, etc.

f) Energy sources - electrical power, air supply, pneumatic and hydraulic fluid supply, designating voltage, current, pressure, etc., shall be shown in detail on the diagram. Input and output signals (e.g., 1-5 VDC, 4-20 mA DC, 3-15 psig, etc.), power and instrument supplies to devices (e.g., 120 VAC, 24 VDC, 80 psig, etc.) shall be shown.

g) Engineering units shall be shown on the diagram.

h) Care shall be taken to prevent overcrowding on the diagram and space shall be provided for future additions.

i) Each wire label and color code shall be shown. Signal and DC polarities shall be shown.

j) All spare wires, cables, and termination points shall be shown. All jumpers, grounding, shielding, power supply details shall be shown.

3) Elementary diagrams shall be provided for all relay logic, power supplies, and other wiring not shown on the loop diagrams. All elementary diagrams shall be drawn in ladder logic EMP/EGP format and standards, similar to those shown on the E-Series elementary diagrams showing ladder rung numbers and coil and contact cross referencing numbers. All loop diagrams shall be drawn per ISA standards. The elementary diagram shall be drawn between vertical lines which represent the source of control power. Show control devices between on the right-hand side. Show contacts between the coils and the left vertical line.

a) Where the internal wiring diagrams of subassemblies are furnished on separate sheets, show as a rectangle in the elementary diagram with all external points identified and cross-referenced to the separate sheets of the control circuit. Show coils and contacts internal to the subassemblies in the rectangle connected to their terminal points.

(1) Exception No. 1: Where relay and electronic circuits are mixed, diagrams may be drawn between horizontal lines which represent the source of control power.

(2) Exception No. 2: Overload relay contacts may be connected to the right of the coil (common) if the conductors between such contacts and the coils of the magnetic devices do not extend beyond the control enclosure.

b) For clarity, show control device symbols in the order in which the controls are positioned on the diagram.

c) Use a cross-referencing system for each relay coil so that associated contacts may be readily located on the diagram. Where a relay contact appears on a sheet separate from the one on which the coil is shown, describe the purpose of the contact on the same sheet.

d) Show spare contacts.

e) Show limit, pressure, floats, flow, temperature sensitive, and similar switch symbols on the elementary diagram with all utilities turned off (electric power, air, gas, oil, water, lubrication, etc.) and with the equipment at its normal starting position.

f) Show contacts of multiple contact devices, e.g., selector switches, on the line of the elementary diagram where they are connected in a circuit. Indicate a mechanical connection between the multiple contacts by a dotted line or arrow. This does not apply to control relays, starters, or contactors.

g) Additional charts or diagrams may be used to indicate the position of multiple contact devices such as drum, cam, and selector switches.

h) Show the purpose or function of all switches adjacent to the symbols.

i) Describe the purpose or function of controls such as relays, starters, contactors, solenoids, subassemblies, and timers on the diagram adjacent to their respective symbols. Show the number of positions of the solenoid valve adjacent to the valve solenoid symbol.

j) Show values of capacitors and resistors on the diagram.

k) Descriptive terms for command and status functions shall be in the present or past tense. For example, Raise Transfer-Transfer Raised; Advance Transfer-Transfer Advanced. Do not use terms such as "Transfer Up."

l) Show field wiring as dashed lines.

4) Elevation diagrams shall be provided that show the front, side, and top view and shall be drawn to scale and dimensioned. Detail all devices, protrusions, penetrations, doors, cutouts, wireways, latching mechanism, etc., on or in the panel to indicate device clearances. Show the actual physical size or each device (i.e., indicating lights, hour meters, switches, push buttons, annunciators, indicators, controllers, breaker diagram. Nameplates, with cross-reference numbers to the elevation schedule shall be shown at the location of mounting. The top view shall detail conduit entrance clearance areas and mounting base bolt locations for floor mounted equipment.

a) "Exterior" panel elevation diagrams, drawn to scale, shall be provided for control panels, and any equipment that has devices mounted on the face of the enclosure.

b) "Interior" enclosure layout panel elevation diagrams shall be provided for the enclosures specified. Diagram format shall conform with JIC, EMP, or EGP panel layout Drawing standards. Backpan and sidepan layout shall be shown in detail, showing the location of all devices, wireways, gutters, relays, power supplies, terminal blocks, etc., drawn to scale. Spare panel space shall be dimensioned to indicate area for expansion. Show fabrication methods and details; including material of construction, paint color, support and latching mechanisms, fans and ventilation system, and conduit entrance areas.

5) Fabrication Diagrams shall be provided for each switchboard, MCC, panel, enclosure, and electrical custom built equipment. Sufficient detail shall be provided on the fabrication diagrams to determine size, weight, material hinge, and hasp locations, method of locking, gauge and type of steel or plastic, metal preparation, paint method, color, construction methods, weld location and type, fabrication and assembly, mounting details, conduit entrance clearance areas, and other information to show the enclosure is suitable for the application. All diagrams shall be scaled. Overall dimensions and minimum clearances shall be shown. Available conduit stub-up areas shall be shown on a base plan.

6) Interconnection diagrams shall show, for each piece of equipment, all wiring between all devices, panels, cabinets, terminal boxes, control equipment, motor control centers and any other devices and equipment. An interconnection diagram shall be furnished for each electrical and instrumentation system, even if one was not shown explicitly on the Contract Drawings. Interconnection diagrams shall be prepared for all conduits listed in the Conduit and Wire Routing Schedule in Section 16111, with the exception of conduits for lights and receptacles which are not required to have interconnect drawings. Each interconnection diagram shall show the following as a minimum:

   a) Interconnect drawings shall be prepared for all equipment by the System Supplier with the exception of the video surveillance, Telephone and Security Alarm Systems which may be produce their own interconnect drawings.

   b) The diagrams shall be utilized by the electrician during all phases of installation and connection of all conductors to ensure coordination of equipment interconnects.

   c) The diagrams shall show wiring as field labeled at the end of the project when as-builts are submitted.

   d) Each wire labeling code as actually installed shall be shown. The wiring labeling code for each end of the same wire must be identical.

   e) All device and equipment labeling codes shall be shown.

   f) Interconnection diagrams shall be of the continuous line type with identified lines. Diagrams of the wireless or wire schedule type are not acceptable. Bundled wires shall be shown as a single line with the direction of entry/exit of individual wires clearly shown.

   g) All terminations points on the diagram shall be shown with the actual equipment identification terminal number or letter. This identification of terminations includes terminal blocks, junction boxes, all devices, computer I/O points, etc.

   h) Diagrams shall include raceway numbers, raceway size, raceway type, cable numbers, wire color code, and wire numbers.

i) Each wire size, and cable size and color code shall be shown. Each conduit with the conduit label and conduit size and wire fill shall be shown. Wire and cable routing through conduits, wireways, manholes, handholes, junction boxes, terminal boxes and other electrical enclosures shall be shown with the appropriate equipment labels. All spare wires, cable, and termination points shall be shown. Cable shields shall be shown.

j) Labeling codes for terminal blocks, terminals, wires, cables, panels, cabinets, instruments, devices, and equipment shall be shown. Place "øA", "øB", and "øC" label next to each breaker to identify phase connected to.

k) Schematic symbols shall be used for field devices, showing electrical contacts. Signal and DC circuit polarities shall be shown.

l) The diagrams shall show all other Contract and Supplier Drawing numbers, for reference, that are associated with each device that is interconnected.

m) Attached to each interconnect, a copy of all the support documents used in preparing interconnects shall be submitted. This includes current issues of panel schematics, elementary diagrams, panelboard schedules, conduit schedules, one-line diagrams, connection diagrams, terminal block diagrams, submittals, contract drawings, vendor drawings and all other data used to develop the interconnection diagram, as noted in the "Reference Documents" corner of interconnect drawings.

n) Do not show the same wires or jumpers, or panel wiring on both the connection and interconnection diagrams. All jumper, shielding, and grounding termination details not shown on the connection diagrams shall be shown on the interconnection diagrams.

o) Interconnection diagrams shall be submitted and approved by Owner for each electrical and instrumentation system.

p) Field wiring shall not start before the interconnection Drawing has been submitted by the Contractor and approved by the Owner.

q) The Contractor shall not pull in any wires into conduits that do not have approved interconnects. If the Contractor pulls in wire without Owner approval of associated Interconnect Drawings, the Contractor will not be reimbursed for labor for re-pulling in wires even if there was an error in wire fill or sizing.

r) If the Contractor pulls in wire without Owner approval of associated Interconnect Drawings, then all progress payments related to field wiring for that particular area of work will be withheld until approved Interconnect Drawings are in use.

s) All interconnection diagrams shall be prepared by a System Supplier under the supervision of or by a State of California Registered Electrical Engineer and shall bear that Engineer's professional stamp and signature for all Interconnection Drawings submitted for approval including as-builts and those used in the field installation. Engineer's stamp missing from interconnection drawings will be sufficient grounds to reject entire interconnection drawing submittal without review.

t) Failure to provide backup references or signed and stamped drawings may be grounds for immediate rejection.

u) Example format of Interconnection diagram is shown on Contract "E"-Series Drawings or may be obtained from the Engineer.

v) Interconnection Drawings shall use bundled wire format as shown on example interconnect Contract Drawing. Interconnect drawings submitted with wiring of a single conduit run separated onto multiple interconnect drawings will be rejected without review. A single conduit run with wiring shown on separate interconnect drawings will be allowed only after written approval is given by the Engineer for each conduit run prior to submitting the associated interconnect drawings.

w) Only field wiring between switchboards, MCCs, Panelboards, Control Panels, and other electrical and instrumentation devices or equipment shall be shown on interconnection drawings. No internal panel wiring shall be shown on interconnect drawings except jumper or other wiring to be installed in field by Electrical Contractor.

x) Interconnect Drawings along with the corresponding support documents shall be submitted in a separate submittal package. Interconnect drawings submitted with non- interconnect drawing packages will be rejected. The latest support documents shall be obtained by System Supplier from Contractor for all non-Division 16 instruments, panels, and equipment, and included with interconnect drawing submittal. Support documents shall have their submittal number marked in upper right hand corner.

y) Provide a notes section on each interconnect drawing. In the notes section, list any variances from the Contract conduit schedule necessary for completing the interconnections. Change orders regarding wire fill, conduit schedule and errors in plans regarding conduits and wires will not be processed until interconnect drawings have been received for such work.

z) The field electrician shall mark-up all interconnection diagrams during installation to show accurate as-built wiring, conduits runs, terminations, etc. If interconnection drawings are not properly as-built, the Contractor will have cost deducted from the Contract for the Owner to field verify and prepare as-built interconnection drawings amount. The amount of the deduction shall be determined on a time and material basis. The cost of such work shall be $150.00 per hour plus expenses.

aa) Interconnects shall include list of all applicable reference drawings, request for clarifications, field instructions and change orders. All deletions and additions of equipment, conduits, wire, and cables shall be clearly shown. Clearly state why termination data is not available. Statements should point to applicable area and be placed in a bold box.

bb) The System Supplier shall be responsible to collect all information necessary to complete each interconnection drawing. This includes making field trips to collect all terminal connection data for new and existing, MCCs, switchboards, panelboards, instruments, equipment and electrical panels.

cc) An index of drawings shall be provided with each Interconnection submittal listing the unique drawing number and the description of the interconnect drawing (e.g. Drawing 4321-IC1004 Pump 1004 Interconnect Drawing).

dd) Provide conduit and interconnect drawing cross reference indexes. Interconnect Conduit Index shall list all conduits listed in the Conduit & Wire Routing schedule and its associated Interconnection Drawing number. An Interconnection Drawing Index shall list all Interconnection drawings and the conduits shown on that specific drawing. These two indexes shall be at the front of all interconnection drawing submittals.

ee) Interconnection submittals that contain more than two motor control panels/centers shall have heavy duty dividers with permanent plastic labeled index tabs separating each group of drawings.

PART 3 EXECUTION

3.1 SUBMITTAL REQUIREMENTS

A. Within 30 calendar days after Contract award the Contractor, Electrical Contractor, System Supplier, Resident Construction Manager and Engineer shall meet to ensure that all parties are in agreement regarding submittals and Contract objective toward the electrical, instrumentation, and control submittal process.

B. Within 90 calendar days after Contract award the Contractor shall furnish to the Engineer all first stage submittals required for the project.

C. Submit shop drawings for review at least 45 days before reviewed drawings will be required for commencing the work.

D. Resubmittals shall address all comments by the Engineer. Partial resubmittals may be returned without review at the discretion of the Engineer. The Contractor shall be responsible for the Engineer's review cost for each resubmittal in excess of the second resubmittal. These costs will be back-charged to the Contractor and will be deducted from his progress payments.

E. No material or equipment shall be allowed at the job site until the submittal for such items has been reviewed by the Engineer and marked "no exceptions taken" or "make corrections noted".

F. The Contractor shall include in writing on the Submittal Check Sheet (see Appendix "A") any proposed departures from the Contract documents, and the reasons therefore. Incorporate no such departures into the work without prior written approval of the Engineer. The approval of departures which substantially deviates from the Contract Documents shall be evidenced by a "change order" directive by the Engineer. Any cost differential associated with this change order must be negotiated with the Engineer to amend the Contract to reflect the costs or savings.

G. Exceptions to the Specifications or Drawings shall be clearly defined by the equipment supplier. Submittal data shall contain sufficient details so a proper evaluation may be made by the Engineer.

H. The equipment specifications have been prepared on the basis of the equipment first named in the Specifications. The Contractor shall note that the second named equipment, if given, is considered acceptable and equal equipment, but in some cases additional design, options, or modifications may be required to meet Specifications all at no additional cost to the Owner.

I. The decision of the Engineer governs what is acceptable as a substitution. If the Engineer considers it necessary, tests to determine equality of the proposed substitution shall be made, at the Contractor's expense, by an unbiased laboratory that is satisfactory to the Engineer.

J. Electronic PDF version of submittals shall be provided with table of contents regardless of hard copy format of submittal. PDF shall be “bookmarked” at each index, subtab, transmittal letter, copy of appropriate check marked Specification Section, bill of materials, copy of submittal comments (for resubmittals), Contractor’s response to submittal comments (for resubmittals), logical division in submittal, drawings, etc. Bookmarks shall be descriptive of actual document, tab, etc. Failure to bookmark PDF or broken bookmarks may be grounds for immediate rejection without review. Bookmarks shall not be out of order; the English description shall match that listed in the Submittal’s Table of Contents.

K. Electronic submissions of submittals may be provided for submittals less than 40 pages and without drawings. Submittals equal to or over 40 pages or those that contain drawings shall be provided in a hardcopy format. Drawings shall be printed at 11 inches by 17 inches. Hardcopy submittals shall be provided in binders as specified herein. The Owner reserves the right to reject submittals that fail to be organized as described herein.

3.2 DRAWINGS AND DATA SUBMITTAL PROCESS

A. General: Submittal data shall be grouped and submitted in three separate stages. Each stage submitted shall be substantially complete. Individual Drawings and data sheets submitted at random intervals will not be accepted for review. Equipment tag numbers or identifications indicated on the Drawings shall be referenced where applicable. Each submittal shall contain the submittal check list.

B. First Stage Submittals: The first stage submittals shall include the following items:

1. A detailed list of any exceptions, functional differences or discrepancies between the Supplier's proposed system and the Contract requirements.

2. Product catalog cut sheets on all hardware items. Clearly marked to show the applicable model number, optional features, and intended service of each device.

3. A brief, concise description of the system proposed, including major hardware and software components, field services and training.

4. A system configuration Drawing in block diagram or schematic format showing the principal items of equipment being furnished and their interrelationship with new and existing system components.

5. Drawings showing floor or desktop space requirements for all equipment items. Drawings shall include space requirements for door swings and maintenance access. Provide dimensioned foot prints of all MCCs and other enclosures.

6. Environmental and power requirements for each equipment item.

7. Standard field termination Drawings for all process input/output equipment, showing typical terminations for each type of point available in the system.

8. Bill of Materials and Material Listing forms.

9. Proposed drawing and diagram format for each type of drawing or diagram specified.

10. Equipment Record Sheets.

11. Electrical System Analysis.

C. Second Stage Submittals: Before any equipment is released for shipment to the jobsite or before factory testing is scheduled, the following data shall be submitted.

1. At the Supplier's option, the stage one and stage two submittals may be combined.

2. Detailed, functional descriptions of all software modules required per the Contract documents and furnished as part of the Supplier's standard system. Software module descriptions shall be marked with the applicable specification paragraph.

3. System one line, elementary, loop and interconnection Drawings for all wiring between components of the system furnished and for interconnection wiring between the related equipment and the equipment furnished. Drawings shall show complete circuits and indicate all connections. If panel terminal designations, interdevice connections, device features and options, or other features are modified as a result of the fabrication process or factory testing, revised Drawings shall be resubmitted prior to shipment of the equipment to the jobsite.

4. Elevation and Fabrication diagrams with nameplate schedules.

5. Process input/output listings showing point names, numbers, and addresses.

6. Factory Test Procedures.

D. Third Stage Submittal - The following information shall be provided as part of the third stage submittals:

1. Field Test Procedures.

2. Documentation on training course content, schedule, instructor's qualifications and recommended prerequisites for all training activities specified herein.

3. The System Supplier shall furnish complete documentation on all software provided with the systems specified herein. Software documentation shall consist of the following principal items:

a. User reference manuals for all standard system and application software provided.

b. User reference manuals for all operation systems.

c. Written as-built reference documentation for any special software provided specifically for this Contract.

E. Operation and Maintenance Manuals shall be furnished for all equipment per Section 16012.

3.3 FIELD REPORTS

System Supplier to submit written report to Engineer at conclusion of each site visit, prior to leaving job site. Report to include copies of all pertinent operating and test data obtained during visit, onsite personnel names, company, time, dates, and description of all work performed.

APPENDIX "A"

Bill of Material

Submittal Check Sheet

Material Listing Form

Equipment Record Sheet

BILL OF MATERIAL

PROJECT: _____ **DATE** / /

LOCATION: _____ **PAGE** _____

SPECIFICATION SECTION	QTY	DESCRIPTION	MFG.	PART NUMBER	TAG No.

SUBMITTAL CHECK SHEET

EQUIP NAME: _____ **DATE** ___/___/___

SUBMITTED BY: _____ **PAGE** _____

EQUIPMENT No.: _____ **SUBMITTAL No.** _____

SUBMITTAL STATUS CHECK				LIST OF ITEMS INCLUDED IN THIS SUBMITTAL	PER SPEC SECTION
I	F	N	P		
				CATALOG CUTS & DOCUMENTS:	
				BILL OF MATERIALS	
				SEISMIC CALCULATIONS	
				NAMEPLATE SCHEDULE	
				GENERATOR DATA	
				PANELBOARD DATA	
				VFD STARTER DATA	
				SPECIAL CALCULATIONS	
				SHORT CIRCUIT & COORDINATION STUDY	
				TEST SCHEDULE	
				TESTING PROCEDURES	
				TEST FORMS	
				FIELD TEST REPORT	
				QUALIFICATIONS OF TESTING PERSONNEL	
				TRAINING PLAN	
				TRAINING MANUALS	
				SOFTWARE DOCUMENTATION & PROGRAM	
				CALIBRATION SHEETS	
				OPERATING INSTRUCTIONS (O&M INFORMATION)	
				DRAWINGS:	
				ELECTRICAL ONE LINE DIAGRAMS	
				MOUNTING DETAILS	
				ANALOG / DIGITAL I/O LOOP DRAWINGS	
				ELEMENTARY DRAWINGS	
				ENCLOSURE LAYOUT DIAGRAMS	
				INTERCONNECTION DIAGRAMS	
				FABRICATION DRAWINGS	
				LIGHTING CONNECTION DIAGRAM	
				LIGHTING POLE ARRANGEMENT DRAWING	
				LIGHTING POLE & FIXTURE OUTLINE DRAWING	
				LIGHTING POLAR PLOTS	
				PLC BLOCK DIAGRAM	
				AS-BUILT PLUS DISK FILES	

LIST OF DEVIATIONS FROM SPECIFICATIONS & DRAWINGS:

SUBMITTAL STATUS CHECK ABBR.:

I => INCLUDED IN THIS SUBMITTAL **N =>** SUBMITTAL NOT REQUIRED

F => TO BE INCLUDED IN FUTURE SUBMITTAL **P =>** PREVIOUSLY SUBMITTED

MATERIAL LISTING FORM
FOR CONTROL PANELS

Description	Mfg.	Model No.	Quantity at Location			
			CP-1	CP-2	CP-3	

EQUIPMENT RECORD SHEET
ELECTRICAL AND INSTRUMENTATION

PROJECT: **DATE:**

DESCRIPTION	LOCATION	
SPEC	DATE INST	WEIGHT
MFR	MFR CONTACT	
MFR ADDRESS		PHONE
LOCAL REP		
LOCAL REP ADDRESS		PHONE

ELECTRICAL DATA

DESCRIPTION	OPTIONS
PART #	SIGNAL IN
MODEL #	SIGNAL OUT
TYPE	POWER SUPPLY
MATERIAL	NEMA RATING
COLOR	MISCELLANEOUS
CALIBRATION EQUIP	CALIBRATION DATE

CALIBRATION DATA

EQUIP # OR TAG	RANGE	ENG UNITS	SPAN

MAINTENANCE

DESCRIPTION	FREQUENCY						
	D	W	M	Q	S	A	OTHERS

END OF SECTION

SECTION 16012

ELECTRICAL AND INSTRUMENTATION OPERATIONS AND MAINTENANCE DATA

PART 1 GENERAL

1.1 SUMMARY

A. Compile product data and related information appropriate for Owner's operation and maintenance of products furnished under the Contract.

B. Prepare operating and maintenance data as specified in this Section and as referenced in other pertinent Sections of Specifications for products furnished under the Contract.

C. Instruct Owner's personnel in the maintenance of products furnished under the Contract and in the operation of equipment and systems.

D. Product data for equipment provided by Owner is not a part of this Contract.

E. Quantity of O&M manuals required is specified in Section 01680.

1.2 REFERENCES

Related requirements specified in Division 16

1.3 QUALITY ASSURANCE

Preparation of data shall be done by Contractor's personnel:

A. Trained and experienced in operation and maintenance of the described products and authorized by the original equipment manufacturer to provide materials for the specified equipment.

B. Completely familiar with requirements of this Section.

C. Skilled as a technical writer to the extent required to communicate essential data to operating personnel.

D. Skilled as a draftsman competent to prepare required Drawings.

1.4 SUBMITTALS

A. Prepare data in the form of an instructional manual for use by Owner's personnel.

B. Format:

1. Size: 8½-inch by 11-inch. (Except Drawings)

2. Text:

a. Manufacturer's printed data properly edited for project. Cross out all data that does not apply to the equipment to be furnished.

b. All documents shall be machine typed; hand written documents are not acceptable. All documents shall be legible and original size, documents that cannot be read or have been reduced will be returned for correction.

3. Drawings:

a. Provide in separate reinforced punched binder to allow drawings to be easily removed.

b. For 11-inch by 17-inch Shop Drawings with less than 20 sheets total in the submittal, provide in an 11½-inch by 17½-inch reinforced punched folder.

c. For 11-inch by 17-inch all Interconnection Drawings or Shop Drawings of 30 sheets or more, provide in separate three-ring binder to allow drawings to be easily removed. Binder shall be Cardinal D-Ring Easy Open Ledger Binder or approved equal.

d. Drawings shall not be folded. 11"x17" drawing shall not be reduced for O&M manuals.

e. Drawings larger than 11-inch by 17-inch to be placed in an 8½-inch by 11-inch envelope bound in text.

f. Suitably identified on Drawing binder.

g. Referenced clearly with index of drawings by title and drawing numbers.

4. Binders: Commercial quality, permanent, all white in color, three-ring, durable, cleanable plastic covers with inserts, full height and width, front, back, and spine, with full-page sheet lifters, as manufactured by "K&M Company, 2-inch with pocket D-Ring View Binders," "Manufacturer No. 79792." Model VS11-20, Wilson Jones D-Ring Binders, or approved equal. All binders shall be 2-inch size.

5. Folder: Commercial quality, permanent. Two-hole "Sandwich" type.

6. Indexing: The manuals shall be fully indexed by use of "Avery Side Tab Legal Index Exhibit Dividers LGT5S1-25," "Avery Number AVY11370," Wilson Jones Commercial Indexes with pre-printed tabs, or approved equal.

7. Cover and Spine:

   a. The cover sheet format inserted in the front of the view binder shall be as stated above herein.

   b. The spine format inserted in the spine of the view binder shall list:

      1) Volume X of X.

      2) Operation and Maintenance Manual.

      3) Supplier Name

      4) Project Name.

      5) Binder Contents

8. Numbering: Number all pages within the O&M manual. The number shall be located ½-inch from the bottom, centered on each page. The system used within each tabbed section shall be the tab section-page number sequentially numbered (i.e., 1-1, 1-2, 1-3, and so on).

9. All of these sets of O&M manuals shall be made up of "original" (no copies or reproductions) documents. No photo or fax copies are allowed of standard published manuals available from manufacturers.

10. Electronic PDF version of O&M manual.

    a. Version format shall follow the hard copy submittal of the O&M, including index, equipment record sheet, warranty information, theory of operation, maintenance instruction, etc.

    b. PDF shall be “bookmarked” at each index, subtab, transmittal letter, equipment record sheet, warranty information, theory of operation, maintenance instruction, etc.

    c. Bookmarks shall be descriptive of actual document, tab, etc. Bookmarks shall not be out of order or misspelled; the English description shall match that listed in the Submittal’s Table of Contents.

    d. Failure to bookmark PDF may be grounds for immediate rejection without review.

C. Review:

1. Submittals that are not fully indexed and tabbed with sequentially numbered pages shall be returned without review.

2. The Engineer has allowed for up to and including two (2) reviews of each submittal. The Engineer shall be reimbursed for all reviews after the first two reviews by the Owner and the Owner will deduct the amount of the reimbursement from the Contractor's Contract. The Engineer's reimbursement shall be on a time and expense basis and the current billing rate of the Engineer. The Engineer shall be the sole source for determining the suitability of any submittal.

3. Electronic submissions of submittals may be provided for submittals less than 40 pages and without drawings. Submittals equal to or over 40 pages or those that contain drawings shall be provided in a hardcopy format. Hardcopy submittals shall be provided in binders as specified herein. The Owner reserves the right to reject submittals that fail to be organized as described herein.

D. O&M manual shall be properly completed, submitted, and approved prior to the personnel training.

1.5 CONTENT OF MANUALS

A. Product of Data:

1. Include only those sheets which are pertinent to the specific product.

2. Annotate each sheet to:

a. Clearly identify the specific project or part installed.

b. Clearly identify the data applicable to the installation.

c. Cross-out references to inapplicable information.

B. Drawings:

1. Supplement product data with Drawings as necessary to clearly illustrate:

a. Relations of component parts of equipment and systems. Include individual parts list with exploded views for all equipment.

b. Control and flow diagrams.

2. Coordinate Drawings with information in project Contract documents to assure correct illustration of completed installation.

3. Do not use project Contract documents as maintenance Drawings.

4. "As Constructed" set of submittal shop documents, data sheets, and drawings for all items in the electrical system as specified in Section 16011 – Electrical Submittal and Drawing Requirements.

C. Written text as required to supplement product data for the particular installation:

1. Organize in a consistent format under separate headings for different procedures.

2. Provide a logical sequence of instructions for each procedure.

D. Provide the index and information layout in the operation and maintenance manual for each unit of equipment, and system, including electrical, and electronic items as follows:

1. Cover sheet including the following:

a. Volume __ of __.

b. Operation and Maintenance Manual.

c. Project title.

d. Owner project number.

e. Manufacturer:

1) Manufacturer's name.

2) Full address.

f. Date.

2. Document Index: Neatly typewritten document index for each volume, arranged as indicated in Appendix "A." Master Table of Contents shall be placed in Volume 1 itemizing all of the information included in the O&Ms and the corresponding volume location of that information.

3. Equipment Record Sheet:

a. Equipment record sheet as specified in Section 16011.

b. A complete list of items supplied, including model and serial numbers, ranges, options, and other pertinent data necessary for ordering replacement parts.

c. Name and location of nearest parts supplier for all equipment.

4. Warranty:

a. Provide copy of warranty as specified in Section 16010. Include procedures in the event of failure.

b. Provide copy of substantial completion with corresponding warranty duties.

5. Theory of Operation.

    a. Description. Provide description of units and components' parts function, normal operating characteristics, and limiting conditions.

        1) Include general descriptive bulletins, brochures, or catalog sheets to describe the equipment.

        2) Performance curves, engineering data and tests.

6. Operating Instructions: Complete, detailed, written description of the operating sequence for all control system and operations in all modes. The description shall be specifically prepared for this work, and shall be fully referenced to control diagrams and system components:

    a. Recommended step-by-step startup, adjustment, calibration and break-in operating instructions.

    b. Routine and normal operating instructions. Include summer and winter operating instructions as applicable. Also include special operating instructions.

    c. Recommended step-by-step regulation, control, stopping, and shut-down instructions.

    d. No photocopies are allowed of standard published manuals available from manufacturers.

    e. Recommended step-by-step Emergency Instructions.

    f. Current and desired control settings.

7. Maintenance Instructions:

    a. Lubrication schedule and list of lubrication required.

    b. Detailed service, maintenance and operation instructions for each item supplied. Preventative maintenance to include routine operation, alignment, adjusting, and checking. Include illustrations, assembly drawings, and diagrams required for maintenance. Preventative maintenance procedure and schedule for all equipment over a five-year cycle.

    c. Corrective maintenance to include disassembly, repair, overhaul and reassembly.

    d. Schematic diagrams of all electronic devices shall be included. A complete parts list with stock numbers shall be provided on the components that make up the assembly.

    e. Special maintenance requirements particular to this system shall be clearly defined, along with special calibration and test procedures.

    f. No photocopies are allowed of standard published manuals available from manufacturers.

g. Include Maintenance Program data entry forms.

h. Original manuals (no copies) shall be provided for all instruments and PLC components.

8. Shipping and Installation:

   a. Receiving and handling.

   b. Long-term storage, and short-term storage.

   c. Complete step-by-step installation instructions of all components.

9. Safety Procedures:

   a. Manufacturer's safety procedures for operating and maintaining all equipment and materials used.

10. List of recommended spare parts:

    a. Original manufacturer's parts list with manufacturer's current prices. Include complete nomenclature and commercial numbers of replaceable parts.

    b. Predicted life of parts subject to warranty.

    c. Items recommended to be stocked as spare parts.

    d. Complete nomenclature and commercial number of all replaceable parts.

11. Test Data:

    a. Include all completed and signed test data and forms from factory and field testing.

12. Troubleshooting instructions.

13. Equipment catalogue sheets and submittals.

    a. Include copy of all approved submittals.

14. Drawings:

    a. All Electrical and Instrumentation Drawings to include:

       1) As-built set of all required Drawings per Section 16011 for the project.

       2) As-built drawings shall be signed and stamped by a registered Electrical Engineer in the State of California.

15. Complete software ladder logic printouts including English descriptions of control operation.

16. Record of all settings or parameters for all programmable devices.

17. At the end of the project these manuals shall be updated to show "as-built" or "as-installed" conditions.

18. Provide to the Owner four (4) each USB drives with lanyards containing all documents in both PDF format and unlocked AutoCAD - DWG format, latest version:

    a. As-built Contract electrical and instrumentation drawings prepared for this project.

    b. As-built set of all required Drawings per Section 16011 for the project.

    c. As-built sets of other computer generated documents prepared for this project, including PLC ladder logic files, and Bill of Materials prepared for this project.

    d. Electronic PDF version of O&M manual. Version format shall follow the hard copy submittal of the O&M, including index, equipment record sheet, warranty information, theory of operation, maintenance instruction, etc. PDF shall be "bookmarked" to at each index and subtab listed in O&M. Bookmarks shall be descriptive of actual document, tab, etc. Bookmarks shall not be out of order; the English description shall match that listed in the Submittal's Table of Contents

    e. Storage devices shall contain the ladder logic program files with all support files.

    f. These files shall be the property of the Owner, for its use on this and future projects.

    g. Label drives with site name using clear plastic with black machine printed lettering as produced by a KROY or similar machine. The size of the nameplate tape shall be with 3/8-inch lettering unless otherwise approved by the Engineer. Securely fasten nameplates in place on the USB drive using the adhesion of the tape.

PART 2 MATERIALS

Not used.

PART 3 EXECUTION

Not used.

APPENDIX "A"

Operation and Maintenance Manual Document Index

OPERATION AND MAINTENANCE MANUAL
DOCUMENT INDEX

COVER SHEET	SECTION
TABLE OF CONTENTS	I
EQUIPMENT RECORD SHEET	1
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END OF SECTION

SECTION 16013

ELECTRICAL AND INSTRUMENTATION SPARE PARTS

PART 1 GENERAL

1.1 GENERAL

A. The Contractor shall provide all spare parts and expendables prior to start-up. All parts shall be sealed in plastic bags and delivered to the site in a heavy-duty plastic storage bag.

B. The Contractor shall recommend for stocking, as spare parts, any replacement parts that are not manufacturer's normal stock items and would not be readily available if a failure occurred. The Contractor shall supply to the Owner a list of any additional Manufacturer's recommended spare parts that should be purchased and stocked by the Owner.

1.2 SECTION INCLUDES

Work specified under Section 01300.

PART 2 MATERIALS

2.1 SPARE PARTS

The following spare parts shall be provided to the Owner as part of this Contract:

A. Instrumentation:

1. Expendables - 2-year supply of expendables required for calibration and operation of instruments.

2. Four (4) surge protection terminals of each type.

B. Control Panels:

1. Five (5) fuses for each type and size of control and analog fuses.

2. Two (2) fuse holders of each type and size.

PART 3 EXECUTION

3.1 DELIVERY

A. An itemized shipping list prepared by Contractor shall be transmitted with all spare parts. The Owner and Contractor shall initial and date each item on shipping list during verification of receipt of spare parts by Owner.

B. Spare parts shall be packaged for safe shipping and storage and clearly labeled on exterior of package with part name and number and the corresponding equipment tagname.

END OF SECTION

SECTION 16020

SEISMIC RESTRAINT FOR ELECTRICAL EQUIPMENT

PART 1 GENERAL

1.1 SCOPE OF WORK

Work Included - Seismic restraint for new electrical equipment.

1.2 RELATED WORK.

The provisions of Section 16010 of these Specifications shall apply, unless otherwise specified.

1.3 SUBMITTALS

A. Provide data and Drawings for all materials furnished under this Section with the content and format as specified Section 16011.

B. Submit seismic anchoring calculations with equipment submittals. Calculations shall be performed, signed and stamped by a licensed civil or structural engineer registered in the State of California.

C. Submit equipment anchoring methods. Include anchoring locations; anchor types, sizes and materials; and minimum anchor embedment depths. All anchors shall be stainless steel.

D. Seismic anchoring calculations and equipment anchoring requirements are required for all:

1. MCCs
2. Switchboards
3. Field Control Stations
4. Panelboards and transformers
5. Control Panels
6. Electrical and instrumentation enclosures
7. Light Pole Bases

8. Rod and Trapeze Conduit Supports
9. Pad mounted transformers
10. Wall mounted equipment over 400 pounds

PART 2 MATERIALS

2.1 SEISMIC ANCHORING AND RESTRAINTS

Equipment Anchors: Securely anchor electrical equipment to wall or floor of structure with 316 stainless steel anchoring. Anchoring shall be designed in accordance with Specification Sections 01610 and 01615.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install equipment anchors and supports in accordance with the seismic calculations and manufacturer's recommendations. Properly torque all bolts to the required values.

B. Install all supports in plumb vertical position. Any support installed that is not plumb shall be removed and reinstalled by the Contractor at no additional cost to the Owner.

C. Floor mounted equipment such as MCCs, switchboards, enclosures, panels, etc. shall be secured to concrete with bolts through the front and back frames at bottom of enclosures. Securing enclosures at the top in place of bolts at bottom back is not allowed without prior approval.

END OF SECTION

SECTION 16110

CONDUITS

PART 1 GENERAL

1.1 SCOPE OF WORK

A. This Specification Section covers the furnishing, installing and testing of all conduits, cable tray, fittings, and supports as specified herein, as shown on the Drawings, and as required for a complete electrical installation. Conduits shall be as listed in Section 16111 Conduit Schedule.

B. The provisions of Section 16010 of these Specifications shall apply, unless otherwise specified in this Section.

C. The conduit system shall consist of the types and sizes as required and shall include all rigid steel conduit, flexible conduit, non-metallic conduit, wireway, and accessories as required for the embedded and exposed raceway systems.

1.2 SUBMITTALS

A. Provide data and Drawings for all materials furnished under this Section with the content and format as specified Section 16011.

B. Submittals for the Conduit materials and equipment shall include, but shall not be limited to, the following:

1. Catalog cuts showing manufacturer, catalog numbers, dimensions, weights and material for all raceway and accessories.
2. Dimensioned "as-built" Drawings of Contract Electrical plans.
3. Marked up "as-built" Conduit and Wire Routing Schedule.

1.3 QUALITY ASSURANCE

A. Materials shall be of a manufacturer that has been fabricating and assembling specified raceway systems in his current facility for a minimum of two (2) years.

B. All materials selected for the manufacture of the hardware shall be the best available for the purpose for which they are used, considering strength, ductility, durability, and the best engineering practice.

C. All like parts shall be interchangeable.

PART 2 MATERIALS

2.1 REFERENCE STANDARDS

A. Conduits supplied under this Contract shall be designed, manufactured, and tested in accordance with the latest version of the following standards.

B. American National Standards Institute (ANSI) Publications:

C33.92	Flexible Liquidtight Metal Conduit
C80.1	Rigid Steel Conduit
C80.4	Rigid Steel Conduit Fittings

C. National Electrical Manufacturer's Association (NEMA):

FB 1	Fittings and Supports for Conduit Cable Assemblies
TC-2 and TC-3	Non-metallic Conduit and Fittings
RN 1	Rigid Steel Conduit PVC jacketed

D. Underwriters Laboratories, Inc.:

UL-514A	Metallic Outlet Boxes, Electrical
UL-870	Wireways, Auxiliary Gutters and Associated Fittings
UL-6	Rigid Metal Electrical Conduit
UL 651	Schedule 40 and 80 Rigid PVC Conduit

2.2 CONDUIT AND CONDUIT FITTINGS

A. General:

1. Conduit, fittings, and raceway materials shall be manufactured in accordance with UL and ANSI standards and shall be UL labeled for the application.

2. The Contractor shall use special conduit, raceways, wireways, construction methods, and materials as shown on the Contract Drawings and "Conduit and Wire Routing Schedule" located in Section 16111; which shall take precedence over any general methods and materials specified in this Section.

3. Continuation of conduit runs, not specifically called out in Conduit and Wire Routing Schedule, especially "flex" conduits, shall be provided with wires listed in Conduit and Wire Routing Schedule of previous runs.

B. Material for the conduit system shall conform to the following:

1. Galvanized Rigid Steel Conduit:

a. Rigid steel conduit, couplings, bends and nipples shall be in accordance with ANSI C80.1 and UL-6.

b. Hotdip galvanized inside and outside after fabrication and then coated with a zinc bichromate finish.

c. Minimum trade size - three-quarters inch (¾") unless otherwise shown on Contract Drawings.

d. Galvanized rigid steel factory elbows for NEMA 1 areas 90 degree transitions. NEMA 4X area transitions shall be GRS-PVC factory ells.

e. EMT or IMC is not considered an equivalent to GRS.

f. GRS conduit is allowed only when specifically called out in the "Conduit and Wire Routing Schedule."

2. Flexible Liquidtight Metal Conduit: (FLEX):

a. Flexible liquidtight metal conduit shall be in accordance with ANSI C33.92 and shall be galvanized steel core with a copper bonding conductor between the spiral segments and an extruded synthetic jacket overall to insure a liquid-tight conduit. Flexible metallic conduit shall be fabricated from galvanized interlocked steep strip. Liquid-tight flexible metallic conduit shall have an extruded polyvinylchloride covering of the flexible steel conduit and shall be in accordance with NEC 350.120. The conduit shall be Anamet Sealtight Flexible conduit, or approved equal.

b. FLEX conduits shall meet the minimum requirements of NEC Code Table Annex 3 C3 "Maximum Number of Conductors and Fixture Wires in Flexible Metallic Conduit" and Table C3A "Maximum Number of Compact Conductors and Fixture Wires in Flexible Metallic Conduit."

c. Minimum trade size - one-half inch (½") unless otherwise shown on Contract Drawings.

d. Flexible conduit lengths shall not be greater than 36 inches for conduits 1½" or smaller (½" minimum) and 48 inches for conduits 2" or larger.

e. Flexible metallic conduit shall not be considered as a ground conductor, Contractor shall install a separate wire for equipment bonding.

f. Non-metallic flexible conduit shall not be used except when connecting from PVC-40 or PVC-80 conduits to equipment.

g. Flexible conduit shall only be installed in exposed or accessible locations.

h. Install flexible conduit in a manner that will minimize stress on connectors per NEC 350.24.

i. Flex connectors shall be PVC coated when connected to GRS-PVC conduits, or when located in NEMA 4X area.

3. Rigid Galvanized Steel Conduit PVC Bonded (GRS-PVC): Conduit shall conform to the requirements of NEMA RN1, Type A40. GRS-PVC conduit shall be rigid galvanized steel conduit to which an epoxy acrylic primer and a 40 mil thick UV rated polyvinyl chloride coating has been bonded. The interior of all GRS-PVC conduits and fittings shall be coated with a two part chemically cured urethane coating at a 2 mil minimum thickness. Bond strength shall exceed the tensile strength of the plastic coat. Furnish Perma Cote Supreme, Robroy Industries, or approved equal.

   a. Minimum trade size – three-quarters inch (¾") unless otherwise shown on Contract Drawings.

   b. Provide PVC coated galvanized rigid steel factory elbows for 45 or 90 degree transitions.

   c. All fittings used with plastic coated conduit shall be similarly coated with not less than 40 mils of polyvinyl chloride and shall be provided with Type #316 stainless steel hardware.

   d. For factory coated conduit, use overlapping PVC sleeves. Sleeves shall extend beyond end of fitting minimum distance equal to nominal diameter of conduit, and shall fit tightly over conduit coating to form a watertight joint. Joints and fittings shall be made tight with strap wrenches.

   e. All damage to PVC jacket shall be repaired with four separate applications of PVC paint. Finished patch shall be 0.040-inch minimum thickness. PVC coating patching material shall be as provided by the Manufacturer.

   f. Support channel and pipe straps shall be PVC coated. Exposed metal bolts/nuts, all-thread rod shall be 316 stainless steel.

   g. GRS-PVC conduits shall be used for all underground conduits except service entrance conduits.

4. Rigid Polyvinyl Chloride (PVC) Conduit: PVC conduit shall be manufactured in accordance with UL 651. PVC conduit shall be Schedule 40 or Schedule 80 high impact polyvinyl chloride, UL listed for direct burial.

   a. Minimum trade size - one inch (1") unless otherwise shown on Contract Drawings.

   b. PVC fittings shall have solvent-weld-type conduit connections.

   c. PVC conduit is not suitable for above grade installation except where specifically called out in Conduit and Wire Routing Schedule.

5. Electrical Metallic Tubing (EMT):

    a. EMT shall be galvanized thinwall conduit conforming to UL 797.

    b. Minimum trade size - three-quarters inch (¾") unless otherwise shown on Contract Drawings.

    c. Couplings and connectors for EMT shall be galvanized or cadmium plated and shall be of the compression type requiring the tightening of a nut on a gland ring.

    d. Rolled steel, zinc coated outside with zinc-coating or other approved corrosion-resistant coating on the inside.

    e. EMT conduits may be used as follows when listed on plans or in the Conduit and Wire Routing Schedule:

        1) Conduit runs on walls and ceilings inside buildings more than 8 feet above the floor. EMT can be used below 8 feet, but not lower than 1 foot above the floor when EMT originates from above and conduit does not penetrate the floor. EMT Conduit may <u>not</u> be used in normal exposed locations lower than 8 feet above the floor when conduits penetrate the floor.

        2) Concealed in drywall partitions.

    f. EMT conduits shall <u>not</u> be used:

        1) When other types of conduit material are specifically called out in the Conduit and Wire Routing Schedule.

        2) Any location subject to physical damage.

        3) Normal exposed locations lower than 8 feet above the floor when conduits penetrate the floor.

        4) In boiler rooms.

        5) Wetwell, outdoor or corrosive locations.

6. Fittings:

    a. GRS Fittings:

        1) Fittings for GRS conduits shall be threaded type. Set-screw type and compression-type are not acceptable. Fittings shall conform to the requirements of ANSI C80.4.

    b. Flex Fittings:

        1) NEMA 1 or 12 locations shall have cadmium-plated malleable iron body and gland nut with cast-in lug, brass grounding ferrule threaded to engage conduit spiral and O-ring seals around the conduit and box connection and insulated throat.

2) NEMA 4X rated areas shall have PVC coated flex fittings and connectors.

3) Fittings, for Class 1 locations only, shall have insulted throats, liquidtight, oil tight, suitable for outdoors and Class I, Div 2 locations.

c. GRS-PVC Fittings:

1) GRS-PVC fittings shall be hot dipped galvanized steel or galvanized cast ferrous metal with a PVC 40 mils thick coating. Provide threaded-type fittings, couplings, and connectors; set-screw type and compression-type are not acceptable. Fittings shall be Robroy Liquitite, Perma-Cote, or approved equal coated fittings.

d. EMT Fittings:

1) Couplings shall be rain tight compression type Appleton 93T Series, Efcor 760 Series, or approved equal.

2) Connectors shall be rain tight compression type with insulated throat Appleton 84T Series, Efcor 750B Series, or approved equal.

C. Conduit Type by Installation: Provide conduits as listed in "Conduit and Wire Routing Schedule" or as shown on Contract Drawings. Conduits not covered by in "Conduit and Wire Routing Schedule" or Contract Drawings shall be GRS-PVC except where EMT is allowed.

2.3 WIREWAY

A. Provide screw cover and hinged wireway only.

B. Wireways shall be constructed in accordance with Underwriter's Laboratories Standards UL 870 for Wireways, Auxiliary Gutters and Associated Fittings. Every component including lengths, connectors, and fittings shall be UL listed.

C. Wireways shall be suitable for "lay-in" of conductors. All screws installed toward the inside shall be protected by spring nuts or otherwise guarded to prevent wire insulation damage.

D. Wireways shall be EMP-1 Sectional flanged oil-tight type with hinged covers and shall be 8 inches by 8 inches in cross Section unless otherwise specified. New wireways that extend existing wireways shall be of the same manufacturer and type.

E. Non-Corrosive Areas: Wireways shall be coated with a rust-inhibiting, phosphatizing coating and gray baked enamel finish. All hardware shall be plated to prevent corrosion.

F. Corrosive or NEMA 4X Areas: Wireways shall be NEMA 4X 316 stainless steel. Non-Metallic wireways may be used when approved by Engineer in writing.

2.4 CONDUIT SEAL

Conduit seal shall provide high adhesion and moisture protection. Seal shall absorb cable-filling material and be re-enterable. Conduit seal shall be 3M #442 High Gel re-enterable encapsulant, or approved equal.

2.5 WARNING TAPE

Bury plastic tape shall be colored for particular underground service, 3-inch minimum width, utilize tape made of material resistant to corrosive soil. Tape shall have aluminum backing to facilitate locating it underground using a non-ferrous locator. Use red tape for “Electric” service and orange tape for “Communication” service. Tape shall have printed wording listing type of service. Tape shall have aluminum backing to locate using non-ferrous locator. Bury detectable warning tape shall be Seton, Blackburn, Griffolyn Co., Terra-Tape, Brady, or equivalent.

2.6 CABLE TRAY

A. MANUFACTURE

1. Subject to compliance with these specifications, cable tray and cable channel systems shall be as manufactured by Cooper B-Line Inc. model 166-P-06-24-144 with dividers as shown, or engineer approved equal.

B. CABLE TRAY SECTIONS AND COMPONENTS

1. General: Except as otherwise indicated, provide metal cable trays, of types, classes and sizes indicated; with splice plates, bolts, nuts and washers for connecting units. Construct units with rounded edges and smooth surfaces; in compliance with applicable standards; and with the following additional construction features.

2. Materials and Finish: Material and finish specifications for each tray type are as follows:

3. Pre-galvanized Steel: Straight sections, fitting side rails, rungs, and covers shall be made from steel meeting the minimum mechanical properties and mill galvanized in accordance with ASTM A653 SS, Grade 33, coating designation G90.

C. TYPE OF TRAY SYSTEM

1. Ladder type trays shall consist of two longitudinal members (side rails) with transverse members (rungs) welded to the side rails. Rungs shall be spaced 6 inches on center. Spacing in radiused fittings shall be 9 inches and measured at the center of the tray's width. Rungs shall have a minimum cable-bearing surface of 7/8 inch with radiused edges. No portion of the rungs shall protrude below the bottom plane of the side rails..

2. Tray Sizes shall have 4 inch minimum usable load depth, or as noted on the drawing.

3. Trays shall span and be supported 12 feet on center.

4. Tray widths shall be 24 inches or as shown on drawings.

5. All fittings must have a minimum radius of 24 inches.

6. Splice plates shall be the bolted type made as indicated below for each tray type. The resistance of fixed splice connections between adjacent sections of tray shall not exceed .00033 ohms. Splice plate construction shall be such that a splice may be located anywhere within the support span without diminishing rated loading capacity of the cable tray.

7. Barrier Strips: Shall be placed as specified on all cable trays having control cables and be fastened into the tray with self-drilling screws.

8. All Cable trays shall have removable flanged covers installed.

9. Outdoor cable trays shall have enclosed bottom and shall be weather tight.

10. Provide all necessary fasteners and supports. Fasteners and supports shall be galvanized steel.

11. All cable trays shall be continuously grounded per manufacturer details.

PART 3 EXECUTION

3.1 CONDUIT AND RACEWAY INSTALLATION

A. Conduit and Raceway Requirements:

1. Install an accessible raceway and conduit system for connection of all boxes, panelboards, cabinets, equipment, etc.

2. All conduit and raceway shall be the size and type as shown on Conduit and Wire Routing Schedule except as follows:

   a. All exposed conduits in NEMA 4X areas (except for indoor corrosive areas) and outdoor locations shall be GRS-PVC.

   b. All exposed conduits in NEMA 12 areas shall be GRS.

   c. All exposed conduits in indoor NEMA 4X corrosive areas shall be PVC-80.

3. All conduit and raceway shall be the type as shown on Conduit and Wire Routing Schedule. In no case shall the conduit size be smaller than that shown.

4. Conduits connected to boxes, cabinets, etc., outdoors, exposed to weather or in areas subject to excessive moisture shall be fitted with watertight sealing hubs of steel or malleable iron with sealing ring and insulated throat, Myers hub, Thomas and Betts 370 Series, or approved equal.

5. Malleable iron threaded grounding bushing, with insulated throat and set screw solderless lugs, Appleton GIB-XXXSL series shall be placed on the end of all rigid conduits. A ground bare copper wire shall bind each bushing to the enclosure ground bus.

6. Spare conduits shall be installed as that type of conduit.

7. Matching Existing Facilities:

    a. When new conduit are added to areas which are already painted, the conduit and its supports shall be painted to match the existing facilities.

    b. Where new conduit is used to replace existing conduit, the existing conduit and supports shall be removed, resulting blemishes shall be patched and repainted to match original conditions.

    c. If existing conduits are to be reused and rerouted, resulting blemishes shall be corrected in the same manner.

    d. Mandrel or conduit piston shall be pulled through the entire existing conduit run to prove the length contains no blockages or obstructions. Mandrelling shall be witness by the Owner

    e. Install new conduit tags for reused conduits at all transition boxes and endpoints. Conduit & Wire Routing Schedule shall be updated as these modifications take place.

8. Contractor is to remove and waste all unused wire associated with existing conduits reused for new work.

9. When existing conduits have new wire pulled to existing equipment, the Contractor is responsible for reconnecting all terminations to the equipment.

10. Contractor to remove and waste all conduit and wire associated with removal or demolition of equipment.

11. Equipment to be replaced with new shall have new flex conduits installed and wire reconnected by Contractor.

12. Painted to match adjoining surface.

13. After complete installation of 2 inch and larger conduit runs, snake conduits with conduit cleaner equipped with a cylindrical mandrel of a diameter not less than 85 percent of nominal diameter of conduit. Remove and replace conduits through which mandrel will not pass.

14. Clean and ensure that new and existing conduit runs are not crushed or creased. Verify internal dimensions of existing conduit prior to installation of conductors. Verify that no foreign objects or obstructions are present in conduit prior to installing conductors.

15. Install conduit system to provide firm mechanical assemblies with electrical conductivity throughout.

B. Exposed Conduit:

1. All exposed conduits shall be run in straight lines parallel to column lines, walls or beams. Where conduits are grouped, the bends and fittings shall be installed so as to present an orderly appearance. Unnecessary bending or offsets shall be avoided. Conduits shall be kept at least 12 inches away from heating devices or similar equipment.

2. Supports for exposed conduit shall be in accordance with Title 24, CAC.

3. Securing and supporting of liquidtight metal conduit shall be in accordance with NEC 350.30.

4. Support rigid conduits at 8 feet intervals and PVC conduits at 4 feet intervals. Support all conduits within 1 foot of boxes or changes in direction. Use riser supports with clamps for vertical conduit risers.

5. For single conduit runs, use pipe straps or suspend from ceiling with single conduit hangers. Single hole malleable iron clamps with backplates may be used for horizontal runs on vertical surfaces. Perforated strap (plumber's tape), not acceptable.

6. For multiple conduit runs, group conduits together and support from ceiling by means of trapeze hangers. Wall brackets or unistrut supports shall be used for conduit runs on vertical surfaces. Clamp each conduit to trapeze or support, using conduit clamp.

7. Fasten hanger rods to structural steel members with beam clamps or to concrete inserts set flush with surface. Install reinforcing rod through opening in concrete insert.

8. Exposed conduit shall be supported rigidly in place. All exposed conduit shall include, where required, the drilling of holes in the bottom or sides of enclosures. The Contractor shall thoroughly examine work prior to drilling to avoid drilling into components within enclosures.

C. Conduits in Concrete Slabs:

1. Conduits may be installed in structural slabs, or in slabs on grade, having the following minimum thickness: 4” thick for conduits greater than ¾”.

2. Maintain a minimum of two-inches of clearance between conduits and any reinforcement bars. In structural slabs, place conduits carefully between upper and lower layers of steel. In pre-stressed concrete slab construction, place conduits in center of slab and do not support from pre-stressed steel.

3. Space conduits to maintain structural integrity of slabs.

4. Place conduits running parallel to slab supports (beams, columns, walls, etc.) not less than 12" from such supports.

5. Where floor slab is in direct contact with earth or fill, rigid steel conduit may be embedded in concrete blister below bottom of slab with 2-inch minimum of concrete cover.

6. Runs of conduit to be embedded in concrete shall be rigidly supported in their proper positions while concrete is being placed. Place conduit separators every 4 feet on centers and securely anchor to prevent movement. Ends of conduits shall be plugged or capped during construction to prevent the entrance of concrete or other foreign matter. Connections shall be checked for tightness before being embedded.

D. Underground Conduits:

1. Buried conduit shall be placed at least 24 inches below grade and be located to avoid interference with other underground piping, foundations, etc. Conduit for Telephone and Power Utilities shall be set to depth as required by Utility engineered drawings and not less than 36" below grade.

2. Conduits placed in concrete which is in contact with earth or water shall be adequately separated from the earth or water by at least 3" of concrete. Concrete encasement shall extend 4" above finished grade or into housekeeping pad at completion of each run.

3. Install expansion couplings in conduit runs crossing expansion or contraction joints in concrete. Expansion couplings shall be zinc coated and watertight.

4. Where other piping systems are encountered or being installed along a raceway route, maintain a 12-inch-minimum vertical separation between raceways and other systems at crossings. Maintain a 12-inch-minimum separation between raceways and other systems in parallel runs. Do not place raceways over valves or couplings in other piping systems. Refer conflicts with these requirements to the Owner's Representative for instructions before further work is done.

5. Underground conduits not encased shall have a minimum 4" sand bedding completely encircling the conduits.

6. Duct taping conduits together is not acceptable. Conduits, installed into concrete pads, shall be installed with a minimum of 2” distance between conduits to allow installation of bushings.

E. Raceway Identification:

1. All conduits and raceways listed in Conduit and Wire Routing Schedule shall have conduit tags at both terminations of each conduit. All conduits and raceways listed in Conduit and Raceway Schedule shall be provided with conduit tags with tag numbers listed in schedule. All spare conduits shall be labeled. Spare conduits that have prefix "X" with a conduit quantity greater than one shall have a unique conduit postfix number assigned to each conduit; i.e., if conduit quantity is 3 for conduit route X0001, then label conduits as X0001A, X0001B, X0001C, etc.

2. All exposed conduit inside buildings entering/leaving panels and enclosures shall conduit tags composed of tag tiles with tag holder where allowed by space. Tag holder shall be secured to conduit using nylon cable ties on both ends. Tag tiles shall be Almetek Type EZ-V, or approved equal. Tag holder shall be Almetek Type TH, or approved equal.

3. Conduit terminating in walls shall be identified by stenciling the conduit number on the wall directly under the conduit.

4. When there is no space available to use tag ties, such as in Motor Control Centers with underground feed or for conduits outside of buildings, then the tag material shall be rigid laminated red phenolic with white lettering. The size of the tag shall be 2" diameter. No letters are allowed smaller than 7/16". Tags shall be heat and UV resistant, stain-proof, electrically non-conductive and non-corroding. Securely fasten tags in place using UV rated plastic ty-wraps. Engrave the tags, on both sides, with the conduit number. Labeling shall be neatly installed for visibility and shall be clearly legible. Conduit tags shall be Brady Custom B-1, or approved equal.

5. Prior to encasement, concealment, backfilling of conduits, temporary conduit labels shall be provided at each end of conduit. Temporary conduit labels shall be provided on conduits when it leaves an open transition point, junction boxes, terminal boxes, pullboxes, vaults, and manholes, etc. Temporary conduit labels shall have ½-inch (minimum) lettering at all transition points. After encasement and concealment temporary conduit labels shall be placed at each exposed end.

6. Each conduit listed in Conduit and Wire Routing Schedule shall have permanent tags where it enters an open transition point, junction boxes, terminal boxes, pullboxes, vaults, and manholes. Where limited conduit length is exposed, use a ½" washer attached with non-metallic tie wraps and having the conduit ID clearly labeled on both sides with black permanent ink.

7. All existing conduits listed in Conduit and Wire Routing Schedule reused for new work shall have new conduit tags installed at all transition boxes and endpoints. Conduit and Wire Routing Schedule shall be updated as these modifications take place.

F. Workmanship and Installation Requirements:

1. Where field changes are required, every precaution shall be taken to insure that the change is coordinated with other conduit, structural, plumbing, and piping work. Information shall be obtained regarding the completed raceway runs to insure that there will be no interference when the raceway run is extended or revised. A complete record of such changes shall be made on the Record Contract Drawings.

2. Conduits shall be cut square, threaded and reamed to remove sharp or rough edges and burrs. Conduit joints and connections shall be made waterproof and rustproof by application of a non-insulating thread compound, such as white lead or graphite, and zinc sealing material. Each threaded joint shall be thoroughly cleaned to remove cutting oil before the compound is applied.

3. All bends and offsets, where required, shall either be made with factory made bends or shall be field bends made with a conduit bender designed specifically for use with the type of conduit to be bent. Elbows and bends for conduits shall be formed in the field and shall be reasonably free from flattened surfaces, indentations, or kinks. Avoid field bends and offsets where possible. Heating of conduit to facilitate bending shall not be acceptable. Metallic conduits shall be bent cold to prevent damage to the protective coating. All bending shall be gradual and be done smoothly to permit the pulling on insulated electrical wires and cables without incurring damage to the insulation or sheath. Radius of curvature shall be not less than that permitted by NEC.

4. Conduit shall be rigidly secured to panels and other electrical equipment terminal boxes with locknuts and bushings in such a manner that each system shall be electrically continuous throughout.

5. Flexible liquidtight metal conduit shall be used to provide flexible connections between the rigid system and motor conduit boxes or other equipment subject to vibration.

6. To reduce damage to the zinc coating, only strap type wrenches shall be used. All wrench marks, field cut threads, and all other places where the zinc coating is damaged, shall be repaired with zinc-rich galvanizing repair compound.

7. Raceway shall be installed with necessary fittings and supports.

8. Contractor shall limit the number of directional changes of the conduit to total no more than the equivalent of 270 degrees in any run between pull points. Where required for ease of pulling and as necessary to meet code, the Contractor shall supply and install junction or pullboxes, even though not shown on Drawings, at no additional cost to the Owner.

9. Conduit runs between two vaults, pull or junction boxes shall be limited to a maximum of 300 feet, or less 50 feet for every 90 degrees of conduit change in direction.

10. Install and equip conduits and fittings installed outdoors or in other wet locations, entering equipment from bottom unless necessary to enter from side, so as to prevent water from entering the equipment. Top entry of conduits into enclosures located outdoors or in other wet locations is not allowed.

11. Spare or Future Conduits:

    a. Provide a braided yellow polypropylene pull ropes, ¼" minimum size.

    b. Provide a waterproof label on each end of the pull cords to indicate the destination of the other end.

    c. Provide caps on conduit ends to prevent entrance of dirt or insects.

    d. Label conduits as specified herein.

12. Contractor shall neatly bundle all new and reused wires with ty-wraps.

13. Conduit stubs for future use shall be capped with coupling, nipple, and plug.

14. Conduit between vibrating equipment and outlet boxes or conduits shall be liquid tight flexible electrical conduits.

15. Whenever possible, make bends for exposed conduit stub-ups completely below the surface. Make stubs vertical and arrange neatly.

16. Where conduits turn up in accessible floor areas or under removable partitions, install coupling flush with finish floor surface (exclusive of floor covering). Provide flush threaded plug in this coupling where conduit is not to be extended.

17. For flush mounted panels, run empty conduits from panel to accessible spaces above. Install a minimum of one ¾" conduit for every 3 single pole spare circuit breakers or spaces, or fraction thereof.

18. Running Threads: Do not use running threads. Where such device is needed, use raintight unions or concrete tight couplings.

19. The entire electrical raceway system shall be bonded and form a continuous metallic electrical conductor from service point to every box and shall be terminated with ground bushings connected to the ground bus. Conduits entering enclosures shall be fitted with insulated grounding bushing. All grounding bushings shall be tied to the grounding system with properly sized bonding conductors per the NEC Code.

20. Connection to steel conduit from PVC shall be made with approved threaded adapters.

21. All conduits which are installed shall be capped during construction to prevent the entrance of foreign material.

22. Secure hangers, brackets, conduit straps, supports and electrical equipment by means of toggle bolts on hollow masonry; expansion shields and machine screws or standard preset inserts on concrete or solid masonry; machine screws or bolts on metal surfaces; wood screws on wood construction. Wood or fiber plugs or concrete nails, not acceptable.

23. Special "Soft–Jaw" type pipe clamps shall be used to prevent damage to PVC-coated conduit while field threading and cutting to length.

G. Raceway shall be installed with necessary Warning Tapes:

1. Bury warning tapes approximately 12 inches above all underground concrete-encased duct banks and other conduit runs over 100' in length. Align parallel to and within 3 inches of the centerline of the conduit or duct bank.

H. Cutting and Patching:

1. The Contractor shall do all core drilling, cutting, and patching required to install his work at no additional cost to the Owner. Core drilling, cutting, and patching is considered standard work to be done at existing facilities, therefore, this work is not specifically called out on Drawings. Any core drilling or cutting which may impair

the structure shall require prior approval by the Engineer. Core drilling, cutting, and patching shall be done only by skilled labor of the respective trades. All surfaces shall be restored to their original condition after core drilling, cutting, and patching and made watertight.

I. Seals:

1. Seal around all conduits, wires, and cables penetrating between panels, any other boxes that house electrical and instrumentation components, walls, ceilings, and floors in all buildings with a fire stop material. Seal shall be made at both ends of the conduit with a fire stop putty. Seal shall have a minimum two hour rating. Fire stop sealing shall be International Protective Coatings Flamesafe, or approved equal.

2. Conduit entrances: Seal each conduit entrance from below grade into the MCC and other electrical enclosures with plugging compound sealant to prevent the entrance of insects and rodents. Conduits between the enclosures shall be sealed with plugging compound sealant on each end. Plugging compound sealant shall be PRC-DeSoto (formerly Courtaulds) Aerospace Semco PR-868 or approved equal.

3. Seal all conduits to prevent water traveling through conduits into buildings, junction boxes, underground facilities, electrical enclosures, panels, instruments.

4. Install conduit drain boxes and plug conduit interior to form an effective barrier to keep out water traveling into equipment or instrumentation from conduit installed higher than equipment or instrumentation.

5. Conduit entrances in the bottom of MCCs, power distribution panels, switchboards, and enclosures shall project into the enclosure a minimum of two inches to prevent water from entering conduits.

J. Excavation and Back Filling:

1. At all times during the excavation and backfilling, the Contractor shall provide barricades, fences, guard rails, etc., to safeguard authorized personnel, and the general public from excavated trenches. Where Access is Deemed Necessary by the Owner, the Contractor shall provide trench plates to allow said access over excavated areas (traffic of all types).

2. Excavations: Provide the excavation for Utility power and telephone services, electrical, and instrumentation equipment foundations and trenches for conduits and ductbanks as necessary. Backfill and surface all areas in accordance with other Contract Sections. Excavations shall be in accordance with other Contract Sections.

   a. Underground conduits outside of structures, excluding utility conduits, shall have a minimum cover of 24 inches. Utility power and telephone conduits shall have a minimum cover of 36 inches.

   b. Trenches for all conduits below floor slabs and underground shall be excavated to the required depths. Conduits under floor slabs shall have trenches no deeper than is required to properly contain bends within walls.

c. All trenching and underground work shall be closely coordinated with the Owner and Engineer. Contractor shall be responsible for locating, and avoiding disruption of, all existing underground facilities such as gas lines, water lines, sewer, fire protection lines, and existing underground electrical facilities. Any damage caused by the Contractor must be repaired at the Contractor's cost, to the satisfaction of the Owner.

d. All trenching shall be done as to minimize disruption to normal plant or construction operations. All open trenches shall be suitably marked and/or protected to avoid any accidents or injuries to workers or plant personnel.

e. Where new electrical ducts intersect existing facilities, at essentially the same depth, Contractor shall gradually divert the electrical facilities down, under, and back up around the existing facilities.

f. All excavations shall be backfilled and resurfaced to match surfaces prior to and adjacent to excavation.

3. Back filling shall be done only after conduits have been inspected by Owner. Excavation and back fill of lines and conduits shall conform to the requirements of the Earthwork Section of these Specifications, unless modified on plans.

   a. Backfill, Non-Paved Areas: Use native backfill, compacted in 6 inch layers to 90 percent relative compaction. Final backfill elevation shall match existing.

   b. Backfill, Paved Areas:

      1) Use clean imported sand rated for use under paved areas.

      2) Imported sand shall be free from organic material, trash, debris and rubbish.

      3) Compact trench backfill by manual methods. Water flooding or jetting is not permitted.

4. Repave any area that was paved prior to excavation. Backfill and surface all areas as shown on the Drawings or where not shown to the original condition that was present prior to the excavation.

3.2 WARRANTY

Provide warranty as specified in Electrical Section 16010 - Warranty.

END OF SECTION

SECTION 16115

DUCT BANKS, VAULTS AND PULL BOXES

PART 1 GENERAL

1.1 SCOPE OF WORK

A. The Contractor shall install, ready for use, the duct banks, vaults, and pull boxes as specified herein. This document describes the function and operation of the system and particular components, but does not necessarily describe all necessary devices. All components and devices shall be furnished and installed as required to provide duct banks, vaults and pull boxes for accomplishing the functions and meeting the performance set forth hereinafter at no additional cost to the Owner.

B. Furnish all required labor, materials, project equipment, tools, construction equipment, safety equipment, transportation, test equipment, incidentals, and services to provide duct banks, vaults, and pull boxes as shown on the Drawings, included in these Specifications as recommended by suppliers, or required for complete installation.

C. This section scope of work includes providing and installing:

1. Duct banks, pull boxes, vaults, and associated hardware.
2. All necessary hardware, fittings, and devices to connect the electrical equipment and grounding system provided under other Sections.
3. Trenching and backfilling.

1.2 RELATED WORK

Junction boxes to be per Section 16140 – Wiring Devices.

1.3 SUBMITTALS AND DRAWINGS

A. Provide submittals and Drawings as specified in Electrical Section 16011.

B. Submit for approval, calculation verifying pull box and vault size and layout of duct banks.

C. Submit for approval, each rack cable and wire support layout proposed for each vault prior to installation.

PART 2 MATERIALS

2.1 GENERAL

A. The Contractor shall use special construction methods, and materials as shown on the Contract Drawings, which shall take precedence over any general methods and materials specified in this Section.

B. The location of pull boxes, vaults, and duct banks are shown on Contract drawing at their approximate location. The Contractor shall relocate theses pullboxes, vaults, and duct banks to avoid conflict with other underground utilities at no additional cost to Owner.

2.2 DUCT BANKS

Duct banks, materials, and installation shall meet all requirements of the NEC and the following minimum Specifications:

A. Concrete shall conform to ASTM C150, with 7-day 2500 PSI compressive strength and minimum cement content of 55%. Use a color additive for identification purposes: Brick red "Colorfull," as manufactured by Owl Manufacturing Company, Arcadia, California; coral red "Chromix C-22," as manufactured by L.M. Scofield Company, Los Angeles, California or equivalent. Add the color additive while the concrete is being mixed, using the quantity per cubic yard of concrete recommended by the color additive Manufacturer for the class of concrete indicated.

2.3 PULL BOXES AND VAULTS

A. General:

1. Box dimensions shall be the minimum size as shown on Contract Drawings and in accordance with size, quantity of conductors, and conduit clearances per NEC article 314 requirements.

2. A copper ground bus shall be provided in each pullbox and vault. Screw type lugs shall be provided for connection of grounding conductors. All grounding conductors shall be sized as shown on plans or in accordance with NEC Table 250-122, whichever is larger.

B. Aboveground Pull Boxes:

1. Surface Mounted Pull Boxes:

a. Pull boxes in "damp", "wet" or NEMA 4X locations shall be stainless steel, with the exception of "corrosive" locations. Accessories and hardware shall be stainless steel.

b. Non-metallic pull boxes shall be used in "corrosive" locations, unless noted otherwise. Non-metallic pull boxes shall be molded PVC or hot compressed reinforced fiberglass. Conduit connections shall be made with solvent cement fittings or other watertight non-metallic fittings. Accessories and hardware shall be stainless steel.

c. Pull boxes in NEMA 12 or 3R areas shall be galvanized steel (unless specifically called out on Contract drawings) and painted to match surrounding surfaces or as designated by Engineer.

d. Pull boxes larger than 20" H by 16" W shall have hinges access covers.

e. Covers shall be attached with stainless steel screws. No devices, screws, rivets, or bolts shall protrude through the exterior surface unless specifically shown on the Drawings.

f. Boxes shall be Circle AW, Hoffman, or approved equal.

2.4 UNDERGROUND PULL BOXES AND VAULTS

A. Underground pull boxes and vaults, where shown or required by length of conduit runs, shall be prefabricated 3000PSI reinforced steel concrete type with the minimum size shown on the Drawings. Provide larger pull boxes/vaults when necessary to allow for adequate pull area or to accommodate the number of conduits entering box. Extension sections shall be provided as necessary to reach the depth of underground conduits.

B. Pullboxes shall have diamond plate galvanized steel full H/20 loading rated traffic covers with galvanized steel hold down bolts and hardware.

C. Vaults shall be precast concrete with traffic rated covers designed for full H/20 loading. Vaults shall have recessed checker plate, galvanized, ¼" (minimum) steel cover. Dimensions shall be as specified on the Drawings. Vaults shall be constructed of 3000 psi reinforced steel concrete.

D. Underground vaults shall be provided with end hinged, torsion spring opening assist type cover assemblies. Provide single leaf assemblies for 2 by 3 feet opening. Provide double leaf assemblies for pullboxes and vaults with openings larger than 2 by 3 feet.

E. Underground pullboxes, vaults and handholes shall be Utility Vault, Christy Concrete Products, Brooks, or approved equal.

2.5 PULL BOX AND VAULT IDENTIFICATION

A. Underground Pull Box and Vault Cover Identification: engrave or bead weld vault and pull box covers with minimum thickness of ¼".

B. Aboveground Pull Box Cover Identification: stainless steel screw attached phenolic nameplates with 1/2" letters meeting the requirements of Section 16144 Nameplates.

C. Identification to indicate services contained within each pull box as shown on Contract E-series Drawings.

PART 3 EXECUTION

3.1 WORKMANSHIP

A. All work in this Section shall conform to the codes and standards specified in Section 16010 - Electrical.

B. The Supplier shall employ personnel that are skilled and experienced in the installation of duct banks, vaults, and pull boxes. All installation labor shall be performed by qualified personnel who have had experience on similar projects. Provide first class workmanship for all installations.

C. Ensure that all vaults and pull boxes fit properly in their installations.

D. Perform any required work to correct that in the opinion of the Engineer are improper installations at no additional expense to the Owner.

3.2 INSTALLATION

A. General:

1. Install all products per Electrical 16010 - Installation, General.

2. Keep boxes, vaults, and other openings closed at all times when not being accessed to prevent entry of foreign matter. Cover to protect them against dirt, paint, water, chemical, or mechanical damage before and during construction period. Restore to original condition damaged products prior to final acceptance.

3. Duct banks and raceways shall not leak water into dry interiors. This applies to duct banks and raceways entering structures, vaults, basements, tunnels, and buildings. Replace defective sections with new duct banks and raceways which leak water into dry spaces.

4. Place non-shrink grout between conduits and void in sides of underground pull boxes and vaults.

B. Duct Banks:

1. Direct burial of conduit shall not be permitted where concrete duct banks are required. Minimum size of conduit in duct banks interconnecting vaults shall be 1 inch.

2. Conduit material for exposed transition from underground to above ground shall be Contract Drawing E44 detail "G."

3. All ducts shall be inspected by the Owner prior to pouring concrete. The Owner will inspect for backfill compaction, drainage slope, spacers, flotation ties and conduit condition, joints, and end bells. Concrete shall not be poured until this inspection is complete.

4. Conduit placed in concrete which is in contact with the earth shall be separated from the earth by at least 4 inches of concrete. Clearances equal to the nominal conduit diameter, but not less than 1½ inches, shall be maintained between conduits. Clearances of less than 1½ inches at conduit crossing and terminating locations may be acceptable with Owner written approval.

5. Expansion fittings shall be provided whenever embedded conduit crosses building expansion joints, between two adjacent structures, and between a duct bank and structure.

6. Plastic conduit spacers shall be located 5 feet on centers. Plastic spacers shall be of the type manufactured specifically for spacing conduits in duct banks. The spacers shall be secured to the conduits by wire ties. The duct bank shall be securely anchored to prevent conduit flotation while the concrete is being placed. Conduit runs shall be watertight. Spacing for spacers shall be as recommended by manufacturer for size of conduit. Spacers shall be interlocking and rated for concrete encasement. Concrete duct bank spacers shall be Underground Devices Wunpeece or approved equal.

7. The ends of conduits shall be protected from damage during construction by using plastic plugs.

8. Conduits shall be thoroughly swabbed inside immediately upon completion of pouring concrete. After the concrete has set, but before backfilling, a mandrel having a diameter equal to the nominal conduit inside diameter minus 1/2 inch, and not less than 4 inches long, shall be pulled through each conduit. The mandrel shall be lead covered or painted white to indicate any protrusion on the inside of the conduit. The protrusion shall be removed or the conduit Section replaced.

9. Duct banks shall maintain a steady slope between the high point of the duct bank to the vault or pull box. Maintain a grade of at least 1 inch per 100 feet, either from one vault or pull box to the next or from a high point between them, depending on the surface contour. Slope duct banks downward away from buildings to pull boxes or vaults.

10. Conduits entering vaults and pull boxes shall have end bells with conduit tags.

11. Conduits tags shall be provided and installed as specified in Section 16110 – Conduits in all pull boxes and vaults.

12. The entire electrical raceway system shall be bonded and form a continuous metallic electrical conductor from service point to every box. Metallic conduits shall be terminated with ground bushings connected to the ground bus or to next section of conduit run.

13. Where other non-electrical systems are encountered or being installed along a duct bank route, maintain a 12-inch-minimum vertical separation between duct bank and other systems at crossings. Maintain a 12-inch-minimum separation between duct banks and other non-electrical systems in parallel runs. Do not place duct banks over valves or couplings in other piping systems. Refer conflicts with these requirements to the Owner's Representative for instructions before further work is done.

14. Conduit Separation in Duct Banks: "E," "XE," "L," "XL," "P" and "XP" prefixed conduit groups shall be separated a minimum of 12" from all other conduit groups.

15. Concrete encasement shall extend continuously to 4" above finished grade or into housekeeping pad at completion of each run; except for fiberglass pull boxes, where duct bank to stop at horizontal and space above filled with pea gravel.

C. Pull Boxes and Vaults Installation:

1. Pull boxes and vaults shall be installed accurately to match the surrounding building outline, pavement or sidewalk grade. Set pullboxes parallel or perpendicular with adjacent structures.

2. Size pull boxes and vaults to meet National Electrical Code requirements and to provide sufficient room for the future conduits and cables indicated on the Drawings at no additional cost to Owner.

3. Contractor shall limit the number of directional changes of the conduit to total no more than 270 degrees in any run between pull points. Where required for ease of pulling and as necessary to meet Code, the Contractor shall supply and install junction, vaults, or pullboxes, even though not shown on Drawings, at no additional cost to the Owner.

4. Conduit runs between two vaults, pull, or junction boxes shall be limited to a maximum of 300 feet, or less 50 feet for every 90 degrees of change in direction.

5. Set underground pull boxes and vaults level on a crushed rock base with a minimum 18 inches thick with horizontal dimensions same as bottom of pull box plus 8 inches minimum all around. Crushed rock shall be 3/4 inch maximum size, 1/4" minimum size.

6. Install covers flush within finished paved or concrete surfaces. In unfinished areas, install covers one inch (1") above finished grade. In areas where a snow plow would access, install covers ½" below grade.

7. In pullboxes and vaults separate power "E, L, P, XE, XL, and XP" wiring to one side within and all other wiring to opposite side in bundles. In vault, these separate bundles are to be supported on plastic cable supports rated for the bundle loading.

D. Vault Installation:

1. Vaults shall be set plumb. Vault covers, unless otherwise shown on Contract Drawings, shall be set at grade.

2. Seal vault joints located between box upper section, extensions and bottom with joint sealing compound to make watertight.

3. Provide plastic cable racks for all cables passing through each vault. No wires or cables are permitted to lie on bottom of the vault. Conductors of different voltages or types shall be suspended from different "saddles" on different sides. Cable racks shall be U.L. listed and suitable for mounting in vault. Design of saddle shall be capture type such that cables shall not be required to be tied to rack. Provide number of cable racks and sizes as required for each vault. Cable racks shall be Underground Devices Saddle Rack or approved equal.

E. Pull Boxes and Vaults Entry: Conduits entering underground pull boxes and vaults shall be horizontal, except when required otherwise by Power and Telephone Utility Standards. Conduits shall not enter through the concrete bottom of boxes, or vaults, except for vaults or boxes with bottoms shown at or above grade.

F. Provide Excavation and Back Filling per requirements of Section 16110-Conduits.

G. Openings:

1. Leave no unused opening in any pull box or vault. Install close-up plugs as required to seal openings.

H. Cleaning:

1. Prior to project completion, clean out debris from all pullboxes and vaults.

2. Remove dirt from vaults with concrete bottoms.

3.3 WARRANTY

Provide warranty as specified in Electrical Section 16010 - Warranty.

END OF SECTION

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SECTION 16120

WIRES, FUSES, AND TERMINAL BLOCKS

PART 1 GENERAL

1.1 SCOPE OF WORK

A. The Contractor shall assemble, ready for use, the electrical and instrumentation system with wires, fuses, and terminal blocks as specified herein.

B. Furnish all required labor, materials, tools, test equipment, incidentals, and services to provide a complete and operational electrical and instrumentation system with wire and electrical devices as shown on the Drawings, included in these Specifications or required for fully operating facilities.

C. Work includes that specified in Section 16010 - Electrical.

1.2 SUBMITTALS AND DRAWINGS

Descriptive literature for all materials furnished under this Section shall be submitted in accordance with Electrical Section 16011.

1.3 QUALITY ASSURANCE

A. All materials selected for the manufacture of the hardware shall be the best available for the purpose for which they are used, considering strength, ductility, durability and the best engineering practice.

B. Conductors shall be less than 12 months old.

C. All like parts shall be interchangeable.

PART 2 MATERIALS

2.1 WIRING AND ELECTRICAL DEVICES

A. General:

1. The Electrical Contractor and the electrical and instrumentation system suppliers shall provide and install wiring and devices as specified herein and per Division 16 requirements.

B. Low Voltage Wire and Cable:

1. General: Low voltage conductors shall be used for power, control, lighting and miscellaneous circuits. This Section applies to all wires or conductors used internally for all electrical equipment or externally for field wiring. Wire shall be new, plainly marked with UL label, gauge, voltage, type of insulation, and Manufacturer's name.

2. Low voltage wire shall conform with the following:

   a. NEMA standards WC70 and UL requirements.

   b. Class B stranding. Solid conductors may be used for lighting and receptacle circuits.

   c. Conductors shall be copper with a minimum of 98% conductivity.

   d. Insulation type for conductors smaller than #6 AWG shall be moisture and heat resistant thermoplastic NEC Type THHN/THWN, rated 90 °C in dry locations and 75 °C in wet locations, or approved equal. Conductors #6 AWG and larger shall be XHHW insulation rated 90 °C in dry locations and 75 °C in wet locations.

   e. Insulation of all conductors shall be rated 600 volt or higher.

   f. Field wire minimum AWG sizes:

      1) #12 for wires used for individual conductor circuits 480 volts and above, except for PLC I/O which may be size listed in Conduit and Wire Routing Schedule.

      2) #14 for wires used for individual conductor circuits below 480 volt.

   g. Non-field or equipment wire minimum AWG sizes if properly protected by fuse or breaker:

      1) #14 for wires used for individual conductor circuits 100 volt and above, except for PLC I/O wiring which may be #16.

      2) #18 for wires used for individual conductor circuits below 100 volt.

C. Color Code:

1. The color code of all wire shall conform with the following table:

DESCRIPTION	PHASE/CODE LETTER	FIELD WIRE WIRE OR TAPE COLOR	NON-FIELD WIRE COLOR
480 V, 3 PHASE	A	BROWN	BROWN
	B	ORANGE	ORANGE
	C	YELLOW	YELLOW
240 V or 208 V, 3P	A	BLACK	-
	B	RED (ORANGE if high leg)	-
	C	BLUE	-
240 / 120 V, 1 P	L1	BLACK	BLACK
	L2	RED	-
12V POSITIVE	12P	DARK BLUE	DARK BLUE
12V NEGATIVE	12N	BLACK/RED STRIPE	BLACK/RED STRIPE
24V POSITIVE	24P	PINK	PINK
24V NEGATIVE	24N	BLACK/WHITE STRIPE	BLACK/WHITE STRIPE
AC CONTROL		VIOLET	RED (YELLOW FOR FOREIGN CIRCUITS)
DC CONTROL		LIGHT BLUE	LIGHT BLUE
NEUTRAL	N	WHITE	WHITE
GROUND	G	GREEN	GREEN
SHIELDED PAIR	+	WHITE OR CLEAR	WHITE OR CLEAR
	-	BLACK	BLACK

2. No other colors shall be used without prior written approval of the Owner.

3. The same color shall be connected to the same phase throughout the panel.

4. All wires shall be properly fused or protected by a breaker at the amperage rating allowed by the NEC.

5. Phase color insulation shall be provided for complete length of #8 wire or smaller, colored phase tape is <u>not</u> allowed on #8 and smaller wire.

6. Neutral used for AC Control shall be white.

D. Instrument Cable:

1. All 4-20mA and 1-5VDC inside instrument and control panel cables shall conform with the following:

   a. Signal wiring shall be shielded twisted pair with #18 AWG tinned copper stranded conductors and shield drain conductor.

b. Conductor insulation shall be polyethylene rated 600VAC, 90° C and outer jacket shall be PVC.

c. A metal foil shield shall completely surround the signal conductors.

d. Multiple pair cables with individually shielded pairs may be used only with prior written approval of the Engineer.

2. All field 4-20mA instrument cables and cables shall conform with the following:

a. Signal wiring shall be shielded twisted pair with a minimum #16 AWG, tinned copper stranded conductors and shield drain conductor.

b. Conductor insulation shall be polyethylene rated 600VAC, 90° C and outer jacket shall be PVC and be "Tray Cable" rated.

c. A metal foil shield shall completely surround the signal conductors.

d. Multiple pair cables with individually shielded pairs may be used only with prior approval written of the Engineer.

3. Instrument Cables shall be Okonite, Okoseal-N Type P-OS, Belden, or approved equal. Note, multi-pair T.S.PR. Cables may be reduced in size to that listed in Conduit and Wire Routing Schedule.

E. Special Purpose Wiring:

1. Manufacturer Supplied Cables (MNFR CBL): Cables and wiring for special systems shall be provided by the manufacturer with the equipment and installed per the manufacturer's recommendations.

2. CAT 6 Cable

a. Underground (UG) buried CAT 5 communication cable meet the following requirements:

b. CAT 6 communication cable in underground (UG) conduit shall meet the following requirements:

1) TIA/EIA-568-B Category 6 Specifications.

2) #24 AWG solid bare copper conductor, 4 or 25 pair shielded twisted pair per “Conduit & Wire Routing Schedule.”

3) Rated for direct burial application.

4) Insulation: Solid Polyolefin, 600v.

5) Filling compound: 80°C extended thermoplastic rubber.

6) Outer Jacket: Water and UV resistant polyethylene.

7) Electrically continuous aluminum shield.

c. Indoor CAT 6 communication cable shall meet the following requirements:

1) TIA/EIA-568-B Category 6 specifications.

2) #24 AWG solid bare copper conductor, 4 twisted pairs.

3) Thermoplastic Dielectric type, 600v.

4) Shielded bulk cable.

5) UL listed.

6) Non-plenum usage rated when routed in conduit.

7) Plenum usage rated when routed in plenum spaces.

3. Vinyl Nylon Tray Cable (VNTC)

a. Cables shall have type THHN or THWN conductors. Individual conductors are bare annealed copper covered with polyvinyl chloride (PVC) insulation over which a nylon (polyamide) or UL listed equal jacket is applied.

b. The overall jacket shall consists of a heat, moisture, ultra violet and sunlight resistant PVC. Jacket shall be flame-retardant per Underwriter's Laboratory Subject 1277, 90 degrees Celsius temperature rating, rip cord laid longitudinally under jacket to facilitate removal.

c. Single Pair or Triad Shielding:

1) Group Shielding: Minimum 1.35 mil double-faced aluminum/synthetic polymer-backed tape overlapped to provide 100 percent coverage.

2) Drain Wire: 7-strand tinned copper drain wire, 2 sizes smaller than conductor.

d. Multiple Pair or Triad Shielding:

1) Group Shield: 1.35 mil aluminum-polyester tape overlapped to provide 100 percent coverage and a 7-strand tinned copper drain wire, 2 sizes smaller than conductor. Completely isolate group shields from each other.

2) Cable Shield: 2.35 mils double-faced aluminum and synthetic polymer backed tape overlapped to provide 100 percent coverage and a 7-strand tinned copper drain wire, same size as conductors.

e. Approved for cable tray installation in accordance with the National Electrical Code

F. Wire Marking:

1. Wire identification: All wire terminations including field interconnect as well as wiring interior MCC cubicles, switchboard, panels, equipment, junction panels and boxes shall be identified with machine printed labels. Hand lettered labels are not acceptable and shall be replaced at the Contractor's expense. The wire identification code for all field interconnect and panel interior wiring, shall be similar to the designations shown on the Contract example drawings.

2. Wire Labels: The labels shall be machine printed with indelible ink, heat shrink type capable of accepting a minimum of 23 machine printed characters per sleeve label by Brady "Bradysleeve" or equal. Labeling shall be neatly installed for visibility and shall be clearly legible. Each wire and conductor shall be labeled with wire label as shown on approved loop, elementary and interconnect Drawings. Labels shall not be wrap-around or snap-on type.

3. Where there is insufficient space for labels on locally interconnected neutral wires such as jumpers between adjacent auxiliary relay coil neutral terminals, these labels may be omitted. "Locally" is defined as wires no longer than 8".

4. Wire labels for lighting and receptacles shall be installed and consist of the panelboard and circuit number (i.e., Panelboard "LP1," circuit breaker #3 would have wire label line "LP1-L3" and neutral "LP1-N3").

5. All control and signal wiring terminations shall have the correct wire label applied prior to making connection.

6. Numerically identify every conductor within each multi-pair and triad tray cable.

G. Pulling Compound:

1. Use only cable pulling compound which is approved by the manufacturer of the cable as being compatible with cable insulation and jacket materials.

H. Distribution:

1. Panel Power:

a. All electrical and instrumentation panels shall be equipped with a main power disconnect circuit breaker and power distribution circuit breakers. The main power disconnect breaker shall disconnect all power to panel. Distribution circuit breakers shall be single pole. The circuit breakers shall be mounted on a standard DIN rail, and shall be Allen - Bradley Channel Mounting Type, or equal.

b. For each power distribution circuit breaker, a neutral return terminal block shall be installed at the bottom of the breaker rail.

2. Analog Signals:

    a. Analog signal transmission between electric or electronic instruments shall be 4-20 milliamperes and shall operate at 24 volts DC unless otherwise specified. Milliampere signals shall be current regulated and shall not be affected by changes in load resistance within the unit's rating. Provide isolated current amplifiers wherever the loop load resistance exceeds the current signal transmitter's rating. Associated shunt resistors shall be located on rail-mounted terminal blocks. Exposed resistor leads shall be insulated with heat-shrink tubing.

    b. Each analog loop source shall be individually fused at the panel analog interface terminal block. Each analog loop shall be provided with a separate fuse, positive terminal, negative terminal and ground terminal at each Control panel

    c. Signal transmission from remote or field electric and electronic devices shall be 4-20 mA. Nonstandard transmission methods such as impulse duration, pulse rate, and voltage regulated will not be permitted except where specifically noted. Outputs of equipment that are not of the standard signals as outlined, shall have the output immediately raised and/or converted to compatible standard signals for remote transmission.

3. Terminal Blocks and Fuses:

    a. General:

        1) Each terminal block shall have a unique identifying alphanumeric code. Terminal numbers shall be assigned starting lowest number at one end, incrementing in sequence top to bottom or left to right (i.e., 1,2,3,4....).

        2) Numbers shall be assigned to all blocks except grounding blocks. Fuse blocks shall be assigned unique tag numbers such as FU1, FU2. No two fuses in a common enclosure shall be assigned the same tag number. Fuse blocks shall also be provided with markers identifying the current rating of the fuse.

        3) A plastic marking tab shall be provided to label each individual terminal block. Each tab shall have a unique number/letter for each terminal which is identical to the "elementary" and "loop" diagram wire designation. Numbers on tabs shall be machine printed and 1/8-inch high.

        4) Terminal blocks shall be physically separated into groups by the level of signal and voltage served. Power and control wiring above 100 volts shall have a separate group of terminal blocks from terminal blocks for wiring below 100 volts, intermixing of these two types of wiring on the same group of terminal blocks is not allowed.

        5) As a minimum, provide a ground terminal or connection point for the power system grounding conductor for each terminal block group.

6) Terminate field wiring on the "field side" of the terminal blocks. Do not connect internal panel wiring to the "field side" of the terminal blocks. Do not connect field wiring to the "panel side" of the terminal block.

7) Provide a separate terminal block for every two neutral terminals or as coordinated with the interconnect diagrams.

8) Terminal blocks shall be, DIN rail, and 600V rated.

9) Provide terminal blocks with "follower" plates which compress the wires and have wire guide tangs for ease of maintenance. Terminal blocks which compress the wires with direct screw compression are unacceptable.

10) All power, control and instrument wires entering and leaving a compartment shall terminate on terminal blocks.

b. MCC – Motor Starter Cubicles Terminal Blocks:

1) MCC cubicle terminal blocks shall be pull-apart, as supplied standard by MCC manufacturer.

2) Fuse blocks shall be per MCC manufacturer or Connectron NDN-F1 with PF-1 fuse puller.

c. Control/Signal – Control and Signal Panel Terminal Blocks, (Excluding Motor Starter Cubicles):

1) Power Distribution, 120 VAC

a) Terminal Blocks: Compression -clamp, black bodies, 600 volt rating, Entrelec M4/6 or approved equal.

b) Fuse Blocks: Compression Clamp, black bodies, 600 volt rating, with fuse blown indicator, Entrelec ML 10/13.SFL or approved equal.

2) Control Circuits, Analog and Digital

a) Terminal Blocks: Compression-clamp, grey bodies, 600 volt rating, Entrelec M4/6 or approved equal.

b) Fuse Blocks: Compression Clamp, grey bodies, 600 volt rating, Entrelec M 4/8.SF or approved equal.

c) Provide a separate fuse and neutral terminal block for each PLC input or output card.

d) The configuration of analog and discrete input/output terminals and associated accessories shall be submitted for approval by the Owner. Colored marking tabs inserted into terminal blocks shall be Entrelec or approved equal. Color coding for all MCC Control Compartment or Panel Section terminal tabs shall be:

Description	Color	TB Code Letter
Digital Inputs	Red	R
Digital Outputs	Yellow	Y
Analog Inputs	Blue	B
Analog Outputs	Orange	O
Distribution / Fuses	Grey	A
Ground	Green	G
Neutral	White	W

3) Analog input and output terminal blocks, in addition to terminal block numbering, shall have "+," "-" and ground prefabricated symbol plastic terminal label inserts.

4) No more than two field wires are to be inserted in any single terminal block.

5) All PLC spare I/O points including spares shall be wired to terminal blocks.

d. Miscellaneous - Terminal Blocks, for locations other than MCC cubicles and Control/Signal Panels:

1) Provide terminal blocks rate a minimum of 20 amps at 600VAC.

2) Terminal blocks shall be Buchanan 500 series, or approved equal.

e. Fuse Sizes:

1) Fuses used in circuits 200 VAC and above shall be time-delay type FNQ, or approved equal, 13/32" x 1½" and have an interrupting rating of 10,000 AIC at 500 VAC. Fuse holders shall be of the barrier type and rated 600 VAC.

2) Fuses used in 120 VAC shall be time-delay type MDL or approved equal, ¼" x 1¼", and have a rating of 250 VAC. Fuse-holders shall be of the terminal block type, and shall be rail-mounted. Fuses shall have neon or LED blown fuse indicators.

3) Fuses used in signal and 24 VDC circuits shall be fast acting type, or approved equal, 5mm x 20mm, and have an rating of 250 VAC. Fuse holders shall be of the terminal block type, and shall be rail mounted.

4) Fuses shall be sized in conformance with the NEC.

I. Splices:

1. No splices are allowed with exceptions as stated in Electrical Section 16010 - Construction Methods, General.

PART 3 EXECUTION

3.1 WORKMANSHIP

A. All work in this Section shall conform to the Codes and Standards specified in Section 16010 - Electrical.

B. The Supplier shall employ personnel that are skilled and experienced in the installation and wiring of electrical enclosure panels, devices, accessories, and assemblies. All installation labor shall be performed by qualified personnel who have had experience on similar projects. Provide first class workmanship for all installations.

C. Ensure that all equipment and materials fit properly in their installations.

D. Perform any required work to correct that in the opinion of the Engineer are improper installations at no additional expense to the Owner.

3.2 INSTALLATION

A. System:

1. Install all products per Electrical Section 16010 - Installation, General.
2. All panels and enclosures shall be completely factory wired and tested before shipment.
3. Lace tie with cord, minimum length 2', each wire bundle entering any enclosure, vault, pull box, cable tray or any other enclosure. Place label with conduit number associated with wire on each of these bundles when there is no place to attach label to conduit. Labels for each cord shall be similar to the engraved circular tag type specified in Section 16110 or approved equal.
4. Pulling lubricant shall be used when installing all wire in conduits.

B. Wiring Methods:

1. Wiring Separation: Wires carrying 100 volts and above shall be physically separated from lower voltage wiring by using separate bundles or wire ways with sufficient distance to minimize the introduction of noise, crossing only at 90 degree angles.

2. Harness: All wiring shall be neatly bundled and laced with plastic tie-wraps, anchored in place by screw attached retainer. Where space is available, all wiring shall be run in slotted plastic wire ways or channels with dust covers. Wire ways or channels shall be sized such that the wire fill does not exceed 60%. Tie-wraps shall be T&B TY-RAP, or approved equal. Wiring inside of conduit, plastic wire duct, duct bank Sections or corrugated loom tubing is not to be wire tied or taped together.

3. Hinge Loops: Where wiring crosses hinged surfaces, provide a "U" shaped hinge loop protected by black head stabilized corrugated loom tubing as manufactured by Panduit # CLT100N-C630, or approved equal. The hinge loop shall be of sufficient length to permit opening and closing of the door without stressing any of the terminations or connections. Corrugated flexible wire duct shall be Graybar T25N, or approved equal.

4. Retainers: Wire ways, retainers, and other devices shall be screw-mounted with round-head 316 stainless steel screws or mechanically mounted by push-in or snap-in attachments. Glue or sticky back attachment of any type or style shall not be used. Retainers shall be T&B TC series, or approved equal.

5. Routing:

    a. Wires shall be routed in slotted plastic wire-ways with snap covers. Wires carrying VAC shall be separated as much as possible from other wires and signal cables, and shall be routed only in wireways for VAC. If the power wiring has to cross the signal wiring, the crossing shall be as close to a right angle as possible. Wireways for signal and VDC wiring shall be used separate from all VAC wireways. Routing of VAC wiring in combined ducts shall not be allowed. Wires and cable shall be routed along the shortest route between termination points, excepting routes which would result in routing VAC and other wires and cables in the same duct. Wires and cables shall have sufficient length to allow slack and to avoid any strain or tension in the wire or cable. Wires and cables shall be placed in the wireways in a straight, neat and organized fashion and shall not be kinked, tangled, or twisted together. Additional wire ducting shall be provided for use by the Electrical Subcontractor for routing field wires to their landing points in the each electrical enclosure and control panel.

    b. Wiring that cannot be routed in wireways, shall be neatly bundled, treed, and laced with plastic ties. Wiring across door hinges shall be carefully made up and supported to avoid straining and chafing of the conductors or from putting any strain on their terminals.

    c. Exposed Tie-Wraps: Plastic tie-wraps used in all outdoor or exposed applications shall be sun resistant UV rated for outdoor usage.

6. Terminations: Single wire and cable conductors shall be terminated according to the requirements of the terminal device.

    a. For screw terminals, appropriately sized locking forked spade lugs shall be used. Lugs shall be crimp on type that form gas tight connections. All crimping shall be done using a calibrated crimping tool made specifically for the lug type and size being crimped.

    b. On shielded cables, the drain wire shall be covered with heat shrunk insulating tubing along its full bare length between the cable jacket and the terminal lug or terminal pressure plate. To insulate the foil or braid shielding use heat shrink tubing sized for the wire and shrunk into place with the properly sized heat gun.

    c. Minimum distance between terminal blocks and relays or other terminations and wireways shall be 2".

    d. The wire label codes for each end of the same wire shall be identical.

7. Spare Terminals: Provide a minimum of 20% spare terminals in all MCC cubicles, electrical and instrumentation enclosures, and instrumentation/control panels.

3.3 WARRANTY

Provide warranty as specified in Electrical Section 16010 - Warranty.

END OF SECTION

SECTION 16140

WIRING DEVICES

PART 1 GENERAL

1.1 SCOPE OF WORK

A. The Contractor shall install, ready for use, the receptacles, plugs, switches, boxes and appurtenances specified herein. This document describes the function and operation of the system and particular components, but does not necessarily describe all necessary devices. All components and devices shall be furnished and installed as required to provide a complete operable and reliable system for accomplishing the functions and meeting the performance set forth hereinafter at no additional cost to the Owner.

B. Furnish all required labor, materials, project equipment, tools, construction equipment, safety equipment, transportation, test equipment, incidentals, and services to provide a complete and operational wiring devices as shown on the Drawings, included in these Specifications, or required for fully operating facilities.

C. Work includes that specified in Division 16.

D. The wiring devices scope of work includes:

1. Provide and install miscellaneous wiring devices, conduits, field interconnection wiring, and associated hardware.

2. Provide all necessary hardware, fittings, and devices to connect the electrical equipment provided under other Sections.

1.2 SUBMITTALS AND DRAWINGS

Provide submittals and Drawings as specified in Electrical Section 16011.

PART 2 MATERIALS

2.1 WIRING DEVICES

A. General: Wiring devices shall be UL approved for the current and voltage specified and shall comply with NEMA area rating.

B. Boxes:

1. Box dimensions shall be in accordance with size, quantity of conductors, and conduit clearances per NEC Article 314 requirements.

2. Boxes shall be located and placed according to Owner requirements.

3. All terminal and junction boxes shall be labeled identifying them by number shown on Contract Drawings engraved with ½" letters on nameplates meeting the requirements of section 16144 Nameplates.

4. Non-Weatherproof Boxes:

   a. Recessed boxes shall be flush with wall. Boxes for fixtures shall not be less than four (4) inches square or diameter. Boxes for switches and receptacles shall be two and one-eight inch (2-1/8) deep. Provide plaster rings or box cover adapters for the wall surface finish.

   b. Surface boxes shall be cast ferrous, deep FD type.

5. Weatherproof Boxes:

   a. Boxes located in NEMA 4X areas shall be 316 stainless steel type rated NEMA 4X.

   b. PVC-coated cast ferrous boxes may be used in place of stainless steel boxes, except where boxes contain devices on cover. Boxes shall be deep, FD type. Single gang boxes shall have cast hubs.

6. Explosion-proof Boxes:

   a. Boxes shall be rated for Class 1, DIV 1 or 2 and weatherproof locations.

C. Switches:

1. General purpose switches shall be manufactured in accordance with UL 20. Switches shall be single pole, rated 20 amps, at 277 VAC. Bodies shall be of ivory phenolic compound supported by mounting strap having plaster ears. Switches shall have copper alloy contact arm with silver cadmium oxide contacts. Switches shall have slotted terminal screws and a separate green grounding screw. Furnish Hubbell 1221, Leviton, or approved equal.

2. Special purpose switches shall be provided with the amperage, voltage, and configuration as shown on the Drawings. Switches used as motor disconnects for single phase motors shall be horsepower rated.

D. Receptacles:

1. General purpose receptacles shall be duplex and rated 20 amps, at 120 VAC, 2 pole, 3 wire grounding, NEMA 5-20R configuration, Specification grade, and side wired to screw terminals. Face color shall be brown in industrial areas and white or ivory in finished areas. General purpose receptacles shall be Bryant, Hubbell, or approved equal.

2. GFI (ground fault circuit interrupting) receptacles shall be "Specification grade". GFI receptacles shall be duplex, 20A, 120V, with "test" and "reset" buttons with shallow design for mounting and standard screw terminals for direct wiring. Receptacles shall be designed, manufactured, and tested to prevent nuisance tripping from voltage spikes, RFI, EMI, or electronic component failures. Chaining multiple receptacles from one GFI unit is not acceptable. GFI receptacles shall be Arrow-Hart, Leviton, or approved equal.

3. Four in One receptacles (4 each 20A-125V receptacles in one housing, shall mount on a single gang box without additional adapters). Four in One receptacles shall be Leviton 21254, Hubbell, or approved equal.

E. Device Plates and Covers:

1. Non-Weatherproof general purpose device plates and covers shall be stainless steel. Plates or covers shall be attached with stainless steel screws. Exception: Device plates and covers within reach of sinks and other wet areas shall have beige plastic covers with plastic screws.

2. Device plates and covers for cast metal boxes shall be same material as the box.

3. PVC coated cast boxes shall have PVC coated cast covers.

4. Weatherproof switch, outlet, and receptacle boxes shall be fitted with cast aluminum gasketed cover rated for wet locations. Each receptacle access cover shall have a gasketed spring door to maintain the weatherproof integrity with plug inserted in accordance with NEC 406.8 for unattended locations. Screws and hinge springs shall be stainless steel. Final decision of type of access cover for specific location shall be per Engineer. Weatherproof access covers shall be Hubbell, Tay Mac, Crouse-Hinds, or approved equal.

5. Receptacle and light switch plates shall be stamped or engraved as specified in Section 16144 Nameplates.

F. Communication Jacks:

1. Communications Jacks shall consist of CAT 5 wall plate and device box mounted at locations shown on Contract drawings. Communications Jacks shall be Leviton Quickport or approved equal as follows:

a. All communication modules shall be UL listed, meet FCC Part 68 requirements, and fully comply with NEC Article 800.

b. Modules shall be high-impact, self-extinguishing plastic rated UL 94V-0.

c. Contacts shall be spring wire with phosphor bronze plated with 50 micro-inches hard gold over 100 micro-inches nickel. Jacks shall be applicable for CAT 5 wire applications.

d. Device box shall be as specified herein. Wall plates and jacks shall be provided as follows:

1) Four-port Wall plate shall be field configurable and flush-mounted. Wall plate shall house any combination of four (4) 8-conductor keyed jacks. Jacks shall be able to be interchangeable depending on application.

2) Single-port wall plate shall have a 8-Conductor keyed jacks and shall be individually terminated using insulation displacement connectors with punchdown caps for installation.

3) Color of jacks shall be as follows:

a) Telephone network => Ivory

b) Spare => Brown

c) Data => White

d) Spare => Black

e. Wall plates shall be mounted on a 2" by 4" (minimum) device box.

PART 3 EXECUTION

3.1 WORKMANSHIP

A. All work in this Section shall conform to the codes and standards specified in Section 16010 - Electrical.

B. The Supplier shall employ personnel that are skilled and experienced in the installation of receptacles, plugs, switches, appurtenances, accessories, and assemblies. All installation labor shall be performed by qualified personnel who have had experience on similar projects. Provide first class workmanship for all installations.

C. Ensure that all equipment and materials fit properly in their installations.

D. Perform any required work to correct that in the opinion of the Engineer are improper installations at no additional expense to the Owner.

3.2 INSTALLATION

A. System:

1. Install all products per Electrical Section 16010 - Installation, General.

2. Keep boxes, and other openings closed during construction to prevent entry of foreign matter. Cover devices and boxes to protect them against dirt, paint, water, chemical, or mechanical damage before and during construction period. Restore to original condition apparatus or equipment damaged prior to final acceptance. Protect bright finished surfaces and similar items until in service. No rust or damage will be permitted.

3. All receptacles shall be tested by Electrical Contractor in presence of Owner for correct connections utilizing a plug-in ground, line and neutral test light plug.

4. Boxes shall be relocated at no additional cost to Owner as directed by Engineer when a conflict occurs in the box placement shown on Contract drawings and other building appurtenances.

B. Device Mounting Heights:

1. Mounting heights of fixtures and devices shall be as follows unless otherwise indicated or when height has to be adjusted to be over or under counter tops.

a.	Wall switches	=>	48 inches
b.	Convenience outlets	=>	18 inches finished areas 24 inches non-finished areas
c.	Telephone outlets	=>	54 inches
d.	Bracket fixtures	=>	7 feet 6 inches
e.	Counter top outlets	=>	12 inches above countertop

C. Cutting and Patching:

1. The Contractor shall do all cutting and patching required to install his work. Any cutting which may impair the structure shall require prior written approval by the Engineer. Cutting and patching shall be done only by skilled labor of the respective trades. All surfaces shall be restored to their original condition after cutting and patching.

D. Boxes:

1. Leave no unused opening in any box. Install close-up plugs as required to seal openings.

2. All spare and/or empty conduits shall terminate in a device box.

3. Use stainless steel boxes when box must support door mounted devices.

4. In NEMA 4X areas boxes are to be spaced ¼-inch minimum from walls using stainless steel, nylon or plastic spacers. Regular steel washers are not considered an approved spacer.

3.3 WARRANTY

Provide warranty as specified in Electrical Section 16010 - Warranty.

END OF SECTION

SECTION 16144

NAMEPLATES

PART 1 GENERAL

1.1 SCOPE OF WORK

A. Contractor shall provide nameplates for all instruments, panels, enclosures, devices, and equipment.

B. All nameplates shall be of the identical style, color, and material throughout the system.

C. Work includes that specified in Division 16.

D. Provide and install nameplates as specified herein.

1.2 SUBMITTALS AND DRAWINGS

A. Provide submittals and Drawings as specified in Electrical Section 16011.

B. Submit schedule of all nameplates to be used on project. Submittal to include the following drawn with AutoCAD or equivalent printout:

1. Dimension of nameplate.
2. Exact lettering, text size and font for each nameplate.
3. Color of nameplate.
4. Color of lettering.
5. Materials of construction.
6. Method and materials for attachment.
7. Drawing showing location of nameplate on each panel and enclosure.

PART 2 MATERIALS

2.1 NAMEPLATES AND TAGS

A. Equipment Exterior Nameplates: Nameplate material shall be rigid laminated black phenolic with beveled edges and white lettering, except for caution, warning, and danger nameplates the color shall be red with white lettering. The size of the nameplate shall be as shown on the Drawings. No letters are allowed smaller than 3/16". All phenolic nameplates located outdoors shall be UV resistant. Securely fasten nameplates in place using two stainless steel screws if the nameplate is not an integral part of the device. Epoxy cement or glued on nameplates will not be acceptable.

1. Each major piece of electrical equipment shall have a manufacturer's nameplate showing the Contract specified name and number designation, the manufacturer's name, model designation, part number, serial number, and pertinent ratings such as voltage, amperage, # of phases, range, calibration, etc.

2. For each device with a specific identity (pushbutton, indicator, field control station, disconnect switches, etc.) mounted on the exterior or deadfront of a piece of equipment, provide a nameplate with the "Equipment Name and Equipment Number" inscription as shown in the Contract Documents. Where no inscription is indicated in the Contract Documents, furnish nameplates with an appropriate inscription providing the name and number of device.

3. For all receptacles and switches, provide a faceplate engraved or stamped with the panelboard and circuit number it is fed from. Also, include on faceplate or on a separate nameplate for each light switch identification use such as "Outside Building Lights," "Perimeter Lights," "MCC Room," etc.

4. All field instruments and devices shall be labeled with designation shown on P&ID diagrams.

5. All transformers and panelboards shall have nameplates with ½" high letters and be engraved with designations as shown on one-line Drawings.

6. All disconnect switches shall have nameplates with ½" high letters and be engraved with designations as shown on one-line drawings or as directed by Owner.

7. Service entrance equipment shall have engraved nameplate with 1/2” letters (red with white lettering) indicating type and location of standby generator per NEC 702.7 (A).

8. Service entrance equipment shall have engraved nameplate for generator grounding per NEC 702.7(B).

9. Service Equipment Label: Per NEC 110.24 (A) Service equipment shall be legibly marked in field with the maximum available fault current. Field marking shall include date the fault current calculation was performed and be weather & UV rated. Service equipment shall not be hand labeled.

10. Generator receptacles and generator lug panels shall have engraved nameplate with ½” letters (red with white lettering) per NEC 702.7.(C).

B. Equipment Interior Nameplates: Nameplate material shall be clear plastic with black machine printed lettering as produced by a KROY or similar machine; except caution, warning, and danger nameplates shall have red lettering. The size of the nameplate tape shall be no smaller than ½" in height with 3/8" lettering unless otherwise approved by the Engineer. Securely fasten nameplates in place on a clean surface using the adhesion of the tape. Add additional clear adhesive to hold the nameplate securely in place when necessary. For each device with a specific identity (relay, module, power supply, fuse, terminal block, etc.) mounted in the interior of a piece of equipment provide a nameplate located above the device with the inscription as shown in the Contract Documents. Where no inscription is indicated in the Contract documents, furnish nameplates with an appropriate inscription providing the name and number of device used on the Submittal Drawings. Stamp the nameplates with the inscriptions as approved by the Engineer in the submittal. Nameplates shall not be attached to wireway covers or to removable devices.

C. Equipment Tags: The Contractor shall attach a tag to the equipment (including instruments) with the same inscriptions as specified above in paragraph A. The tag shall be made from stainless steel material and the size of the nameplate shall be no smaller than 3/8"h x 2"w with 3/16" machine printed or engraved lettering unless otherwise approved by the Engineer. The tag shall be attached to the equipment with stainless steel wire of the type normally used for this purpose. SST wire must be crimp connected. Twisting ends together is not acceptable.

D. Engrave or machine print the tags with inscriptions as approved by the Engineer in the nameplate submittal.

E. Provide temporary labels for all instruments and devices immediately when installed. Temporary labels shall be provided with 1/2" letters minimum and labeled with P&ID tag number.

PART 3 EXECUTION

3.1 WORKMANSHIP

A. All work in this Section shall conform to the codes and standards specified in Section 16010 - Electrical.

B. All installation labor shall be performed by qualified personnel who have had experience on similar projects. Provide first class workmanship for all installations.

C. Perform any required work to correct improper installations or nameplates at no additional expense to the Owner.

D. Nameplates shall be readily visible and not painted over.

E. Damaged nameplates shall be immediately replaced.

F. Phenolic nameplates that are glued on shall be replaced with stainless steel screw attached nameplates.

3.2 INSTALLATION

A. Install all products per Electrical Section 16010 - Installation, General.

B. Securely fasten nameplates in place using two stainless steel screws if the nameplate is not an integral part of the device. Epoxy cement or glued on nameplates will not be acceptable.

C. All nameplates shall be in place prior to the start of any field test.

D. Epoxy cement or glued on nameplates will be acceptable only for NEMA 4X enclosures.

3.3 SPARE PARTS

The Contractor shall include in his bid price the following to be designated during testing and start-up by the Engineer or Owner:

A. Five (5) additional engraved 1-1/8" x 3-5/8" nameplates with 1/4" letters.

B. Five (5) additional engraved ring type nameplates.

END OF SECTION

SECTION 16190

SUPPORTING DEVICES

PART 1 GENERAL

1.1 SCOPE OF WORK

A. The Contractor shall install, ready for use, the supporting devices as specified herein. This document describes the function and operation of the system and particular components, but does not necessarily describe all necessary devices. All components and devices shall be furnished and installed as required to provide a complete operable and reliable system for accomplishing the functions and meeting the performance set forth hereinafter at no additional cost to the Owner.

B. Furnish all required labor, materials, project equipment, tools, construction equipment, safety equipment, transportation, incidentals, and services to provide supporting devices as shown on the Drawings, included in these Specifications, or required for fully operating facilities.

C. Work includes that specified in Division 16.

D. The supporting devices scope of work includes:

1. Provide all necessary hardware, supporting devices, and devices to support and align raceways, cabinets, boxes, fixtures, and other appurtenances in an approved manner and as herein specified.

2. The location of field control stations on Drawings is tentative. During construction the Owner will direct the Contractor as to the exact position and direction of orientation at no additional cost to the Owner.

E. The Electrical Contractor shall supply and install all supporting devices listed under column "DWG REF DET MOUNTING" that references "E" Series Contract Drawings in all Division 16 indexes.

1.2 SUBMITTALS AND DRAWINGS

A. Provide Submittals and Drawings as specified in Section 16011.

B. Submit detailed fabrication Drawings showing material of construction for each type of support.

C. Submit seismic and anchoring calculations that show that each support meets the seismic requirements of Seismic restraint under Section 16020.

D. Submit dimensioned supporting device drawings for each type of enclosure, instrument, and panel. The mounting tab locations for device mounting shall be clearly shown and dimensioned.

PART 2 MATERIALS

2.1 SUPPORTING DEVICES

A. General: Materials and installation shall meet all requirements of the NEC, and meet the minimum following Specifications.

1. Inserts, hangers, brackets and miscellaneous supports for electrical equipment and conduits must be designed with minimum safety factor of 4, based on ultimate strength of material used. For empty conduits, include weight of 4 Type XHHW copper wires of maximum permissible size.

2. Secure hangers, brackets, conduit straps, supports and electrical equipment as specified in Electrical Section 16010 - Fasteners.

3. Power driven or velocity driven inserts may be used where their use does not affect finished appearance of work, but may not be used on structures in tension. They may not be used in pre-stressed slabs, beams, purlins, or in precast members.

4. All concrete embedded bolts shall be 316 stainless steel.

5. Support channels steel shall conform to the requirements of ASTM A570. These shall be nominal 1 5/8" x 1 5/8" roll formed low carbon 12-gauge galvanized steel in dry areas and 316 stainless steel NEMA 4X areas (fiberglass in "corrosive areas" when supporting fiberglass boxes). One side of the channel shall have a continuous slot with in-turned lips. Double strut shall be two of these welded back to back.

B. Mounting, support, or bracing bolts shall not be used as an attachment point for ground conductors. Attachment of the grounding conductor to equipment or enclosures shall be by connectors specifically provided for grounding.

C. Conduit Supports:

1. Single Conduit Hangers: 3/8" minimum diameter 316 stainless steel rod or anchor.

2. Trapeze Hangers: Channel, with 1/2" minimum diameter 316 stainless steel rods.

3. Supports for Indoors in Non-Corrosive/Dry Locations:

   a. Hangers, channels, clamps, supports and rods; galvanized steel.

   b. Conduit straps and single hole clamps; galvanized.

   c. Steel bolts, screws, nuts and washers; galvanized.

   d. Paint surfaces to match adjacent finishes.

4. Supports for Outdoors, Corrosive/Wet, and NEMA 4X Locations:

   a. Hangers, channels, clamps, supports and rods; 316 stainless steel. Fiberglass may be used when approved in writing by Engineer.

   b. Conduit straps and single hole clamps; 316 stainless steel or PVC-coated galvanized steel with PVC coated backplates.

   c. Bolts, screws, nuts and washers; shall be 316 stainless steel.

5. All supports shall be braced at 10-foot intervals, minimum.

D. Equipment and Device Supports:

1. Equipment and device supports shall be similar to that detailed on the Contract E-series Drawing "Miscellaneous Electrical Details."

2. In wet and/or corrosive environments, all metal brackets and fasteners shall be 316 stainless steel.

PART 3 EXECUTION

3.1 WORKMANSHIP

A. All work in this Section shall conform to the codes and standards specified in Section 16010 - Electrical.

B. The Supplier shall employ personnel that are skilled and experienced in the installation of support devices and assemblies. All installation labor shall be performed by qualified personnel who have had experience on similar projects. Provide first class workmanship for all installations.

C. Ensure that all equipment and materials fit properly in their installations.

D. The Contractor shall perform any required work to correct that in the opinion of the Engineer are improper installations at no additional expense to the Owner.

3.2 INSTALLATION

A. System:

1. Install all products per Electrical Section 16010 - Installation, General.

2. Restore to original condition apparatus or equipment damaged prior to final acceptance. Protect bright finished surfaces and similar items until in service. No rust or damage will be permitted.

B. Conduit Supports Installation - Conduits shall be secured using approved manufactured supports, connectors, and securing devices. Conduits shall be supported independently of one another.

1. Single Runs: Conduit straps or ring bolt type hangers with specialty spring clips. Do not use plumbers perforated straps.

2. Multiple Runs: Unistrut conduit rack with 25 percent spare capacity.

3. Provide additional supports where obviously required or as directed by Engineer.

C. Equipment and Device Supports: Install plumb and level. Install anchors as listed in the approved seismic calculation submittals. Provide grout bases around all floor supports.

3.3 WARRANTY

Provide warranty as specified in Electrical Section 16010 - Warranty.

END OF SECTION

SECTION 16450

GROUNDING

PART 1 GENERAL

1.1 SCOPE OF WORK

A. The Contractor shall install, ready for use, the grounding system as specified herein. This document describes the function of the grounding system and particular components, but does not necessarily describe all necessary devices. All components and devices shall be furnished and installed as required to provide a complete grounding system for accomplishing the functions and meeting the performance set forth hereinafter at no additional cost to the Owner.

B. Furnish all required labor, materials, project equipment, tools, construction equipment, safety equipment, transportation, test equipment, incidentals, and services to provide a complete grounding system as shown on the Drawings or included in these Specifications.

C. The grounding system scope of work includes:

1. Provide and install miscellaneous trenching, grounding system wiring, and associated hardware.

2. Related work specified in Division 16.

1.2 SUBMITTALS AND DRAWINGS

A. Submittals and Drawings

1. Provide Submittals and Drawings as specified in Section 16011 for all grounding system components.

PART 2 MATERIALS

2.1 SERVICE GROUNDING

A. The ground ring shall consist of bare wire laid in a grid as detailed on the Contract E-Series Drawings. Bond ring to building steel frames and to metal water pipe within 5 feet of pipe entrance to building when available.

B. Network ground bond wires shall be connected from the UFFER ground to locations shown on Contract Drawings. The network ground bonding wires shall be bare copper sized as shown on Contract Drawings.

C. The system neutral shall be connected to the system's grounding conductor at only a single point in the system. This connection shall be made by a removable bonding jumper sized in accordance with the applicable provisions of the National Electrical Code. The grounding of the system neutral shall be in the enclosure that houses the service entrance main breaker.

D. Ground grid and bond wires shall be AWG bare copper as manufactured by Southwire or approve equal. Ground grid and bond wires shall be sized as shown on the Plans or in accordance with NEC Table 250.66, whichever is greater.

E. All grid and bond wire connections shall be made with U.L. approved material and methods. Ground clamps and connectors shall be made of cast bronze.

2.2 RACEWAY, EQUIPMENT AND ENCLOSURE GROUNDING

A. All raceway systems, supports, enclosures, panels, motor frames, and equipment housings shall be permanently and effectively grounded.

B. Ground clamps shall be bolt-on cast bronze type as manufactured by ILSCO type AGC, O-Z Gedney type GRC, or approved equal.

C. Grounding conductors shall be sized as shown on the Plans or in accordance with NEC Table 250.122, whichever is greater.

D. Bonding wires shall be installed on ends all metallic conduits with grounding bushings, expansion joints, and for continuity of raceways transitions. Bonding wires shall be solid bare copper sized and installed per NEC 250.102. Bonding wires at endpoints shall be connected to enclosure ground bus or equipment grounding lug. No aluminum fittings, bushings and lugs shall be used.

E. All equipment and devices shall be grounded in a manner that satisfies the requirements of the National Electrical Code.

F. One side of neutral of the secondary on all transformers shall be grounded to the ground bus or ground bond wire.

G. All receptacles shall have their grounding contact connected to a grounding conductor.

H. Branch circuit grounding conductors for receptacles or other electrical loads shall be arranged such that the removal of a lighting fixture, receptacle, or other load does not interrupt the ground continuity to any other part of the circuit.

I. All metallic light fixture enclosures and ballasts shall be grounded.

J. Attachment of the grounding conductor to equipment or enclosures shall be by connectors specifically provided for grounding. Mounting, support, or bracing bolts shall not be used as an attachment point for ground conductors.

K. The negative side of all DC power supplies shall be grounded.

L. Each ground bus shall be copper. Screw type fasteners shall be provided on all ground buses for connection of grounding conductors. Ground bus shall be a Challenger GB Series, ILSCO CAN Series, or approved equal.

2.3 ENCLOSURE GROUND BUS

A. Each electrical, control and instrumentation enclosure shall be provided with a copper grounding bus bar, mounted on the inside of the enclosure. The grounding bar shall be mounted on non-insulated standoffs so that a good electrical connection is made between the ground bar and the cabinet through the mounting.

B. The bus bar shall be sized to meet the panel grounding requirements of NEC, and for connection of a minimum of 10 groundings conductors.

C. Each ground bus shall be copper and UL recognized. Screw type fasteners shall be provided on all ground buses for connection of grounding conductors. Ground bus shall have a minimum of 10 taps, and be rated for copper conductors. Ground bus shall be an ILSCO CAN Series, or approved equal.

D. Aluminum ground bus and lugs are not acceptable.

2.4 GROUND RODS

A. The ground rod shall consist of not less than 10 continuous feet of 3/4 inch copper coated electroplated high grade carbon steel. The ground rod shall be a NEHRING type NCC 3410, or approved equal. The ground rod shall extend up for visible connection of a UL approved "ground clamp" to the ground bus.

B. Provide 14 inch diameter, 9-inch nominal throat, concrete ground rod boxes, minimum 12 inches deep, with a cast-iron traffic cover embossed or engraved "GROUND." Ground rod boxes to be as manufactured by BES Concrete Products or approve equal.

PART 3 EXECUTION

3.1 WORKMANSHIP

A. All work in this Section shall conform to the codes and standards specified in Section 16010 - Electrical.

B. The Supplier shall employ personnel that are skilled and experienced in the installation grounding system, accessories, and assemblies. All installation labor shall be performed by qualified personnel who have had experience on similar projects. Provide first class workmanship for all installations.

C. Ensure that all equipment and materials fit properly in their installations.

D. The Contractor shall perform any required work to correct that in the opinion of the Engineer are improper installations at no additional expense to the Owner.

E. All grounding system components installed by the Contractor shall be in accordance with the Drawings, NEC, and the manufacturer's recommendations and instructions.

3.2 INSTALLATION

A. System:

1. Install all products per Electrical 16010 – Installation.
2. Ground rods that are unable to be driven vertically into the earth shall be installed per NEC 250.53(G) at a 45 degree angle or buried 30 inches below grade.
3. Install additional ground rods as required to meet NEC 250.53.
4. Provide a separate grounding conductor in each raceway, securely grounded to equipment at each end of raceway.
5. Bond metal piping and building structure metal frames to grounding electrode per NEC.
6. Contractor shall not conceal or cover any ground connections until the Engineer or Owner has established that every grounding connection conforms to the Contract Drawings and Specifications and has given the Contractor written confirmation.

7. Grounding details shown on plans are minimum. If additional equipment, such as ground rods, clamps, conductors, etc., is required per NEC, Title 24, CAC, furnish and install same without additional cost to Owner.

B. Connections:

1. Use U.L. approved ground clamps specifically designed for grounding purposes. Strap metal is not acceptable for grounding or bonding.

2. Exposed connections to ground buses, raceways, and small pipes shall be made by means of U.L. approved grounding clamps. Exposed connections between different metals shall be sealed with No-Oxide Paint Grade A, or approved equal.

3. All buried, ground rod, large pipe, and steel plate or frame ground bond connections shall be made by welding process equal to Cadweld.

C. Electrical Equipment Grounding:

1. Metal conduits shall be bonded together to the enclosure ground bus.

2. Lightning arresters or suppressors shall be directly connected to the ground system using copper conductors sized per manufacturer's literature.

3. Transformer secondary neutrals shall be directly connected to the ground system using copper conductors sized as per NEC.

4. All motors shall be grounded by bonding the grounding conductor within the raceway to the motor frame. Motors as shown on Electrical Plans shall also have a supplemental grounding conductor bonded to the ground grid in the immediate area of the motor.

5. Each enclosure containing metallic components shall be grounded to the ground grid per NEC 250.4(A) (1) ~ (5).

6. A ground bus shall be provided in each enclosure or cabinet. It shall have provisions for connecting a minimum of ten grounding conductors. Screw type lugs shall be provided for connection of grounding conductors. All grounding conductors shall be sized as shown on Contract Drawings or in accordance with NEC Table 250.122, whichever is larger.

7. Each panelboard shall be equipped with a ground bus secured to the interior of the enclosure. The bus shall be equal to panelboard neutral bus amp rating and shall have adequate quantity of lugs. No more than two grounding conductors shall be installed per lug.

D. Excavation and Back Filling:

1. Trenches for all bare copper ground bond wires shall be excavated to a minimum depth of 30".

2. Back filling shall be done only after grounding system has been inspected. Excavation and back fill of grounding system shall conform to the requirements of the Earthwork Section of these Specifications.

3. At all times during the installation of the grounding system, the Contractor shall provide barricades, fences, guard rails, etc., to safeguard all personnel, including small children, from excavated trenches.

E. Cutting and Patching:

1. The Contractor shall do all cutting and patching required to install his work. Any cutting which may impair the structure shall require prior written approval by the Engineer. Cutting and patching shall be done only by skilled labor of the respective trades. All surfaces shall be restored to their original condition after cutting and patching.

3.3 FIELD TEST

Provide field testing on grounding system as specified in Section 16620.

3.4 WARRANTY

Provide warranty as specified in Electrical Section 16010 – Warranty.

END OF SECTION

SECTION 16605

ELECTRICAL SYSTEM ANALYSIS

PART 1 GENERAL

1.1 SUBMITTALS

A. Provide the following submittals per Section 16011 for all switchboards, switchgear and MCCs, including existing:

1. Short Circuit and Load Flow Study.
2. Protective Device Coordination.
3. Arc Flash Study.
4. Harmonic Analysis.

B. Short Circuit, Load Flow, and Protective Device Coordination Studies shall be prepared, stamped and signed by a professional Electrical Engineer registered in the State of California and in accordance with NFPA 70E, IEEE 242 and IEEE 399.

C. Exceptions / Clarifications

1. Itemize all exceptions and clarifications to the Contract Documents in a letter (located in the front of the submittal) on company letterhead.
2. Exceptions that are noted in the study, but not listed on the Exceptions/Clarifications letter, will be considered as non-responsive and not accepted as changes to the Contract Documents.
3. All exceptions taken from the Drawings and specifications shall be documented with justifications. When noting the exception, list which Drawings or which Specification Subsection number the exception is taken.
4. Clarification requests shall list which Drawing or Specification Subsection number the clarification is required for.

D. Provide two (2) DVDs at the completion of the project. One DVD will contain the as-built set of studies, reports, settings, etc. The other DVD will contain the original source format of input data used for the PC based computer software. Provide all setup information used for the computer based study and report.

E. For each resubmittal, provide a copy of submittal comments and a separate letter, on Company letterhead, identifying how each submittal comment has been addressed in the resubmittal.

F. When submittals are provided in PDF format, utilize the "Bookmark" feature of the Adobe Acrobat and clearly bookmark locations in the report to locations identified in the Report's Table of Contents. Bookmarks shall not be out of order; the English description shall match that listed in the Report's Table of Contents.

1.2 SEQUENCING AND SCHEDULING

A. It is the people performing the electrical system analysis responsibility to collect and field verify all data (i.e. existing breaker relay types, settings, and feeder wire sizes. This includes obtaining all data from the serving utility for this project; Merced Irrigation District (MID) and Pacific Gas and Electric (PG&E).

B. Contractor shall provide letter certifying the inspection and verification of existing equipment and distances used in study.

C. A complete Protective Device Coordination Study shall be submitted within 60 days after approval of Short Circuit and Load Flow Study.

D. The Short Circuit, Load Flow, Protective Device Coordination and Arc Flash Studies shall be updated prior to Project Completion. Utilize characteristics of as-installed equipment and materials. The protective device coordination study shall be submitted and approved prior to start of field breaker test per Section 16620.

E. Complete protective device coordination study listing all device settings shall be utilized during start-up of electrical equipment.

F. When previous electrical system analysis studies are available and provided to the Contractor, it is the Contractor's responsibility to verify the accuracy of the data used and to update it to match existing conditions.

PART 2 MATERIALS

2.1 GENERAL

A. Equipment and component titles used in the Studies shall be identical to the equipment and component titles shown on the Drawings.

B. Perform Studies using PC based computer software. State program name and version in report.

C. Perform complete fault calculations for each Utility and Generator source. Equipment shall not be grouped as a single large load; they shall be treated as individual loads. When generators are incorporated into the system, develop two separate networks: one with utility only (no generator attached) and one with generator only (no utility attached).

D. Utilize proposed load data for the Study obtained from submittals, Utility Company and field verifications.

E. Complete protective device coordination study listing all device settings shall be utilized during start-up of electrical equipment.

F. Provide unique page numbers for every sheet in all Studies. Unique page numbers to be manually placed by Study Company after printout if study report doesn't assign page numbers.

G. One line diagrams

1. Shall be readable on 11" x 17" paper. One line diagrams shall be redrawn in AutoCAD on multiple sheets if necessary or as requested by Owner.

2. Buses and branches shall have descriptive names matching one line diagram or existing system (i.e. not Bus-0084).

3. Automatic transfer switches (ATSs), Main Switchboards (MSBs), shall not have multiple node buses.

4. Primary and secondary for transformers, Variable Frequency Drives (VFDs), etc. shall be changed to node buses.

2.2 SHORT CIRCUIT AND LOAD FLOW STUDY

A. Include in Short Circuit and Load Flow study the following containing:

1. Cable impedances based on copper conductors.

2. Bus impedances based on copper bus bars.

3. Transformer impedances based on tolerances specified in ANSI C57.12.00.

4. Input data including motor loads, wire lengths, and sizes.

5. Utility data:
    a. Impedance of Utility source.
    b. Primary voltage of Utility source.
    c. Fault information from Utility Company:
        1) Three phase bolted fault.
        2) X/R ratio (positive sequence).
        3) Line to ground fault.
        4) X/R ratio (zero sequence).
6. Voltage drop and current flow at each node and load in system.

B. Calculate Short Circuit interrupting duties for an assumed three-phase bolted fault and line-to-ground fault at each of the following locations:
    1. Main Switchgear.
    2. All Switchboards.
    3. All Motor Control Centers (MCCs).
    4. All panelboards.
    5. All 480V, 3 phase motor and equipment loads 10HP and larger.
    6. All 3 phase transformer secondaries.

C. Verify:
    1. Equipment and protective devices are applied within their ratings.
    2. Adequacy of switchboard, panelboard and MCC bus bars to withstand Short Circuit stresses.
    3. Adequacy of transformer windings to withstand Short Circuit stresses and over-current.
    4. Cable sizes for ability to withstand normal and fault load currents.

D. Provide the following in the Short Circuit and Load Flow study report:
    1. Calculation methods and assumptions.
    2. Input data.
    3. Short Circuit and Load Flow data.
        a. Impedances.
        b. X to R ratios.
        c. Asymmetry factors.

d. Motor contributions.

e. Short Circuit kVA.

f. Symmetrical and asymmetrical line-to-line and line-to-ground fault currents.

g. Device evaluation including rating of equipment.

h. Bus evaluation including rating of equipment.

i. Source data, from Electric Utility Company.

j. Load flow amperage and voltage at each load and node of system.

4. Tabulations of calculated quantities.

5. Results, conclusions, and recommendations.

6. One line diagram of distribution system.

7. Impedance diagram showing the resistances and reactances for all cables of the distribution system.

2.3 PROTECTIVE DEVICE COORDINATION STUDY

A. Provide Protective Device Coordination drawings for each section of distribution system that includes the following:

1. Graphically diagram displaying coordination time-current curves on conventional log-log curve sheets. Each time-current curve shall have a unique identifier label. This identifier shall be used in the tabulated settings spreadsheet and on the associated one-line diagram.

2. Time-current curves shall include the following curves (minimum):

a. Utility relays (phase & ground) and high voltage switchgear relays (phase and ground).

b. All upstream protective devices and breakers.

c. All mechanical overloads.

d. MCP breaker and associated motor or equipment load. Duplicates of the same sized protective device and motor size may be omitted (i.e., when there are 3 pumps for same application).

e. All transformers and associated primary and secondary protection.

f. Unique identifier for each protective device.

g. Provide separate TCC for phase and ground curves.

h. TCC for Ground curves shall include the transformer magnetizing inrush currents for all transformers downstream of the circuit breaker. Ground shall clear the inrush currents.

3. One-line diagram that applies to specific portion of distribution system associated with time-current curves. One-line diagram shall include the following:

    a. Location of each device.

    b. Power and voltage ratings, primary and secondary transformers amperages.

    c. All significant circuit elements such as transformers, cables, breakers, fuses, relays, etc. with their corresponding amperage ratings.

    d. Tag of each branch and node (shall be the same tags used in Short Circuit and Load Flow study).

    e. Mechanical overload and contactor.

    f. English description, equipment name, HP, and full load amp rating of motors and other 3 phase loads.

    g. Terminate device characteristic curves at a point reflecting maximum fault current to which device is exposed as calculated in short circuit study.

B. Characteristics plotted on time current curves shall include:

1. Protective current relays.

2. Fuses including manufacturer's minimum melts, total clearing, tolerance, and damage bands.

3. Circuit breaker trip devices, including manufacturer's tolerance bands.

4. Transformer full-load currents at 100% and 600%.

5. Motor and equipment full load currents.

6. Transformer magnetizing inrush currents.

7. Transformer damage curves.

8. ANSI transformer withstand parameters.

9. Fault currents.

10. Ground fault protective device settings.

11. Other electronic protective devices.

C. Provide the following recommended settings for all protective devices in spreadsheet format in the Protective Device Coordination study report:

1. Relay settings including CT values.

2. Circuit Breakers adjustments:

   a. Long Delay Pickup and Time.

   b. Short Time Pickup and Time.

   c. Instantaneous Pickup and Time.

   d. Ground Pickup and Time.

3. Programmable settings for all electronic devices. Settings for non-current relay settings shall also be provided.

4. Settings shall be given both in amps and seconds as well as the corresponding physical setting (i.e. 30A and setting B on MCP) for device.

5. Identify breaker and protective device associated with each curve by manufacturer type, function and part number.

2.4 HARMONIC STUDY

A. Perform a harmonic analysis study in accordance with the latest version of IEEE 519 unless otherwise specified in contract documents.

B. The total harmonic distortion (THD) at the point of common coupling (PCC) shall be predicted through computer modeling of the distribution system and connected AC drives. PCC shall be considered as the main breaker of all MCCs and switchboards. Contractor shall calculate TDD and THD at each PCC.

C. Do not exceed harmonic voltage and current distortion limits at PCC for general system applications, as recommended and defined by IEEE 519, unless specified otherwise in contract drawings.

D. If the calculations determine that the harmonic distortion levels are higher than the voltage and current specified, the drive manufacturer shall provide line reactors, isolation transformers, multi-pulse drives or trap filters to meet the intent of IEEE 519.

2.5 ARC FLASH HAZARD STUDY

A. General:

1. Arc flash boundary and incident energy shall be calculated, using a PC computer program, at all significant locations in the electrical network, including switchgears, switchboards, MCCs, transformers, etc. where work could be performed on energized equipment.

2. Arc flash computation shall include both line and load side of main breaker calculations, where necessary.

3. Document method of calculation.

4. Do not include the motor contribution of motors fed by VFDs in the arc flash hazard study.

B. Safe working distances shall be specified for calculated fault locations based upon the calculated arc flash boundary and considering incident energy of 1.2 cal/cm2.

C. Study shall include the following:

1. All significant locations in 12KV, 480 volt, 240 volt and 208 volt systems fed from transformers equal to or greater than 125 kVA.

2. Incident energy and flash protection boundary calculations in spreadsheet format in the Arc Flash Hazard study report.

3. Provide the following incident energy and flash protection boundary calculations in spreadsheet format in the Arc Flash Hazard study report (values shall be calculated for all electrical equipment in the power distribution system):

a. Arcing fault magnitude

b. Device clearing time

c. Duration of arc

d. Boundary for:

1) Arc flash limited shock approach

2) Limited shock approach

3) Restricted shock approach

e. Working distance

f. Incident energy at 18 inches (in cal/sq.-cm)

g. Recommendations for arc flash energy reduction for each location having more than 8 cal/sq.-cm. Provide preliminary cost estimate for implementing recommendations.

4. Provide recommendations for the Personal Protective Equipment (PPE) that the Owner should maintain on site for the level of hazard.

5. Provide recommendations for safety label design that should be posted on electrical equipment.

6. Spreadsheet summarizing incident energy and flash protection boundary list Arc Flash Boundary in inches on label. No fractional distance in feet.

2.6 STUDY REPORTS

A. Written reports submitted for approval shall contain:

1. Scope of Studies performed.
2. Explanation of bus and branch numbering system.
3. Report calculations, tabulations and spreadsheets.
4. Selected equipment deficiencies.
5. Results of Short Circuit, Load Flow, Coordination and Arc Flash Studies.
6. Comments or suggestions regarding:
    a. Changes and additions to equipment wire and cable sizes, ratings, and/or characteristics.
    b. Circuit protective devices and breakers improperly rated for overload or fault conditions.
    c. Arc flash protective equipment and safety labels.
7. Tabulation spreadsheet for all protective device and breaker settings with the following column entries:

Device Code	Description	MFR	Type	Plug Trip	Frame	KAIC	Long Time		Short Time		Inst	Ground	
							Amps	Time	Amps	Time	Amps	Amps	Time

8. Stamped, signed and dated by Electrical Engineer registered in the State of California who performed the analysis.

B. Reports are to be updated to reflect as-built conditions and placed in O&M manual per Section 16012 requirements.

PART 3 EXECUTION

3.1 GENERAL

A. Make minor modifications to equipment settings as required to accomplish conformance with the Short Circuit, Load Flow, and Protective Device Coordination Studies.

B. Notify Engineer in writing of any required major equipment modifications.

3.2 FIELD TESTS

A. Provide field testing of breakers and protective equipment as specified in Section 16620 – Electrical and Instrumentation Field Tests.

B. Adjust breaker, relay, and protective device settings according to values established by coordination Study.

3.3 ARC FLASH WARNING LABELS

A. All Arc Flash warning labels shall meet NEC requirements, OSHA standards and NFPA recommendations.

B. Provide and install 4 in. x 6 in. thermal transfer type labels of high adhesion polyester for each work location analyzed and as required by the NEC for flash protection on power distribution equipment.

C. Each label shall have an orange header with the wording, "WARNING, ARC FLASH HAZARD", and shall include the following machine printed information:

1. Location designation
2. Nominal voltage
3. Arc Flash boundary
4. Available incident energy and working distance (in inches)
5. Minimum arc rating of clothing
6. Site specific level of PPE
7. Engineering report number, revision number and issue date
8. Company preparing report and contact phone number.

D. Labels shall not be hand labeled.

E. Labels shall be submitted for approval. No labels shall be installed without prior approval by Owner or Owner representative.

F. For all areas, Contractor shall post the following:

1. Working distances
2. Shock hazard voltage
3. Shock Approach Boundaries:
    a. Limited
    b. Restricted

G. Provide Arc Flash labels for the each of the following pieces of equipment:

1. 480V and applicable 208V panelboards
2. MCCs
3. Switchboard
4. Switchgears
5. Control Panels
6. All electrical equipment with an incident energy level greater than 1.2 Cal/cm2.
7. Provide separate labels at each circuit breaker that has arc flash reduction switches indicating the appropriate values when the switch is enabled.

3.4 ARC FLASH TRAINING

Provide Arc Flash Training per Section 16900.

END OF SECTION

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SECTION 16620

ELECTRICAL AND INSTRUMENTATION FIELD TESTS

PART 1 GENERAL

1.1 SCOPE OF WORK

A. This Section specifies the field testing of electrical and instrumentation materials, equipment and systems as specified in this Section and in each Section of Division 16. All equipment provided under Division 16 shall be tested as specified herein. The Electrical Contractor shall be present and assist the System Supplier and testing firm in testing all equipment. The Electrical Contractor shall be on site while the System Supplier and testing firm are performing field tests in order to correct any wiring problems.

B. The Electrical Contractor, System Supplier and the testing firm shall provide all labor, tools, material, power, and technical supervision to perform the specified tests and inspections.

C. Prior to start of any field testing, the Field Test Procedures, Interconnection Drawings and Preliminary Operation and Maintenance Manuals shall have been submitted by the Contractor and approved by the Engineer.

D. All field tests shall be documented in writing by the person performing the test on test forms similar to those shown in Appendix "A", and signed by the Owner as satisfactorily completed.

1. Contractor shall fill in the associated Field Test Forms, prior to the start of any field test, with all of the equipment information required on the Equipment Data Forms for the specific area being tested.

2. The testing firm, Electrical Contractor or System Supplier performing tests shall keep a detailed log of all tests that failed or did not meet Specifications, including date of occurrence and correction.

1.2 RELATED SECTIONS

Additional testing requirements may be found in Division 16.

1.3 PROJECT SUBMITTALS

A. Provide field test procedure submittals in format as specified in Section 16011.

B. A copy of the completed test forms shall also be placed in the O&M manual as specified in Section 16012. Test forms submitted without witness signatures will be rejected and re-testing shall be performed at Contractor's expense.

C. Test procedures shall be submitted in separate binders for approval as follows:

1. Pre-Energization Field Tests by third party testing firm.
2. Powered Field Tests by third party testing firm.
3. Field tests by Contractor.
4. Field tests by System Supplier.

PART 2 MATERIALS

2.1 DEFECTS

Contractor shall notify the Owner of any material or workmanship found defective within 24 hours of discovery. All defective equipment shall be replaced with new equipment at no additional expense to Owner.

2.2 TEST EQUIPMENT

A. Test instruments shall be calibrated to references traceable to the National Bureau of Standards and shall have a current sticker showing date of calibration, name of calibration laboratory and technician, and date re-calibration is required.

B. Test instruments shall be calibrated to references traceable to the National Bureau of Standards and shall have a current sticker showing date of calibration, name of calibration laboratory and technician, and date re-calibration is required.

C. All test equipment to be used as part of field testing shall be listed in the submittal field testing forms.

D. On each day, prior to start of field test, confirm with resident engineer

2.3 TESTING FIRM

A. The Electrical Contractor shall engage and pay for the services of an approved qualified third party independent testing company for the purpose of performing inspections and all tests as specified except for those listed below in paragraph B. The independent testing firm shall not be affiliated in any way with the System Supplier or Electrical Contractor. Submit detailed field test procedures and test forms along with the name of company to perform tests and resumes of person to perform tests. Testing firm shall have been actively engaged in the type of electrical and instrumentation testing specified in this Division for the past three years (minimum).

B. The following field tests may be performed by:

1. Electrical Contractor:

    a. Torque Connections.

    b. Wire Insulation and Continuity Tests.

    c. Phase Rotation Tests.

    d. Motor Tests.

    e. Start-up and Operational Tests.

2. System Supplier:

    a. Instrumentation Tests.

    b. Start-up and Operational Tests.

    c. Program Parameter Record.

    d. Fiber System Tests.

PART 3 EXECUTION

3.1 TESTING

A. General Requirements:

1. It is the intent of these tests to ensure that all equipment is operational within industry and manufacturer's tolerances and is installed in accordance with design plans and Specifications.

2. All tests shall be witnessed by the Engineer and/or Owner. The person performing tests shall fill in two sets of test forms. One set of these test forms shall be given to the Engineer and/or Owner the day of the test. Test forms that are not signed by the Engineer or the Owner on the day of the test will require repeating of the test at no additional cost to the Owner or extension of the Contract time.

3. The Contractor shall give the Owner 10 working days' notice of the dates and time for witnessed inspections and testing using the "Scheduled Test Request Form." Fill in and submit for approval the "Scheduled Test Request Form" located in Appendix "A" for each Field test. Date of testing shall be as agreed upon by both the Contractor and Owner.

B. Failure to Meet Test: Any system material or workmanship which is found to be defective on the basis of acceptance tests shall be reported to the Engineer. The Contractor shall replace the defective material or equipment and have tests repeated until test proves satisfactory to the Owner without additional cost to the Owner.

C. Safety:

1. Testing shall conform to the respective manufacturer's recommendations. All manufacturer's safety precautions shall be followed.

2. The procedures stated herein are guidelines for the intended tests, the Contractor shall be responsible to modify these tests to fit the particular application and ensure personnel safety. Absolutely no tests shall be performed that endanger personal safety.

3. The Electrical Contractor shall have two or more people present during all tests.

4. Two portable radios are to be made available by the Contractor to be used during all field tests.

5. California Electrical Safety Orders (ESO) and Occupational Safety and Health Act (OSHA): The Contractor is cautioned that testing and equipment shall comply with ESO and OSHA as to safety, clearances, padlocks, and barriers around electrical equipment energized during testing.

D. Separate test procedures in separate binders shall be submitted for approval for each of the following tests:

1. Pre-Energization Field Tests.

2. Powered Field Tests.

E. All of the pre-energization tests shall be performed by the Contractor prior to energization and start of any powered field tests.

F. If the results of any of the tests are unacceptable to the Engineer, the Contractor shall make corrections and perform the tests again until they are acceptable to the Owner; these additional tests shall be done at no additional cost to the Owner.

3.2 ELECTRICAL ACCEPTANCE TESTS

A. Pre-Energization Field Tests: These tests shall be completed prior to applying power to any equipment.

1. Field Inspections:

a. Visual and Mechanical:

1) Inspect for physical damage, proper anchorage, and grounding.

2) Compare equipment nameplate data with design plans and starter schedule.

3) Compare overload setting with motor full load current for proper size.

4) The Contractor shall fill in, for each piece of equipment, Test Form TF4 located in Appendix "A".

b. The testing firm shall compile, by visual inspection a record of all motor nameplate data, the following minimum data shall be neatly tabulated in spreadsheet form and submitted to Owner:

1) Manufacturer.

2) Part and model number.

3) Equipment driven.

4) Motor horsepower.

5) Nameplate amperes, volts and phase.

6) Service factor.

7) Temperature ratings.

2. Torque Connections:

a. All electrical, mechanical, and structural threaded connections inside equipment shall be tightened in the field after all wiring connections have been completed. Every worker tightening screwed or bolted connections shall be required to have and utilize a torque screwdriver/wrench at all times. Torque connections to the value recommended by the equipment manufacturer. If they are not available, use the torque guidelines per NEC Annex I.

3. Wire Insulation and Continuity Tests:

a. All devices that are not rated to withstand the 500V megger potential shall be disconnected prior to the megger tests.

b. Megger insulation resistances of all 600 volt insulated conductors using a 500 volt megger for 5 seconds. Make tests with circuits installed in conduit and isolated from source and load. Each conductor shall be meggered conductor-to-conductor and conductor-to-ground. These tests shall be made on cable after installation with all splices made up and terminators installed but not connected to the equipment.

c. Electrical Contractor shall megger the insulation resistances of all 480 VAC pump, mixer, fan motors, etc. supplied for this project under divisions 11, 15, and 16. Megger each set of motor leads using a 500 volt megger for ten seconds. Make these tests with motors installed in place and not connected to any other wiring. Each motor lead shall be tested conductor-to-ground.

d. Each megger reading shall not be less than 10 Meg-ohms resistive. Corrective action shall be taken if values are recorded less than 10 Meg-ohms. Conductors with high ohm values, that do not match similar lengths of conductors the same size, shall be replaced at no additional cost to the Owner.

e. Each instrumentation conductor twisted shielded pair and manufacturer supplied instrumentation cables shall have the conductor and shield continuity measured with an ohmmeter. Conductors with high ohm values compared to conductors of similar size and length shall be replaced at no additional cost to the Owner.

f. The Contractor shall fill in test forms Power and Control Conductor Test Form TF1 and Instrumentation Conductor Test Form TF2, located in Appendix "A."

4. Grounding System Tests:

a. Visual and Mechanical Inspection:

1) Verify ground system is in compliance with Drawings and Specifications.

b. Electrical Tests:

1) Ground Grid

a) Before making connections to the ground electrodes at equipment, and before placement of sidewalks, landscape and paving, measure the resistance of each electrode to ground using a ground resistance tester. Perform the test not less than two days after the most recent rainfall and in the afternoon after any ground condensation (dew) has evaporated.

b) After all individual ground electrode readings have been made, interconnect as required and measure the system's ground resistance.

c) The grounding test shall be in conformance with IEEE Standard 81.

d) The current reference rod shall be driven at least 100 feet from the system under test.

e) Measurements shall be made at 10 feet intervals beginning 25 feet from the test electrode and ending 75 feet from it in a direct line between the system being tested and the test electrode.

2) Point-to-Point

a) Perform point-to-point tests to determine the resistance between the main grounding system and all major electrical equipment frames, system neutral, and/or derived neutral points.

c. Test Values:

1) The resistance between the main grounding electrode and ground shall be no greater than five ohms per IEEE Standard 142.

2) Investigate point-to-point resistance values that exceed 0.5 ohms.

3) The Contractor shall fill in Grounding System Test Form TF3, located in Appendix "A."

4) Plots of ground resistance shall be made and submitted to the Engineer for approval.

B. Powered Field Tests:

1. Control System Tests: The following tests shall be performed for all MCCs and for the control panels listed in Section 16010 Appendix "A," including all non-Division 16 Control Panels.

a. Component Tests:

1) Measure insulation resistance of starter phase to phase and phase to ground with the starter contacts closed and the protective device open. Test voltage and minimum acceptable values shall conform to NETA Section 3 "Test Values." Measure insulation resistance of each control circuit with respect to ground.

2) Motor overload units shall be tested by injecting primary current through overload unit and monitoring trip time.

3) Test the motor circuit protectors and thermal breakers as specified herein.

b. Control Tests:

1) Remove motor overload heaters from each motor starter or disconnect pump/motor coupling. In case the motor overload heaters are fed by current transformers, the motor conductors shall be removed and insulated away from the load lugs of the motor starter.

2) Verify the pump control circuits are wired and operate as shown on the elementary diagrams. Check the indicator lights, alarm lights, local and remote selector switches, alarm contacts, power fail relays, overloads, etc., for proper operation.

3) Reinstall all heaters and all wiring removed for this test.

c. The Contractor shall fill in Operational Device Checks and Tests Form TF7, located in Appendix "A."

2. Phase Rotation Tests:

a. Check connections to all equipment for proper phase relationship. During this test, disconnect all devices which could be damaged by the application of reversed phase sequence. Three-phase equipment shall be connected for the phase sequence "ABC" front to back, left to right, and top to bottom. Operate all motors to check for proper phase rotation.

b. All three phase motors shall be tested for proper phase rotation. Revise wire color codes to indicate correct phase color if wires are swapped.

c. The Contractor shall fill in Phase Rotation Test Form TF8, located in Appendix "A."

3. Motor Tests:

a. Record the amperage draw on all phases of each motor operating under full load. Ensure that these values do not exceed the motor nameplate full load amperage.

b. Record the voltage between all phases of each motor operating under full load. If the voltage balance is not within plus or minus 5 percent of nominal, request the Utility power company or other responsible party to correct the problem.

c. The Contractor shall compile, by visual inspection of equipment installed for each motor, the following data in neatly tabulated form and be placed in the O&M manual:

1) Equipment driven.

2) Motor horsepower.

3) Nameplate amperes.

4) Service factor.

5) Temperature rating.

6) Overload catalog number.

7) Overload current range and setting.

8) Circuit breaker rating.

9) Circuit breaker trip setting, for magnetic only circuit breakers.

d. The Contractor shall fill in Motor Test Form TF11, located in Appendix "A."

4. Fiber System Tests:

a. All the fiber system components shall be tested by the Fiber System Supplier with assistance from Electrical Contractor for proper operation.

b. Fiber optic cable shall be tested for optical loss in accordance with Standard Fiber Optic Cable OTDR Test procedures. Cables shall be verified to have an optical loss below that required to perform optimum communications throughput.

c. Report shall also include the following:

1) Measured losses

2) Additional Columns

a) Acceptable losses at “x” feet

b) Losses within tolerance

c) Losses too high

d) Losses too low

d. All fiber system tests shall be witnessed by Owner. Fiber System Supplier shall record all results on forms to be turned over to Owner when tests are completed.

5. Instrumentation Tests:

a. Instrumentation tests shall be conducted per the following criteria:

1) As a minimum, all the tests indicated/specified on the test forms Instrumentation Data Sheet and Calibration Record Test Form TF15 in Appendix "A" shall be performed by the Contractor for the instruments listed in Section 16940 Appendix "A," "Device Index."

2) Test equipment used for testing shall be of suitable quality so as not to mask performance deficiencies. All test equipment shall be traceable to National Bureau of Standards and have been calibrated within six months of test date.

3) The overall accuracy of each instrument loop shall be checked to ensure that it is within acceptable tolerance.

4) Calibration stickers shall be supplied for all equipment and instruments. Calibration stickers for MCC devices shall be placed on the inside of the cubicle or panelboard door. Calibration stickers shall list the following information:

a) Tag number.

b) Calibrated by who (name), firm, city and telephone number.

c) Date calibrated.

d) Calibration range.

5) The System Supplier shall provide a minimum of two (2) hours of field testing for each instrument listed in Instrumentation Indexes. If any instrument has not been fully tested during its allotted time, the System Supplier shall provide additional hours for finishing testing of the instrument, at no additional cost to the Owner.

3.3 INITIAL STARTUP

The following listing is a general sequence of startup activity steps to be used in placing systems in operation:

A. Perform initial lubrication of equipment and have manufacturers check and adjust equipment. Equipment supplier's representative, including the Electrical Contractor and System Supplier, shall be present when equipment is tested and placed in operation.

B. Perform satisfactory testing of electrical work required prior to energizing of the electrical system. Complete all pre-energization field tests.

C. After completion of Step B, perform satisfactory electrical testing required after energizing of the electrical system.

D. Complete calibration of instruments.

E. Assist Owner by field verifying all PLC I/O and SCADA screen data points by activating field devices.

F. After completion of Steps A, B and C, perform a rotational test of equipment and correct backward rotating drives.

G. After completion of Steps E and F, test operate the equipment by manually initiating the operation from the MCC or Field Control Station. Where manual operation bypasses alarm or safety monitoring, provide continuous supervision of such parameters.

H. Concurrent with Step G and where possible at this stage of startup, complete the performance testing when specified for equipment in the individual equipment Specification Section.

I. After Steps A through H have been completed, operation of the equipment being tested shall be placed under automatic control.

J. Concurrent with Step I, perform instrumentation and PLC/SCADA control testing and adjustments as related to the equipment being automatically controlled.

K. Repeat Steps A through I as required for other equipment systems. It may be necessary for the Contractor to put portions of the newly constructed facility in service before construction of other portions of the facility or completing the work as a whole. The Contractor shall demonstrate operation of each part of the MCC and instrumentation system to the satisfaction of the Owner. Tests shall be repeated by the Contractor at no additional cost to the Owner and at the discretion of the Owner to resolve whether the system has been demonstrated that it will operate under all modes of operations and varying conditions.

L. Upon completion of all the above steps initiate the Operational Testing in accordance with subsection 3.4.

M. After successful completion of the operational testing, the Owner will take over maintenance duties as well as operation.

3.4 OPERATIONAL TESTS

A. After all the previous tests of Section 3.2 and 3.3 are complete, the Contractor shall conduct operational testing.

B. The Contractor shall demonstrate operation of each part of the electrical, control and instrumentation systems to the satisfaction of the Owner. Tests shall be repeated by the Contractor at no additional cost to the Owner and at the discretion of the Owner to resolve whether the system has been demonstrated that it will operate under all modes of operations and varying conditions.

C. For the operational testing the equipment shall be activated to automatically run for 5 days, Monday through Friday. During this five day period the Owner with the Contractor's presence and assistance will run the different combinations of the control options for each piece of equipment. If equipment failure occurs during the 5 days of operational testing, the Contractor shall repair or replace the defective equipment and shall begin another 5 day operational test, Monday through Friday. This shall be continued until the new equipment functions acceptably for 5 consecutive days.

D. The Electrical Contractor, testing firm and System Supplier shall re-visit the jobsite as often as necessary, until all field tests, start-up and operation tests are completed and approved.

3.5 WARRANTY

Provide warranty as specified in Electrical Section 16010 - Warranty.

APPENDIX "A"

TEST FORMS

Scheduled Test Request Form

TF1 Power and Control Conductor Test Form

TF2 Instrumentation Conductor Test Form

TF3 Grounding System Test Form

TF4 Visual and Mechanical Inspection Form

TF7 Operational Device Checks and Tests Form

TF8 Phase Rotation Test Form

TF11 Motor Test Form

TF14 I/O Point Checkout Test Form

TF15 Instrumentation Data Sheet and Calibration Record Test Form

SCHEDULED TEST REQUEST FORM

COMPANY PERFORMING TEST: _____
TESTING PERSONNEL : _____ _____
PHONE NUMBER OF COMPANY: _____
TEST PROCEDURE SUBMITTAL: _____ APPROVED : ___/___/___
SCHEDULED TEST DATE : _____ DATE : ___/___/___

TIME	DESCRIPTION OF TEST
8:00	
9:00	
10:00	
11:00	
12:00	
13:00	
14:00	
15:00	
16:00	

NOTES:

TESTED BY : _____ DATE : ____/____/____
WITNESSED BY: _____

POWER AND CONTROL CONDUCTOR TEST FORM

TEST FORM (TF1)

EQUIPMENT

NAME : _____ LOCATION : _____

CALIBRATION EQUIPMENT DATE: _____

DESCRIPTION _____

CONDUCTOR NUMBER	INSULATION TESTS					
	PHASE TO GROUND			PHASE TO PHASE		
	A	B	C	AB	BC	CA

NOTES:

Record insulation test values in meg-ohms.

TESTED BY : _____ DATE : ____/____/____

WITNESSED BY: _____

INSTRUMENTATION CONDUCTOR TEST FORM

TEST FORM (TF2)

EQUIPMENT

NAME : _____ LOCATION : _____

CALIBRATION EQUIPMENT DATE: _____

DESCRIPTION : _____

CONDUCTOR PAIR NUMBER	CONTINUITY TESTS		INSULATION TESTS		
	CONDUCTOR TO CONDUCTOR	CONDUCTOR TO SHIELD	CONDUCTOR TO CONDUCTOR	CONDUCTORS TO GROUND*	SHIELD TO GROUND

NOTES:

Record continuity test values in ohms.

record insulation test values in meg-ohms.

* With both conductors tied together

TESTED BY : _____ DATE : ____/____/____

WITNESSED BY: _____

GROUNDING SYSTEM TEST FORM

TEST FORM (TF3)

CALIBRATION EQUIPMENT DESCRIPTION : DATE: _____

FALL IN POTENTIAL TEST

MAIN GROUND LOCATION	APPLIED VOLTAGE V	MEASURED POINT 1 VOLTAGE	MEASURED POINT 2 VOLTAGE	MEASURED POINT 3 VOLTAGE	CALCULATED RESISTANCE OHMS

TWO POINTS TESTS

EQUIPMENT NAME	EQUIPMENT #	CIRCUIT #	APPLIED CURRENT	MEASURED VOLTAGE	CALCULATED RESISTANCE OHMS

NOTES:

TESTED BY : _____ DATE : ____/____/____

WITNESSED BY: _____

VISUAL AND MECHANICAL INSPECTION FORM

TEST FORM (TF4)

EQUIPMENT

NAME : _____ LOCATION : _____

NAMEPLATE DATA

MFGR. :	_____	SERIES # :	_____
MODEL # :	_____	U.L. # :	_____
VOLTAGE :	_____	PHASE :	_____
AMPERAGE :	_____	SERVICE :	_____
BUS TYPE :	_____	BUS BRACING:	_____
VERT. BUS :	_____	HORZ. BUS :	_____
GND. BUS :	_____	NEU. BUS :	_____
ENCLOSURE :	_____		_____
	_____		_____

INSPECTION CHECK LIST

ENTER: A-ACCEPTABLE R-NEEDS REPAIR OR REPLACEMENT NA-NOT APPLICABLE

TIGHTEN ALL BOLTS AND SCREWS	_____
TIGHTEN ALL WIRING AND BUS CONNECTIONS	_____
VERIFY ALL BREAKERS AND FUSES HAVE PROPER RATING	_____
CHECK BUS BRACING AND CLEARANCE	_____
CHECK MAIN GROUNDING CONNECTION AND SIZE	_____
INSPECT GROUND BUS BONDING	_____
CHECK EQUIPMENT GROUNDS	_____
CHECK CONDUIT GROUNDS AND BUSHINGS	_____
INSPECT NEUTRAL BUS AND CONNECTIONS	_____
CHECK HEATERS AND THERMOSTATS	_____
CHECK VENTILATION AND FILTERS	_____
CHECK FOR BROKEN OR DAMAGED DEVICES	_____
CHECK DOOR AND PANEL ALIGNMENT	_____
INSPECT ANCHORAGE	_____
CHECK FOR PROPER CLEARANCES AND WORKING SPACE	_____
REMOVE ALL DIRT AND DUST ACCUMULATION	_____
INSPECT ALL PAINT SURFACES	_____
CHECK FOR PROPER WIRE COLOR CODES	_____
INSPECT ALL WIRING FOR WIRE LABELS	_____
CHECK FOR PROPER WIRE TERMINATIONS	_____
CHECK FOR PROPER WIRE SIZES	_____
INSPECT ALL DEVICES FOR NAMEPLATES	_____
CHECK IF DRAWINGS MATCH EQUIPMENT	_____
CHECK ACCURACY OF OPERATION & MAINTENANCE	_____
	_____

TESTED BY : _____ DATE : ____/____/____

WITNESSED BY: _____

OPERATIONAL DEVICE CHECKS AND TESTS FORM

TEST FORM (TF7)

NAME : _____ LOCATION : _____

CUB. #	EQUIPMENT NAME	EQUIP #	LOCAL SITE DEVICE CHECKS AND TESTS							REMOTE SITE DEVICE CHECKS & TESTS		
			SELECTOR SWITCH	INDICATOR LIGHTS	PUSHBUTTON & LOS	METERING & INDICATORS	OVERLOAD RESET	INTERLOCKS & CONTROL	ALARM & STATUS	SELECTOR SWITCH	INDICATOR LIGHTS	PUSHBUTTON & LOS

TESTED BY : _____ DATE : ____/____/____

WITNESSED BY : _____

NOTES:

PHASE ROTATION TEST FORM

TEST FORM (TF8)

EQUIPMENT NAME	EQUIPMENT #	CIRCUIT #	PHYSICAL PHASE LOCATION	PHASE COLOR CODE	MEASURED PHASE ROTATION

NOTES:
Use phase tester to verify all circuits and equipment have a clockwise A-B-C phase rotation.
Physical phase locations: Left to Right - LR or Top to Bottom - TB
Phase color codes: Brown, Orange, & Yellow -BOY
Black, Red, & Blue -BkRBe

TESTED BY : _____ DATE : ____/____/____
WITNESSED BY: _____

MOTOR TEST FORM

TEST FORM (TF11)

EQUIPMENT
NUMBER : _____ NAME : _____

CALIBRATION EQUIPMENT DATE: _____
DESCRIPTION : _____ _____

NAMEPLATE DATA - FIELD RECORDED

MANUFACTURER	MODEL #	SERIAL #	FRAME #

H.P.	R.P.M	F.L.A	VOLTS	PHASE	FREQ.	P.F.	S.F.
CODE	N.E.M.A.	INSUL.	ENCLOSR.	DUTY	DESIGN		

INSULATION TESTS PHASE TO GROUND MEG-OHMS			MOTOR FRAME GROUNDING SYSTEM TEST			MOTOR HEATER	MOTOR THERMAL
			APPLIED	MEAS.	CALC.	MEAS.	TRIP
A	B	C	VOLTS	AMPS	OHMS	AMPS	TEST

MOTOR TESTS - MEASURED VALUES

AMPERAGE			VOLTAGE			POWER	
A	B	C	AB	BC	CA	FACTOR	WATTAGE

NOTES:
VOLTAGE, AMPERAGE, POWER FACTOR, & WATTAGE SHALL BE RECORDED WITH A TRUE RMS METER.

TESTED BY : _____ DATE : ____/____/____
WITNESSED BY: _____

I/O POINT CHECKOUT TEST SHEET

TEST FORM (TF14)

I/O TYPE : _____ LOCATION : _____

TEST EQUIPMENT : _____ CAL. DATE : _____

I/O POINT TAGNAME	I/O POINT ADDRESS	TEST INPUT VALUE %			DISPLAY VALUE %			PLC REGISTER VALUE	TEST RESULT FAIL OR PASS COMMENTS	DATE OF CORRECTIVE ACTION
		0	50	100	0	50	100			

NOTES:

TESTED BY : _____ DATE : ____/____/____

WITNESSED BY: _____

INSTRUMENTATION DATA SHEET AND CALIBRATION RECORD TEST FORM
TEST FORM (TF15)

Component Description	Manufacturer	Location
	Name	Site
Component Tag Name	Model	Equip
	Serial #	

	Range	Unit
Indicator Range		
Input Range		
Output Range		

General Notes

1) Attach Calibration Curves for dp Flowmeters

2) Include mounting elevations for level Instruments

3) All entries within solid box to be typed in prior to start of test

Designed Calibration			Measured Calibration		
Input Signal	Output	Eng. Value	Input	Output	Comments

Notes

Tested by (Print Name) Witnessed by (Print Name)

Signature Signature

Date / / Date / /

END OF SECTION

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SECTION 16900

ELECTRICAL AND INSTRUMENTATION TRAINING

PART 1 GENERAL

1.1 SECTION INCLUDES

Related work is included in Division 16.

1.2 SUBMITTALS

A. Provide training manuals furnished under this Section with the content and format as specified Section 16011.

B. "Supplier" means the organization, distributor, system house, or representative that is responsible for providing a system which is comprised of one or more manufactured products (sales representatives are not acceptable for training).

C. The Contractor shall submit for approval each Supplier's proposed "Training Plan" to the Owner at least four weeks prior to the start of training. Training shall not commence until the training procedures have been reviewed and approved by the Owner. This "Training Plan" shall include, for each course proposed:

1. Definitions of each course.
2. Course title and objectives.
3. Prerequisite training and experience of attendees.
4. Recommended types of attendees.
5. Course content - a topical outline.
6. Training Course material.
7. Course duration.
8. Course format - lecture, laboratory demonstration, etc.
9. Resumes of actual training instructors.
10. Check off sheets for each training course to record when training has been given.
11. References to specific sections of the O&M manuals.

D. Training shall not commence until the following have been completed:

1. Equipment/instrument has been accepted by Owner.

2. Training documents and procedures have been reviewed and approved by the Owner.

3. Arc Flash Study has been completed and approved.

4. Approved Arc Flash Labels have been installed

5. Owner has provided a list of all personnel who may work on energized equipment or who must attend the training.

E. The Contractor shall notify the Owner and the Engineer of the Supplier's readiness to begin the training in writing, a minimum of 10 working days prior to proposed training date. Training dates shall be scheduled on dates agreed to by the Owner and the Engineer.

1.3 INSTRUCTION OF OWNER'S PERSONNEL

A. After equipment start up testing has been completed and prior to final inspection or acceptance, qualified representatives of the equipment manufacturers shall fully instruct Owner's designated operating and maintenance personnel in the operation, adjustment, and maintenance of all products, equipment, and system.

B. Operation and maintenance manual shall constitute the basis of instruction:

1. Review contents of manual specified in Section 16012 with personnel in full detail to explain all aspects of operations and maintenance.

2. Instruct personnel as to how to use the operations manual and all related documents for proper operations, maintenance, and troubleshooting, and repair of equipment.

3. Instruct personnel as to how to obtain technical assistance for troubleshooting and repair of equipment.

4. Instruct personnel as to how procure repair parts for equipment.

C. Additional requirements for specialized instruction of Owner's personnel are given in the detailed equipment Specifications.

D. Each training session(s) shall be video recorded by the Supplier. Two (2) copies in DVR format shall be provided to the Owner together with the O&M manuals.

E. Provide all training materials necessary to conduct the training. O&M manuals shall be complete, approved and utilized for the training session.

F. Equipment shall be completely operational prior to training. If equipment is not operational, training session shall be rescheduled and restarted at no additional expense to the Owner.

PART 2 MATERIALS

2.1 TRAINING COURSE MATERIAL

Provide training course material for all attendees. Course material shall include:

A. Detailed curriculum outline. The outline shall include the following minimum topics and be customized for the equipment being supplied:

1. Familiarization:

   a. Review catalog, parts lists, Drawings, etc., which have been provided for the O&M manuals.

   b. Check out of the installation of the specific equipment items.

   c. Demonstrate the unit and indicate how all parts of the Specifications are met.

   d. Answer questions.

2. Safety:

   a. Using O&M manuals review safety references.

   b. Discuss proper precautions around equipment.

3. Operation:

   a. Using O&M manuals, review reference literature.

   b. Explain all modes of operation (including emergency).

   c. Check out the Owner's personnel on proper use of the equipment. The Owner personnel shall be allowed to use the equipment during the check-out.

4. Preventative Maintenance:

   a. Using O&M manuals, review preventative maintenance lists including:

      1) Reference material.

      2) Daily, weekly, monthly, quarterly, semi-annually, and annually maintenance procedures.

      3) Discuss known wear parts.

      4) Show how to perform Preventive Maintenance procedures.

      5) Show the Owner's personnel what to look for as indicators of equipment problems.

5. Corrective Maintenance:

    a. List possible problems.

    b. Discuss repairs – point out special problems.

    c. Discuss overhaul and rebuilding of all components.

    d. Open up equipment and demonstrate procedures, where practical.

6. Parts:

    a. Show how to use previously provided parts list and how to order parts.

    b. Make recommendations regarding spare parts that should be kept in stock at the Plant.

7. Local Representative:

    a. Where to order parts: name, address, telephone, fax, e-mail.

    b. Service problems:

        1) Who to call.

        2) How to get emergency help.

8. Operating Instructions:

    a. Review any other material submitted.

    b. Update material as required.

9. Student trainee guide:

    a. Hardcopy print out of all overhead projection cells used during the training session. If a video recording is used during the training session, an outline of all procedures and topics discussed during the video shall be provided.

    b. Equipment and/or software user's manual.

PART 3 EXECUTION

3.1 CLASSROOM TRAINING

A. General:

1. Classroom training shall be held at a facility designated by the Owner, prior to the "field acceptance" tests.

2. The "Training Plan" shall be conducted by a qualified supplier person(s), who has conducted similar training for the type of system supplied.

3. Acceptable Operation and Maintenance Manuals shall be on site and available when training sessions are implemented.

B. System Supplier shall provide a minimum of two (2) days (8 hours per day) of classroom training (either Wednesday or Thursday) for a minimum of eight (8) operations and maintenance personnel.

C. Classroom Training Curriculum:

1. Hardware and Software – Eight (8) hour duration.

a. The level of classroom training shall be sufficient to familiarize the Owner personnel with the PLC/OI Plant Controls and operation.

b. Owner personnel shall be trained in PLC ladder logic and control strategies programming prepared for this project. The level of training shall enable the Owner personnel to understand the program, make programming changes to the system and to debug the program.

c. Utilize O&M manual and review in detail Operating Instructions described Section 16012.

2. Operation and Maintenance - Eight (8) hour duration.

a. The level of classroom training shall be sufficient to familiarize the personnel with the operation and maintenance of the system. All essential system operating procedures shall be described as required to enable Owner's personnel to observe the equipment operation. Preventive maintenance procedures shall be described as required to enable personnel to maintain the equipment in operation.

3.2 FIELD TRAINING

A. General:

1. Field training shall be administered on site using the delivered system in real time situations. Field training shall not start until the "field acceptance" tests have been completed and the corresponding operating instructions have been submitted and approved.

2. The "Training Plan" shall be conducted by a qualified supplier person(s), who has conducted similar training for the type of System supplied.

3. Acceptable Operation and Maintenance Manuals shall be on site and available when training sessions are implemented.

4. Field training shall be held after classroom training for the equipment has been completed.

5. System Supplier and Electrical Contractor shall provide field training for a minimum of eight (8) operations and maintenance personnel

B. Field Training:

1. Hardware and Software

a. The "diagnostic and calibration" training, eight (8) hours minimum, shall demonstrate PLC/OI hardware diagnostic routines, test equipment, and test procedures as required to enable the personnel to detect and isolate system faults to the circuit board or module level and to implement repairs by replacing failed circuit boards or modules. Demonstrate uploading and downloading software to make backups and restore programs.

2. Operation and Maintenance

a. The "operator" hands-on training, sixteen (16) hours minimum, shall be given to show to non-technical and technical Owner personnel the basics in day-to-day operations and control strategies involving the electrical and control systems. Preventive maintenance procedures shall also be demonstrated for Owner personnel.

3. Equipment

4. Instruments and Devices:

a. The Supplier shall provide a minimum of two (2) hours of field training to instruct Owner personnel in the use, operation, calibration, programming, and maintenance on each different type of panels, instruments or devices. This applies to the panels, instruments and devices listed in the following Appendixes:

Section	Index
16010	Panel and Equipment
16970	Flow Instrument

5. Arc Flash Training:

a. General:

1) The Supplier shall secure the services of a qualified safety training firm to provide NFPA 70E/Arc Flash Electrical Safety to eight (minimum) Owner personnel.

2) Training shall be scheduled for days and times agreed to by the Owner (minimum two – eight hour days).

3) Training firm shall provide original Arc Flash Training manuals for all personnel in attendance (eight minimum).

b. Qualifications:

1) Submit qualifications of Safety Training firm. Firm shall have regularly provided Arc Flash safety training courses for the past three years.

2) Submit for approval the resume of the training instructor listing all relevant experience.

c. Training shall include:

1) Review OSHA standards Arc flash standards related to facility.

2) Safe installation and maintenance of electrical equipment, including lockout/tagout procedures.

3) Reviewing OSHA penalties for non-compliance.

4) Personnel protective equipment.

5) Fault current calculations and clearing times.

6) Practical solutions to reducing arc flash hazard.

d. Maintenance procedures shall be in accordance with the requirements of NFPA 70E, Standard For Electrical Safety Requirements For Employee Workplaces

e. Copy of NFPA 70E, Standard for Electrical Safety Requirements for Employee Workplaces shall be provided in each Arc Flash Training manual.

END OF SECTION