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SAN BERNARDINO COUNTY

SECTION F

TECHNICAL SPECIFICATIONS

COUNTY SERVICE AREA (CSA) 70 F MORONGO VALLEY – TANK REPLACEMENT PROJECT

FOR

COUNTY SERVICE AREA (CSA) 70 F
SAN BERNARDINO, CALIFORNIA

PROJECT NO.: 30.30.0157

MORONGO VALLEY WATER TANK REPLACEMENT

100% TECHNICAL SPECIFICATIONS

Prepared For

SAN BERNARDINO COUNTY
PUBLIC WORKS

San Bernardino County
Department of Public Works – Special Districts
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April 5, 2024

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CERTIFICATION

Thes specifications have been prepared by Kimley-Horn and Associates, Inc. under the direct supervision of the following Registered Civil Engineer.

April 5, 2024

Sarp Sekeroglu, PE
Registered Civil Engineer
C92140, Exp. 12/31/2025

Date

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SPECIAL DISTRICTS DEPARTMENT
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DESIGN CRITERIA AND PLAN PREPARATION
WATER

The following requirements pertain to the design and preparation of plans for construction of the various components to the water system.

1.1 General

1.1.01 Scope -- All wells, transmission and distribution mains, storage reservoirs and booster stations to be owned, maintained, and/or operated by the District shall be designed and plans prepared according to the criteria set forth in this section, and shall be so designed to conform to all applicable State and local laws, ordinances and regulations. The design shall also take into consideration any environmental restrictions applicable to a particular region.

1.1.02 Design Competence -- In general, all water facilities shall be designed by licensed Professional Engineers in the state of California according to accepted practice in the water field.

Generally, the design standards and construction standards provided herein shall be in compliance with the American Water Works Association (AWWA) and the Insurance Services Office (ISO). Other recognized standards may be accepted; however, request for use of other standards shall be offered to this agency in writing and shall include reasons for requesting a variance from the above mentioned authorities.

1.1.03 Legal Access -- Each lot to be served by water shall have frontage to a public street or recorded easement containing a water line, or be provided with permanent legal access to such a water line.

Any water facilities required for operation shall be provided within lands which have been dedicated in perpetuity and recorded, or which have been provided in fee title and recorded. Dimensions of property offered either for dedication or in fee title shall be adequate to facilitate the ultimate size of the proposed water facility and be adequate to provide space required for turning movements of heavy equipment which normally would be required to construct, maintain and replace the water facility.

1.1.04 Deviations -- Deviations from any of the criteria adopted herein may be permitted upon written request to and approval by the District.

1.2 Water Demand

1.2.01 Domestic Use -- Domestic flows shall be based on consumption records of surrounding water systems. In the absence of such records, domestic flows shall be based on the following: an average daily use of 180 gallons per capita per day; a peak daily flow of two times the average daily flow; and a peak hourly flow of four times the average annual daily flow.

1.2.02 Fire Flow -- Fire flow demand on the system shall be per the standards entitled “Guide for Determination of Required Fire Flow” published by Insurance Services Office. All fire protection water systems shall require the approval of the fire authority having jurisdiction in that given area prior to final approval of the water system design.

All fire flow requirements are over and above the average daily consumption of water, and shall be achieved at not less than twenty-(20) psi minimum residual pressure at the point of fire flow.

1.3 Design For Future Growth

Transmission and distribution mains shall be designed for ultimate demand. Storage, supply, and booster station facilities shall be reviewed by the District on a per case basis.

1.4 Supply

1.4.01 General -- The supply system shall be designed as a multi-source system capable of handling peak daily demand with the largest source of supply not in operation.

1.4.02 Wells -- Wells shall be housed in a structure compatible with the surroundings. Provisions within this structure shall be made to facilitate removing of pumps, motors and other equipment. Wells shall be located upon land to which legal access is provided and for which a permanent easement or title is recorded. Vertical turbine pumps shall meet the standards set forth in AWWA Standard E-101. All wells shall be furnished with sounding tube, air line, water meter, electric kilowatt hour meter, running time meter, air valve, gravel shoot casing vent, check valve or pump control valve, and shutoff valve on the discharge piping.

1.5 Storage

Storage capacity shall consist of operational storage plus fire flow storage as related to each pressure zone. Operational storage shall be the maximum day demand. The inclusion of emergency storage should be considered depending upon the reliability of supply.

1.6 Booster Stations

1.6.01 Pumps in Hydropneumatic Systems -- In systems where pumps shall be instantaneous peak demands, without supplementary flows from storage, the pump capacity shall be based on peak hour demand together with coincidental fire flow demand for the highest fire flow anticipated for the proposed land use with one pump out of service.

1.6.02 Pumps in Gravity Systems -- In systems with adequate available flows from storage to supplement pumping, pumping capacity should be based on peak day demand together with coincidental fire flow demand for the highest fire flow anticipated for the proposed land use with one pump out of service.

1.6.03 Structure -- Booster pumps shall be housed in a weather-tight structure compatible with the surroundings. Provisions within this structure shall be made to facilitate removing of pumps, motors and other equipment.

1.7 Transmission and Distribution Mains

1.7.01 Pipe Size -- Mains shall be sized to accommodate the greater of the following while maintaining a minimum pressure as specified in subsection 1.7.02 herein at street service connections. The minimum pipe diameter is 8".

1) peak hour demand

2) peak day demand plus fire flow

3) nighttime storage replenishment flow

The capacity of water mains shall be determined by using the Williams and Hazen Formula with an appropriate "C" value. The velocity of the water in the pipe shall be limited to 8-feet per second maximum, except in hydrant branch lines.

The maximum loss of head during either peak hour or nighttime replenishment flow conditions shall be 3-feet per 1,000 lineal feet of pipeline.

1.7.02 Operating Pressures -- Maximum pressure in mains shall not exceed 125 psi. Pressure reducers will be required on service connections where static pressure exceeds 90 psi.

Minimum pressure in mains shall be 40 psi during peak hour operation without fire flows and shall not be less than 20 psi during peak hour operation with fire flows.

1.7.03 Depth of Cover -- A minimum four – foot depth of cover from top of pipe to finish grade or top of pavement shall be maintained on all pipelines below grade. Additional cover may be required where deemed necessary by the District.

1.7.04 Location and Alignment -- Wherever possible, water mains shall be located in public streets parallel to street centerlines.

1.7.05 Clearance from Sewer Lines -- Where possible, a minimum horizontal clear distance of 10-feet shall be provided between water and sewer line laid parallel. Where such lines cross a minimum vertical clearance of 3-feet shall be provided with the sewer under the water line.

If the above conditions cannot be met, special construction will be required according to the requirements set forth on Standard Drawing No. H-1 herein.

1.7.06 Mains under Structures -- No water mains shall be located beneath a structure (including fences and block walls) except as approved in writing by the District.

1.7.07 Looped Lines and Flushouts -- Looped lines shall be provided where practical. Where dead ends are necessary, provisions for flushing shall be included. No flushing device shall be connected directly to a sewer. Flushout assembly and size shall conform to Standard Drawing No. H-8A. Blowoff assemblies shall be utilized on pipelines greater than or equal to 24 inches in diameter.

Fire hydrants may be used for flushout, where applicable, and upon approval by the District.

1.7.08 Valves -- Provide sufficient valves to permit isolation and repair of leaks and breaks, and in accordance with good water works practice. Except for transmission lines, in no case should a length of pipe greater than 1,320 feet be left without valve control. A valve box and cover shall be provided for all valves below grade and shall conform to Standard Drawing No. H-11 herein, unless part of an assembly covered by another standard drawing.

1.7.09 Fire Hydrants -- Fire hydrants shall be spaced along distribution mains as follows:

Single Family Residential (R-1)	660 feet maximum
Multiple Residential, Commercial & Industrial	330 feet maximum

Spacing of fire hydrants shall not exceed the above maximum distances but fire hydrants may be spaced at closer intervals in conformance with requirements of local fire control authorities.

Hydrants shall be located at street corners or intersection whenever practical. Hydrants shall be 5 1/4-inch Type “B” according to land use as follows:

Medium to High density residential, Commercial, and Industrial	Type “B”

Hydrant installation assembly shall conform to Standard Drawing No. H-2A and H-2B herein.

1.7.10 Service Connections -- Service connection assemblies shall conform to Standard Drawings No. H-4A and H-4B herein.

1.7.11 Air and Vacuum Valves -- Air release valves, air-vacuum valves, and air-vacuum combination valves shall be used in supply, transmission and distribution lines according to accepted practice in the water field. Air-vacuum combination valves shall be provided at high points in distribution system mains.

Valve assemblies shall conform to Standard Drawing No. H-6 herein.

1.7.12 Blowoffs -- Blowoff assemblies will be required at low points in distribution system mains 4 inches or greater in diameter.

Blowoff assemblies shall conform to Standard Drawings No. H-7A herein.

1.7.13 Thrust Blocks -- Concrete thrust blocks shall be installed as required according to Standard Drawing H-3A and H-4B herein. Where circumstances prevent the use of standard thrust blocks, special thrust restraint design shall require District approval.

1.7.14 Casing Spacers-- Installation of pipeline into a casing will require the use of restrained casing spacers, the number of spacers will vary by size, type and length of pipe. Quantities and brand to be approved by engineer/inspector.

1.8 Electrical Equipment

Electrical starters, switches, lights, motors, fixtures, controllers and instruments shall be enclosed and constructed in accordance with the National Board of Fire Underwriter’s Specifications to meet hazardous conditions anticipated. The Health and Safety Code of the State of California and National Electrical Code shall also be met.

Starters shall be of the magnetic type and shall be provided with hand-off automatic selector switches. The design of electrical equipment shall require District approval.

1.9 Automatic Controls

Wells, booster stations, and storage facilities shall be electrically inter-connected to give the system complete automatic control. Provision shall be made for manual operation of controls in the event of failure of automatic controls, and automatic controls shall be designed fail-safe, and shall meet the District's approval. Where additions to existing automatic control systems are contemplated, the design of the proposed additions and the interfacing methods shall require District approval.

1.10 Miscellaneous Requirements

1.10.01 Pump Discharge Runs -- A gate valve shall be placed on the discharge line of each pump. A pump control valve shall be placed on each discharge line between the gate valve and the pump.

Sufficient valves shall be provided to isolate each pump from the system.

An air release valve, properly vented to the outside of the pump house, shall be provided on each pump discharge line.

Pump discharge lines shall be protected from pressure surges created by starting and stopping of pumps. Pump control valves or other surge controls shall be utilized where required by the District. A pressure relief valve is required in the discharge line.

1.11 Plan Preparation

Plans prepared for additions to the District's water system and submitted to the District for approval shall be in substantial form and contain the information herein set forth. A sample plan is enclosed in the rear of Division "F."

1.11.01 -- Drawings shall be in ink on mylar. Sheet size shall be 36-inch by 24-inch with standard District title block. FINAL drawings shall be placed in AutoCAD electronic format, copied and given to the District for archiving.

1.11.02 -- The General Notes shall appear once on the first sheet of the Plans. All required certifications and approvals shall also appear on the first sheet.

1.11.03 -- Each sheet shall have a title block in the lower right hand corner.

1.11.04 -- Each sheet shall have a North arrow, where applicable.

1.11.05 -- A key (vicinity and location) map having a scale of 1 inch – 500 feet or larger shall be shown on the first sheet of each set of drawings. Said key map shall show water lines, their sizes, gate valves, fire hydrants, and appurtenances in their scaled relation to one another. All roads shall be shown.

TECHNICAL SPECIFICATIONS

San Bernardino County - Public Works Special Districts Department, Division “G” Technical Specifications (2020).

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1.11.06 -- Plan and profile are required for pipelines. Double plan and profile sheets may be used. Scales to be used are as follows:

Plan and Profile	1 inch =	40 feet horizontal
	1 inch =	4 feet vertical

If approved by the District, the following scales may be used:

	1 inch =	80 feet horizontal
	1 inch =	8 feet vertical

Profiles shall show pipe size; existing ground elevation or finish grade elevation; appurtenances; the depth, size, location, and nature of other utilities which cross over or under the water line; the location and nature of special construction such as concrete blankets or encasement; flow line elevations at grade changes; and any other information pertinent and necessary to the proper construction and recordation of the water lines.

1.11.07 -- At least one BenchMark shall be shown and/or described on each sheet. The indicated elevation shall be referenced to U.S.C. & G.S. datum.

1.11.08 -- The plans shall show the Tract and Lot numbers of property adjacent to the water line to be constructed.

1.11.09 -- The plans shall show all right of way lines, the distance from the centerline of roads, rights of way and easements to the center of the water line and other distances necessary to easements.

1.11.10 -- Show limits and type of street payment, curb, gutter, and sidewalk.

1.11.11 -- Show location of proposed service connections.

1.11.12 -- Show exact location of all structures within 20 feet of the water centerline.

1.12 Technical Specifications

The District's Technical Specifications shall be utilized in the design of water facilities. Technical Specifications are in Division "G" of the District's policies.

1.13 Standard Drawings

The District's Standard Drawings shall be utilized in the design of water facilities. Standard Drawings are in Division "H" of the District's policies.

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COUNTY OF SAN BERARDINO

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SPECIAL DISTRICTS DEPARTMENT
COUNTY OF SAN BERNARDINO

PREFACE TO THE TECHNICAL SPECIFICATIONS WATER

1.0 Supplemental Definitions

Whenever in these Technical Specifications the following terms, or pronouns in place of them, are used, the intent and meaning shall be interpreted as defined in the Ordinance and Rules and Regulations of the District which regulate the use and construction of water facilities. These supplemental definitions shall apply only to the interpretation of these Technical Specifications.

Contract: The written agreement covering the performance of the work and the furnishing of labor, materials, tools and equipment in the construction of the work. The contract shall include the Proposals, Plans, Specifications, Insurance, and Contract Bonds; also, any and all written supplemental agreement amending or extending the work in a substantial and acceptable manner. Supplemental agreements are written agreements covering alterations, amendments or extensions to the contract and include contract change orders.

Plans: The official project plans, profiles, typical cross sections, general cross sections, working drawings and supplement drawings, or reproductions thereof, approved by the Engineer, which show the location, character, dimensions and details of the work to be performed, and which are to be considered a part of the Contract.

Contractor: The individual, partnership, corporation, joint venture or other legal entity entering into a contract with the District to perform the work. When the work is being done under permit issued by the District, the Permittee shall be construed to be the Contractor.

Specifications, Technical Specifications: The directions, provisions and requirements contained in the Technical Specifications for the District.

Work: All the work specified, indicated, shown or contemplated in the contract to construct the improvement, including all alterations, amendments or extensions thereto made by supplemental agreements or written orders of the Engineer. (It includes the furnishing of all labor, materials, equipment, and services.)

Engineer: the district representative that acts as the resident engineer, or engineering project manager, chief engineer of the District, or other person designated by the District, acting either directly or through authorized agents.

Design Engineer: The engineer representing the Owner that is responsible for the project engineering design.

District: The Office of Special Districts, County of San Bernardino, California

Inspector: The Individual or firm charged with the responsibility of project inspection and represents the interests of the District.

Drawings: The offered and approved project drawings.

Owner: The developer of the project.

2.0 Work Schedule

One week prior to starting construction, the Contractor shall submit to the District, Engineer and Inspector a work schedule which shall describe the sequence, time and method of operation he plans to use on the job. The Engineer reserves the right to alter this schedule where he feels the intent of the contract could not be carried out.

It shall be the Contractor's responsibility to update this schedule once a month showing work completed and work in progress. The Contractor shall provide the District, Engineer and Inspector copies of this updated schedule.

The Contractor shall notify the District, Engineer and Inspector one-week in advance of when he plans to start construction.

SPECIAL DISTRICTS DEPARTMENT
COUNTY OF SAN BERNARDINO
TECHNICAL SPECIFICATIONS

SECTION 1.0

EARTHWORK

1.1 General

Earthwork includes all plant labor, equipment, appliances and materials as required or necessary to clear, grub, excavate, trench, fill, backfill, and grade for the construction of all structures, pipe lines, ditches, embankments and graded areas as shown and specified.

1.2 Obstructions

All trees, shrubs, brush, including stumps and roots, fences, rocks, stones, debris and all obstructions of whatsoever kind or character. Whether natural or artificial, encountered in the construction of the work shall be removed unless otherwise specified on the construction plans or in the special conditions.

In the installation of pipelines outside of public rights of way or in easements, trees shall not be removed unless otherwise authorized in writing by the Engineer, and all fences, structures and landscaping which are removed or damaged by the Contractor shall be restored to their original condition at the Contractor's expense without any compensation therefor. Any damage done to private property by reason of work on easements shall be the responsibility of the Contractor.

Material that is removed as hereinabove specified, and is not to be incorporated in the improvement being constructed, shall be disposed of away from the construction site at Contractor's expense at an approved and lawful disposal site.

The Contractor's attention is directed to the possible existence of pipe and other underground improvements which may or may not be shown on the plans. All reasonable precautions shall be taken to preserve and protect any such improvements whether shown on the plans or not. Where it is necessary to remove and replace or to relocate such improvements in order to prosecute the work, they shall be removed, maintained and permanently replaced at no expense to the District.

1.3 Earthwork in City, County, State and Railroad Rights of Way

Earthwork within rights of way California Department of Transportation (Caltrans), the County Road Department, or any City or other governmental agency having jurisdiction, shall be done in accordance with requirements and the provisions of the permits issued by those agencies for the construction within their respective rights of way.

Such requirements and provisions, where applicable, shall take precedence and supersede the provisions of these specifications. The requirement of these Technical Specifications shall be the minimum requirement.

1.4 Safety Precautions

All excavations shall be performed, protected and supported as required for safety and in the manner set forth in the operating rules, order the regulations prescribed in the Cal/OSHA program by the Division of Occupational Safety and Health (DOSH) of the State of California. Barriers shall be placed at each end of all excavations and at places as may be necessary along excavations to prevent accidents. Lights shall also be placed along excavations from sunset each day to sunrise the next day until such excavation is entirely refilled. The Contractor shall submit to the Engineer for approval a safety barrier and traffic control plan prior to construction.

1.5 Excavated Materials

Arrangements for disposing of excess excavated material shall be made by the Contractor. Excavated material suitable for backfill shall be stored temporarily in such a manner as will facilitate work under the Contract.

1.6 Shoring, Sheeting and Bracing

Where sheet piling, shoring, sheeting, bracing, or other supports are necessary, they shall be furnished, placed, maintained and removed by the Contractor. Sheet piling and other supports shall be withdrawn in such a manner as to prevent additional backfill on the pipelines which might cause overloading. At all times the rules of Cal OSHA of the Department of Occupational Safety and Health of the State of California with respect to excavation and construction shall be strictly observed.

1.7 Clearing and Grubbing

Areas where construction is to be performed shall be cleared of all trees, shrubs, brush, rubbish, and other objectionable material of any kind which, if left in place, would interfere with the proper performance or completion of the contemplated work, would impair its subsequent use, or form obstructions therein. Trees and other natural growths outside the actual lines of construction operations shall not be destroyed and such measures as are necessary shall be taken by the Contractor for the protection thereof.

Organic material from clearing and grubbing operations will not be permitted for use as excavation backfill.

It shall be the Contractor's responsibility to remove and dispose of all excess material resulting from clearing and grubbing operations at his/her own expense. The Contractor shall make his/her own arrangement for disposal sites at his/her own expense, at which said material may be wasted. The site shall be an approved and lawful disposal site.

1.8 Control of Water

The Contractor shall provide and maintain at all times during construction ample means and devices with which to promptly remove and dispose of all water entering the excavations or other parts of the work. No concrete footings or floors shall be placed in water nor shall water be allowed to rise over them until the concrete or mortar has set at least eight hours. Water shall not be allowed to rise unequally against walls for a period of 28 days. Ground water shall not be allowed to rise around pipe installations until jointing compound in the joints has set.

The Contractor shall dispose of the water from the work in a suitable manner without damage to adjacent property and shall be in accordance with any and all permit requirements. No water shall be drained into work built or under construction. Water shall be disposed of in such a manner as not to be a menace to the public health.

Dewatering for structures and pipelines shall commence when ground water is first encountered, and shall be continuous until such times as water may be allowed to rise in accordance with the provisions of this Section.

1.9 Pipeline Excavation

1.9.01 Excavation -- Excavation for pipelines, fittings, valves, and appurtenances shall be open trench to the depth and in the direction necessary for the property installation of the same as shown on the plans or as otherwise directed by the Engineer, except where another method is specifically called for on the plans or in these specifications.

1.9.02 Limit of Excavation -- Except with specific approval of the Engineer, no more than 400 feet of open trench shall be excavated in advance of laying of pipe. All operations shall be carried out in an orderly fashion. Backfilling and clean up work shall be accomplished as sections of the pipe installation are approved. Public travel through the work shall be impeded or obstructed as little as possible. Trench plating may be allowed as long as it meets the appropriate regulations.
The remainder of the trench excavated that day shall be backfilled, compacted and the roadway opened to the public. At the end of each week, all trenches, including manhole excavations, shall be backfilled, compacted and the roadway opened to the public on Saturday, Sunday, and Holidays.

1.9.03 Tunneling -- Tunneling will be permitted only where native earth is of such firmness that it will remain in its original position, without sloughing off, throughout the work of excavation and backfilling; if sloughing occurs, the roof of the tunnel shall be broken down and the trench excavated as an open trench as herein specified.

1.9.04 Trench Width -- Banks of open cut trenches shall be kept as nearly vertical as possible. Where necessary in order to maintain the banks nearly vertical, the trench shall be properly sheeted and braced. The overall trench width shall not be more than 16 inches or less than 12 inches wider than the largest outside diameter of the pipe to be laid therein, measured at a point 12 inches above the top of the pipe exclusive of branches. Excavation and trenching shall be true to the line so that a clear space of not more than 8 inches or less than 6 inches in width is provided on each side of the largest outside diameter of the pipe in place. For the purpose of this article, the largest outside diameter shall be the outside diameter of the coupling.

1.9.05 Correction of Faulty Grades -- Should the excavation for the pipeline be carried below grade without instruction from the Engineer, it shall be refilled to proper grade with pipe zone material compacted to 90 percent relative compaction or crushed rock, at the expense of the Contractor. If compaction tests are required, they shall be at the expense of the Contractor.

1.10. Pipe Foundation and/or Subgrade

1.10.01 Foundation in Good Soil -- The trench shall have a flat or semi-circular bottom conforming to the grade to which the pipe is to be laid.

1.10.02 Foundation in Poor Soil -- All soft, spongy, or unstable material in the bottom of the trench shall be removed and replaced with approved material to a depth as determined in the field by the Engineer. The approved material shall be compacted to a minimum of 90 percent relative compaction to provide an unyielding foundation for the pipe. The removal and replacement of material from depths greater than 2 feet below the grade shown on the plans will considered as Extra Work.

1.10.03 Foundation in Rock -- Where rock is encountered, it shall be removed below grade and the trench backfilled with suitable material to provide a compacted earth cushion with a thickness under the pipe of not less than ½ inch per inch of nominal diameter of the pipe to be installed with a minimum allowable thickness of 6 inches.

1.11 Trench Backfill

1.11.01 General -- All trenches shall be backfilled after pipe, fittings, valves, and appurtenances have been installed, inspected by the inspector, and approved by the engineer.

All wood and waste material shall be removed from excavation preparatory to backfilling. Backfill material shall be approved in all cases by the Engineer and shall be free of trash, wood, large rock, or other objectionable debris. Backfilling shall include the refilling and compacting of the fill in trenches or excavations up to the subgrade of the street or to the existing ground surface.

1.11.02 Procedure in Pipe Zone -- The pipe zone shall be considered to extend the width of the trench and up to 12 inches above the top of the pipe. The backfill material in this zone shall be free of clods, clay or other deleterious materials and may contain rock which will pass a 2 ½ inch Screen in quantity not exceeding 40 percent of the volume when said coarse materials are well distributed throughout the finer materials and the specified compaction can be attained. When the excavated material is not as specified above, the Contractor shall import and place, at his/her own expense, a suitable granular backfill material. In placing the backfill in the pipe zone, particular attention is to be given to the underside of the pipe and fittings to provide a firm bedding support along the full length of the pipe. Backfill material may be densified by applying water or hand tamping. Care shall be exercised in backfilling to avoid damage to the pipe. All pipe shall be placed and backfilled in accordance with the recommendations and guidelines of the manufacturer.

1.11.03 Procedure Above Pipe Zone -- From the top of the pipe zone backfill to ground surface, the material for backfill may contain stones ranging in size up to 6 inches in diameter, in quantity not exceeding 40 percent of the volume when said coarse materials are well distributed throughout the finer materials and the specified compaction can be attained. All work necessary to conform to these requirements shall be performed at the Contractor's expense.

1.11.04 Compaction Requirements -- Whenever a relative compaction requirement value is specified, the optimum moisture content and density shall be determined in accordance with the Caltrans test method no 216 or 231 (ASTM D-1556 or D-1557). County of San Bernardino Transportation Department Road Design Standards will govern all paved road trenching, whether in County Roadways or non County roadways. A minimum of three soils compaction test per trench crossing of paved roadways shall be required at Contractors expense. The trench shall have a minimum compaction of 98% prior to asphalt repair. A 1-sack of Portland cement per cubic yard of sand slurry may be used in lieu of replacing the existing trench soil and re-compacting to a 98% soil density.

A). Compaction in roads and under structures except where governed under other jurisdiction (Caltrans, County Road Dept., City or other governmental agency having authority) will be per the governing entity. However a 95 percent minimum will be required for Class 2 aggregate base or for that portion between 0.5 foot and top subgrade.

B). Compaction in Easements -- In easements or open terrain, the backfill, if sufficiently granular (sand equivalent of 20 or greater), shall be consolidated by a method approved by the Engineer. A minimum of 90 percent relative compaction, however, will be attained.

1.11.05 Mechanically Compacted Backfill -- Mechanically compacted backfill shall be placed in horizontal layers of such depths (not exceeding those specified herein) compatible to the material being placed and the type of equipment being used. All such equipment shall be of a size and type approved by the Engineer. Each layer shall be evenly spread, moistened (or dried, if necessary), and then tamped or rolled until the specified relative compaction has been attained. Permission to use specific compaction equipment shall not be construed as guarantying or implying that the use of such equipment will not result in damage to adjacent ground, existing improvements, or improvements installed under the contract. The Contractor shall make his/her own determination in this regard. Any damage which results shall be the responsibility of the Contractor and repaired or replaced at the Contractor's expense.

Material for mechanically compacted backfill shall be placed in lifts, which, prior to compaction, shall not exceed the depths specified below for the various types of equipment.

(1) Impact, free-fall, or "stomping" equipment – maximum lift depth of 3 feet.

(2) Vibrator smooth-wheel rollers, and vibratory pneumatic-tired rollers – maximum depth of 2 feet.

(3) Rolling equipment, including sheepsfoot (both vibratory and non-vibratory), grid, smooth-wheel (non-vibratory), pneumatic-tired (non-vibratory), and segmented wheels – maximum lift depth of 1 foot.

(4) Hand directed mechanical tampers -- maximum lift depth of 4 inches.

1.11.06 Water Densified Backfill -- As used in these specifications, flooding shall mean the inundation of backfill with water, puddled with poles or bars to insure saturation of the backfill material for its full depth. Jetting shall be accomplished by the use of a jet pipe to which a hose is attached carrying a continuous supply of water under pressure.

1.11.07 Requirements of Densified by Jetting -- Densified by jetting shall be subject to all of the following requirements:

(1) Application of Water

The Contractor shall apply water in a quantity and at a rate sufficient to thoroughly saturate the entire thickness of the lift being densified. Water for jetting shall be from a continuous supply of water under pressure.

(2) Use of Vibration

Where densities are required which cannot be attained by jetting alone, the Engineer may direct the Contractor to supplement the jetting process with the application of vibrating compacting equipment to the backfill.

(3) Lift Thickness

The lift of backfill shall not exceed that which can be readily densified by the jetting procedure, but in no case shall the undensified lift exceed 10 feet for jetting.

(4) Character of Material

The material being used with the water settling methods to backfill the trenches in street rights of way shall have a sand equivalent of at least 20 when tested in accordance with the Caltrans, Test Method No. “Calif. 217” and having a maximum of 10 percent passing a 200 mesh standard sieve. Where the nature of the material excavated from the trench is generally unsuitable for densification with water, the Contractor may, at no cost to the District, import suitable material for jetting, or densify the excavated material by other methods. If water densification methods are employed, the Contractor shall, at his own expense, provide a sump and pump to remove the accumulated water from the downstream end of the construction.

(5) Damage to Adjacent Improvements

The Contractor shall make his own determination that the use of flooding or jetting methods will not result in damage to existing improvements. Permission to use such methods in densifying backfill shall not be construed as guarantying or implying that adjacent ground and improvements will be unaffected.

1.11.08 Compaction Tests -- Compaction will be tested in accordance with methods specified by Highways Caltrans, test method no. 216, sandcone ASTM D-1556 or no. 231, Nuclear Gauge testing (ASTM D-2992). Sand Equivalent tests will be in accordance with Caltrans test no. 217. Compaction testing shall be the responsibility of the contractor. Final acceptance of construction will not be granted until test reports are accepted and approved by the Engineer. Frequency of tests will be as follows.

A). Longitudinal Trenches -- A complete series of compaction tests will be taken for each lift (thickness) of backfill, lifts will be determined by mechanical means of compaction (see section 1.11.05) or water densified backfill (sec. 1.11.06 & 1.11.07). Each series consists of tests taken randomly at various depths but not to exceed a maximum of 300 linear foot intervals, or as directed by the engineer.

B). Lateral Trenches -- Tests will be taken on 20 percent of all laterals constructed, one test for each 4 foot depth randomly selected.

Failing tests will be reworked and retested to the satisfaction of the Engineer by the Contractor at no cost to the District.

The Contractor, at his/her expense, shall excavate the holes for all tests, backfill the holes and compact this backfill, and repave the surface if necessary.

1.11.09 Excess Excavated Material -- The Contractor shall make the necessary arrangements for and shall remove and dispose of all excess or waste material at an approved and lawful disposal site. All costs for the disposal of excess or waste material shall be borne by the Contractor.

It is the intent of these specifications that all surplus material not required for backfill shall be disposed by the Contractor outside the limits of the public rights of way and in accordance with the requirement of the County Grading Ordinance or ordinance of any other agencies having jurisdiction at no cost to the District.

Excavated material shall not be deposited on private property unless written permission from the owner thereof is secured by the Contractor. Copies of said written permission, duly signed by the owner of the private property involved, shall be furnished to the Engineer by the Contractor before such material is placed on private property.

1.11.10 Imported Backfill Material -- Whenever the excavated material is unsuitable for backfill, the Contractor shall arrange for and furnish imported backfill material per the specifications herein at his own expense. He/she shall dispose of the excess trench excavation as specified in the preceding paragraph. The backfilling with imported material shall be done in accordance with the methods described in section 1.11.

1.12 Structural Earthwork

1.12.01 Structural Excavation -- The site shall be cleared of all natural obstructions, pavements, utilities, and other items which will interfere with construction. Any method of excavation may be employed which, in the opinion of the Contractor, is considered best. Ground shall not be dug by machinery nearer than 3 inches from any finished subgrade without the express approval of the Engineer. The last 3 inches shall be removed without disturbing the subgrade. Should the excavation be carried below the lines and grades indicated on the plans, the Contractor shall, at his own expense, refill such excavated space to the proper elevation in accordance with the procedures specified for backfill or, if under footings, the space shall be filled with concrete.

Excavation shall extend a sufficient distance from walls and footings to allow for placing and removal of forms, installation of services, and for inspection, except where concrete is authorized to be deposited directly against excavated surfaces.

1.12.02 Structural Backfilling -- After completion of foundation footings and walls, and of other construction below the elevation of the final grade, and prior to backfilling, all forms shall be removed and the excavation shall be cleaned of all debris. Unless otherwise shown, material for backfilling shall consist of excavated material, or imported sand, gravel, or other material approved by the Engineer and shall be free of trash, lumber, or other debris. Backfill shall be placed in horizontal layers not exceeding 9 inches in thickness, and shall have moisture content such that the required degree of compaction may be obtained. Each layer shall be compacted by hand or machine tampers or by other suitable equipment or means to a relative compaction of at least 90 percent. Dewatering shall be maintained during the placement of compacted clay backfill.

1.12.03 Stripping -- All vegetation, such as roots, brush, heavy sods, heavy growth of grass and all decayed vegetable matter, rubbish, and other unsuitable material within the area of the work, shall be stripped or otherwise removed before fill is started. Surfaces under paved areas, dikes, and elsewhere as directed by the Engineer, shall be wetted and compacted prior to placing fill.

1.12.04 Grading -- After stripping has been done, excavation of every description and of whatever substance encountered within the grading limits of the work shall be performed to the lines and grades indicated on the drawings. All suitable excavated material shall be transported to and placed in the fill area within the limits of the work. All excavated materials which are considered unsuitable by the Engineer, and any surplus of excavated material which is not required for fill shall be known as waste and shall be disposed of as directed in Section 1.11.09 above. During construction excavation and filling shall be performed in a manner and sequence that will provide drainage at all times.

Ditches shall be cut accurately to the cross sections and grades indicated. Any excessive ditch excavation shall be backfilled to grade either with suitable, thoroughly compacted material, or with suitable stone or cobble to form an adequate paving.

1.12.05 Fill -- Fills or embankments shall be constructed at the locations and to the lines and grades indicated on the plans. Suitable material from excavations may be used for fill. Material shall be placed in horizontal layers of from 8 to 12 inches in loose depth for the full width of the cross section and compacted as specified.

For general fill areas, the fill shall be compacted to 90 percent relative compaction.

For roadways and all areas to be paved, the fill shall be compacted, by means of tamping roller or three-wheel power roller, to at least 95 percent relative compaction.

Dikes and embankments shall be compacted by the use of compaction rollers or three-wheel power rollers to 90 percent relative compaction.

Relative compaction shall be as determined in accordance with the Caltrans Test Method No. "California 216-F," or ASTM Designations D 1557 and D1556.

1.12.06 Finish Grading -- All areas covered by the work including excavated and filled sections and transitions areas, shall be graded uniformly to the elevations shown on the plans. The finished surface shall be reasonably smooth, compacted, and free from any irregular surface changes. The degree of finish shall be that ordinarily obtainable from a blade-grader. The finished surface shall be not more than 0.1 foot above or below the established grade. Ditches shall be graded to drain readily. The surface of areas to be paved, on which a surface course is to be placed, shall not vary more than 0.05 feet from established grade and approved cross section.

1.12.07 County and City Grading Ordinances -- In addition to the requirements herein set forth for structural earthwork, all work shall be done in accordance with the requirements of the County Grading Ordinance or ordinance of any other agencies having jurisdiction.

1.13 Drilling and Blasting

1.13.01 Use of Explosives -- All operations, storage and handling of explosives shall be according to provisions of Division II, Part I, of the Health and Safety Code, State of California, and shall comply with all State, County and local laws.

1.13.02 Skilled Workmen -- Drilling and blasting are to be done only by personnel skilled in rock techniques.

1.13.03 Safety -- All necessary precautions shall be taken for protection of life and property. Warnings shall be given to nearby property owners that blasting is in progress. Safety mats shall be used to restrict flying particles. The Contractor shall size each "shot" to minimize nuisance and reduce the possibility of damage to local structures. Warning signs shall be posted along all roads, vehicle accesses and pedestrian walkway adjacent to the blasting operations. All radio transmissions within the blasting area shall be prohibited.

1.14 Final Cleanup

After all earthwork operations have been completed, the right of way and all other areas shall be dressed smooth and left in a neat presentable condition to the satisfaction of the Engineer and Owner.

1.15 Erosion Control

The contractor shall comply with all requirements for the National Pollution Discharge Elimination System (NPDES) program and obtain any and all required permits.

SPECIAL DISTRICTS DEPARTMENT
COUNTY OF SAN BERNARDINO
TECHNICAL SPECIFICATIONS

SECTION 2.0

CONCRETE CONSTRUCTION

2.1 General

Concrete shall be composed of Portland cement, sand, coarse aggregate, water, and admixtures as specified or approved, all well mixed and brought to the proper consistency suitable for the specific conditions of placements and in accordance with the requirements of these specifications.

2.2 Classes of Concrete

All Portland cement concrete used on the work shall be one of the classes described below. Unless otherwise stated, each class shall be used in the locations as listed:

2.2.01 Class I

Compressive Strength -3000 psi minimum.
Mix – 6-sack minimum, test required
7 sack
Use – Walls, beams, slabs, footings
Equivalent California State Highway Designation
(1984) – Class D (for 7 sack minimum)

2.2.02 Class II

Compressive Strength – 3000 psi minimum.
Mix – 6 sack (4.85 cement, 1.15 pozzolan)
Use – Walls, beams, slabs, footings (where specified on the plans).

2.2.03 Class III

Compressive Strength – 2500 psi minimum.
Mix – 6 sack
Use – Slabs, footings, walls (where specified)
Equivalent California State Highway Designation
(1984) – Class A

2.2.04 Class IV

Compressive Strength – 2500 psi minimum.
Mix - 5 sack
Use – Paving, cradles, curbs, gutters, sidewalks, thrust blocks, Manholes bases, pipe encasement, or where specified
Equivalent California State Highway Designation (1984) – Class B

2.3 Portland Cement

Unless otherwise specified, Portland cement shall be Type I or Type II complying with ASTM Designation C-595 or C-150, and shall have a total alkali content not exceeding 0.6 percent when calculated as sodium oxide as determined by methods given in ASTM Designation C-114.

2.4 Sand

Sand shall be a washed natural sand having hard, strong and durable particles and which does not contain more than 2 percent by weight of such deleterious substances as clay lumps, shale, schist, alkali, mica, coated grains, or soft and flaky particles. Sand shall be graded uniformly from fine to coarse such that the combined grading of coarse aggregate and sand set forth in Section 2.6 will be met. Not more than 3 percent shall pass the No. 200 screen as determined by ASTM Designation C-117.

2.5 Coarse Aggregate

Coarse aggregate shall be a clean, hard, fine, grained, uncoated, sound crushed rock, or washed gravel or combination of both. It shall be free from oil, organic matter or other deleterious substances and shall not contain more than 2 percent by loss of shale or cherty material; and shall show a loss of not more than 10 percent when tested for soundness in sodium sulfate solution in accordance with ASTM Designation C-88. Coarse aggregate shall be graded uniformly from one-quarter inch size to maximum.

2.6 Combined Aggregate Grading

The combined grading of coarse and fine aggregate shall fall within the following percentages by weight:

	Percentage Passing Sieves	
Sieve Size	1-1/2" Max.	1" Max.
2"	100	
1-1/2"	90-100	100
1"	50-86	90-100
¾"	45-75	55-100
3/8"	38-55	45-75
No. 4	30-45	35-60
No. 8	23-38	27-45
No. 16	17-33	20-35
No. 30	10-22	12-25
No. 50	4-10	5-15
No. 100	1-3	1-5
No. 200	0-2	0-2

2.7 Mixing Water

Mixing water shall be clean and free from deleterious amounts of acids, alkalis, salts or organic materials. Any domestic, potable water supply is acceptable. However, some waters that are not suitable for drinking (i.e. recycled and raw state project waters) may be acceptable for concrete. These waters shall meet the standards as stated in the Portland Cement Association's recommendations for the acceptance criteria for questionable water supplies. (Reference ASTM C94)

2.8 Air Entrainment

Unless otherwise specified or directed by the Engineer, water reducing and plasticizing admixtures shall be used to reduce the required mixing water, for equivalent slump in plan concrete, at least 10 percent without entraining air in excess of 2 percent by volume. If the admixture used entrains more than 2 percent air, the water reductions shall be an additional 2 percent of air entrained over 2 percent, but in no case shall air entrained exceed 5 percent. Admixtures containing Calcium Chloride are not permitted unless approved by the inspector or engineer. All admixtures shall be used in strict accordance with manufacturer's recommendations.

2.9 Pozzolan

Pozzolan shall conform to ASTM Designation C-618, except that minimum compressive strength for the lime-reactivity test shall be 1000 psi at 7 days.

2.10 Other Admixtures

No other admixtures shall be used without the Engineer's approval.

2.11 Reinforcing Steel

Reinforcing steel shall consist of deformed bars of the size called for on the plans. Reinforcing steel shall conform to ASTM A-65, and shall be Grade 60 unless specified otherwise. Mill certificates showing conformity with these requirements shall be furnished to the Engineer for each melt, if so requested. Wire reinforcement shall conform to ASTM A-82.

2.12 Tests on Concrete

From each day's placing of each class of concrete from each batching plant used, at least one set of three standard test cylinders shall be made and cured in accordance with ASTM Designation C-31. The cylinders shall be dated, numbered, and marked to indicate the location from which the sample was taken. The result of the slump test shall be noted on the cylinder. Not more than two cylinders shall be made from any one point or batch concrete. The average of three cylinders crushed at the required age shall constitute one standard test, except that occasional additional cylinders may be made for crushing at early ages to determine the approximate strength of the concrete for form stripping or other purposes.

Specimens shall be tested in accordance with ASTM Designation C-39.

The standard age of test shall be 28 days.

If more than one in ten laboratory control strength test cylinders for any structure falls below the specified compression strength, the Engineer shall have the right to order a change in proportions or the water content of any concrete for the remaining structures. If the strength of any job cured cylinders falls below the specified compressive strength, assuming they have received protection and curing equivalent to concrete in the structure, the Engineer shall have the right to require condition of temperature and moisture necessary to secure the required strength and may require tests in accordance with ASTM Designation C-42, or order load tests to be made on the structures so affected if preliminary testing with the Schmidt Impact Hammer indicates the concrete to be defective.

Any concrete found that does not meet the minimum 28 day compressive strength requirements so Specified will be removed and replaced by the Contractor at the Contractor's expense.

2.13 Mix Design

Before beginning concrete work, the proper proportions of materials for each class of concrete shall be determined by the Contractor and/or his/her supplier. The mix design shall be prepared at the Contractor's expense, by a recognized inspection and testing laboratory, approved by the Engineer, and shall show the expected strengths and corresponding slumps, and all ingredient weights and other physical properties necessary to check the design mix. A trial batch shall be made for each class of concrete to be used on the job and from each batch four standard test cylinders shall be cast, cured and tested as specified for the job concrete. Certified copies of all laboratory reports shall be sent promptly to the Engineer directly from the testing laboratory stating whether the items reported meet the Specifications. A final report shall be submitted at the completion of all concrete placement summarizing all findings concerned with concrete used in the project.

If the Contractor uses more than one supplier of concrete, each supplier shall submit their design mix as described above.

2.14 Joint Filler

Preformed fillers shall be of the type indicated on the plans and shall be installed as indicated on the plans.

2.15 Shop Drawings

Placing sheets and bending schedules shall be submitted to the Engineer for approval.

2.16 Waterstops

Waterstops shall be installed where so indicated on the plans. Waterstops shall be of polyvinyl chloride plastic and shall be lock-rib, U-centered, or flat-strip type. Proper care in placing of waterstops in forms shall be exercised so that the center bulb coincides with the construction joint. When concrete is being placed, it shall be properly vibrated to insure density at waterstop location. Waterstops shall be made continuous at splices and intersections (horizontal and/or vertical) by "welding" with a polyvinyl chloride splicing iron.

2.17 Mixing

Job mixing of structural concrete will not be permitted unless otherwise specified. When allowed, concrete shall be mixed in a batch mixer of approved type, which will insure a uniform distribution of materials throughout the mass, so that the mixture is uniform in color and homogenous. All concrete shall be placed within 90 minutes after water is first added to the batch. The mixer shall be equipped with a suitable charging hopper, a water storage tank and water measuring device controlled from a case which may be kept locked and so constructed that the water may be discharged only while the mixer is being charged. The entire contents of the mixing drum shall be discharged before recharging. The mixer shall be cleaned at frequent intervals while not in use. The volume of mixed materials per batch shall not exceed the rated capacity of the mixer.

Transit mixed concrete shall be batched, mixed and delivered in accordance with ASTM Designation C-94, except that truck agitators may not be used. All concrete shall be deposited in place not more than 45 minutes after water is added when the temperature of the concrete exceeds 85°F and not more than 1-1/2 hours after water is added when the temperature of the concrete is less than 85°. Certified public weighmaster tickets shall be delivered to the Engineer or his representative in the field prior to placing the concrete to which the ticket applies.

2.18 Consistency

The quantity of water required for the proper consistency of the concrete shall be determined by the slump test, in accordance with ASTM Designation C-143. Unless otherwise stated, slump allowances shall be as follows:

Vertical Wall Sections, Column - Maximum 4 inch plus or minus one inch.

Floor Slabs, Beams, Footings - Maximum 3 inch plus or minus ½ inch.

2.19 Retempering

Retempering of concrete that has partially hardened, that is, mixing with or without additional cement, aggregate, or water, will not be permitted.

2.20 Depositing

Concrete shall not be placed until the forms and reinforcement have been approved by the Engineer. Concrete shall be conveyed from the mixer to the place of final depositing as rapidly as possible by methods which will prevent the separation or loss of ingredients. It shall be deposited in the forms as nearly as practical in its final position with lifts not over 1-1/2 feet high, so as to maintain a plastic surface approximately horizontal. Concrete shall not be dropped more than 6 feet vertically unless a suitable chute or tube is used.

Forms for walls, or other sections of considerable height, shall be provided with openings, or other devices shall be used which will permit the concrete to be placed in a manner that will avoid accumulations of hardened concrete on the forms or metal reinforcement. Under no circumstances shall concrete that has partially hardened be deposited in the work. Temporary joints shall not remain exposed for more than 45 minutes before adjacent concrete is placed. Concrete shall be continually inspected by the inspector who shall be afforded an opportunity to check the forms for accuracy, cleanliness and position of reinforcing before the placement is started.

2.21 Subgrade Preparation

Subgrade for slabs over native earth or fill shall be finished to the exact location and section of the bottom of the slab and shall be maintained in a smooth, compacted condition, until concrete is placed. Subgrade shall be thoroughly moistened but not muddy, at the time concrete is placed. At no time shall concrete be placed in standing or running water unless approved by the Engineer.

2.22 Consolidation

Concrete during and immediately after depositing shall be thoroughly worked around the reinforcement and embedded fixtures and into corners of the forms. Internal vibrators shall be used for all walls, and self-supporting beams or slabs. Experienced workmen shall handle vibrators and care shall be taken to avoid separation of aggregate due to excessive vibration. At least one vibrator shall be used for each 15 cubic yards per hour of concrete placed. Standby vibrators shall be kept on hand.

2.23 Construction Joints

Concrete in each unit of construction shall be placed continuously, and the Contractor shall not be permitted to begin work on any part unless his facilities and forces are sufficient to complete the unit without interruption. All joints in concrete shall be located as indicated on the drawings and as approved by the Engineer. The Contractor shall submit to the Engineer for approval, drawings showing the location and sequence of pours.

All construction joints shall be made as watertight as possible. Waterstops shall be provided where called for on the plans or where deemed necessary by the Engineer. Where these methods fail, joints shall be grouted under pressure after the concrete has set and forms have been removed.

The surface of construction joints in any location shall be thoroughly cleaned and roughened by dry method sand-blasting to remove all Latinate and expose aggregate solidly embedded in the mortar matrix.

2.24 Bonding

Before new concrete is deposited on or against concrete which has set, the forms shall be re-tightened, the surface of the set concrete shall be roughened, thoroughly cleaned of foreign matter and Latinate, as specified under Section 2.23, “Construction Joints,” and sprayed with water so that the concrete is saturated but no free water is left on the surface. The new concrete placed in contact with hardened or partially hardened concrete shall contain an excess of mortar to insure bond. To insure this excess mortar at the juncture of the hardened and new deposited concrete on vertical and inclined surfaces, the cleaned and saturated surfaces of the hardened concrete shall first be thoroughly coated with a coating of neat cement grout against which the new concrete shall be placed before the grout has attained its initial set. For horizontal surfaces, a layer of at least 1-inch thick of cement mortar composed of 1 part cement and 2 parts sand shall be placed before depositing the concrete.

2.25 Curing

2.25.01 Water Curing -- Unformed concrete surfaces shall be covered with wet burlap mats as soon as the concrete has sufficiently set, and shall thereafter be kept wet under burlap until backfilled or for 14 days after the concrete is placed. Where drying conditions are severe, as determined by the Engineer, fog sprays shall be employed to prevent checking of the fresh concrete surface. Immediately following the first leveling, the fog spray shall be applied whenever the concrete surface will absorb moisture and shall be discontinued when the applied moisture is rejected. Fog spraying shall be continued as specified until the finished surface has attained sufficient strength to permit flooding or covering with burlap mats.

Formed surfaces, both interior and exterior, shall be water cured under burlap maps or by water sprays beginning as soon as the forms are stripped. Prior to stripping of forms, the concrete shall be kept moist by water sprays.

2.25.02 Curing Compounds -- With the written approval of the Engineer, concrete surfaces may be cured by curing compounds as defined below. Any concrete curing compound shall be of a nature and composition not deleterious to concrete, and thinned to a working consistency either with a volatile solvent or by emulsification with water. The curing compound shall be of a standard and uniform quality ready for use as shipped by the manufacturer.

Curing compound shall form a continuous, unbroken membrane which shall adhere to moist concrete and which will not disintegrate, check, peel from the surface, nor show signs of such deterioration within 30 days after application under actual working conditions. The compound shall be sufficiently transparent and free from color that there will be no permanent change in the color of the concrete. The compound shall contain, however, a temporary dye of sufficient color to make the membrane clearly visible for a period of at least four hours after application. If the Contractor applies a deleterious compound to paint, plaster, gunite, or other surface treatment, he shall thoroughly sandblast the surface to remove all vestiges of the compound.

2.26 Protection of Concrete Construction

All surfaces shall be protected against injury, during the first 72 hours after placing, wheeling, working, or walking on the concrete shall not be permitted. All slabs subject to wear shall be convered with a layer of sand or other suitable material as soon as the concrete has set, and either shall be cured by the use of a curing compound or shall be kept wet for not less than 14 days, or they shall be kept covered for the same period with Sisalcraft paper or other similar tough waterproof paper. All joints between adjacent strips of paper shall be sealed.

No concrete shall be placed during rain, and during such weather, all concrete placed within the preceding 12 hours shall be protected with waterproof canvas or other suitable coverings. These shall be provided and kept ready at hand.

All concrete construction shall be protected from excessive loading.

2.27 Repair and Patching

After removing forms and before the concrete is thoroughly dry, any poor joints, voids, stone pockets, or other defective areas and all tie holes shall be patched. Defective areas shall be chipped away to a depth of not less than 1 inch with the edges perpendicular to the surface. The area to be patched and a space of at least 6 inches wide entirely surrounding it shall be wetted to prevent absorption of water from the patching mortar.

The patch shall be made of the same materials and proportions as used for the concrete, except that the coarse aggregate shall be omitted. The amount of mixing water shall be as little as consistent with the requirements of handling and placing.

The mortar shall be thoroughly compacted into place and screened, leaving the patch slightly higher than the surrounding surface. After being undisturbed for one to two hours to permit initial shrinkage, the patch shall be finished to match the adjoining surface.

Tie holes left by the withdrawal of form clamp rods or holes left by removal of snap ties shall be filled solid with mortar. For holes passing entirely through the wall, a plunger-type grease gun or other device shall be used to force mortar through the wall, starting at the back face. When the hole is completely filled, the excess mortar shall be struck off with a cloth flush with the surface. Holes not passing entirely through the wall shall be filled with a small tool that will permit packing the hole solid with mortar, any excess mortar being struck off flush with the surface.

2.28 Placing Reinforcing Steel

Reinforcing steel, before being positioned, shall be cleaned thoroughly of mill and rust scale or other coatings that will destroy or reduce the bond. Reinforcement appreciably reduced in seciton shall be rejected. Where there is delay in depositing the concrete, reinforcement shall be re-inspected and, when necessary, cleaned.

Reinforcement shall be carefully formed as indicated on the plans. Stirrups and tie bars shall be bent around a pin having a diameter of not less than three times the diameter of the bar. Except where specifically indicated otherwise on the plans, bends for other bars shall be made around a pin having a diameter of not less than six bars diameters. All bars shall be bent cold. Reinforcing steel shall not be bent or straightened in a manner that will injure the material. Bars with kinks or bends not shown on the plans shall not be used. Heating of bars will be permitted only when the Engineer approves the entire operation. Welding on any steel reinforcing bar is not permitted.

Reinforcing steel shall be positioned accurately and secured against displacement by using annealed iron wire or suitable clips at intersections and shall be supported by concrete chairs or spacers, or metal hangers.

In slabs, beams and girders, and walls subject to lateral pressure, splices of reinforcement shall not be at points of maximum stress without the express approval of the Engineer. Splices, where permitted, shall provide sufficient lap to transfer the stress between bars (bond and shear). Adjacent bars shall not be spliced at the same point. The minimum allowable lap at points of maximum stress shall be 30 times the diameter of the larger bar of the splice, but in no case shall the lap be less than 18 inches. Minimum allowable lap distances for masonry wall reinforcement shall be 40 times the diameter of the larger bar of the splice, but in no case less than 18 inches.

2.29 Form Material

2.29.01 Class I -- For permanently exposed concrete surfaces where architectural appearance is important, Class I forms shall be constructed with particular care to assure a high type of architectural finish of uniform texture free from visible irregular ties, patch marks and discoloration. Forms shall be of synthetic resin bonded plywood especially made for concrete work or non-warping hardboard. The entire surface shall be lightly sanded, if necessary.

2.29.02 Class II -- This class shall be used for unplastered interior of all rooms and for all surfaces in contact with water such as interior walls of channels and tanks. These forms shall be of hardboard, steel or waterproof synthetic resin bonded plywood specially made for concrete work.

The Contractor shall be permitted to use the most advantageous panel sizes and panel joint location. Class II forms for painted concrete surfaces shall be free of all surface imperfections. Neat patches and minor surface imperfections will be permitted in forms for unpainted concrete provided the finished surface conforms to the requirements specified hereunder.

2.29.03 Class III -- This class shall be used for formed surfaces not exposed to view such as footings, backfilled walls, and pipe trenches. These forms shall be of metal or smooth planed boards in good condition free from large or loose knots.

2.30 Form Construction

Exposed edges of concrete on the outside and inside of structures shall be chamfered or beveled at an angle of 45°, such bevel being 1 inch on a side. If so directed by the Engineer, however, the Contractor shall provide square edges for any portion of the work.

All dirt, chips, sawdust and other foreign matter shall be removed from within the forms before any concrete is deposited therein. Forms previously used shall be thoroughly cleaned of all dirt, mortar and foreign matter before being used. Before concrete is deposited within the forms, all inside surfaces of the forms shall be thoroughly coated with an approved, non-staining, form release agent which leaves no objectionable film on the surface of the forms that can be absorbed by the concrete.

Bolts, rods, or single wires shall preferably be used for internal ties and if so used shall be so arranged that when the forms are removed, no metal shall be within 1 inch of any surface. Twisted wire ties will not be permitted in the forms for any wall later to be subjected to water pressure. The Contractor shall take due precaution to prevent future leakage or seepage along ties used in all walls, which will be subjected to water pressure. Ties used in all such walls must be cut back into the face of the wall at least 1 inch and the resulting holes pointed up with 1:3 mortar.

Temporary openings shall be provided at the base of column and wall forms and at other points where necessary to facilitate cleaning and inspection immediately before depositing concrete.

Forms, bracing and shoring shall be kept in place until their removal is approved by the Engineer and in no case shall removal commence earlier than the following schedule:

Side of footings and raft ears	1 Day
Walls above ground	3 Days
Walls before ground	7 Days
Columns	10 Days
Slabs	14 Days
Beams	21 Days

Members subject to additional loads during construction shall be adequately re-shored to support both member and construction loads in a manner that will protect the member from damage or failure.

2.31 Finish of Formed Surfaces

All finished or formed surfaces shall conform accurately to the shape, alignment, grades and sections as shown on the plans or prescribed by the Engineer. Surfaces shall be free from fins, bulges, ridges, offsets, honeycombing, or roughness of any kind and shall present a finished, smooth, continuous hard surface. All sharp angles, where required, shall be rounded or beveled.

Where Class I forms are required, the surface of the concrete shall be given the following finish: After wetting the surface, a grout shall be rubbed in using a rubber float or burlap. The grout shall be made by mixing one part of cement and 1-1/2 parts of fine sand with sufficient water to give it the consistency of thick paint. After the grout hardens sufficiently, it shall be scraped from the surface with the edge of a steel trowel without disturbing the grout in the air holes. After further drying, the surface shall be rubbed with burlap to remove all surface grout. The entire surface shall be finished to secure a uniform texture.

2.32 Finish of Slabs

Where floors and flat roof surfaces are to be provided with drains, and on all exterior concrete floors, sidewalks, flat surfaces, the Contractor shall be particularly careful to provide an adequate slope to the drains or to suitable points of disposal. The direction of slope and the amount of crowning generally are shown on the plans otherwise they shall be subject to the approval of the Engineer.

2.32.01 Wood Float Finish -- The forms shall be completed with filled concrete with as little working as possible. All high or low spots exceeding ¼ inch in 10 feet shall be eliminated. The surface shall then be wood floated until it is smooth and free from blemishes.

2.32.02 Broom Finished -- Surfaces to receive a broom finish shall be wood floated as specified above, followed by steel troweling. After steel troweling and before initial set, the surface shall then be slightly roughened by means of a broom or burlap mat to produce an even textured surface finish.

2.33 Inserts

Where pipes, castings, or conduits are to pass through the walls, the Contractor shall place such pipes or castings in the forms before pouring the concrete, or in special cases, with the express consent and approval of the Engineer or as specified herein, he/she shall build approved boxes in the forms to make openings for subsequent insertion of such pipes, castings or conduits. To withstand water pressure and to insure water-tightness around the openings formed, the boxes or cores shall be provided with continuous keyways all the way around and shall have a slight flare to facilitate grouting and the escape of entrained air during grouting. The grout shall be a non-expansive Embeco grout or similar material and shall be mixed and placed in accordance with the manufacturer's instructions.

Additional reinforcement shall be provided around such openings to meet the approval of the Engineer. The space around pipes, castings, or conduits, as specified, shall be filled by pouring grout under a head of at least 4 inches. The grout shall be poured, rammed or joggled into place to fill complete space between the pipes, castings, or conduits, and the sides of the openings so as to obtain the same water-tightness as through the wall itself. The grouted castings shall then be water cured. The grouting material so placed shall be surfaced when the forms are removed to give a uniform appearance to the wall if such wall will be exposed to view.

The Contractor shall set accurately and hold in exact position in the forms until the concrete is poured and set, all gate frames, gate thimbles, special castings, channels, or other metal parts that are to be embedded in concrete, and he/she shall furnish and set accurately all inserts and anchor or other bolts necessary for the attaching of piping, valves, metal sash, and equipment. All nailing blocks, plugs, strips and the like necessary for the attachment of trim, finish and similar work and all wires suspending ceilings will be finished and placed by the Contractor.

2.34 Gunite

When the use of gunite is proposed, the Design Engineer shall submit his/her gunite design and specifications proposals to the Engineer for approval.

2.35 Pre-stressed Concrete

When the use of pre-stressed concrete is proposed, the Design Engineer shall submit his/her prestressed concrete design and specification proposal to the Engineer for approval.

2.36 Miscellaneous Concrete Mixes

Miscellaneous concrete mixes shall be used as listed below:

Use	28 Day Strength	Mix
Grout	3,000 psi min.	7 sacks with pea gravel
Mortar	1,800 psi min.	1 part cement, ¼ part lime putty, 3 parts sand
Grout for filling Masonry blocks & for bond beams	2,000 psi min.	1 part cement, 3 parts sand, 2 parts pea gravel

2.37 Cold Weather Requirements

Adequate equipment shall be provided for heating the concrete during freezing or near freezing weather. No frozen materials or materials containing ice shall be used.

All concrete materials and all reinforcement, forms, fillers and ground that the concrete is to come in contact with shall be free from ice and frost. Whenever the temperature of the surrounding air is below 40°F, all concrete placed in the forms shall have a temperature of between 70°F and 80°F and adequate means shall be provided for maintaining a temperature of between 50°F and 80°F during the curing period.

The housing, covering or other protection used in connection with curing shall remain in place and intact at least 24 hours after the artificial heating is discontinued. The use of salt or chemicals for the prevention of freezing is prohibited.

When heating of concrete materials is required, the mixing of water and aggregate shall be heated to not more than 90°F prior to being placed in the mixer so that the temperature of the mixed concrete shall not be less than 70°F and not more than 80°F. Aggregates shall be heated either by steam or by dry heat, and the heating apparatus shall be of a type which will heat the mass uniformly and in such a manner as to preclude the possible occurrence of over-heated areas, or hot spots, which will burn the material. Flame throwers or other similar direct heating devices will not be allowed.

2.38 Hot Weather Requirements

When ambient air temperature at the job site reaches 90°F or greater, proper attention shall be given ti ingredients, production methods, placing, protection and curing to prevent excessive concrete temperatures or water evaporation that may impair required strength or service ability of the concrete. Approved methods include cooling/shading of aggregate piles and water, use of shaved ice as a partial water replacement, and shading the concrete placement area. Under no circumstances shall concrete be placed when the concrete temperature has reached or exceeded 90°F or if the concrete has reached it's initial set. Retempering the concrete with additional water and mixing is not permitted. If shaved ice is used as a partial water replacement, it shall be fully melted at the time of mixing and the melt water shall be thoroughly mixed into the concrete mass. Pieces of unmelted ice or any frozen materials found in the concrete will be sufficient grounds for the rejection of the entire concrete batch. If the above recommended procedures are found to be insufficient in keeping the concrete temperature at or below 90°F, then the concrete placement shall be postponed until favorable weather conditions prevail.

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SECTION 3.0

PIPELINE MATERIALS AND INSTALLATION

3.1 General

This portion of the work shall include the furnishing and installation of all materials necessary to complete the water line installation in conformance with the Plans and Specifications, true to line and grade and free from leaks, cracks, and obstructions. Where choices are allowed, the Contractor shall select such materials and construction methods as will result in a satisfactory completed project. Materials and equipment used in the work shall be new and unused unless otherwise specified. In case a reference is not clear as to which of several grades is desired, the highest quality material shall be used. Materials and strength of pipe shall be as shown on the Plans. Unless two or more materials are approved as equals, the Contractor shall not substitute another material for the one specified.

3.2 Location Tape and Wire

3.2.01 Location Tape – Locating tape will have a metallic core and shall have a minimum thickness of 0.35 mils. The tape must have imprinted continuously over its length in permanent ink "CAUTION – WATER LINE BURIED BELOW." Maximum imprint length will be 36 inches per message. Location tape shall be a minimum of 2 inches wide and be highly visible, impervious to alkalis, chemical reagents, and solvents found in the soil. The tape will be installed 18 inches below finish grade directly above the pipe. The tape will run continuously down the length of the pipe with tape running laterally on all facilities attached to the pipeline.

3.2.02 Location Wire - Location wire will be 14 Ga. Coated copper and laid continuously with the pipe. The wire will be looped and secured around each joint and the adjacent valves. The wire will be laid parallel with pipe at all connecting points a 3M connector or approved equal will be used.

3.3 Excavation and Backfill

The Contractor is referred to Section 1.0, "Earthwork," of the Technical Specifications of these specifications.

3.4 Cement Mortar Lines and Coated Welded Steel Water Pipe

3.4.01 Materials - All welded steel pipe, cement lined and reinforced mortar coated shall be the Class noted on the Plans. The materials and workmanship in the manufacture of welded steel pipe cement lined and reinforced mortar coated shall conform to the provisions of the American Water Works Association (AWWA) Standard C-200 and C-205. The thickness of the steel cylinders shall be a minimum of No. 12 gage (.1046 inch).

3.4.02 Fabrication

(1) Pipe Dimensions

The diameter of pipe shown on the Plans refers to the net actual inside diameter, after lining. The pipe shall be manufactured in sections not less than 18 feet not more than 40 feet in length and having not more than one longitudinal welded seam per section, except where shorter lengths or more than one longitudinal seam are required by special conditions.

Pipe manufactured in sections of 20 feet or less in length shall have not more than one circumferential seam. Sections more than 20 feet in length but less than 30 feet in length shall not have more than two circumferential seams. Sections 30 feet or more in length shall not have more than three circumferential seams, except where it is necessary to increase the number of seams due to special conditions.

(2) Ends of Pipe Sections

All field joints shall be 0-ring, rubber-gasketed slip joints, except where welded or flanged joints are shown on the Plans. The pipe fabricator shall furnish a written certification and guarantee stating that the 0-ring, rubber-gasketed slip joints, when properly jointed in the field, have a safe working pressure equal to the safe working pressure for steel pipe of corresponding size and gage. One end of each section shall be swaged approximately 5 inches deep with a flare lip to form the bell. The spigot end shall be formed in such a manner as to assure perfect roundness of the ends with a groove of uniform dimensions.

(3) Flanges

Flanges shall be fabricated in accordance with AWWA Standard C-207.

(4) Plain Ends for Flexible Couplings

Both ends at coupling shall be square sheared before rolling or shall be cut square after fabrication. Use of cutting torches will not be permitted.

(5) Large Radius Curves

When horizontal and vertical, large radius curves are specified, slight deflections may be made with straight pipe, provided that the deflection shall not exceed the pipe manufacturer's recommendations for maximum deflection.

(6) Fabricated Fittings

All bends, ells, tees, crosses, reducers, and other special fittings, except as specifically noted to the contrary on the Plans, shall be constructed of cement mortar lined steel pipe with a reinforced mortar coating as specified for pipe mains and shall be fabricated at the plant for delivery and installation in the work in accordance with AWWA C-208.

A modified cut and fit installation in the field will be permitted, in which case a full-engineered pipe system will not be required. The modified cut and fit installation will consist of not more than one flexible coupling per fitting.

All other connections at a fitting shall be either flanged or “O-ring” gasketed to the connecting pipe or valve. All fittings shall be shop fabricated. Fabrication drawings shall be provided for all fittings and couplings. Protection of all inside joint recesses and outside joints shall be as hereinafter specified.

Flexible joints will consist of a ball joint with a telescoping capability. This fitting may be installed in the ground, in a vault or above the surface. Installation of the fitting and the type of fitting will be approved by the Engineer.

3.4.03 Hydrostatic Test -- All pipes shall undergo hydrostatic testing in accordance with the provisions of AWWA C-2000.

3.4.04 Inspection -- The Engineer or an authorized representative shall at all times have the right to inspect the work and materials in the course of manufacture. The manufacturer shall furnish the Engineer reasonable facilities for obtaining such information as may be desired regarding the progress and manner of the work and the character and quality of materials used.

3.4.05 Loading and Transporting Pipe -- After the pipe has been properly cured, it shall be loaded on trucks or railroad cars, adequately supported and chocked with sawdust bags or by other methods approved by the Engineer. During loading and unloading operations, the pipe shall be moved with slings of sufficient width to prevent damage to the exterior coating and in such a manner as to prevent injury to the cement mortar lining.

Unloading shall be accomplish in a workmanlike manner by the Contractor who lays the pipe, and every precaution shall be taken to prevent damage to the pipe. Under no circumstances are pipe sections to be dropped or bumped in handling.

3.4.06 Installation Procedures -- All welded steel pipe shall be installed in accordance with installation instructions furnished by the pipe manufacturer, and these instructions shall be closely and carefully followed by the Contractor. The pipe shall be laid true to line and grade and at the locations as indicated on the plans, and as herein specified.

(1) Lowering

Pipe shall be carefully lowered into the trench using suitable means that will prevent disturbing the prepared foundation or getting dirt inside the pipe or couplings. All pipes ends and coupling parts shall be thoroughly cleaned before final assembly of the joint. Rubber rings and couplings sleeves shall be installed in an approved and workmanlike manner.

(2) Lubricating

A specifically prepared non-toxic and water-soluble lubricant shall be applied to machined pipe ends just prior to installation of the couplings. Proper location of all rubber rings shall be checked by use of a suitable feeler gage at all points around the circumference of coupling ends.

(3) Capping

At all times when the work of installing pipe is not in progress, all openings into the pipe and the ends of the pipe in the trench shall be tightly closed to prevent entrance of animals and foreign materials. The Contractor shall take all necessary precautions to prevent the pipe from floating due to the water entering the trench from any source, shall assume full responsibility for any damage due to this cause, and shall, at his/her own expense, restore and replace the pipe to its specified condition and grade if it is displaced due to floating. The Contractor shall maintain the inside of the pipe free from foreign materials and in a clean and sanitary condition until its acceptance by the District.

(4) Inside Joint Recess

The inside joint recess shall be buttered with cement mortar in such a manner and in sufficient quantity to completely fill the space between the respective mortar linings. After the jointing is completed, the pipe interior shall be swabbed to remove all excess mortar by drawing an approved type swab or squeegee through the pipe. Mortar shall be as per AWWA C-602.

This procedure also applies to the inside joint recesses of all flexible couplings.

(5) Outside Joints

After the pipe has been installed, but before backfill has been completed, the exterior of the joint shall be completely mortared to a thickness at least that of the adjacent factory applied coating. Mortar shall be as per AWWA C-602.

The pipe manufacturer’s recommendations shall be followed in the fabrication of this joint.

All flexible couplings shall be coated in their entirety as outlined above.

(6) Flange Joints

Contractor shall furnish all necessary bolts and gaskets for flange joints and all other material for jointing specials, fittings and valves to pipe.

3.5 Asbestos Cement Pipe Water Lines, Couplings and Cast-Iron Fittings

3.5.01 General -- Asbestos cement pipe is not allowed for any new installations. It may be utilized for the repair of an existing asbestos cement pipe water line. The handling of asbestos cement pipe must follow the EPA/COSHA Regulations.

3.5.02 Materials -- All asbestos cement pipes shall be of the Class noted on the plans. The minimum class of asbestos cement water pipe shall be Class 150. Materials and workmanship in the manufacture of asbestos cement water pipe shall conform to the requirements of AWWA Standard C-400.

(1) Deflection

The couplings, rings, and ends of pipe sections shall be so manufactured that a deflection of five degrees (5°) may be obtained at each coupling.

(2) End Separation

Ends of pipe sections shall be so manufactured that in conjunction with couplings and rings they shall provide, when assembled, automatic separation of pipe ends.

(3) Pipe Ends

Asbestos cement pipe ends shall be of a design for which there is available, local stock, cast-iron fittings and gate valves having bells with sealing ring grooves of the same design as the ring groove of the couplings with which the pipe sections are joined.

(4) Fittings

All elbows, tees, crosses, reducers, and other special fittings in asbestos cement pipeline shall be rubber ring or bell end cast-iron fittings manufactured of tough gray cast-iron, in accordance with AWWA Standard C-110, free of all imperfections, with cement mortar lining for use with the class of pipe specified. All bolted fittings will be coated with Bitumastic or approved equal.

3.5.03 Shop Drawings -- Shop drawings of all pipe and fittings shall be submitted to the Engineer and shall be approved by him/her prior to fabrication of the pipe and fittings.

3.5.04 Installation Procedures -- All asbestos cement pipe shall be installed in accordance with installation instructions furnished by the pipe manufacturer and in accordance with AWWA standard C-603, and these instructions shall be closely and carefully followed by the Contractor.

The pipe shall be laid true to line and grade and at the location as indicated on the plans as herein specified.

3.5.05 Concrete Thrust Blocks and Pipe Encasements -- The Contractor is referred to Section 10.0, "Concrete Thrust Blocks and Blankets," of the Technical Specifications of these specifications.

3.5.06 Testing and Disinfection of Water Lines -- The Contractor is referred to Section 9.0, "Testing and Disinfection of Water Lines," of the Technical Specifications of these specifications.

3.6 Polyvinyl Chloride (PVC) Pipe Water Lines, Couplings and Cast-Iron Fittings

3.6.01 Materials -- All PVC pipe shall be of the Class shown on the Plans. The minimum class of PVC pipe shall be Class 150. Materials and workmanship in the manufacture of PVC pipe shall conform to the requirements of AWWA Standard C-900 and C-905. Standard lengths of PVC pipe shall be 20 feet.

(1) Deflection at Joints

Deflection couplings of the same class as the adjacent pipe shall be used on curvilinear alignments or where otherwise required.

(2) Large Radius Curves C-900

When Horizontal and Vertical Large Radius Curves are specified, slight deflections of (2.5°) up to 8" and (1°) 10" and up may be made with straight pipe.

(3) Ends of Pipe Sections

Joints shall be rubber-gasketed slip joints, unless otherwise shown on the Plans or where deflection joints are necessary.

(4) Fittings

All elbows, tees, crosses, reducers, and other special fittings in asbestos cement pipeline shall be rubber ring or bell end cast-iron fittings manufactured of tough gray cast-iron, in accordance with AWW Standard C-110, free of all imperfections, with cement mortar lining for use with the class of pipe specified. All bolted fittings will be coated with Bitumastic or approved equal.

3.6.02 Installation Procedures -- All PVC shall be installed in accordance with installation instructions furnished by the pipe manufacturer and according to AWWA Manual M23, PVC Pipe-Design and Installation.

3.6.03 Concrete Thrust Blocks and Pipe Encasements -- The Contractor is referred to Section 10.0, "Concrete Thrust Blocks and Blankets," of the Technical Specifications of these specifications.

3.6.04 Testing and Disinfection of Water Lines -- The Contractor is referred to Section 9.0, "Testing and Disinfection of Water Lines," of the Technical Specifications of these specifications.

3.6.05 End of the Line, Cross and Tee -- All pipeline installations that have an ending point with out connecting to an existing pipeline will have a fitting (tee or cross), isolation valve, a 5' long length of pipe stubbed out, end cap and a thrust block installed. The 5' section of pipe will allow for future tie-ins to the system. All pipelines with the possibility for future connections will require installation of pipe and fitting restraints 100' before the end of the line including the tee or cross and isolation valve.

3.6.06 Tie-In's -- All tie-in's will be scheduled with the inspector or with an authorized District Employee. If the tie-in requires the existing water system to be shut-down the contractor will be required to complete the tie-in to the water system in a timely manner, not to exceed 8 hours. If more time is needed, special arrangements must be made with the system supervisor. If there are fittings that require thrust blocks to harden before the system can be brought back on line the contractor must make arrangements to install a temporary thrust system to prevent fitting from moving until the concrete hardens. All temporary mechanical type restraints will require approval by the district engineer or his representative before tie-in can be scheduled.

3.6.07 Tie-In Fittings -- If the tie-in point is at an AC type fitting the contractor will install a Newby transition rubber or approved equal to transition from C900 or Ductile iron pipe to the AC fitting. If the tie-in point is at a section of AC pipe the contractor will use a 10" long JCM "Optimum Range Coupling" or an approved equal. If the tie-in point is at a section of C900 to C900 the contractor will use a 12" long Tyler/Union coupling or a C900 repair coupling or an approved equal.

All in line push on type Bell reducers will be restrained on both sides of the fitting with pipe restraints.

3.6.08 Backfill Stabilizer -- Backfill stabilizers will be installed for all slopes with 16 degree fall or greater. The number of stabilizers require for a project will be determined by the engineer and will take into consideration the length and degree fall on a particular slope. The stabilizer will be installed in undisturbed soil with #4 re-bar framework as shown on drawing H-18.

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SECTION 4.0

FIRE HYDRANT ASSEMBLIES

4.1 General

Fire hydrant assemblies shall be as called for on Standard Drawings No. H-2A and H-2B and as specified in the other applicable sections of these specifications.

Fire hydrants shall be Mueller or approved equal only and shall be the post-type dry-barrel type conforming to the Standard for Dry-Barrel Fire Hydrants (AWWA C502). An Affidavit of Compliance may be required from the manufacturer to the effect that the materials furnished under the purchaser's order comply with all applicable requirements of this standard.

Fire hydrants shall have a 6-inch inlet connection with a minimum 5-1/2 inch I.D. compression type main valve, 1-1/2 inch pentagon nut that turns to the left (counter clockwise) to open, and 0-ring stem seals. Type "B" fire hydrants shall be equipped with one 4-inch California Standard thread pumper outlet and two 2-1/2 inch National Standard hose thread outlets. Hose nozzles shall be threaded in type and retained with a setscrew. Caulked or leaded nozzles are not acceptable. Outlet nozzles shall be provided with outlet caps and caps shall be securely chained to the hydrant barrel with a metal chain as specified in AWWA C502. Hydrants shall be traffic models with suitable bolted or 3'x3'x6" nonslip concrete pad installed around the base of the break away to insure that no lateral movement occurs when hit, that causes fractures on impact without flooding, provided near the ground level. The bonnet shall be dry top and factory packed with grease, oil reservoir or equal. Hydrants shall have a bronze drain way with two drain holes to adequately drain the barrel when the hydrant is closed, and said drain opening shall be capable of accepting a tapered, self-tapping screwed plug for the purpose of either slowing or stopping the drain stream flow when the hydrant is in a partially opened position 1 cubic foot of gravel shall be placed around each drain hole to facilitate drainage. All working parts including the main valve and seat ring shall be removable through the tope of the hydrant without necessity of excavation.

The manufacturer's warranty for the hydrants shall be required prior to approval of their use.

4.2 Excavation and Backfill

The Contractor is referred to Section 1.0, "Earthwork," of the Technical Specifications of these specifications.

4.3 Painting

All fire hydrants shall be surface prepared to receive paint by scraping and wire brushing, and shall be painted with one (1) coat of surface primer and two (2) coats of finish paint. The paint shall be 215958 single application Heavy Duty Rust Inhibitive Red Primer and 215950 single application Safety Yellow Finish coat, as manufactured by Rust-Oleum, or approved equal paint system using compatible primer and finish supplied by one manufacturer.

SPECIAL DISTRICTS DEPARTMENT
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SECTION 5.0

FLUSH-OUT AND BLOWOFF ASSEMBLIES

5.1 Flush-Outs

Flush-out assemblies shall be as called for on the Special District's Standard Drawing No. H-7A, and H-7B and as specified in other applicable sections of these specifications.

Flush-outs shall be constructed in the size and at the locations shown on the plans.

5.2 Excavation and Backfill

The Contractor is referred to Section 1.0, "Earthwork," of the Technical Specifications of these specifications.

5.3 Blowoffs

Blowoff assemblies shall be as called for on Standard Drawing No. H-7A and H-7B and as specified in the other applicable sections of these specifications.

Blowoffs shall be constructed in the size and at the locations shown on the plans.

5.4 Protective Coatings

All portions of flush-out and blowoff pipe and appurtenances extending above finished grade shall be surface prepared to receive paint by scraping and wire brushing, and shall be painted with one (1) coat of surface primer and two (2) coats of finish paint. The paint shall be 215958 single application Heavy Duty Rust Inhibitive Red Primer and 215950 single application Safety Yellow finish coat as manufactured by Rust-Oleum, or approved equal paint system using compatible primer and finish supplied by one manufacturer. All flush out and blowoff pipe below grade shall be standard steel or galvanized pipe (Schedule 40), asphalt coated.

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SECTION 6.0

VALVES, VALVE BOXES AND COVERS

6.1 Gate Valves

Gate valves shall be iron-body Mueller valves or approved equal only, resilient-seated gate valves with non-rising stem and 0-ring seals. Gate valves shall conform to the Standard Specifications for gate valves, 3 inches through 12 inches, for water and other liquids (AWWA C-509) of the American Water Works Associations.

An Affidavit of compliance may be required from the manufacturer to the effect that the materials furnished under the purchaser's order comply with all applicable requirements of this standard.

Valves shall be designed to operate for cold water service with up to 200 psi working pressure on either side of the valve.

Underground valves shall be fitted with 2 inch operating bolts and exposed valves shall be furnished with handwheels. All valves shall turn to the left (counter clockwise) to open the valve.

All internal parts shall be accessible without removing the main body from the pressure line. All ferrous metal internal parts shall be epoxy coated with a factory applied corrosion resistant coating of at least 4-mil thickness conforming to AWWA Standard C-550.

6.2 Butterfly Valves

Butterfly valves for use on larger diameter mains shall be of the Class 150B rubber-seated tight closing type. They shall meet or exceed the requirements of AWWA Standard C-504. Valve body shall be high strength cast-iron ASTM A126 Class B. Shaft seals shall be 0-ring type.

An Affidavit of Compliance may be required from the manufacturer to the effect that the materials furnished under the purchaser's order comply with all applicable requirements of this standard.

Underground valves shall be fitting with 2 inch operating nuts and exposed valves shall be furnished with handwheels. All valves shall turn to the left (counter clockwise) to open the valve.

6.3 Excavation and Backfill

The Contractor is referred to Section 1.0, "Earthwork," of the Technical Specifications of these specifications.

6.4 Valve Ends

The valve ends shall be of the type shown on the plans. Valves with welding ends will not be permitted for use in welded steel lines.

6.5 Valve Boxes and Covers

Valve boxes shall be provided for all valves which are set in the ground and shall extend to a point flush with the finished or established ground or paved surface. Valve boxes covers shall be as manufactured by Alhambra Foundry, No. A-29606, or approved equal.

The valve box shall be adjustable and shall consist of a 6-5/8 inch by 18 inch steel (10 gage) valve box top with a cast-iron cover that extends into the valve box top. The bottom sections shall be 6-inch SDR35 pipe and be of varying length to meet field conditions.

Where valve operating nuts are more than 60 inches below finish surface, the Contractor shall install a valve extension stem either of standard manufacture or shop fabricated, which shall bring the operating nut to within 12 inches of the surface. The extension stem shall be made of solid round steel bar of diameter equal to the valve stem diameter with a minimum of 1-inch diameter or extra heavy steel pipe of a minimum of 1-1/4 each inside diameter. The stem extension shall have a round disc dirt shield guide made of ¼ inch minimum thickness solid steel plate having a diameter approximately ½ inch less than the valve cover inside diameter which will allow smooth stem operation.

Installation of the valve box and cover shall conform to Standard Drawing No. H-11 and to other applicable drawings.

(1) Nameplate

The nameplate on each and every valve box cover shall read as follows: “WATER”

SPECIAL DISTRICTS DEPARTMENT
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SECTION 7.0

WATER SERVICES

7.1 General

Where the District requires the Contractor to install water services, the Contractor shall furnish and install the materials in accordance with the standards herein. Services shall be installed at the locations shown on the plans, at right angles to the centerline of the main, and shall be spaced a minimum of 10 feet from any sewer lateral. No services will be permitted in driveway areas.

All pipes, valves and fittings shall have a minimum working pressure rating of 200 pounds per square inch. Pipe ends, where joining special fittings, compression for adaptation to copper tube couplings.

Water service connections shall be installed in conformance with Standard Drawings No. H-4A, H-4B, H-5, H-10, H-13 and H-14 and other applicable Standard Drawings.

Fire detector check valve assemblies (Std. Dwg. No. H-5) shall be used for services requiring sprinkler systems or other privately owned fire protection systems.

A backflow prevention device (Std. Dwg No. H-13 or H-14) shall be required if it is determined by the District that the type of occupancy could impose a health hazard.

7.2 Earthwork

The Contractor is referred to Section 1.0, "Earthwork," of the Technical Specifications of these specifications.

7.3 Plastic Water Service Tubing

All plastic water service tubing shall be manufactured by extrusion from virgin plastic compound, Type III, Grade P34, Class C Polyethylene Resin (PE3408) as defined by ASTM D 2737.

Extruded tubing shall have a Standard Dimension Ratio (SDR) of 9. All service tubing shall be rated for use with water at 73.4°F at a minimum hydrostatic design stress of 1,250 psi.

All service tubing delivered to the job site shall be clearly marked at intervals of not more than 2 feet with the following information: nominal size tubing, type of material, SDR, pressure rating, ASTM designation, manufacturer's trade name and production code and seal of approval of an accredited testing laboratory.

All plastic tubing shall be Driscoplex 5100 Ultra-Line "CTS" Poly Tube (200 PSI working pressure)

7.4 Angle Meter Stops

All 1-inch angle meter stops shall be Mueller only, H-14250 or approved equal.

All 1-1/2 inch and 2 inch angle meter stops shall be flanged Mueller H-14276 or approved equal.

7.5 Corporation Stops

All corporation stops shall be Mueller H-15000 or H-15025 or approved equal.

7.6 Service Saddles

All service saddles for asbestos cement pipe shall be Mueller A-16100 BR1B and solid bronze or approved equal.

All service saddles for AWWA C900 PVC pipe shall be BR1B Mueller only and solid bronze or approved equal.

Service saddles used on cement mortar lined and coated steel pipe shall be Rockwell 362 or approved equal.

7.7 Meter Box

Meter boxes shall be Brooks Products Poly Plastics No. 1419 with snap-lid or No. 3 concrete box used only in concrete and asphalt applications and lid for ¾ inch services; No. 1320 or No. 37 for 1 inch services; and No. 1730 or No. 66 for 1-1/2 inch to 2 inch services; or approved equal.

7.8 Main Pipeline Hot Tap

Size on taps require a 5-piece, cast iron sleeve with mechanical joint ends per Mueller H-615 and H-616. All other will use 622 smith & Blair apoxy coated or approved equal.

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SECTION 8.0

AIR AND VACUUM AND AIR RELEASE ASSEMBLIES

8.1 General

The air and vacuum valve, air release valve, valves, unions, piping, vault, vault lid, and other appurtenances shall be as called for on Standard Drawing No. H-6 "Air and Vacuum Valve Assembly", and other applicable Standard Drawings. Installations shall be made at the locations shown on the plans.

8.2 Earthwork

The Contractor is referred to Section 1.0, "Earthwork," of the Technical Specifications of these specifications.

8.3 Plastic Water Service Tubing

All plastic water service tubing shall be manufactured by extrusion from virgin plastic compound, Type III, Grade P34, Class C, Polyethylene Resin (PE3408) as defined by ASTM D 2737.

Extruded tubing shall have a Standard Dimension Ratio (SDR) of 9. All service tubing shall be rated for use with water at 73.4°F at a minimum hydrostatic design stress of 1,250 psi.

All service tubing delivered to the job site shall be clearly marked at intervals of not more than 2 feet with the following information: nominal size tubing, type of material, SDR, pressure rating, ASTM designation, manufacturer's trade name and production code and seal of approval of an accredited testing laboratory.

All plastic tubing shall be Drisco CTS Poly or approved equal.

8.4 Corporation Stops

All corporation stops shall be Mueller H-15020 or H-15045 or approved equal.

8.5 Curb Valves

All curb valves shall be Mueller H-15175 or approved equal.

8.6 Air and Vacuum Valves

All air and vacuum valves shall be Apco Series 140, 1 inch 140, 2 inch 142, Crispin Type AL, or approved equal.

8.7 Air Release Valves

All air release valves (compound level) shall be Crispin Type PL, Apco Series 200, 1 inch 200A, 2 inch 200, or approved equal.

8.8 Air and Vacuum Combination Valves

All air and vacuum combination valves shall be Crispin UL Apco Heavy duty Combination Air Release Valve, 1 inch 143C, 2 inch 145C, or approved equal.

8.9 Meter Box and Lid

All meter boxes and lids shall be AEP 1015/T-26 lid or approved equal. The meter box size shall be adequate to contain and allow room to service all valves and appurtenances contained herein.

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SECTION 9.0

TESTING AND DISINFECTION OF WATER LINES

9.1 General

It is the intent of the Plans and Specifications that the completed water pipes, blowoffs, flush-outs, hydrants and other appurtenances shall be water tight and clean.

9.2 Testing

Pressure and leakage tests shall be performed in accordance with AWWA C603 except as herein modified.

Separate tests shall be performed for structural and leakage. After trenches are backfilled and compacted, the pipelines shall be subjected to a structural hydrostatic pressure test of 50 pounds per square inch in excess of the allowable working pressure for the class of pipe to be tested for a period of two hours. Any noticeable leaks shall be stopped on any defective pipe shall be repaired and replaced with new sections and re-tested as specified above.

All labor, material and equipment for test shall be furnished by the Contractor. Water for the test shall be furnished by the Contractor.

9.3 Disinfection of water Mains

Before being placed in service, each portion of the line shall be disinfected in accordance with the American Water Works Association Standard for Disinfecting Water Mains, AWWA C651.

SPECIAL DISTRICTS DEPARTMENT
COUNTY OF SAN BERNARDINO
TECHNICAL SPECIFICATIONS

SECTION 10.0

CONCRETE THRUST BLOCKS, RESTRAINTS AND BLANKETS

10.1 General

Concrete thrust blocks shall be installed in accordance with Standard Drawings No. H-3A and H3-B. Restraints shall be installed as required by District per Standard Drawings No. H-3C and H3-D. Blankets shall be installed per standard H-12 at the locations on the plans and in conformance with these specifications.

10.1.01 Plastic Wrap -- All fittings to be wrapped in 10 mil plastic or approved equal when in contact with concrete thrust block.

10.1.02 Bearing Area -- Bearing area may vary with soil type, sandy/loss soil will require larger bearing area.

10.2 Concrete Blanket

10.2.01 General -- Concrete blanket shall be constructed at the locations shown on the plans and in accordance with Standard Drawing No. H-12. Concrete shall be of Class IV Portland Cement concrete, containing not less than five sacks of Portland cement per cubic yard.

10.2.02 Blanket Type -- A Type I blanket is to be used in a location where the pipe is to be protected from surcharge and wheel loadings.

A Type II blanket is to be used at locations where the pipe installation is to be protected from erosion due to the flow of water over the pipe.

SPECIAL DISTRICTS DEPARTMENT
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SECTION 11.0

CHAIN LINK FENCE AND GATE

11.01 General

The Contractor shall furnish and install the chain link fencing as shown and specified; replace chain link or barbed wire fencing damaged by his operations. All fencing materials shall be hot-dip galvanized. Fencing shall be topped with 3 lines of barbed wire unless otherwise shown. Fencing shall be 7 feet high unless otherwise shown.

11.02 Materials

(a) Fabric shall be No. 9 gage galvanized steel wire, 2-inch mesh.

(b) Fabric ties shall be No. 9 gage galvanized steel wire, spaced 14 inches apart on posts and 24 inches apart on rails. Aluminum ties will not be permitted. A continuous No. 7 gage galvanized steel wire shall be interlaced with the fabric or attached to the fabric with clips along the extreme bottom of the fence, and shall be pulled taut.

(c) Line post shall be standard weight 2-1/2-inch OD pipe, 3.65 lbs. per foot.

(d) End and corner post shall be 3-inch OD pipe, 5.79 lbs. per foot.

(e) Gate posts shall be made from 4-inch OD pipe, 9.1 lbs. per foot.

(f) Top rail braces shall be made from 1-5/8 inch OD pipe, 2.27 lbs. per foot.

(g) Barbed wire shall be 2-stnd, 4-point pattern, 12-1/2 gage galvanized steel or iron wire with barbs spaced 5-inches apart, conforming to ASTM A-121.

(h) Nuts, bolts, and screws shall be galvanized steel, minimum size 3/8-inch diameter.

(i) Swing gate frames, if any, shall be constructed of pipe at least as heavy as the top rails for the fence and shall be fabricated by welding. Each gate leaf shall be provided with at least one diagonal brace. Frames shall be galvanized after fabrication. Galvanized malleable iron fittings for latching the gate shall be provided. Fabric shall match the fabric used in the fence. Each pair of gates shall be provided with a heavy drop rod latch assembly with a locking device for a padlock (see the detailed drawings for both the fence and gate).

(j) Concrete shall have a minimum compressive strength of 2,000 psi at the age of 28 days.

11.03 Installation

(a) Post shall be set plumb and shall be centered in concrete encasement. The top surfaces of the concrete encasement shall be sloped outward to shed water and shall have a neat appearance.
Line posts shall be spaced not more than 100 feet apart and shall be set in the ground to a depth of 36 inches. Post shall be set in concrete bases not less than 10 inches in diameter.

(b) Bracing shall be provided at all ends, gate, and corner posts, the latter in both directions. Horizontal brace rails shall be set midway between top rail and ground running from the corner, end or gate post to first line post. Diagonal tension members shall connect tautly between posts below horizontal braces.

(c) Any galvanized coating damaged during construction of the fencing shall be repaired by application of molten Galvo-Weld, Galvonox, or equal.

(d) For additional requirements see the standard detail drawings H-19 (Fence) and H-20 (Gate).

ATTACHMENT A – SUPPLEMENTARY SPECIAL PROVISIONS

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The following Supplementary Special Provisions (SSP) modifies the following documents:

i. County of San Bernardino Special Districts Department, Division "F" Design Criteria and Plan Preparation (2020)
ii. County of San Bernardino Special Districts Department, Division "G" Technical Specifications (2020)

Division "F"
Design Criteria and Plan Preparation
Water

Section 1.7 – Transmission and Distribution Mains

For the County Standards for Domestic Water Systems, REPLACE the following:

1.7.07 Looped Lines and Flushouts -- Looped lines shall be provided where practical. Where dead ends are necessary, provisions for flushing shall be included. No flushing device shall be connected directly to a sewer. Flushout assembly and size shall conform to Standard Drawing No. H-8A**, for AC and PVC mains**. Blowoff assemblies shall be utilized on pipelines greater than or equal to 24 inches in diameter.

For the County Standards for Domestic Water Systems, REPLACE the following:

Fire hydrants may be used for flushout, where applicable, and upon approval by the District.

1.7.13 Thrust Blocks -- Concrete thrust blocks shall be installed as required according to Standard Drawing H-3A and **H-3B** herein. Where circumstances prevent the use of standard thrust blocks, special thrust restraint design shall require District approval.

Division "G"
Technical Specifications
Water

Section 2.0 – Concrete Construction

For the County Standards for Domestic Water Systems, REPLACE the following:

2.38 Hot Weather Requirements

When ambient air temperature at the job site reaches 90°F or greater, proper attention shall be given **to** ingredients, production methods, placing, protection and curing to prevent excessive concrete temperatures or water evaporation that may impair required strength or service ability of the concrete. Approved methods include cooling/shading of aggregate piles and water, use of shaved ice as a partial water replacement, and shading the concrete placement area. Under no circumstances shall concrete be placed when the concrete temperature has reached or exceeded 90°F or if the concrete has reached it's initial set. Retempering the concrete with additional water and mixing is not permitted. If shaved ice is used as a partial water replacement, it shall be fully melted at the time of mixing and the melt water shall be thoroughly mixed into the concrete mass. Pieces of unmelted ice or any frozen materials found in the concrete will be sufficient grounds for the rejection of the entire concrete batch. If the above recommended procedures are found to be insufficient in keeping the concrete temperature at or below 90°F, then the concrete placement shall be postponed until favorable weather conditions prevail.

For the County Standards for Domestic Water Systems, ADD the following Supplementary Special Provisions (SSP):

Section 1.0 - Factory Powder Coated Bolted Steel Tank

Section 2.0 - Temporary Polyethylene Storage Tank

Section 3.0 – Summary of Work

Section 4.0 – Mobilization

Section 5.0 – Electrical

Section 6.0 – Site Selective Demolition

Section 7.0 – Utility Piping

SECTION 1.0

BOLTED STEEL TANK

PART 1 - GENERAL

1.1 DESCRIPTION

This specification is for furnishing and erecting a new bolted steel water storage tank with 0.139 MG operational capacity in accordance with AWWA Standard D103-09 except as may be modified herein. The requirements specified in the conditions of the contract, Special Conditions and the Technical Specifications apply to this section as fully as if repeated herein.

1.2 BASIC REQUIREMENT

GENERAL: The Contractor shall furnish, erect, and chlorinate a new bolted steel water storage tank with 0.139 MG of operational capacity and specific appurtenances; including reinforced concrete ring-wall foundation (designed by Tank Supplier), Class 2 base with Oil-Sand foundation; furnishing all labor, materials, equipment, and methods, excepting all labor, materials, equipment, and methods specifically stated as being furnished by others, in order to provide the Owner with a complete, correctly erected water storage tank with specified appurtenances, in accordance with these Technical Specifications and Drawings. Contractor shall be required to meet all applicable provisions of AWWA Standard D103-09 for bolted steel water storage tank.

STEEL PLATES: All steel plate furnished under these specifications, utilized to erect the new steel tank, shall be “prime” quality material manufactured by an approved steel mill. All steel plate furnished shall be accompanied by mill certificates prepared by the manufacturer.

RADIOGRAPHIC TESTING: Not Applicable.

QUALIFICATIONS: The Contractor shall be responsible for the selection of factory applied bolted steel water storage tank construction for this facility which has been predicated upon specific criteria, construction methods, and an optimum coating for resistance to internal and external tank corrosion. Deviations from the specified design, construction or coating details, as described in this specification, will not be permitted.

The Contractor shall provide a new tank structure as supplied from a manufacturer specializing in the design, fabrication and erection of factory fabricated bolted steel water storage tanks.

All contract construction shall be by an organization which has had not less than five (5) years successful experience in the fabrication and construction of bolted steel water storage tanks, and the organization must provide references of work, and statement of qualifications in the state of California.

The Contractor shall follow strict adherence to the standards of design, fabrication, erection, product quality, and long-term performance established in this Specification.

STANDARDS: The Contractor shall be responsible for the materials, design, fabrication and erection of the bolted steel water storage tank, which shall conform to the AWWA Standard for "Factory-Coated Bolted Steel Tanks for Water Storage" - ANSI/AWWA D103-09.

The tank coating system shall be a thermoset powder coating conforming solely to Section 12.6 of ANSI/AWWA D103-09.

All materials furnished by the tank manufacturer, which are in contact with the stored water shall be certified and listed by the National Sanitation Foundation (NSF) to meet ANSI/NSF Additives Standard No. 61. Certification of a coating type alone will not be sufficient to meet this requirement.

1.3 SHOP DRAWINGS AND SUBMITTALS

GENERAL: Contractor shall, within thirty (30) calendar days from the "Notice of Award" of Contract, submit to the Owner for approval, prior to commencing construction:

1. Complete detailed drawings of the tank showing connection details, appurtenances details, dimensions, thicknesses, gauges, materials, finishes, joint attachment and erection procedures and other pertinent data; the tank manufacturer's standard published warranty; and the tank manufacturer’s standard Operation and Maintenance Manual.

2. The complete design calculations required in the Special Conditions herein. All submittals shall include both completed design calculations and complete drawings of the tank, tank appurtenances, tank concrete hold down ring, tank foundation grade beams, all

submitted together and signed by a civil engineer registered in the State of California.

3. Submittals shall verify compliance with the Contract Documents, and shall include drawings and descriptive information in sufficient detail to show the kind, size, arrangement, and the operation of component materials and devices; the external connections, anchorages, and supports required; the performance characteristics and dimensions needed for installation and correlation with other materials and equipment. When an item consists of components from several sources, Contractor's initial submittal shall be complete including all components.

4. All submittals, regardless of origin, shall be stamped with the approval of Contractor and identified with the name and number of this Contract, Contractor's name, and reference to applicable specification paragraphs and Contract Drawings. Each submittal shall indicate the intended use of the item in the Work. When catalog pages are submitted, applicable items shall be clearly identified and inapplicable data crossed out. The current revision, issue number, and date shall be indicated on all drawings and other descriptive data.

5. Contractor shall be solely responsible for the completeness of each submittal. Contractor's stamp of approval is a representation to Engineer that Contractor accepts sole responsibility for determining and verifying all quantities, dimensions, field construction criteria, materials, catalog numbers, and similar data, and that Contractor has reviewed and coordinated each submittal with the requirements of the Work and the Contract Documents.

6. Each drawing and the necessary data shall be submitted to Engineer. Engineer will one marked reproducible copy to Contractor. Engineer will not accept submittals from anyone but Contractor. Submittals shall be consecutively numbered in direct sequence of submittal and without division by subcontracts or trades. Shop drawings shall be submitted with promptness and in an orderly sequence so as to cause no delay in prosecution of the work.

7. Contractor shall accept full responsibility for the completeness of each resubmittal. Contractor shall verify that all corrected data and

additional information previously requested by Engineer are provided on the resubmittal.

USE OF COMPUTER PROGRAMS: Should the Contractor use a computer program for the said design calculations, the output shall be of a form that easily facilitates checking (i.e. intermediate steps in each calculation shall be provided). Computer output with the selected design members only will not be acceptable.

ADDITIONAL REQUIRED SUBMITTALS: In addition to the tank shop drawings and calculations, Contractor shall submit to the Owner for approval, within the time-frame outlined above, the following data concerning this contract:

1. Mix design for the oil-sand mixture, including certified aggregate sieve analysis, certified asphalt test data, percentage of asphalt, etc.

2. Concrete mix design and take-off for reinforcing bar requirements, including concrete forming.

3. Certified sieve analysis of Class II base material.

4. Foundation and reinforced concrete design shall be submitted and signed and stamped by a registered professional engineer in the state of California.

5. Mill certification shall be provided by tank manufacturer that the specified material alloys, sizes and quantities shall be furnished and shall be submitted per Section 01 33 00.

6. Fiberboard material 1-inch for space between ringwall and tank bottom. Also, high strength, non-shrink grout, detail and methodology for proposed grouting.

7. Provide shop coating data sheets and procedures. Include color charts (3) for Owner selection of exterior color.

CONTRACTOR RESPONSIBILITY: The Owner's approval of the Contractor's submittal shall not relieve the Contractor from having the entire responsibility for the correctness of details and dimensions. The Contractor shall assume all responsibility and risk for misfits due to any errors in the Contractor's submittal data.

DEVIATIONS: All deviations from the Contract Documents shall be identified as deviations on each submittal and shall be tabulated in Contractor's letter of transmittal. Such submittals shall, as pertinent to the deviation, indicate essential details of all changes proposed by Contractor (including modifications to other facilities that may be a result of the deviation) and all required piping.

COMMENCEMENT OF WORK: No portion of the work requiring a shop drawing submittal shall be commenced until the submittal has been reviewed by the Engineer and returned to the Contractor with a notation indicating that resubmittal is not required.

ENGINEER'S REVIEW:

1. Engineer's review of submittals covers only general conformity to the Drawings and Specifications, external connections, and dimensions that affect the layout; it does not indicate thorough review of all dimensions, quantities, and details of the material, equipment, device, or item covered.

2. Engineer's review shall not relieve Contractor of sole responsibility for errors, omissions, or deviations in the drawings and data, nor of Contractor's sole responsibility for compliance with the Contract Documents.

3. Engineer's submittal review period will be fifteen (15) consecutive number of calendar days and shall commence on the first calendar day following receipt of the submittal or resubmittal.

RESUBMITTALS:

1. When corrected copies are resubmitted, Contractor shall direct specific attention to all revisions in writing and shall list separately any revisions made other than those called for by Engineer on previous submittals. Requirements specified for initial submittals shall also apply to resubmittals. Resubmittals shall bear the number of the first submittal followed by a letter or point number decimal (A, B, etc, or 2.1, 2.2, etc).

2. If more than one resubmittal is required because of failure of Contractor to provide all previously requested corrected data or additional information, Contractor shall reimburse Owner for the

charges of Engineer for review of the additional resubmittals. This does not include initial submittal data such as shop tests and field tests that are submitted after initial submittal.

3. When resubmittals are needed, resubmittals shall be made within fifteen (15) days of the date on the letter returning the material to be modified or corrected as required; unless within the number of days, as required, Contractor submits an acceptable request for an extension of time, listing the reasons why the resubmittal cannot be completed within the stipulated time.

4. The need for more than one resubmittal, or any other delay in obtaining Engineer's review of submittals, will not entitle Contractor to extension of the Contract Times for completion unless delay of the Work is the direct result of a change in the Work authorized by a Change Order or failure of Engineer to review and return any submittal to Contractor within the specified review period.

PART 2 PRODUCTS

2.1 WATER STORAGE TANK DATA

For tank design dimensions and elevations, refer to the construction plan sheets.

2.2 WATER STORAGE TANK DESIGN

DESIGN CONDITIONS: The use of high strength steel having a tensile strength greater than 60,000 psi shall not be used. Water storage tank shells shall be designed per Section 5 of AWWA D103-09; however, allowable hydro-static hoop stress (f_t) for design shall not exceed 20,000 psi. Contractor shall provide Owner with fully executed Compliance Certification in accordance with AWWA D103-09.

1. The coldest 1-day mean ambient temperature, for purposes of design, will be 5° F or warmer. Therefore, Design Metal Temperature (DMT) shall be +20° F per AWWA D103-09. No additional thickness for corrosion will be required.

SEISMIC: The seismic calculations shall be based upon AWWA D103-09, Section 14; except as modified herein. The tank shall be checked for overturning moment, shell compression force, hydrodynamic seismic hoop stresses and

other seismic checks required by the standard. The tank shall be a flat-bottom tank having a 1-percent minimum rise to the center point radially from the circumference. The tank shall be anchored. The following criteria and coefficients shall apply in the seismic calculations.

1. Seismic Important Factor: (I_E) = 1.50

2. Seismic Use Group: III

3. Soil Site Class B Rock

No reduction for "I_E" (Seismic Importance Factor) shall be allowed. A vertical acceleration value of 0.35g shall be considered for the tank seismic design in combination with horizontal acceleration for hydro-dynamic hoop stress of individual structural members. Pressure stability shall not be utilized for shell buckling stress calculations or for seismic loading.

WIND LOADING: The Contractor shall design the water storage tank, with respect to wind loading, in accordance with AWWA D103-09, the California Building Code, latest edition, and San Bernardino County requirements; and the highest and most stringent requirement shall govern.

ROOF LOADING: Roof design live load (snow) shall be 75 p.s.f.

RAFTER SPACING: 6.28 feet (maximum). Provide 3/4 inch diameter tie-rods between rafters.

COLUMNS: Columns shall be tubular sections of 6-inch minimum diameter standard steel pipe or greater, if structural calculations so indicate. Center column shall be provided with a reinforced concrete footing (minimum 3-feet square by 2-feet deep) with reinforced concrete pile. Provide design calculations and submittal.

CENTER COLUMN CAP PLATE: The center column cap plate(s) shall be of the "dollar plate" type, designed in accordance with Load Case #22, pg. 223 from "formulas for Stress and Strain", 4th edition, by Raymond J. Roark or equivalent as approved by Engineer. The maximum allowable bending stress shall be 20,000 psi.

BUCKLING: The Contractor shall perform buckling calculations with respect to wind loading requirements stated herein, in accordance with AWWA D103-09, with the safety factor incorporated therein. In addition, the Contractor shall perform

buckling calculations, with respect to seismic loading requirements stated herein, and per AWWA D103-09 with pressure stability not considered.

General shell buckling shall be determined in accordance with the latest edition of AWWA D103 section 14.3.

ALLOWABLE TENSION: Allowable tension (f_t) shall be per AWWA D103-09 with the exception that f_t shall not exceed 20,000 psi.

TANK SHELL THICKNESS: For the static condition, the tank shell thickness stressed by pressure of the tank contents shall be computed per the formula set forth in AWWA D103-09 Sec. 5.4, "Tank Shell". For the hydrodynamic condition, seismic hoop tensile stresses shall be determined per Section 14 for the specified horizontal and vertical design accelerations.

1. Minimum bottom shell course thickness shall be 3/16-inches (0.1875 inches); or greater where dictated by structural calculations.

2. Maximum shell height is 27 feet. Minimum shell thickness shall be 10 ga. Shell thicknesses shall be greater than these minimum requirements if structural analysis so indicates.

DESIGN FREEBOARD: The design freeboard for the tank (distance between maximum shell height to maximum overflow height) shall be calculated by tank manufacturer.

FLOOR AND ROOF PLATES: Floor plate thickness shall be a minimum of 3/16-inches (0.1875 inches); and roof plate thickness shall be a minimum of 10 ga (0.1345 inches)

Sidewall Structure:

1. Field erection of the bolted steel tank shall be in strict accordance with the procedures outlined in the manufacturer's manual, and performed by the tank manufacturer or an authorized dealer of the tank manufacturer, regularly engaged in erection of these tanks, using factory trained erectors.

2. The contractor shall perform the work described herein with mechanics skilled and experienced in the fabrication and erection of aluminum dome roof structures. All field work shall be directed by a qualified supervisor who will remain on the job site until the dome construction is completed.

3. Field re-fabrication of structural components or panels will not be accepted. Forcing of the structure to achieve fit-up during construction is expressly forbidden and not acceptable. Any indication of improper fit-up of parts shall be immediately reported to the dome fabricator.

4. Particular care shall be taken in handling and bolting of the tank panels, structural members, and appurtenances to avoid abrasion of the coating system. Prior to a liquid test, all surface areas shall be visually inspected by the Engineer.

5. An electrical leak test shall be performed during erection using a wet sponge nine (9) volt leak detection device. All electrical leak points found on the inside surface shall be repaired in accordance with manufacturer's published touch up procedure.

6. No backfill shall be placed against the tank sidewall without prior written approval of the tank manufacturer and the Engineer.

7. All sealant joints shall be tooled slightly concave after sealant is installed. Care shall be taken to keep sealant confined to the joint in a neat manner. Any sealant applied outside of the joint shall be removed so that the panels will be free from misplaced sealant. All gasket materials shall be continuous, splices will not be allowed.

Roof Vent:

1. Roof vent diameter size is 20 inches minimum (or larger where indicated on Contract Drawings) and the design shall be provided by Contractor. A properly sized vent assembly in accordance with AWWA D103-09 shall be furnished and installed above the maximum water level of sufficient capacity so that at maximum design rate of water fill or withdrawal, the resulting interior pressure or vacuum will not exceed 0.5" water column.

2. The center air vent shall be substantially in accordance with Standard R-1 including but not limited to, basic design, throat diameter, net screen area, thickness, screen size and material, etc. Engineer will, (subject to approval during shop drawing review) allow some minor

modification to standard R-1 to accommodate manufacturer's design.

3. Center vent screening shall be protected from any potential windblown matter.

4. The overflow pipe shall not be considered to be a tank vent.

5. The vent shall be constructed such that the hood can be unbolted and used as a secondary roof access.

6. The vent shall be so designed in construction as to prevent the entrance of birds or other animals by including stainless steel wire cloth 8-inch by 8-inch mesh, (8 openings/1-inch) 23 GA. Backed by 2-inch by 2-inch (square openings) wire mesh. 10 GA. minimum (typical of each section).

Tank materials:

1. PLATES AND SHEETS: Plates and sheets used in the construction of the tank shell, tank floor and tank roof, shall comply with the minimum standards of AWWA D103, latest edition.

2. STRUCTURAL SHAPES: Material for structural slopes shall conform to requirements and ASTM designations of AWWA D103-09, Section 4.5.

3. BOLT FASTENERS: Tank joint bolting shall be minimum 1/2-inch diameter ; shall meet requirements of AWWA D103-09 Section 4.2.1 and have tensile strength of at least 120,000 psi.

   All bolts on the vertical tank wall shall be installed such that the head portion is located inside the tank, and the washer and nut are on the exterior.

   Bolt lengths shall be sized to achieve a neat and uniform appearance. Excessive threads extending beyond the nut after torqueing will not be permitted.

4. GASKETS AND SEALANTS: All gaskets and sealants used shall conform to the requirements of AWWA D103-09, Section 4.10. Sealant shall be NSF 61 approved.

5. BOLT FINISH: Zinc, mechanically deposited. 2.0 Mils Minimum under bolt head, on shank and threads.

6. BOLT HEAD ENCAPSULATION: For tank interior, provide high impact polypropylene copolymer encapsulation of entire bolt head up to the splines on the shank. The bolt head encapsulation shall be certified to meet the ANSI/NSF Standard 61 for indirect additives.

TANK COATING

1. GENERAL: All metal plates, supports, members and miscellaneous ports, except bolts, shall be Factory Powder Coated in accordance with AWWA D103-09 Section 12.6 and this section. Field coating other than touch-up will not be permitted.

2. SURFACE PREPARATION: Surface preparation shall be in accordance with the following:

   a. All steel surfaces shall be shot blasted to equivalent of a SP 10 or better near white metal finish. The surface anchor pattern shall be no less than 1.5 mils.

   b. Spray a final Deionized water rinse with Silica-Zirconium (Si-Zr) sealer to prevent rusting prior to the powder coating application and provide additional level of corrosion protection.

   c. All steel surfaces shall drip dry for seven (7) minutes prior to entering the dry off oven for eight (8) minutes at 425 degrees F.

3. COATING

   a. All interior steel surfaces, support members and miscellaneous parts shall receive 5 mils minimum average dry film thickness using *Dupont/Axalta* “Tank Tan” (an NSF 61 approved, Thermal set Epoxy Powder Coating).

   b. All exterior steel surfaces, support members and miscellaneous parts shall receive minimum 2 mils average dry film thickness “Tank Tan” primer under 3 mils minimum average dry film thickness using Dupont “Superior Sand” (a Thermal Set TGIC-Polyester Powder Costing).

4. FACTORY INSPECTION: The tank manufacturer shall have a thorough quality control system in place. Coated sheets shall be inspected for mil thickness (Mikrotest or equal). Coated sheets shall be checked for color uniformity by an electronic colorimeter. An electrical leak detection test shall be performed on the inside surface after fabrication of the sheet. Sheets with excessive electrical leakers shall be rejected. Provide documentation and certifications to Owner.

5. PACKAGING: All sheets that pass Factory Inspection and Quality Control checks and shall be protected from damage prior to packing for shipment. Heavy paper or plastic foam sheets shall be placed between each panel to eliminate sheet-to-sheet abrasion during shipment. Individual stacks of panels shall be wrapped in heavy mil plastic and steel banded to special wood pallets built to maintain the roll-radius of the tank panels and minimize contact or movement of finished panels during shipment. Shipment from the factory will be by truck, hauling the tank components exclusively.

2.3 WATER STORAGE TANK FOUNDATION

TANK FOUNDATION - GENERAL: Contractor shall submit concrete ringwall foundation design signed and stamped by a registered professional engineer in the state of California for approval by Owner. All Class II base shall be compacted to 95% relative compaction.

The tank foundation (concrete and reinforcing) are a part of this contract and shall be installed by the Contractor. The Contractor shall design the tank foundation to safely sustain the structure and its live loads. The Contractor shall design the tank footing based on the soil bearing capacity given in the the Geotechnical Report prepared by the soils engineer.

The concrete foundation shall be designed and constructed in accordance with the highest and most stringent requirements, but no less than the specified minimum requirements as stated herein and shown on the Drawings. Contractor shall provide signed and stamped design details and calculations for review and approval by the Engineer.

TANK FOUNDATION – MINIMUM REQUIREMENTS: The tank foundation shall be a reinforced concrete ringwall, supporting the tank shell as shown on the Contract Drawings. Within the ringwall shall be a 3-inch thick oil-sand mixture

placed by the Tank Contractor on compacted 8-inch minimum thickness Class II aggregate base, overlying the zone of over-excavated and recompacted on-site material by others. The foundation shall be reinforced with Grade 60 steel. Contractor shall submit ringwall foundation design for approval by Owner. Class II base shall be compacted to 95% relative compaction. The concrete ringwall shall be designed and constructed in accordance with the highest and most stringent requirements, but no less than the specified minimum requirements.

REINFORCING STEEL: All reinforcing steel for the reinforced concrete ringwall foundation shall be 100% tied, or as directed by the Owner or Field Inspector.

FORMING: Unless otherwise approved by Owner, concrete ringwall foundation shall be full formed (with chamfer installed in forms) as approved by Owner using 3/4" plywood adequately braced. Use snap tie bolts for spacers; or other method as approved by the Owner.

1. Any movement or bellying of forms during construction or variations in excess of the tolerances specified will be considered just cause for the removal of such forms and, in addition, the concrete work so affected.

2. Reconstruction of forms and new concrete (including disposal of rejected materials) shall be furnished at no additional cost to the Owner.

3. Two (2) working days prior to pouring concrete, Contractor shall notify Owner so that forms can be checked by survey crew for correctness of elevation.

4. Concrete shall not be ordered until forms are approved by inspector for concrete placement.

CONCRETE: Concrete for slab foundation shall develop a minimum compressive strength of 4,000 psi at 28 days, and shall contain a minimum of 7 sacks (658 lbs.) of Portland Cement per cubic yard; and shall be in accordance with the concrete submittal approved by the Owner. Use pump mix design.

CANE FIBER JOINT FILLER: Tank Contractor shall furnish and install 1-inch thick, low compressibility cane fiber joint filler (full width and length of foundation less distance between outside of ringwall and 8-inches inside from tank shell) for placement between concrete ringwall foundation and tank shell.

1. Distance and space from tank shell to 8-inches inside tank shell at the top of the ringwall shall be filled with 1-inch thick high-strength (6,000 psi or greater) non-shrink grout. Submit material and methodology/installation detail for approval.

2. Joint filler material shall be shop cut to match outside radius of tank less 8-inches. Submit for approval.

CONCRETE RINGWALL FOUNDATION TOLERANCES: Concrete ringwall foundation (before placement of fiber joint filler and grouting) shall be level within ± 1/8" in any 30-foot circumference under the shell.

The levelness on the circumference shall not vary by more than ± 1/4" from any established plane.

OIL SAND/CLASS II BASE FOR TANK: The oil-sand mixture and Class II base material shall conform to the applicable sections of the State of California Department of Transportation Standard Specifications, and shall have the following characteristics:

1. Oil-Sand Mixture: The oil-sand mixture shall be plant mixed asphalt-sand, with sand mix base, No. 4 maximum gradation per Section 39-2.02, mixed with 7% (±1%) by weight SC 800 liquid asphalt per Section 93-1.01. Mixing, transporting, and placing of the asphalt-sand plant mix shall be in accordance with all applicable provisions of Section 39.

2. Aggregate Base: The aggregate base shall consist of Class II base material conforming to the specifications - for 3/4" maximum gradation per Section 26-1.02B.

3. Tolerances: The top of the oil-sand foundation shall be smooth and level within plus or minus 1/8" in any 30' circumferential length. No point in the circumference of the foundation shall vary more than plus or minus 1/4" from the average elevation.

CONCRETE POUR PROCEDURE: Concrete pouring procedure and sequence shall be approved by Owner no less than two working days prior to beginning of pour.

CONCRETE REQUIREMENTS:

1. At least two vibrators, as approved by Owner, will be required to be utilized at jobsite (1 additional vibrator shall be provided at jobsite as a standby).

2. Unless otherwise approved by Owner, Contractor shall use pumpers for concrete pour(s).

3. The approved concrete mix delivered jobsite shall all be from the same plant.

4. Reinforced concrete slab foundation shall be allowed to cure for at least seven (7) days prior to installation of Class 2 base and oil-sand foundation.

2.4 WATER STORAGE TANK APPURTENANCES

GENERAL: The Contractor shall furnish the appurtenances per AWWA D103-09, Section 7, described herein on the water storage tank unless specified otherwise herein.

APPURTENANCES:

1. 1 - Full-height fiberglass inside ladder.

2. 1 - Outside ladder, including OSHA safety cage and horizontal swing-type anti-climb (full height ladder). Provide stop on horizontal swing. Ladders shall be fabricated of aluminum and utilize grooved, skid-resistant rungs. Safety cage and step-off platforms shall be fabricated of galvanized steel. Ladders shall be equipped with a hinged lockable entry device. Provide expanded metal mesh on lower 6-ft of cage.

3. 1 - 30-inch diameter manhole in shell (hinged construction), complete with gasket. The access door (shell manhole) and the tank shell reinforcing shall comply with AWWA D103-09 latest edition, Sec. 5.1.

4. 1 - 24" x 24" roof access hatch with hinge and hasp.

5. 1 – Grip strut walkway with metal handrail and toeboard.

6. 5 - Brackets for future 1" diameter conduit up tank wall to top outlet on side of roof hatch.

7. 1 - Screened steel center roof vent per Std. R-1 designed for 75 lbs./sq. ft. snow loading.

8. 1 - 3/4” Shell Outlet for level transducer.

9. 1 - 8" dia. side outlet drain, extra strong steel pipe, interior epoxy lined, exterior primed and shop coated per tank coating specifications, extending 9" inside tank wall with plain end and 9" outside shell with ASA 150 lb. flanged end to mate gate valve per Contract Drawings.

10. 1 - 6" diameter overflow, with standard steel pipe down outside of the tank shell, with flanged end; interior coated with epoxy, exterior primed and shop painted per tank coating specifications.

11. 1 - Complete liquid level indicator; Varec Figure No. 6700, Superior Tank Model #2400 or equal; including mounting connections, standard pipe and fittings, half-travel aluminum gauge board graduated in feet and tenths, guided float of stainless steel, no alarm switches, no liquid seal, with strip of scotchlike reflector tape on indicator, and with each numeral of foot graduations on gauge board to be made of scotchlike reflector tape. Guide wires for float shall be of stainless steel. Manufacturer’s standard gage board may be substituted subject to approval by Engineer.

12. 1 - Identification Plate: A manufacturer's nameplate shall list the tank serial number, tank diameter and height, and maximum design capacity. The nameplate shall be affixed to the tank exterior sidewall at a location approximately five (5) feet from grade elevation in a position of unobstructed view.

ORIENTATION FOR APPURTENANCES: The Owner will provide the Contractor with the exact orientation of tank appurtenances as approved fabrication drawings are being transmitted to the Contractor; and/or exact orientation of appurtenances will be field determined by Owner.

OUTLET REINFORCEMENT: All outlets greater than 3" in diameter shall be reinforced per the A.P.I. Std. 650.

PIPE CONNECTIONS: Fabricate in shop in conformance to the Drawings and these specifications.

PART 3 EXECUTION

3.1 TANK CONSTRUCTION

FIELD ERECTION: Field erection of Factory Powder Coated bolted steel tanks shall be in strict compliance with manufacturer's recommendations and performed by manufacturer's employees or certified erection crew to alleviate any potential disputes in coating quality or erection thereof. Particular care shall be exercised in handling and bolting of the tank plates, supports, and members to avoid abrasion or scratching the coating. Prior to placing water in the tank, a "holiday" inspection of the entire tank, corners included, shall be provided and performed by the manufacturer in the presence of the owner Touch-up coating shall be done per the manufacturer's recommendations where needed and as directed to achieve 100% holiday-free surface.

TANK TESTING AND INSPECTION

1. GENERAL: Test storage tank after erection. Floor shall be clean and free from dirt, foreign substance and debris.

2. BOTTOM: Vacuum test seams in floor plates.

3. SHELL: Test by filling with water to elevation of overflow. Completed storage tank shall show no leaks at end of 24 hour test period. No charge will be made to Contractor for initial water required to fill tank.

3.2 TANK FILLING PROCEDURE

GENERAL: After the construction of the tank and before the filling and testing, the Owner may establish survey points on the tank for vertical control.

TANK FILLING: The tank (complete including approved interior and exterior coating) shall then be filled to not more than one-half its full capacity and the survey points checked periodically (up to a two-week period) to assure that any settlement which may have taken place has stopped.

1. Maximum settlement shall be limited to one-half inch (1/2") unless otherwise approved by geotechnical engineer.

2. The tank can then be filled to capacity and a final check for settlement made. The structure shall be tested for liquid tightness by filling tank to its overflow elevation. The Contractor is responsible for any leaks disclosed by this test. The Contractor shall correct any leaks per AWWA D103-09 and by the authorized dealer in accordance with the manufacturer's recommendations. Labor and

equipment necessary for hydrostatic tank testing is to be included in the bid price of the bolted steel water storage tank.

3. For initial testing, the water will be provided by others at no cost to the Contractor. Any water required for re-testing shall be at the expense of the Contractor.

3.3 CLEANING AND CHLORINATION

GENERAL: The Contractor shall clean and chlorinate the completed water tank in accordance with A.W.W.A. C652-11 Section 4.3 Chlorination Method 2 as modified herein. Bidder shall coordinate directly with Owner regarding location(s) of closest available water source facilities. All water disposed of by the Contractor shall be dechlorinated and NPDES Permit obtained for such discharges.

CLEANING OF INTERIOR:

1. Prior to disinfecting, the complete interior shall be cleaned with an approved cleaner or detergent applied via high pressure hot solution method.

2. Cleaned surfaces shall then be rinsed with clean water. Residual water and contamination removed during washing process shall be thoroughly flushed from tank. Contractor shall obtain approval of Owner prior to draining any residual water to waste. This operation shall be accomplished after completion of interior coating work as directed by the Owner.

DISINFECTION: After completion of cleaning cycle as noted above, all interior surfaces shall be jet washed with a chlorine solution having a content of 200 PPM. Chlorine solution, which accumulates on the bottom, shall be de-chlorinated prior to draining to waste. Contractor shall not drain any chlorinated water directly to waste. Rinsing with clean water is not required unless directed by Owner.

1. Acceptable forms of chlorine for disinfection shall be: Liquid chlorine as specified in AWWA C652-11. Sodium hypochlorite as specified in AWWA C652-11.

2. Acceptable methods of chlorination shall be: Chlorination Method 1 as outlined in AWWA C652-11, Section 4.3. Chlorination Method 2

as outlined in AWWA C652-11, Section 4.3. Chlorination Method 3 as outlined in AWWA C652-11, Section 4.3.

3. Acceptable application methods shall be: Chemical feed pump. Spraying, brushing, or painting of all water-contact surfaces.

FILLING OF TANK AND BACTERIOLOGICAL TESTING: Once the tank has been completely filled, the tank will be isolated from the water system and the Owner will take a Bac-T test. Should the Bac-T test fail, the Contractor shall be responsible for reimbursing the Owner for the water and will be required to re-chlorinate the tank as described above until the Bac-T tests are negative.

3.4 TEST AND GUARANTEE

The Contractor shall be responsible for filling the tank with water, (as per the "Tank Filling Procedure" herein) and water-testing the tank for a 24-hour period. The Contractor shall guarantee the tank against any defect for an eighteen (18) month period, beginning with the date of final payment, and shall make all repairs or replacements occasioned by any defects, without cost to the Owner during the guarantee period.

3.5 TANK SHOP COATING INSPECTION

The Owner, at its option, may provide an independent, full-time painting inspector to ensure the quality application of all specified tank shop coatings. Expenses for said inspection will be paid for by the Owner.

3.6 CONSTRUCTION WATER

GENERAL: The Owner will furnish construction water to the Contractor, free of charge, from existing water systems adjacent to a portion of the work.

DEPOSIT: Contractor shall provide Owner with a deposit for a meter which is refundable on return of the meter. The Contractor shall contact Owner for the amount of the deposit.

TEMPORARY PIPING: The Contractor shall furnish and install all necessary temporary piping, fittings, connections, pumps, gages, etc., required to provide approved facilities to deliver filling and testing water into the tank and, obtain construction water to be used in compacting earth backfill.

ALTERNATE SOURCES: Contractor shall develop any other sources of construction water at his own expense.

3.7 POTHOLING OF EXISTING UTILITIES BY CONTRACTOR

GENERAL: The Engineer has shown from a field check and/or record research the approximate location of known underground waterline interference facilities. Other underground facilities, not shown on the Drawings, may exist.

RESPONSIBILITY: It shall be the Contractor's responsibility to locate, protect, preserve, etc. all existing underground or overhead facilities in accordance with other applicable provisions of the Technical Specifications, and Drawings.

1. Contractor shall field determine the exact location and depth of all existing underground interference and immediately notify the Owner in the event there is a conflict with the proposed pipeline alignment or grades.

2. Contractor shall "pothole" all utility line crossings and points of connection to existing waterlines (if applicable) prior to construction.

ADJUSTMENTS IN ALIGNMENT AND GRADE: Not applicable.

3.8 CONSTRUCTION STAKING

GENERAL: The Contractor will provide construction staking required for the water storage tank in accordance with the contract drawings.

Construction staking will be performed by a Field Survey Crew, and it will include: Set Construction Benchmark for Tank Site, Orientation Staking for Appurtenances, Tank Concrete Ringwall Foundation, Concrete Piles and Center of Tank.

ADVANCE NOTIFICATION: The Contractor shall inform the Owner a reasonable time in advance (at least 4 working days) as to the need for additional grades and lines.

PRESERVATION OF SURVEY POINTS: The Contractor shall preserve bench marks, survey stakes, and points set for lines, grades, or measurement of the work in their proper places until authorized by the Owner to remove them.

PART 4 MEASUREMENT AND PAYMENT

4.1 MEASUREMENT

A. Water Tank shall be measured by the number of nominal gallons (actual volume) = Tank height of shell x diameter of tank as determined from field measurement.

4.2 PAYMENT

A. The Contract unit price paid for Water Tank shall include full compensation for furnishing all labor, materials, equipment, tools and incidentals and for doing all the work of Water Tank complete in place, including all pipe penetrations of tank shell, tank foundation preparation, tank fabrication/erection, testing, coatings, water for filling, as shown on the Plans and as specified in these Special Provisions and the Standard Specifications for Public Works Construction (SSPWC).

END OF SECTION 1.0

SECTION 3.0

SUMMARY OF WORK

To the County's Standard Specifications, ADD the following:

PART 1 – GENERAL

3.1 WORK INCLUDED

The work to be performed under this Contract shall consist of furnishing all tools, equipment, materials, supplies, and manufactured articles and furnishing all labor, supervision, and all other incidental work, transportation and services, including fuel, power, water, and essential communications, and performing all work, or other operations required for the fulfillment of the Contract in strict accordance with the Contract Documents. The work shall be complete, and all work, materials, and services not expressly indicated or called for in the Contract Documents which may be necessary for the complete and proper construction of the work in good faith shall be provided by the Contractor as though originally so indicated, at no increase in cost to the District.

3.2 RELATED WORK SPECIFIED ELSEWHERE (NOT USED)

3.3 WORK COVERED BY CONTRACT DOCUMENTS

The work generally includes, but is not limited to, furnishing all products, labor, equipment, material, supervision, and all other incidental work, transportation, and incidental services to construct the following:

A. Replace the existing welded steel water tank with a replacement bolted steel water tank.

3.4 PROJECT LOCATION

A. The Project is located in County Service Area 70F – CSA 70 F Little Morongo Heights. Refer to the project plans for specific location of the project work.

PART 2 – MEASUREMENT AND PAYMENT

3.1 GENERAL

The CONTRACTOR shall provide all labor, materials, equipment, supervision and, all other incidental work described within these specifications and construction drawings. Payment for each bid item shall be included in the contract unit price or price shown on the Bidder's proposal. Measurement for payment of lump sum items will be based on the component parts listed in the Bid Items, as required in this specification. Payment for component parts will be based on the Schedule of Values approved by the District. The cost breakdown shall include quantities and items aggregating the Bid Item in payments during construction. All measurements of quantities shall be approved by the District. Payment for each bid item shall include full compensation for all labor, materials, tools, and equipment necessary to complete the work as shown on the construction drawings and within these specifications and no additional compensation shall be allowed. This includes the cost of work not specifically listed in the Bid Schedule or Schedule of Values but, is necessary to complete the project as described and shown in the Contract Documents. Work for which no separate payment has been provided will be considered a subsidiary obligation of the Contractor, and the cost therefore shall be included in the applicable contract price for the item to which the work applies. All measurements of work done will be made by the District or its representative.

PART 3 – EXECUTION

3.1 WORK SEQUENCE

A. The general sequence of work shall be as follows:

1. Submit proposed schedule of work, insurance and bonds. The Obtain required permits, licenses, and construction easements. After construction survey, call Underground Service Alert (DIGALERT) and utility owners to obtain mark out of buried utilities.
2. Contractor is responsible for obtaining construction water and meter from the for any temporary water usage throughout duration of construction.
3. Secure laydown/staging areas. Contractor shall obtain approval for use of any public or private rights-of-way.
4. Take pre-construction photographs of the existing facility.
5. Submit shop drawings and other submittals required by the plans or Contract Documents.
6. Begin manufacturing and shipping materials and equipment after

receiving approved submittals.
7. Complete work according to approved Proposed Work Schedule.
8. Finalize clean up and restore construction areas.

3.2 CONTRACTOR USE OF PROJECT SITE

A. The Contractor's use of the project site shall be limited to its construction operations. On-site storage of materials, on-site fabrication facilities, and field offices located within public right-of-way require approval from the District.

B. The Contractor shall install signs, barricades and lights necessary to ensure public safety and safety of District's operators and personnel. Provide plates across ditches to enable safe access of District's personnel to facilities or the public across excavations within public right-of-way that cannot be backfilled at the end of the day. Traffic control during hours of construction work shall be in accordance with the District approved traffic control plans included in this bid package.

3.3 DISTRICT USE OF PROJECT SITE

A. The District may utilize all or part of the existing facilities during the entire period of construction for the conduct of the District's normal operations. The Contractor shall cooperate and coordinate with the District to facilitate the District's operations and to minimize interference with the District's operations at the same time. In any event, the District shall be allowed access to the project site during the period of construction.

3.4 DEFECT ASSESSMENT

A. At the discretion of the Owner, Contractor shall replace the Work, or portions of the Work, not conforming to specified requirements at no cost to the Owner.

B. If, in the opinion of Engineer, it is not practical to remove and replace the Work, Engineer will direct appropriate remedy or adjust payment.

1. The defective Work may remain, but unit sum/price will be reduced at discretion of Owner.
2. Defective Work may be partially repaired according to instructions of Engineer, and unit sum/price will be reduced at discretion of Owner.
3. Individual Specification Sections may modify these options or may identify specific formula or percentage sum/price reduction.

C. Authority of Owner to assess defects and identify payment adjustments is final.

D. Nonpayment for Rejected Products: Payment will not be made for rejected

products for any of the following reasons:

1. Products wasted or disposed of in a manner that is not acceptable.
2. Products determined as unacceptable before or after placement.
3. Products not completely unloaded from transporting vehicle.
4. Products placed beyond lines and levels of the required Work.
5. Products remaining on hand after completion of the Work.
6. Loading, hauling, and disposing of rejected products.

PART 4 – PAYMENT

GENERAL

The CONTRACTOR shall provide all labor, materials, equipment and incidentals for the work described within these specifications and construction drawings. Payment for each bid item shall be included in the contract unit price or lump sum price shown on the Bidder's proposal. Payments shall be made as outlined in Section D – General Conditions of the District's Bid Package. Measurement for payment of lump sum items will be based on the component parts listed in the Bid Items, as required in this specification. Payment for component parts will be based on the Schedule of Values approved by the District. The cost breakdown shall include quantities and items aggregating the Bid Item in payments during construction. All measurements of quantities shall be approved by the District. Payment for each bid item shall include full compensation for all labor, supervision, and all other incidental work, materials, tools, and equipment necessary to complete the work as shown on the construction drawings and within these specifications and no additional compensation shall be allowed. This includes the cost of work not specifically listed in the Bid Schedule or Schedule of Values but, is necessary to complete the project as described and shown in the Contract Documents. Work for which no separate payment has been provided will be considered a subsidiary obligation of the Contractor, and the cost therefore shall be included in the applicable contract price for the item to which the work applies. All measurements of work done will be made by the District or its representative.

3.1 MOBILIZATION

Payment for Mobilization will be made at the contract lump sum, completed in accordance with the Contract Documents, and as directed by the District. Payment for this bid item shall include, but is not limited to, a pre-construction survey of the existing project site and staging area; development of a Staging and Storage Area Layout Plan; movement of personnel, equipment, supplies, and incidentals on and off the project site; the set up and removal of offices, temporary utilities, and other facilities from the project site, including transportation; and the cleanup and restoration of the project site, storage, and staging areas. All work shall be considered as compensated for in the lump sum price and no additional compensation shall be made thereafter. The price bid for Mobilization shall not exceed five percent (5%) of the total bid amount.

A. Insurance premiums, bonds, permitting fees, security fencing, utilities, water pollution control plan, traffic control, potholing and other facilities at the jobsite,

Contractor's overhead, and costs inclusive of administering the Contract, management and quality control procedures, and coordination as required to construct and complete the Project.

B. Supply, transportation, and/or movement of personnel, equipment, supplies and incidentals to the work site. Equipment and major materials listed in Contractor's proposal shall be staged on site in the types and quantities shown. Additional shipments of material or transportation of equipment, if required, shall be approved in writing by Owner in advance.

C. Cleaning of equipment prior to mobilizing to the jobsite.

D. Identification and protection of existing facilities/utilities.

E. Site preparation of construction zone, vehicle/visitor parking, staging, laydown, and stockpile areas.

F. All project demobilization, site cleanup, and removal of personnel, equipment, materials, supplies, temporary facilities, site delineators, and construction waste from the jobsite to satisfy applicable elements of the Contract Documents.

Not Included in the Scope.

G. Work will be paid for on a lump sum basis. Contractor may apply for payment for up to one-third of the total lump sum amount with the Contractor's first application for payment and after completion of the Contractor's pre-construction obligations. Contractor may apply for payment for the remaining lump sum amount on a project percent complete basis.

3.2 TEMPORARY POLYETHELENE TANKS

Payment for Temporary Polyethylene Tanks will be made at the contract price, completed in accordance with the Contract Documents, and as directed by the District. All work, furnishing all labor, materials, incidentals, and equipment to perform work as described in the contract documents shall be considered as compensated for in the price and no additional compensation shall be made thereafter.

3.3 BOLTED STEEL TANK

Payment for Bolted Steel Tank will be made at the contract price, completed in accordance with the Contract Documents, and as directed by the District. The contract price for Bolted Steel Tank shall include full compensation for furnishing all labor, materials, equipment, tools and incidentals, including all pipe penetrations of tank shell, tank foundation, preparation, tank fabrication/erection, testing, coatings, water for filing, as shown on the Plans, and as specified in these Special Provisions. Tank Appurtenance Works such as the exterior ladder, interior ladder, handrails, walkway, complete, identification plans, manhole, inlet/outlet, overflow, roof vent, outlet for level

transducer, and liquid level indicator, are also included in the price of the Bolted Steel Tank. No additional compensation will be provided beyond the agreed price.

3.4 DEMOLITION AND DISPOSAL OF EXISTING STEEL WATER TANK

Payment for Demolition and Disposal of Existing will be made at the contract price, completed in accordance with the Contract Documents, and as directed by the District. The Contract amount price paid for the Demolition and Disposal of Existing Steel Water Tank shall include full compensation for furnishing all labor materials, equipment, tools and incidentals, and for doing all the work, including dewatering the tank, complete in place as shown on the Plans and as specified in these Special Provisions. All work, furnishing all labor, materials, incidentals, and equipment to perform work as described in the contract documents shall be considered as compensated for in the price and no additional compensation shall be made thereafter.

3.5 EXCAVATION AND BACKFILL

Payment for Excavation and Backfill will be made at the contract price, completed in accordance with the Contract Documents, and as directed by the District. All work, furnishing all labor, materials, incidentals, and equipment to perform work as described in the contract documents shall be considered as compensated for in the price and no additional compensation shall be made thereafter.

3.6 EROSION AND SEDIMENTATION CONTROL

Payment for Erosion and Sedimentation Control will be made at the contract price, completed in accordance with the Contract Documents, and as directed by the District. Erosion and Sedimentation Control including installation and maintenance of all BMPs described in the SWPPP will be paid for at the Contract lump sum amount for Erosion and Sedimentation Control, which amount shall include full compensation for furnishing all labor, materials, equipment, tools, and incidentals, and for doing all the work of Erosion and Sedimentation Controls (including re-handling, relocation, and continuous maintenance, preparation of SWPPP), complete in place, including regular monitoring, maintenance repair and replacement, cleanup of erosion and sedimentation control features as specified in these Special Provisions, and as shown on the Plans. No additional compensation shall be made thereafter.

3.7 REINFORCED CAST IN PLACE CONCRETE FOR TANK FOUNDATION

Payment for Reinforced Cast in Place Concrete – Tank Foundation will be made at the contract price, completed in accordance with the Contract Documents, and as directed by the District. All work, furnishing all labor, materials, incidentals, and equipment to perform work as described in the contract documents shall be considered as compensated for in the price and no additional compensation shall be made thereafter. The Contract unit price paid for the Water Tank Foundation Concrete shall include full compensation for furnishing all labor, materials, equipment, tools and

incidentals and for doing all the work of Water Tank Foundation, including reinforcement, anchor bolts, complete in place, as shown on the Plans and as specified in these Special Provisions.

3.8 SAND AND CRUSHED AGGREGATE BASE FOR TANK FOUNDATION

Payment for Tank Foundation – Sand and Crushed Aggregate Base will be made at the contract price, completed in accordance with the Contract Documents, and as directed by the District. All work, furnishing all labor, materials, incidentals, and equipment to perform work as described in the contract documents shall be considered as compensated for in the price and no additional compensation shall be made thereafter.

3.9 6-INCH AND 8-INCH DI GATE VALVES

Payment for 6-Inch and 8-Inch gate Valve will be made at the contract price, completed in accordance with the Contract Documents, and as directed by the District. All work, furnishing all labor, materials, incidentals, and equipment to perform work as described in the contract documents shall be considered as compensated for in the price and no additional compensation shall be made thereafter.

3.10 6-INCH AND 8-INCH FORCE BALANCED EXPANSION JOINT

Payment for 6-Inch and 8-Inch Force balanced Flextend Expansion Joint (or approved equal) will be made at the contract price, completed in accordance with the Contract Documents, and as directed by the District. Force Balanced Flextend Expansion Joint will be measured by the number of Force Balanced Expansion Joints installed, as determined from field measurement. The Contract price paid for force balanced expansion joints shall include full compensation for furnishing all labor, materials, equipment, tools, and incidentals and for doing all the work of providing force balanced expansion joint complete in place, as shown on the Plans, and as specified in these Special Provisions.

3.11 REMOVEABLE PROTECTION POSTS

Payment for Removable Protection Posts will be made at the contract price, completed in accordance with the Contract Documents, and as directed by the District. The contract unit price paid for Removable Protection Posts includes full compensation for furnishing all labor, materials, equipment, tools, and incidentals, and for completing all work involved in the construction of the guard posts. This includes fabrication, concrete footing, installation, painting, and filling with concrete, as shown on the Plans and

specified in these Special Provisions. No additional compensation shall be made thereafter.

3.12 ELECTRICAL AND TRANSDUCER REINSTALLATION

Not Included in the Scope

Payment for Electrical and Transducer Reinstallation will be made at the contract price, completed in accordance with the Contract Documents, and as directed by the District. All work, furnishing all labor, materials, incidentals, and equipment to perform work as described in the contract documents shall be considered as compensated for in the price and no additional compensation shall be made thereafter.

3.13 TEMPORARY PIPING AND VALVES AND TEMPORARY DEMOBILIZATION

Payment for Temporary Piping and Valves will be made at the contract price, completed in accordance with the Contract Documents, and as directed by the District. All work, furnishing all labor, materials, incidentals, and equipment to perform work as described in the contract documents shall be considered as compensated for in the price and no additional compensation shall be made thereafter.

3.14 MISCELLANEOUS PIPING SPOOLS AND FITTINGS

Payment for Tank Inlet and Outlet Piping will be made at the contract price, completed in accordance with the Contract Documents, and as directed by the District. Class 52 DIP will be measured based on the linear footage of pipe installed, as determined from field measurement. Misc. Piping Spools and Fittings will not be measured for payment. This includes horizontal and vertical segments of DIP and DIP fittings, as well as supply pipe diffusers and check valves and return pipe and check valves inside the tank. Also, all sizes of transition couplings not otherwise depicted on the plans. Other valves will be measured by the number of valves installed, as determined from field measurement. The Contract unit price paid for Class 52 DIP includes full compensation for all labor, materials, equipment, tools, incidentals, and all work related to Class 52 DIP. This includes fittings, flanges, restrained joints, DIP vertical pipe risers, pipe diffusers and check valves inside tank, pipe supports, testing, excavation, trenching, trench backfill material in trench zone, pipe embedment material in pipe zone, trench patching, and dewatering. It also includes shoring, thrust, and support blocking, as well as connections. The Contract unit price paid for other valves shall include full compensation for furnishing all labor, materials, equipment,

tools, and incidentals and for doing all the work of providing other valves complete in place, as shown on the Plans, and as specified in these Special Provisions.

END OF SECTION 3.0

SECTION 4.0

MOBILIZATION

To the County Standard Specifications, ADD the following:

PART 1 – GENERAL

4.1 WORK INCLUDED

The work to be performed under this Contract shall consist of furnishing all tools, equipment, materials, supplies, and manufactured articles and furnishing all labor, transportation and services, including fuel, power, water, and essential communications, and performing all work, or other operations required for the fulfillment of the Contract in strict accordance with the Contract Documents. The work shall be complete, and all work, materials, and services not expressly indicated or called for in the Contract Documents which may be necessary for the complete and proper construction of the work in good faith shall be provided by the Contractor as though originally so indicated, at no increase in cost to the District.

4.2 RELATED WORK SPECIFIED ELSEWHERE (NOT USED)

4.3 WORK COVERED BY CONTRACT DOCUMENTS

The work generally includes, but is not limited to, furnishing all products, labor, equipment, material, transportation, and incidental services to construct the following:

A. Replace the existing welded steel water tank with a replacement bolted steel water tank.

4.4 PROJECT LOCATION

A. The Project is located in County Service Area 70F – CSA 70 F Little Morongo Heights. Refer to the project plans for specific location of the project work.

PART 2 – EXECUTION

4.1 WORK SEQUENCE

A. The general sequence of work shall be as follows:

1. Submit proposed schedule of work, insurance and bonds. The Obtain required permits, licenses, and construction easements. After construction survey, call Underground Service Alert (DIGALERT) and utility owners to obtain mark out of buried utilities.
2. Contractor is responsible for obtaining construction water and meter from the for any temporary water usage throughout duration of construction.
3. Secure laydown/staging areas. Contractor shall obtain approval for use of any public or private rights-of-way.
4. Take pre-construction photographs of the existing facility.
5. Submit shop drawings and other submittals required by the plans or Contract Documents.
6. Begin manufacturing and shipping materials and equipment after receiving approved submittals.
7. Complete work according to approved Proposed Work Schedule.
8. Finalize clean up and restore construction areas.

4.2 CONTRACTOR USE OF PROJECT SITE

A. The Contractor's use of the project site shall be limited to its construction operations. On-site storage of materials, on-site fabrication facilities, and field offices located within public right-of-way require approval from the District.

B. The Contractor shall install signs, barricades and lights necessary to ensure public safety and safety of District's operators and personnel. Provide plates across ditches to enable safe access of District's personnel to facilities or the public across excavations within public right-of-way that cannot be backfilled at the end of the day. Traffic control during hours of construction work shall be in accordance with the District approved traffic control plans included in this bid package.

4.3 DISTRICT USE OF PROJECT SITE

A. The District may utilize all or part of the existing facilities during the entire period of construction for the conduct of the District's normal operations. The Contractor shall cooperate and coordinate with the District to facilitate the District's operations and to minimize interference with the District's operations at the same time. In any event, the District shall be allowed access to the project site during the period of construction.

END OF SECTION 4.0

SECTION 5.0

ELECTRICAL – GENERAL PROVISIONS

To the County Standard Specifications, ADD the following:

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. General requirements applicable to all Electrical Work.
2. General requirements for electrical submittals.
3. Electrical Subcontractor Qualification Requirements.

B. Related Sections:

1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
2. It is the Contractor's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of Contractor's Work.

C. Interfaces to Equipment, Instruments, and Other Components:

1. The Drawings, Specifications, and overall design are based on preliminary information furnished by various equipment manufacturers which identify a minimum scope of supply from the manufacturers. This information pertains to, but is not limited to, instruments, control devices, electrical equipment, packaged mechanical systems, and control equipment provided with mechanical systems.
2. Provide all material and labor needed to install the actual equipment furnished, and include all costs to add any additional conduit, wiring, terminals, or other electrical hardware to the Work, which may be necessary to make a complete, functional installation based on the actual equipment furnished:
3. Make all changes necessary to meet the manufacturer's wiring requirements.
4. Submit all such changes and additions to the Engineer for acceptance.
5. Review the complete set of Drawings and Specifications in order to ensure that all items related to the electrical power and control systems are completely accounted for. Include any such items that appear on the Drawings or in the Specifications from another discipline in the scope of Work:
    a. If a conflict between Drawings and Specifications is discovered, refer conflict to the Engineer as soon as possible for resolution.

D. All Electrical Equipment And Systems For The Entire Project Must Comply With The Requirements Of The Electrical Specifications, Whether Referenced In The Individual Equipment Specifications Or Not:

1. The requirements of the Electrical Specifications apply to all Electrical Work specified in other sections.
2. Inform all vendors supplying electrical equipment or systems of the requirements of the Electrical Specifications.
3. The Owner is not responsible for any additional costs due to the failure of the Contractor to notify all subcontractors and suppliers of the Electrical Specifications requirements.

E. Special Subcontractor Requirements:

1. As specified elsewhere in this Section, provide the Work specified in the Electrical Specifications by a pre-qualified electrical subcontractor.

F. Contract Documents:

1. General:
    a. The Drawings and Specifications are complementary and are to be used together in order to fully describe the Work.
2. Specifications:
    a. The General and Supplementary Conditions of the Contract Documents govern the Work.
    b. These requirements are in addition to all General Requirements.
3. Contract Drawings:
    a. The Electrical Drawings show desired locations, arrangements, and components of the Electrical Work in a diagrammatic manner.
    b. Locations of equipment, control devices, instruments, boxes, panels, etc. are approximate only; exercise professional judgment in executing the Work to ensure the best possible installation:
        i. The equipment locations and dimensions indicated on the Drawings are approximate. Use the shop drawings to determine the proper layout, foundation, and pad requirements, etc. for final installation. Coordinate with all subcontractors to ensure that all electrical equipment is compatible with other equipment and space requirements. Make changes required to accommodate differences in equipment dimensions.
        ii. The Contractor has the freedom to select any of the named manufacturers identified in the individual specification sections; however, the Engineer has designed the spatial equipment layout based upon a single manufacturer and has not confirmed that every named manufacturer's equipment fits in the allotted space. It is the Contractor's responsibility to ensure that the equipment being furnished fits within the defined space.
    c. Installation details:
        i. The Contract Drawings include typical installation details the Contractor is to use to complete the Electrical Work. For cases where a typical detail does not apply, develop installation details that may be necessary for completing the Work, and submit these details for review by the Engineer.

ii. Not all typical installation details are referenced within the Drawing set. Apply and use typical details where appropriate.

d. Schematic diagrams:

i. All controls are shown de-energized.

ii. Schematic diagrams show control function only. Incorporate other necessary functions for proper operation and protection of the system.

iii. Add slave relays, where required, to provide all necessary contacts for the control system or where needed to function as interposing relays for control voltage coordination, equipment coordination, or control system voltage drop considerations.

iv. Mount all devices shown on motor controller schematic diagrams in the controller compartment enclosure, unless otherwise noted or indicated.

v. Schematic diagrams are to be used in conjunction with the descriptive operating sequences in the Contract Documents. Combine all information and furnish a coordinated and fully functional control system.

1.02 ELECTRICAL SUBCONTRACTOR QUALIFICATIONS

A. The Electrical Subcontractor Shall Meet Or Exceed The Criteria Described Below:

1. The electrical subcontractor shall have successfully completed electrical construction on three water or wastewater treatment plant related projects within the past 6 years.

2. The electrical subcontractor shall have, in their employ, the following full time employees that will be assigned to perform the electrical work of this contract:

a. A minimum of (1) Licensed Master Electrician who is overall responsible for the supervision of personnel performing the construction, installation startup and testing of all electrical related facilities and systems.

b. A minimum of (1) Licensed Journeyman Electrician responsible for the daily construction activities and guidance of the electrical contractor's on site employees. The Licensed Journeyman's primary assignment will be the construction of the electrical facilities of this project until project completion.

3. The electrical subcontractor shall not be involved in any current or pending litigation which may have a material negative impact on the ability to complete the project. The electrical subcontractor shall provide a statement advising all current or pending litigations.

1.03 REFERENCES

A. Code Compliance:

1. The publications are referred to in the text by the basic designation only. The latest edition accepted by the Authority Having Jurisdiction of referenced publications in effect at the time of the bid governs.

2. The standards listed are hereby incorporated into this Section.

a. American National Standards Institute (ANSI).

b. American Society of Civil Engineers (ASCE):

i. ASCE 7 - Minimum Design Loads for Buildings and Other Structures.

c. ASTM International (ASTM).

d. Illuminating Engineering Society (IES). Institute of Electrical and Electronics Engineers (IEEE).

e. Insulated Cable Engineers Association (ICEA).

f. International Code Council (ICC).

i. International Code Council Evaluation Service (ICC-ES).

I. AC 156 – Acceptance Criteria for Seismic Certification by Shake Table Testing of Non-Structural Components (ICC-ES AC 156).

g. International Society of Automation (ISA).

h. National Electrical Manufacturers Association (NEMA):

i. 250 - Enclosures for Electrical Equipment (1000 V Maximum).

i. National Fire Protection Association (NFPA):

i. 70 - National Electrical Code (NEC).

j. National Institute of Standards and Technology (NIST).

k. Underwriters' Laboratories, Inc. (UL).

1.04 DEFINITIONS

A. Definitions Of Terms And Other Electrical And Instrumentation Considerations As Set Forth By:

1. IEEE.
2. NETA.
3. IES.
4. ISA.
5. NEC.
6. NEMA.
7. NFPA.
8. NIST

B. Specific Definitions:

1. FAT: Factory acceptance test.
2. ICSC: Instrumentation and controls subcontractor (henceforth referred to as the SYSTEM SUPPLIER).

3. LCP: Local control panel: Operator interface panel that may contain an HMI, pilot type control devices, operator interface devices, control relays, etc. and does not contain a PLC or RIO.
4. PCP: Process control panel: An enclosure containing any of the following devices: PLC, RTU, or RIO.
5. PCIS: Process control and instrumentation system.
6. Space: That portion of the switchgear, motor control center, panelboard, switchboard or control panel that does not physically contain a device but is capable of accepting a device with no modifications to the equipment, i.e., provide all standoffs, bus, and hardware, as part of the space.
7. Spare: That portion of the switchgear, motor control center, panelboard, switchboard or control panel that physically contains a device with no load connections to be made.
8. System supplier: Refer to Quality Assurance in this Section.
9. Unequipped space: That portion of the switchgear, motor control center, panelboard, switchboard or control panel that does not physically contain a device, standoff, bus, hardware, or other equipment.

1.05 SYSTEM DESCRIPTION

A. General Requirements:

1. The Work includes everything necessary for and incidental to executing and completing the Electrical Work indicated on the Drawings and specified in the Specifications and reasonably inferable there from:
    a. The Electrical Drawings are schematic in nature; use the Mechanical and Civil Drawings for all dimensions and scaling purposes.
2. It is the intent of these Specifications that the entire electrical power, instrumentation, and control system be complete and operable. Provide all necessary material and labor for the complete system from source of power to final utilization equipment, including all connections, testing, calibration of equipment furnished by others as well as equipment furnished by the Contractor, whether or not specifically mentioned but which are necessary for successful operation.
3. Provide all Electrical Work, including conduit, field wiring, and connections by the electrical subcontractor under the provisions of the Electrical Specifications for all aspects of the Work.
4. Coordinate all aspects of the Work with the electrical subcontractor and other subcontractors before bidding in order to ensure that all costs associated with a complete installation are included. The Owner is not responsible for any change orders due to lack of coordination of the Work between the Contractor, the electrical subcontractor, the other subcontractors, or suppliers.
5. Demolition:
    a. Where demolition is specified or indicated on the Drawings, disconnect all associated electrical equipment and render the equipment safe.

b. Remove and dispose of all conduit, wire, electrical equipment, controls, etc. associated with the items and/or areas to be demolished as indicated on the Drawings unless otherwise indicated.

c. Salvage electrical equipment as specified on the drawings.

d. For each piece of equipment to be removed, remove all ancillary components (e.g. instruments, solenoid valves, disconnect switches, etc.).

e. Conduit:

i. Where conduit removal, other than associated with equipment to be removed, is indicated on the Drawings:

I. Remove exposed conduit to the point of encasement or burial.

II. Cut conduit flush and plug or cap encased or buried conduit.

ii. Where conduits are to remain in place and removal is not indicated on the Drawings:

I. Cap conduit open ends.

II. Re-label empty conduits as spare.

f. Remove all wire back to the source for all conduits to be removed or abandoned in place.

g. Provide new nameplates for modified electrical distribution equipment, motor control centers etc. to identify equipment and circuits that are no longer used as spares.

h. Provide new typewritten schedules for all panelboards.

6. Portions of this Project involve installation in existing facilities and interfaces to existing circuits, power systems, controls, and equipment:

a. Perform and document comprehensive and detailed field investigations of existing conditions (circuits, power systems, controls, equipment, etc.) before starting any Work. Determine all information necessary to document, interface with, modify, upgrade, or replace existing circuits, power systems, controls, and equipment.

b. Provide and document interface with, modifications to, upgrades, or replacement of existing circuits, power systems, controls, and equipment.

7. Provide all trenching, forming, rebar, concrete, back filling, hard surface removal and replacement, for all items associated with the Electrical Work and installation:

a. As specified in the Contract Documents.

B. Construction Constraints:

1. Contractor shall provide a detailed written electrical construction sequence. Electrical construction sequence shall be in-line or follow the process construction sequence.

2. It is the Contractor's responsibility to provide all necessary temporary power with all temporary distribution equipment, temporary wires, temporary power source,

or temporary generator with fuel, etc. for any shutdown without additional cost to the Owner.

3. According to individual circumstances and in compliance with the Drawings, extend or replace conduit and cable connections from existing locations.
4. The standards of documentation, instrument tagging, cable and conductor ferruling, terminal identification and labeling that apply to the new installation apply equally to the existing installation which forms part of the modified system.

1.06 SUBMITTALS

A. Furnish Submittals As Specified In This Section.

B. General:

1. Instruct all equipment suppliers of submittals and operation and maintenance manuals of the requirements in this Section.
2. Furnish the submittals required by each section in the Electrical Specifications.
3. Adhere to the wiring numbering scheme throughout the Project:
    a. Uniquely number each wire.
    b. Wire numbers must appear on all Equipment Drawings.
4. Use equipment and instrument tags, as indicated on the Drawings, for all submittals.

C. Quality Control Submittals:

1. Factory test certification and reports for all major electrical equipment.
2. As part of the electrical submittal, the contractor shall provide a minimum of 1/2”=1’-0” scaled conduit layout drawings of the electrical equipment in the existing electrical buildings, new electrical buildings, sludge dewatering building, operations building, or major electrical equipment in a mechanical room showing sizes of all equipment and their spatial relationship. Non-electrical equipment shall be approved before finalizing the electrical layout in mechanical rooms.
3. In addition, the Contractor shall submit for the approval, electrical installation working drawings for the overall site work. Site plan conduit layout drawings shall be at 1” = 60’-0”.
4. Provide complete conduit and equipment layouts.
5. Provide a conduit plan for major power, instrumentation and control conduits, both interior and exterior, showing routing, size and stub up locations for buried or in slab conduits.
6. Concrete floors and/or walls containing concealed conduits shall not be poured until conduit layouts are approved.
7. Plans shall be drawn with at least ACAD 2019, size 36-inch x 24-inch, and shall be presented in a neat, professional manner. Drawing files shall be provided for review. Note: ACAD drawing files are available from the Engineer.

D. Seismic Requirements:

1. Provide electrical equipment with construction and anchorage to supporting structures designed.
2. For equipment installed in structures designated as seismic design category C, D, E or F, prepare and submit the following:
    a. Statement of seismic qualification, and special seismic certification:
        i. "Statement of seismic qualification:" Provide manufacturer's statement that the equipment satisfies the seismic design requirements of the building code, including the requirements of ASCE 7, Chapter 13.
        ii. "Special seismic certification:" Provide manufacturer's certification that the equipment, when subjected to shake table testing in accordance with ICC-ES AC 156, meets the "Post-Test Functional Compliance Verification" requirements of ICC-ES AC 156 for "Components with Ip = 1.5." Compliance shall include both operability and containment of hazardous materials as appropriate to the unit being tested.
    b. Substantiating test data: With seismic qualification and special seismic certification statements, submit results of testing in accordance with ICC-ES AC 156.
    c. Anchoring design calculations and details:
        i. Submit project-specific drawings and supporting calculations, prepared and sealed by a professional engineer licensed in the state where the Project is being constructed, and showing details for anchoring electrical equipment to its supports and for anchoring supports provided with the equipment to the structure.
3. Exemptions: A "statement of seismic qualification" and a "special seismic certification" are not required for the following equipment:
    a. Temporary or moveable equipment.
    b. Equipment anchored to the structure and having a total weight of 20 pounds or less.
    c. Distribution equipment anchored to the structure and having a total unit weight of 3 pounds per linear foot, or less.

E. Submittal Organization:

1. First page:
    a. Specification section reference.
    b. Name and telephone number of individual who reviewed submittal before delivery to Engineer.
    c. Name and telephone number of individual who is primarily responsible for the development of the submittal.
    d. Place for Contractor's review stamp and comments.
2. Next pages:
    a. Provide confirmation of specification compliance in a tabular form that individually lists each specification section, paragraph, and

sub-paragraphs and unequivocally states compliance with said requirement or takes exception to the requirement and lists the reason for said exception and offers alternative means for compliance.

b. Include a response in writing to each of the Engineer's comments or questions for submittal packages which are re-submitted:

i. In the order that the comments or questions were presented throughout the submittal.

ii. Referenced by index section and page number on which the comment appeared.

iii. Acceptable responses to Engineer's comments are either:

I. Engineer's comment or change is accepted and appropriate changes are made.

II. Explain why comment is not accepted or requested change is not made.

III. Explain how requirement will be satisfied in lieu of comment or change requested by Engineer.

iv. Any re-submittal, which does not contain responses to the Engineer's previous comments shall be returned for Revision and Re-submittal.

v. No further review by the Engineer will be performed until a response for previous comments has been received.

3. Remaining pages:

a. Actual submittal data:

i. Organize submittals in exactly the same order as the items are referenced, listed, and/or organized in the specification section.

ii. For submittals that cover multiple devices used in different areas under the same specification section, the submittal for the individual devices must list the area where the device is intended to be used.

F. Submittal Requirements:

1. Furnish submittals that are fully indexed with a tabbed divider for every component.

2. Sequentially number pages within the tabbed sections. Submittals and operation and maintenance manuals that are not fully indexed and tabbed with sequentially numbered pages, or are otherwise unacceptable, will be returned without review.

3. Edit all submittals and operation and maintenance manuals so that the submittal specifically applies to only the equipment furnished.

a. Neatly cross out all extraneous text, options, models, etc. that do not apply to the equipment being furnished, so that the information remaining is only applicable to the equipment being furnished.

4. Submit copies of shop drawings, and product data:

a. Show dimensions, construction details, wiring diagrams, controls, manufacturers, catalog numbers, and all other pertinent details.

5. Where submittals are required, provide a separate submittal for each specification section. In order to expedite construction, the Contractor may make more than 1 submittal per specification section, but a single submittal may not cover more than 1 specification section:

    a. The only exception to this requirement is when 1 specification section covers the requirements for a component of equipment specified in another section. (For example, circuit breakers are a component of switchgear. The switchgear submittal must also contain data for the associated circuit breakers, even though they are covered in a different specification section.)

6. Exceptions to Specifications and Drawings:

    a. Include a list of proposed exceptions to the Specifications and Drawings along with a detailed explanation of each.

    b. If there is insufficient explanation for the exception or deviation, the submittal will be returned requiring revision and re-submittal.

    c. Acceptance of any exception is at the sole discretion of the Engineer.

        i. Provide all items (materials, features, functions, performance, etc.) required by the Contract Documents that are not accepted as exceptions.

    d. Replace all items that do not meet the requirements of the Contract Documents, which were not previously accepted as exceptions, even if the submittals contained information indicating the failure to meet the requirements.

7. Specific submittal requirements:

    a. Shop drawings:

        i. Required for materials and equipment listed in this and other sections.

        ii. Furnish sufficient information to evaluate the suitability of the proposed material or equipment for the intended use, and for compliance with these Specifications.

        iii. Shop drawings requirements:

            I. Front, side, and, rear elevations, and top and bottom views, showing all dimensions.

            II. Locations of conduit entrances and access plates.

            III. Component layout and identification.

            IV. Schematic and wiring diagrams with wire numbers and terminal identification.

            V. Connection diagrams, terminal diagrams, internal wiring diagrams, conductor size, etc.

            VI. Anchoring method and leveling criteria, including manufacturer's recommendations for the Project site seismic criteria.

            VII. Weight.

            VIII. Finish.

IX. Nameplates

X. Temperature limitations, as applicable.

b. Product data:

i. Submitted for non-custom manufactured material listed in this and other sections and shown on shop drawings.

ii. Include:

I. Catalog cuts.

II. Bulletins.

III. Brochures.

IV. Quality photocopies of applicable pages from these documents.

V. Identify on the data sheets the Project name, applicable specification section, and paragraph.

VI. Identify model number and options for the actual equipment being furnished.

VII. Neatly cross out options that do not apply or equipment not intended to be supplied.

c. Detailed sequence of operation for all equipment or systems.

G. Operation And Maintenance Manuals:

1. Furnish the Engineer with a complete set of written operation and maintenance manuals 8 weeks before Functional Acceptance Testing.

2. Additional operation and maintenance manual requirements:

a. Completely index manuals with a tab for each section:

i. Each section containing applicable data for each piece of equipment, system, or topic covered.

b. Assemble manuals using the approved shop drawings, and include, the following types of data:

i. Complete set of 11-inch by 17-inch drawings of all equipment.

ii. Complete set of control schematics.

iii. Complete parts list for all equipment being provided.

iv. Catalog data for all products or equipment furnished.

H. Material And Equipment Schedules:

1. Furnish a complete schedule and/or matrix of all materials, equipment, apparatus, and luminaries that are proposed for use:

a. Include sizes, names of manufacturers, catalog numbers, and such other information required to identify the items.

I. Schedule Of Values:

1. In addition to completing all items referred to in the schedule of values, submit per unit material and labor costs used in developing the final bid for the electrical

system, for the express purpose of pricing and cost justification for any proposed change orders. In addition to the items shown on the schedule of values, provide per unit material and labor costs for conduit and wire installation for specific types, sizes, and locations as indicated on the Drawings and Conduit Schedule. It is the responsibility of the electrical subcontractor to prove to the Engineer's satisfaction that said per unit costs were used in the development of the final Bid amount.

J. Roof Penetrations:

1. Submit details of all portions of the electrical installation that penetrate the roof. Include details showing support of the penetrating component, and the sealing means to be utilized.

K. Record Documents:

1. Provide Record Documents of all Electrical Drawings.
2. Record Drawing requirements:
    a. Update Record Drawings weekly.
    b. Record Drawings must be fully updated as a condition of the monthly progress payments.
    c. Submit Record Drawings upon completion of the Work for final review.
    d. Clearly and neatly show all changes including the following:
        i. All existing pipe, conduit, wire, instruments or other structures encountered or uncovered during construction.
3. Shop drawings:
    a. Upon completion of the Work, update all shop drawings to indicate the final as-built configuration of the systems:
        i. Provide as-built shop drawings for all electrical equipment on 11-inch by 17-inch paper.
        ii. Size all drawings to be readable and legible on 11-17 inch media.
        iii. Provide electronic copies of these documents through ShareFile link in Adobe Acrobat (i.e. PDF extension).
4. Review and corrections:
    a. Correct any record documents or other documents found to be incomplete, not accurate, of poor quality, or containing errors.
    b. Promptly correct and re-submit record documents returned for correction.

L. Test Reports:

1. Include the following:
    a. A description of the test.
    b. List of equipment used.
    c. Name of the person conducting the test.
    d. Date and time the test was conducted.

e. All raw data collected.

f. Calculated results.

g. Each report signed by the person responsible for the test.

M. Calculations:

1. Where required by specific Electrical Specifications:

a. Because these calculations are being provided by a registered professional engineer, they will be reviewed for form, format, and content but will not be reviewed for accuracy and calculation means.

1.07 QUALITY ASSURANCE

A. Furnish All Equipment Listed By And Bearing The Label Of UL Or Of An Independent Testing Laboratory Acceptable To The Engineer And The Authority Having Jurisdiction.

B. System Supplier Responsibilities:

1. Requirements as specified in the Instrumentation and Control Specifications.

2. System supplier:

a. Due to the critical and complex technical requirements of this Project, all Work (materials, equipment, products, submittals, labor, services, etc.) specified in the Electrical, and Instrumentation and Control Specifications, and shown on the Electrical and Instrumentation Drawings is to be furnished by a single system supplier who has single source responsibility for both the process control and instrumentation systems and the electrical power system.

3. Contractual relationship:

a. Form a contractual relationship between the electrical subcontractor and the ICSC.

b. If the Owner is the preferred integration and controls sub contractor for portions of existing PLC programming and integration of components supplied by Owner, then the subcontractor requirements of this section do not apply and all liability for a working system to be accepted by Owner.

c. Requirements for the first tier subcontractor:

i. Contract directly with the Contractor.

ii. Be either the electrical subcontractor or the ICSC.

d. Requirements for the second tier subcontractor:

i. A division of the first tier subcontractor, or

ii. ii.A joint venture with the first tier subcontractor, or

iii. iii.A subcontractor to the first tier subcontractor.

e. The system supplier manages, directs, and supervises all of the Work of its second tier subcontractor. The system supplier is solely responsible for the entire electrical and instrumentation system, including, but not limited

to, all Electrical, Instrumentation, and Process Contract Drawings, Electrical Specifications, and Instrumentation and Control Specifications:

i. Provide any additional conduit, wire, etc.

ii. Any additional I/O, programming, screens, interface devices needed by the system supplier are to be provided by the electrical subcontractor or the ICSC, under the above outlined working agreement.

iii. Ensure compatibility between the PCIS system and the electrical system being installed.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Shipping Precautions:

1. After completion of shop assembly and successful factory testing, pack all equipment in protective crates, and enclose in heavy duty polyethylene envelopes or secured sheeting to provide complete protection from damage, dust, and moisture.
2. Place dehumidifiers, when required, inside the polyethylene coverings.
3. Skid-mount the equipment for final transport.
4. Provide lifting rings for moving without removing protective covering.
5. Display boxed weight on shipping tags together with instructions for unloading, transporting, storing, and handling at the job site.

B. Delivery And Inspection:

1. Deliver products in undamaged condition, in manufacturer's original container or packaging with identifying labels intact and legible. Include date of manufacture on label.

C. Special Instructions:

1. Securely attach special instructions for proper field handling, storage, and installation to each piece of equipment before packaging and shipment.

1.09 PROJECT OR SITE CONDITIONS

A. Site Conditions:

1. Provide an electrical, instrumentation and control system, including all equipment, raceways, and any other components required for a complete installation that meets the environmental conditions for the Site as specified in the General Requirements and below.
2. Seismic load resistance:
    a. Provide electrical equipment with construction and anchorage to supporting structures
3. Wind load resistance:

a. Provide electrical equipment with construction and anchorage to supporting structures designed to resist site wind loads in accordance with the 2023 California Building Code.

4. Altitude, temperature and humidity:

   a. Provide all electrical components and equipment fully rated for continuous operation at this altitude, with no additional derating factors applied.

   b. Provide additional temperature conditioning equipment to maintain all equipment in non-conditioned spaces subject to these ambient temperatures, with a band of 10 degrees Fahrenheit above the minimum operating temperature and 10 degrees Fahrenheit below maximum operating temperature, as determined by the equipment manufacturer's guidelines:

      i. Provide all power conduits wiring for these devices (e.g. heaters, fans, etc.) whether indicated on the Drawings or not.

5. Site security:

   a. Abide by all security and safety rules concerning the Work on the Site.

6. Outdoor installations:

   a. Provide electrical, instrumentation and control equipment suitable for operation in the ambient conditions where the equipment is located.

   b. Provide heating, cooling, and dehumidifying devices incorporated into and included with electrical equipment, instrumentation and control panels to maintain the enclosures within the rated environmental operating ranges as specified in this Section for the equipment:

      i. Provide all wiring necessary to power these devices.

B. Provide Enclosures For Electrical, Instrumentation And Control Equipment, Regardless Of Supplier Or Subcontractor Furnishing The Equipment, That Meet The Requirements Outlined In NEMA Standard 250 For The Following Types Of Enclosures:

1. NEMA Type 1: Intended for indoor use, primarily to provide a degree of protection from accidental contact with energized parts or equipment.

2. NEMA Type 3R: Intended for either indoor or outdoor use, primarily to protect equipment against ingress of solid foreign objects (falling dirt); to provide a degree of protection with respect to harmful effects on the equipment due to ingress of water (rain, sleet, snow); and that will be undamaged by the external formation of ice on the enclosure.

3. NEMA Type 4: Intended for indoor or outdoor use, primarily to protect equipment from exposure to windblown dust and rain, splashing or hose directed water, ice formation, and freezing.

4. NEMA Type 4X: Made from corrosion resistant materials (fiberglass reinforced plastic, 316 stainless steel or equal) and are intended for indoor or outdoor use, primarily to protect equipment from exposure to windblown dust and rain, splashing or hose directed water, ice formation and freezing, and corrosion.

5. NEMA Type 7: Enclosures constructed for use in hazardous (classified) locations as defined per NFPA 70.
6. NEMA Type 12: Intended for indoor use, primarily to provide a degree of protection from dust, falling dirt and dripping non-corrosive liquids.

C. Plant Area Electrical Work Requirements:

1. Provide all Electrical Work in accordance with the following table, unless otherwise specifically indicated on the Drawings:

1.10 SCHEDULING

A. Pre-Submittal Conference:

1. Before producing any submittals, schedule a pre-submittal conference for the purposes of reviewing the entire Project, equipment, control philosophy, schedules, and submittal requirements.
2. The Contractor, electrical subcontractor, all suppliers, and individual equipment manufacturers furnishing major pieces of equipment must attend.

B. Factory Acceptance Testing (FAT):

1. Where FAT is required for equipment covered by these Specifications, notify the Engineer in writing when the equipment is completed and ready for factory inspection and testing:
    a. Indicate the desired dates for inspection and testing.
    b. Schedule the FAT after approval of the FAT procedures submittal:
        i. Submit a copy of the test procedures including all forms at least 21 days before any scheduled test date.
        ii. Notify the Engineer of the scheduled tests a minimum of 15 days before the date of the test.

1.11 WARRANTY

A. Warrant The Electrical Work:

1. Provide additional warranty as specified in the individual Electrical Specifications.

1.12 SYSTEM START-UP

A. Replace Or Modify Equipment, Software, And Materials That Do Not Achieve Design Requirements After Installation In Order To Attain Compliance With The Design Requirements:

1. Following replacement or modification, retest the system and perform additional testing to place the complete system in satisfactory operation and obtain compliance acceptance from the Engineer.

1.13 MAINTENANCE

A. Before Substantial Completion, Perform All Maintenance Activities Required By Any Sections Of The Specifications Including Any Calibrations, Final Adjustments, Component Replacements Or Other Routine Service Required Before Placing Equipment Or Systems In Service.

B. Furnish All Spare Parts As Required By Other Sections Of The Specifications.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Provide Similar Items Of Same Manufacturer Throughout The Electrical And Instrumentation Portion Of The Project.

B. Allowable Manufacturers Are Specified In Individual Electrical Specifications.

2.02 MATERIALS

A. Furnish All Materials Under This Contract That Are New, Free From Defects, And Standard Products Produced By Manufacturers Regularly Engaged In The Production Of These Products And That Bear All Approvals And Labels As Required By The Specifications.

B. Provide Materials Complying With The Applicable Industrial Standard.

C. Stainless Steel:

1. Where stainless steel is indicated or used for any portion of the Electrical Work, provide a non-magnetic, corrosion-resistant alloy, ANSI Type 316, satin finish.
2. Provide exposed screws of the same alloys.
3. Provide finished material free of any burrs or sharp edges.
4. Use only stainless steel hardware, when chemically compatible, in all areas that are or could be in contact with corrosive chemicals.
5. Use stainless steel hardware, when chemically compatible, in all chemical areas or areas requiring NEMA Type 4X construction.
6. Do not use stainless steel in any area containing chlorine, gas or solution, chlorine products or ferric chloride.

2.03 SOURCE QUALITY CONTROL

A. Provide All Equipment That Is New, Free From Defects, And Standard Products Produced By Manufacturers Regularly Engaged In The Production Of These Products.

PART 3 EXECUTION

3.01 EXAMINATION

A. The Electrical Subcontractor Is Encouraged To Visit The Site To Examine The Premises Completely Before Bidding.

B. It Is The Electrical Subcontractor's Responsibility To Be Fully Familiar With The Existing Conditions And Local Requirements And Regulations.

C. Review The Site Conditions And Examine All Shop Drawings For The Various Items Of Equipment In Order To Determine Exact Routing And Final Terminations For All Wiring And Cables.

3.02 INSTALLATION

A. Equipment Locations Shown On Electrical Drawings May Change Due To Variations In Equipment Size Or Minor Changes Made By Others During Construction:

1. Verify all dimensions indicated on the Drawings:

    a. Actual field conditions govern all final installed locations, distances, and levels.

2. Review all Contract Documents and approved equipment shop drawings and coordinate Work as necessary to adjust to all conditions that arise due to such changes.

3. Make minor changes in location of equipment before rough in, as directed by the Owner's representative and/or Engineer.

4. Provide a complete electrical system:

B. Install all extra conduits, cables, and interfaces as may be necessary to provide a complete and operating electrical system.

C. Install The Equipment In Accordance With The Accepted Installation Instructions And Anchorage Details To Meet The Seismic And Wind Load Requirements At The Project Site.

D. Cutting And Patching:

1. Perform all cutting, patching, channeling, core drilling, and fitting required for the Electrical Work, except as otherwise directed:

    a. Secure the permission of the Engineer before performing any operation likely to affect the strength of a structural member such as drilling, cutting or piercing:

        i. Before cutting, channeling, or core drilling any surface, ensure that no penetration of any other systems will be made:

            I. Verify that area is clear and free of conduits, cables, piping, ductwork, post-tensioning cables, etc.

            II. Use tone-locate system or X-ray to ensure that area is clear of obstructions.

    b. Review the complete Drawing set to ensure that there are no conflicts or coordination problems before cutting, channeling, or core drilling any surface.

E. Install All Conduits And Equipment In Such A Manner As To Avoid All Obstructions And To Preserve Headroom And Keep Openings And Passageways Clear:

1. Install all conduits and equipment in accordance with working space requirements in accordance with the NEC.
    a. This includes any panel, disconnect switch or other equipment that can be energized while open exposing live parts regardless of whether it is likely to require examination or has serviceable parts.
2. Where the Drawings do not show dimensions for locating equipment, install equipment in the approximate locations indicated on the Drawings.
    a. Adjust equipment locations as necessary to avoid any obstruction or interferences.
3. Where an obstruction interferes with equipment operation or safe access, relocate the equipment.
4. Where the Drawings do not indicate the exact mounting and/or supporting method to be used, use materials and methods similar to the mounting details indicated on the Drawings.

F. Earthwork And Concrete:
1. Install all trenching, shoring, concrete, backfilling, grading and resurfacing associated with the Electrical Work:
    a. Requirements as specified in the Contract Documents.

G. Roof Penetrations:
1. Seal conduit penetrations in accordance with roofing manufacturer's instructions.

H. Terminations:
1. Provide and terminate all conductors required to interconnect power, controls, instruments, panels, and all other equipment.

I. Miscellaneous Installation Requirements:
1. In case of interference between electrical equipment indicated on the Drawings and the other equipment, notify the Engineer.
2. Location of manholes and pullboxes indicated on the Drawings are approximate. Coordinate exact location of manholes and pullboxes with Mechanical and Civil Work.
3. Provide additional manholes or pullboxes to those shown where they are required to make a workable installation.
4. Circuits of different service voltage:
    a. Voltage and service levels:
        i. Low voltage: 120 V to 480 V.
        ii. Instrumentation: Less than 50 VDC.
    b. Install different service voltage circuits in separate raceways, and junction boxes, manholes, hand holes, and pullboxes.
    c. In manholes, install all cables operating at less than 50 VDC in PVC coated flexible metallic conduit, with corrosion resistant fittings.

J. Equipment Tie-Downs:

1. Anchor all instruments, control panels, and equipment by methods that comply with seismic and wind bracing criteria, which apply to the Site.
2. All control panels must be permanently mounted and tied down to structures in accordance with the Project seismic criteria.

3.03 COMMISSIONING AND PROCESS START-UP

A. For Owner And Engineer Witnessed FAT:
   1. The Contractor is responsible for the Owner's and Engineer's costs associated with FAT.

B. Source Testing (FAT):
   1. Provide source testing and Owner training on electrical equipment as defined in the table below:

3.04 FIELD QUALITY CONTROL

A. Inspection:
   1. Allow for inspection of electrical system installation.
   2. Provide any assistance necessary to support inspection activities.
   3. Engineer inspections may include, but are not limited to, the following:
      a. Inspect equipment and materials for physical damage.
      b. Inspect installation for compliance with the Drawings and Specifications.
      c. Inspect installation for obstructions and adequate clearances around equipment.
      d. Inspect equipment installation for proper leveling, alignment, anchorage, and assembly.
      e. Inspect equipment nameplate data to verify compliance with design requirements.
      f. Inspect raceway installation for quality workmanship and adequate support.
      g. Inspect cable terminations.
      h. Schedule structural engineer to inspect all mounting of electrical devices and all penetration and connections to structures.
   4. Inspection activities conducted during construction do not satisfy inspection or testing requirements.

B. Field Acceptance Testing (Functional Testing):
   1. Notify the Engineer when the Electrical Work is ready for field acceptance testing.
   2. Record results of the required tests along with the date of test:
      a. Use conduit identification numbers to indicate portion of circuit tested.

C. Workmanship:

1. Leave wiring in panels, manholes, boxes, and other locations neat, clean, and organized:

a. Neatly coil and label spare wiring lengths.

b. Shorten, re-terminate, and re-label excessive used as well as spare wire and cable lengths, as determined by the Engineer.

3.05 CLEANING

A. Remove All Foreign Material And Restore All Damaged Finishes To The Satisfaction Of The Engineer And Owner's Representative.

B. Clean And Vacuum All Enclosures To Remove All Metal Filings, Surplus Insulation And Any Visible Dirt, Dust Or Other Matter Before Energization Of The Equipment Or System Start-Up:

1. Use of compressors or air blowers for cleaning is not acceptable.

C. Clean And Re-Lamp All New And Existing Luminaries That Were Used In The Areas Affected By The Construction, And Return All Used Lamps To The Owner's Representative (Plant Superintendent).

D. As Specified In Other Sections Of The Contract Documents.

3.06 PROTECTION

A. Protect All Work From Damage Or Degradation Until Substantial Completion.

1. Maintain All Surfaces To Be Painted In A Clean And Smooth Condition.

END OF SECTION

SECTION 5.1

WIRES AND CABLES

To the County Standard Specifications, ADD the following:

PART 1 -GENERAL

1.01 SUMMARY

A. Section includes:

1. 600 volt class or less wire and cable.

B. Related sections:

1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
2. It is the Contractor's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of Contractor's Work.
3. The following sections are related to the Work described in this Section. This list of related sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the Contractor to see that the completed Work complies accurately with the Contract Documents.

1.02 REFERENCES

A. ASTM International (ASTM):

1. B 3 - Standard Specification for Soft or Annealed Copper Wire.
2. B 8 - Standard Specification for Concentric-Lay–Stranded Copper Conductors, Hard, Medium-Hard, or Soft.

B. CSA International (CSA).

C. Insulated Cable Engineers Association (ICEA):

1. NEMA WC 70/ICEA S-95-658-1999 - Standard for Nonshielded Power Cables Rated 2000 Volts or Less for the Distribution of Electrical Energy.
2. NEMA WC 57/ICEA S-73-532 - Standard for Control, Thermocouple Extension, and Instrumentation Cables.

D. National Fire Protection Association (NFPA):

1. 70 - National Electrical Code (NEC).
2. 72 - National Fire Alarm and Signaling Code.
3. 101 - Life Safety Code.

E. Telecommunications Industry Association/Electronics Industry Association (TIA/EIA):
    1. 568-C.2 - Balanced Twisted-Pair Telecommunication Cabling and Components Standard.
F. Underwriter's Laboratories Inc., (UL):
    1. 44 - Thermoset-Insulated Wires and Cables.
    2. 1424 - Standard for Cables for Power-Limited Fire-Alarm Circuits.
    3. 1569 - Standard for Metal-Clad Cables.
    4. 2196 - Standard for Tests for Fire Resistive Cables.
    5. 2225 - Standard for Cables and Cable-Fittings For Use in Hazardous (Classified) Locations.

1.03 DEFINITIONS

A. Definitions of terms and other electrical considerations as set forth in the:
    1. ASTM.
    2. ICEA.

1.04 SYSTEM DESCRIPTION

A. Furnish and install the complete wire and cable system.

1.05 SUBMITTALS

A. Product data:
    1. Manufacturer of wire and cable.
    2. Insulation:
        a. Type.
        b. Voltage class.
    3. American wire gauge (AWG) size.
    4. Conductor material.
    5. Pulling compounds.
B. Shop drawings:
    1. Show splice locations.
        a. For each proposed splice location provide written justification describing why the splice is necessary.
C. Test reports:
    1. Submit test reports for meg-ohm tests.

D. Calculations:

1. Submit cable pulling calculations to the Engineer for review and comment for all cables that will be installed using mechanical pulling equipment. Show that the maximum cable tension and sidewall pressure will not exceed manufacturer recommended values:

    a. Provide a table showing the manufacturer's recommended maximum cable tension and sidewall pressure for each cable type and size included in the calculations.

    b. Submit the calculations to the Engineer a minimum of 2 weeks before conduit installation.

1.06 QUALITY ASSURANCE

A. All wires and cables shall be UL listed and labeled.

PART 2 -PRODUCTS

2.01 MANUFACTURERS

A. One of the following or equal:

1. 600 volt class wire and cable:

    a. General Cable.

    b. Allied Wire and Cable.

    c. Southwire Company.

2. Instrumentation class wire and cable:

    a. Alpha Wire Company.

    b. Belden CDT.

    c. General Cable BICC Brand.

    d. Okonite Company.

    e. Rockbestos Surprenant Cable Corporation.

3. Network cables:

    a. Belden CDT.

    b. General Cable.

    c. CommScope.

B. Soft Starter Output Power Cable:

1. Section applies to power cables routed between the output of soft starter and motor terminals.

2. Cable shall be rated for 2000 volts and shall meet the requirements below:

    a. Conductors shall be stranded Class B bare copper.

b. All wire shall be brought to the job in unbroken packages and shall bear the data of manufacturing; not older than 12 months.

c. Type of wire shall be XLPE RHH/RHW-2 rated 90 degrees Celsius suitable for wet locations.

d. Provide overall 5 millimeter metallic shield (copper tape shield) overlapped 50 percent.

e. No wire smaller than No. 12 gauge shall be used unless specifically indicated.

f. Cable construction shall consist of three insulated current-carrying phase conductors and three bare ground conductors, symmetrically placed between the phase conductors, and twisted beneath a continuous overall PVC polymeric jacket.

C. Each ground conductor size (circular mil area) shall be one-third (1/3) of the NEC required size (circular mil area) for a single ground conductor. If one third of the required circular mil area does not correspond to a standard size (circular mil area) of construction, the next largest size of standard construction shall be used. All conductors shall be megger tested after installation and insulation must be in compliance with the Insulated Power Cable Engineers Association Minimum Values of Insulation Resistance.

D. Manufacturers:

1. General Cable .
2. Southwire.
3. Allied Wire and Cable.

2.02 MATERIALS

A. Conductors:

1. Copper in accordance with ASTM B 3.

2.03 MANUFACTURED UNITS

A. General:

1. Provide new wires and cables manufactured within 1 year of the date of delivery to the Site.
2. Permanently mark each wire and cable with the following at 24-inch intervals:
   a. AWG size.
   b. Voltage rating.
   c. Insulation type.
   d. UL symbol.
   e. Month and year of manufacture.

f. Manufacturer's name.

3. Identify and mark wire and cable:
   a. Use integral color insulation for Number 2 AWG and smaller wire.
   b. Wrap colored tape around cable larger than Number 2 AWG.

B. 600 volt class wire and cable:
   1. Provide AWG or kcmil sizes as indicated on the Drawings:
      a. When not indicated on the Drawings, size wire as follows:
         i. In accordance with the NEC:
            I. Use 75 degree Celsius ampacity ratings.
            II. Ampacity rating after all derating factors, equal to or greater than rating of the overcurrent device.
         ii. Provide Number 12 AWG minimum for power conductors.
         iii. Provide Number 14 AWG minimum for control conductors.
   2. Provide Class B stranding in accordance with ASTM B 8:
      a. Provide Class C stranding where extra flexibility is required.
   3. Insulation:
      a. XHHW-2.
      b. 90 degrees Celsius rating.
   4. Multiconductor cables:
      a. Number and size of conductors as indicated on the Drawings.
      b. Individual conductors with XHHW-2 insulation.
      c. Overall PVC jacket.
      d. Tray cable rated.
      e. Color-coding for control wire in accordance with ICEA Method 1, E-2 in accordance with NEMA WC 57/ICEA S-73-532.
      f. Ground conductor: Insulated green:
         i. Sized in accordance with NEC, unless otherwise noted on the electrical drawings.

C. Instrumentation class cable:
   1. Type TC.
   2. Suitable for use in wet locations.
   3. Voltage rating: 600 volts.
   4. Temperature rating:
      a. 90 degrees Celsius rating in dry locations.
      b. 75 degrees Celsius rating in wet locations.

5. Conductors:
    a. Insulation:
        i. Flame-retardant PVC, 15 mils nominal thickness, with nylon jacket 4 mils nominal thickness.
    b. Number 16 AWG stranded and tinned.
    c. Color code:
        i. Pair: Black and white.
        ii. Triad: Black, white and red.
        iii. Multiple pairs or triads:
            I. Color-coded and numbered.
6. Drain wire:
    a. 18 AWG.
    b. Stranded, tinned.
7. Jacket:
    a. Flame retardant, moisture and sunlight resistant PVC.
    b. Ripcord laid longitudinally under jacket to facilitate removal.
8. Shielding:
    a. Individual pair/triad:
        i. Minimum 1.35-mil double-faced aluminum foil/polyester tape overlapped to provide 100 percent coverage.
    b. Multiple pair or triad shielding:
        i. Group shield: Minimum 1.35-mil double-faced aluminum foil/polyester tape overlapped to provide 100 percent coverage.
        ii. Completely isolate group shields from each other.
        iii. Cable shield: 2.35 mils double-faced aluminum and synthetic polymer backed tape overlapped to provide 100 percent coverage.
    c. All shielding to be in contact with the drain wire.

D. Network cables:
1. Category 6:
    a. General:
        i. Provide all Cat 6 cables meeting the standards set by TIA/EIA-568-C.2.
        ii. The specified system is an unshielded balanced twisted-pair cabling system designed for 10 Gb/s networking environments.
        b. Conductors:
        i. 23 AWG solid bare copper or bonded pair conductors.

c. Insulation:
    i. Polyolefin or FEP.
    ii. 4 non-bonded twisted pair cables formed into a cable core.
d. Color code:
    i. Pair 1: White/blue stripe and blue.
    ii. Pair 2: White/orange stripe and orange.
    iii. Pair 3: White/green stripe and green.
    iv. Pair 4: White/brown stripe and brown.
e. Outer jacket:
    i. PVC with ripcord.
f. Electrical characteristics:
    i. Frequency range: 0.772-100 MHz.
    ii. Attenuation: 32.1 dB/100 m.
    iii. Near-end crosstalk (NEXT): 39.3 dB.
    iv. Power sum NEXT: 37.3 dB.
    v. Attenuation to crosstalk ratio (ACR): 7.2 dB.
    vi. Power sum attenuation to crosstalk ratio (PSACR): 5.3 dB/100 m.
    vii. Equal level far-end crosstalk (ELFEXT): 22.8 dB.
    viii. Power sum ELFEXT: 19.8 dB/100 m.
    ix. Return loss: 17.3 dB.
    x. Propagation delay: 537 ns/100 m.
    xi. Delay skew: 45 ns/100 m.
    xii. Propagation delay (skew), max: 2.5 ns/100 m.

E. Instrumentation, Type B-No. 16 AWG, Twisted, Shielded Pair Cable:
1. Use this instrumentation cable, where shown on drawings.
    a. Outer Jacket: 45-mil nominal thickness.
2. Individual Pair Shield: 1.35-mil, double-faced aluminum/synthetic polymer overlapped to provide 100 percent coverage.
3. Dimension: 0.31-inch nominal OD.
4. Conductors:
    a. Bare soft annealed copper, Class B, seven-strand concentric, meeting requirements of ASTM B8
    b. 20 AWG, seven-strand tinned copper drain wire.
    c. Insulation: 15-mil nominal PVC.

d. Jacket: 4-mil nominal nylon.

e. Color Code: Pair conductors black and red.

5. Manufacturers:

   a. Okonite Co.

   b. Alpha Wire Corp.

6. The following test shall be performed on instrumentation and control system cables. All tests shall be end-to-end test of installed cables with the ends supported in free air, not adjacent to any ground object. All test data shall be recorded on forms acceptable to the Engineer. Complete records of all tests shall be made and delivered to the Engineer.

   a. Continuity tests shall be performed by measuring wire/shield loop resistances of signal cable as the wires, taken one at a time, are shorted to the channel shield. No loop resistance measurement shall carry by more than $\pm$2 ohms from the calculated average loop resistance valve.

   b. Insulation resistance tests shall be performed by using a 500 volt megohmeter to measure the insulation resistance between each channel wire and channel shield, between individual channel shields in a multi-channel cable, between each individual channel and the overall cable shield in multi-channel cable, between each wire and ground, and between each shield and ground. Values of resistance less than 10 megohms shall be unacceptable.

2.04 ACCESSORIES

A. Wire ties:

   1. One of the following or equal:

      a. T&B "Ty-Rap" cable ties.

      b. Panduit cable ties.

2.05 GROUNDING CONDUCTORS

A. Equipment: Stranded copper with green, Type USE/RHH/RHW-XLPE for No.6 and larger, other use THHN/THWN, insulation.

B. Direct Buried: 4/0 Bare tinned stranded copper, unless otherwise noted on drawings

2.06 SOURCE QUALITY CONTROL

A. Assembly and testing of cable shall comply with the applicable requirements of ICEA S-95-658-1999.

B. Test Type XHHW-2 in accordance with the requirements of UL 44.

PART 3 -EXECUTION

3.01 INSTALLATION

A. Color-coding:

1. Color-coding shall be consistent throughout the facility.
2. The following color code shall be followed for all 240/120 volt and 208/120 volt systems:
    a. Phase A - Black.
    b. Phase B - Red.
    c. Phase C - Blue.
    d. Single phase system - Black for one hot leg, red for the other.
    e. Neutral - White.
    f. High phase or wild leg - Orange.
    g. Equipment ground - Green.
3. The following color code shall be followed for all 480/277 volt systems:
    a. Phase A - Brown.
    b. Phase B - Orange.
    c. Phase C - Yellow.
    d. Neutral - Gray.
    e. Equipment ground - Green.
4. The following color code shall be followed for all 120 VAC control wiring:
    a. Power - Red.
    b. Neutral - White.
5. The following color code shall be followed for all general purpose DC control circuits:
    a. Grounded conductors - White with blue stripe.
    b. Ungrounded conductors - Blue.
6. Switch legs shall be violet. Three-way switch runners shall be pink.
7. Wires in intrinsically safe circuits shall be light blue.
8. Wire colors shall be implemented in the following methods:
    a. Wires manufactured of the desired color.
    b. Continuously spiral wrap the first 6 inches of the wire from the termination point with colored tape:
        i. Colored tape shall be wrapped to overlap 1/2 of the width of the tape.

B. Install conductors only after the conduit installation is complete, and all enclosures have been vacuumed clean, and the affected conduits have been swabbed clean and dry:

   1. Install wires only in approved raceways.
   2. Do not install wire:
      a. In incomplete conduit runs.
      b. Until after the concrete work and plastering is completed.

C. Properly coat wires and cables with pulling compound before pulling into conduits:

   1. For all Number 4 AWG and larger, use an approved wire-pulling lubricant while cable is being installed in conduit:
      a. Ideal Products.
      b. Polywater Products.
      c. 3M Products.
      d. Greenlee Products.
      e. Or equal as recommended by cable manufacturer.
      f. Do not use oil, grease, or similar substances.

D. Cable pulling:

   1. Prevent mechanical damage to conductors during installation.
   2. For cables Number 1 AWG and smaller, install cables by hand.
   3. For cables larger than Number 1 AWG, power pulling winches may be used if they have cable tension monitoring equipment.
   4. Provide documentation that maximum cable pulling tension was no more than 75 percent of the maximum recommended level as published by the cable manufacturer. If exceeded, the Engineer may, at his discretion, require replacement of the cable.
   5. Ensure cable pulling crews have all calculations and cable pulling limitations while pulling cable.
   6. Make splices or add a junction box or pullbox where required to prevent cable pulling tension or sidewall pressure from exceeding 75 percent of manufacturer's recommendation for the specified cable size:
      a. Make splices in manholes or pull boxes only.
      b. Leave sufficient slack to make proper connections.

E. Use smooth-rolling sheaves and rollers when pulling cable into cable tray to keep pulling tension and bending radius within manufacturer's recommendations.

F. Install and terminate all wire in accordance with manufacturer's recommendations.

G. Neatly arrange and lace conductors in all switchgear, panelboards, pull boxes, and terminal cabinets by means of wire ties:

   1. Do not lace wires in gutter or panel channel.

2. Install all wire ties with a flush cutting wire tie installation tool:
    a. Use a tool with an adjustable tension setting.
3. Do not leave sharp edges on wire ties.

H. Terminate stranded conductors on equipment box lugs such that all conductor strands are confined within the lug:
1. Use ring type lugs if box lugs are not available on the equipment.

I. Splices:
1. Provide continuous circuits from origin to termination.
2. If approved by the Engineer, splices shall be allowed for long wire or cable lengths that exceed standard manufactured lengths:
    a. Splice box NEMA rating requirements as specified in Section 26 05 00.
    b. Make splices in labeled junction boxes for power conductors.
    c. Make splices for control and instrument conductors in terminal boxes:
        i. Provide terminal boards with setscrew pressure connectors, with spade or ring lug connectors.
3. Clearly label junction and terminal boxes containing splices with the word "SPLICE LOCATED WITHIN".
4. Leave sufficient slack at junction boxes and termination boxes to make proper splices and connections. Do not pull splices into conduits.
5. Install splices with compression type butt splices and insulate using a heat-shrink sleeve:
    a. In NEMA Type 4 or NEMA Type 4X areas, provide heat-shrink sleeves that are listed for submersible applications.
6. Splices in below grade pull boxes, in any box subject to flooding, and in wet areas shall be made waterproof using:
    a. A heat shrink insulating system listed for submersible applications.
    b. Or an epoxy resin splicing kit.

J. Apply wire markers to all wires at each end after being installed in the conduit and before meg-ohm testing and termination.

K. Instrumentation class cable:
1. Install instrumentation class cables in separate raceway systems from power cables:
    a. Install instrument cable in PVC conduit within non-dedicated manholes or pull boxes.
    b. Install cable without splices between instruments or between field devices and instrument enclosures or panels.
2. Do not make intermediate terminations, except in designated terminal boxes as indicated on the Drawings.

L. Multi-conductor cable:

1. Where cable is not routed in conduit with a separate ground conductor, use one conductor in the cable as a ground conductor:

    a. Use an internal ground conductor, if it is no smaller than as indicated on the Drawings and in accordance with NEC requirements for equipment ground conductor size.

    b. Where 2 parallel cables are used, and the internal ground conductor in each cable does not meet NEC requirements for the combined circuit, use 4-conductor cable, with one of the full-sized conductors serving as ground.

M. Soft Starter cable:

1. Install cables in raceway.

2. Install cables as per manufacturer's recommendation. Provide all necessary connectors as recommended by the VFD cable manufacturer and install accordingly.

3.02 COMMISSIONING AND PROCESS START-UP

A. As specified in Section 00 16 55.

END OF SECTION

SECTION 5.2

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

To the County Standard Specifications, ADD the following:

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes:

1. Mounting and supporting electrical equipment and components.

B. Related sections:

1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
2. It is the Contractor's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of Contractor's Work.
3. The following sections are related to the Work described in this Section. This list of related sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the Contractor to see that the completed Work complies accurately with the Contract Documents.

1.02 REFERENCES

A. ASTM International (ASTM):

1. A 123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
2. A 153 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
3. A 240 – Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.

1.03 SYSTEM DESCRIPTION

A. Design requirements:

1. Conform to the requirements of the applicable Building Code.
2. Demonstrate the following using generally accepted engineering methods:
   a. That the anchors to the structure are adequate to resist the loads generated in accordance with the Building Code and equipment requirements.
   b. That the required load capacity of the anchors can be fully developed in the structural materials to which they are attached.

3. Design loading and anchoring requirements:
    a. As indicated in the Building Code unless otherwise specified.
    b. Seismic loading requirements:
        i. Freestanding or wall-hung equipment shall be anchored in place by methods that will satisfy the requirements for the seismic design specified.
    c. Wind loading requirements:
        i. All exterior freestanding equipment shall be anchored in place by methods that will satisfy the requirements for wind design.
    d. Minimum safety factor against overturning: 1.5.
    e. The foundation and structures to which hangers and supports are attached shall be capable of withstanding all anchor loads.

B. Performance requirements:
    1. Hangers and supports individually and as a system shall resist all weights and code-required forces without deflections and deformations that would damage the supporting elements, the equipment supported, or the surrounding construction.

1.04 SUBMITTALS

A. Product data:
    1. Supports:
        a. Materials.
        b. Geometry.
        c. Manufacturer.
    2. Hardware:
        a. Materials.
        b. Manufacturer.

B. Shop drawings:
    1. Complete dimensioned and scalable shop drawings of all supporting structures, trapezes, wall supports, etc.
    2. Complete anchoring details for equipment, lighting and raceway, supporting structures, trapezes, wall supports for all equipment in excess of 200 pounds, and all freestanding supports:
        a. Stamped by a professional engineer licensed in the state where the Project is being constructed.
        b. Said submittals, by virtue of the fact that they bear the stamp of a registered engineer, will be reviewed for general consistency with the requirements specified in the Contract Documents, but not for context, accuracy, or method of calculation.

3. Include data on attachment hardware and construction methods that will satisfy the design loading and anchoring criteria.

C. Installation instructions:

1. Furnish anchorage instructions and requirements based on the seismic and wind conditions of the Site:

a. Stamped by a professional engineer licensed in the state where the Project is being constructed.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. One of the following or equal:

1. Thomas & Betts.
2. Power-Strut.
3. Unistrut.
4. Cooper B-Line.
5. Robroy.
6. Aickinstrut.

2.02 MATERIALS

A. Use materials appropriate for the area where work is being performed. All work installed outdoors shall be 316 stainless steel. All work installed indoors in air conditioned dry clean areas shall be galvanized steel. All work installed indoors in non-air conditioned rooms shall be 316 stainless steel.

B. Hot dip galvanized steel:

1. Supports:

a. In accordance with ASTM A 123 or A 153.

b. Minimum zinc coating thickness of 2.5 mils.

2. Hardware:

a. Electro-galvanized.

b. In accordance with ASTM A 153.

C. Stainless steel:

1. Supports:

a. In accordance with ASTM A 240.

b. ANSI Type 316 material.

2. Hardware:

a. ANSI Type 316 material.

D. PVC coated galvanized steel:
    1. Supports:
        a. Hot dip galvanized steel as specified in this Section.
        b. PVC coating thickness of 10 to 20 mils.
    2. Hardware:
        a. ANSI Type 316 material.

E. Fiberglass:
    1. Supports:
        a. Vinyl ester.
    2. Hardware:
        a. Polypropylene.
        b. Thermal plastic elastomer.
        c. Fiberglass reinforced plastic.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Mount all raceways, cabinets, boxes, fixtures, instruments, and devices on Contractor-fabricated racks unless otherwise indicated on the Drawings.
    1. Provide the necessary sway bracing to keep trapeze type structures from swaying.

B. Brace and anchor freestanding equipment supports using methods that provide structural support based on the seismic loads and wind loads:
    1. Lateral deflection at top of supports not to exceed support height divided by 240 unless otherwise approved by the Engineer.

C. Provide fabricated steel support pedestals for wall mounted panels that weigh more than 200 pounds:
    1. Fabricate pedestals out of welded angle, tube sections, or preformed channel.
    2. If the supported equipment is a panel or cabinet, match the supported equipment in physical appearance and dimensions.
    3. Provide auxiliary floor supports for transformers hung from stud walls and weighing more than 200 pounds.
    4. Mount all equipment, cabinets, boxes, instruments, and devices in damp or wet locations on minimum of 7/8-inch preformed mounting channel.
        a. Mount channel vertically along the length of the device so that water or moisture may run freely behind the device.

D. Corrosion protection:
    1. Isolate dissimilar metals, except where required for electrical continuity.

a. Use neoprene washers, 9-mil polyethylene tape, or gaskets for isolation.

E. Raceway:

1. Furnish all conduit racks and trapeze structures needed to support the raceway from the structure.

a. Group conduits and position on racks to minimize crossovers.

b. Provide the necessary bracing to keep trapeze type structures from swaying under loads from cable installation, seismic forces, or wind forces.

F. Anchoring methods:

1. Solid concrete: Anchor bolts, anchor rods or post-installed anchors.

2. Metal surfaces: Machine screws or bolts.

3. Hollow masonry units: Post-installed anchors.

G. When supporting devices on metal or wood stud construction, bridge studs with preformed channel, and mount the devices to the channel.

H. Re-coat all scratches, cuts, and drilled holes in galvanized surfaces with CRC "Zinc-It" or similar product.

I. Re-coat all drilled holes and cut surfaces on PVC-coated materials.

J. Seal all drilled holes and cut surfaces on fiberglass materials.

END OF SECTION

SECTION 5.3

RACEWAYS AND FITTINGS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Metallic conduits.
2. Nonmetallic conduits.
3. Conduit bodies.
4. Conduit fittings and accessories.
5. Conduit installation.

B. Related Sections:

1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
2. It is the Contractor's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of Contractor's Work.
3. The following sections are related to the Work described in this Section. This list of related sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the Contractor to see that the completed Work complies accurately with the Contract Documents.

1.02 REFERENCES

A. American National Standards Institute (ANSI):

1. C80.1 - Electrical Rigid Steel Conduit.
2. C80.3 - Steel Electrical Metallic Tubing.
3. C80.5 - Electrical Rigid Aluminum Conduit.
4. C80.6 - Electrical Intermediate Metal Conduit.

B. National Electrical Manufacturer's Association (NEMA):

1. RN-1 - Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Steel Conduit.
2. TC2 - Electrical Polyvinyl Chloride (PVC) Conduit.
3. TC3 - Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing.
4. TC7 - Smooth-Wall Coilable Electrical Polyethylene Conduit.
5. TC13 - Electrical Nonmetallic Tubing.
6. TC14 - Reinforced Thermosetting Resin Conduit (RTRC) and Fittings.

C. Underwriters Laboratories (UL):

1. 1 - Standard for Flexible Metal Conduit.

2. 6 - Standard for Electrical Rigid Metal Conduit - Steel.
3. 6A - Standard for Electrical Rigid Metal Conduit - Aluminum, Red Brass, and Stainless Steel.
4. 360 - Standard for Liquid-Tight Flexible Steel Conduit.
5. 651 - Standard for Schedule 40 and 80 Rigid PVC Conduit and Fittings.
6. 651B - Standard for Continuous Length HDPE Conduit.
7. 797 - Standard for Electrical Metallic Tubing - Steel.
8. 1242 - Standard for Electrical Intermediate Metal Conduit - Steel.
9. 1653 - Standard for Electrical Nonmetallic Tubing.
10. 1660 - Standard for Liquid-Tight Flexible Nonmetallic Conduit.
11. 1684 - Standard for Reinforced Thermosetting Resin Conduit (RTRC) and Fittings.

1.03 DEFINITIONS

A. Specific Definitions and Abbreviations:

1. Conduit bodies: A separate portion of a conduit system that provides access through a removable cover to the interior of the system at a junction of 2 or more conduit sections. Includes, but not limited to: shapes C, E, LB, T, X, etc.
2. Conduit fitting: An accessory that serves primarily a mechanical purpose. Includes, but not limited to: bushings, locknuts, hubs, couplings, reducers, etc.
3. GRC: Galvanized rigid steel conduit.
4. PCS: PVC coated rigid steel conduit.
5. PCA: PVC coated rigid aluminum conduit.
6. IMC: Intermediate metallic conduit.
7. EMT: Electrical metallic tubing.
8. PVC: Polyvinyl chloride rigid nonmetallic conduit.
9. HDPE: High density polyethylene conduit.
10. SLT: Sealtight – liquid-tight flexible conduit.
11. EFLX: Explosionproof flexible conduit.
12. FLX: Flexible metallic conduit.
13. NFC: Nonmetallic flexible conduit.
14. ENT: Electrical nonmetallic tubing.
15. RAC: Rigid aluminum conduit.
16. FRD: Fiberglass reinforced duct.
17. NPT: National pipe thread.

1.04 SYSTEM DESCRIPTION

A. Provide Conduits, Conduit Bodies, Fittings, Junction Boxes And All Necessary Components, Whether Or Not Indicated On The Drawings, As Required, To Install A Complete Electrical Raceway System.

1.05 SUBMITTALS

A. Product Data:

1. Furnish complete manufacturer's catalog sheets for every type and size of conduit, fitting, conduit body, and accessories to be used on the Project.
2. Furnish complete manufacturer's recommended special tools to be used for installation if required.
3. Certified test results for PVC-coated metallic conduit showing the adhesive bond is stronger than the tensile strength of the PVC.

B. Certifications:

1. Furnish PVC-coated conduit manufacturer's certification for each installer.

C. Record Documents:

1. Incorporate all changes in conduit routing on electrical plan drawings.
2. Dimension underground and concealed conduits from building lines.
3. Furnish hard copy drawings and electronic files in 22 inch by 34 inch AutoCAD format Version: 2015 and PDF format.

D. Installation Drawings: Installation Drawings, Including Individual Conduit Numbers, Routing, Sizes, Cable Sizes, And Circuit Numbers For Each Conduit.

1.06 QUALITY ASSURANCE

A. All Conduits, Conduit Bodies, And Fittings Shall Be UL Listed And Labeled.

B. Every Installer Of PCA Or PCS Conduits Shall Be Certified By The Manufacturer For Installation Of The Conduit.

1.07 DELIVERY, STORAGE, and HANDLING

A. Do Not Expose Type PVC, FRD, NFC And ENT To Direct Sunlight.

B. Do Not Store Conduit In Direct Contact With The Ground.

C. Do Not Store Aluminum Conduit In Contact With Concrete.

1.08 SEQUENCING

A. Before Installing Any Conduit Or Locating Any Device Box:

1. Examine the complete set of Drawings and Specifications, and all applicable shop drawings.

2. Verify all dimensions and space requirements and make any minor adjustments to the conduit system as required to avoid conflicts with the building structure, other equipment, or the work of other trades.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Galvanized Rigid Steel Conduit:
   1. One of the following or equal:
      a. Western Tube and Conduit.
      b. Allied Tube and Conduit.
      c. Wheatland Tube Co.

B. Polyvinyl Chloride Coated Rigid Steel Conduit:
   1. One of the following or equal:
      a. Robroy Industries.
      b. Ocal, Inc.
      c. Calbond.

C. Intermediate Metallic Conduit:
   1. One of the following or equal:
      a. Allied Tube and Conduit.
      b. Western Tube and Conduit.

D. Electrical Metallic Tubing:
   1. One of the following or equal:
      a. Allied Tube and Conduit.
      b. Western Tube and Conduit.

E. Rigid Aluminum Conduit:
   1. One of the following or equal:
      a. Allied Tube and Conduit.
      b. Patriot Aluminium Products.
      c. Republic Conduit.
      d. Wheatland Tube Co.

F. Polyvinyl Chloride Coated Aluminum Conduit:
   1. One of the following or equal:
      a. Robroy Industries.
      b. Ocal, Inc.
      c. Calbond.

G. Flexible Metallic Conduit:
    1. One of the following or equal:
        a. AFC Cable Systems.
        b. Southwire.
        c. Electri-flex Company.
H. Flexible Nonmetallic Conduit:
    1. One of the following or equal:
        a. Electriflex.
        b. Carlon.
        c. Anaconda.
        d. Liquatite.
I. Sealtight Liquid-Tight Flexible Conduit:
    1. One of the following or equal:
        a. Southwire.
        b. AFC Cable Systems.
        c. Electriflex.
        d. Anaconda.
J. Explosionproof Flexible Conduit:
    1. One of the following or equal:
        a. Appleton.
        b. Crouse Hinds.
        c. Hubbell Killark.
K. Rigid Nonmetallic Polyvinyl Chloride Conduit:
    1. One of the following or equal:
        a. Carlon.
        b. Cantex.
        c. Triangle Conduit and Cable.
L. Electrical Nonmetallic Tubing:
    1. One of the following or equal:
        a. Carlon Flex-Plus Blue.
        b. Specified Technologies, Inc.
M. High Density Polyethylene Conduit:
    1. One of the following or equal:
        a. Carlon.

b. Endot Industries.
c. Blue Diamond Industries.

N. Inner Duct:
1. One of the following or equal:
a. Carlon.
b. Endot Industries.
c. MaxCell.

O. Fiberglass Reinforced Duct:
1. One of the following or equal:
a. Champion Fiberglass.
b. Smith Fiberglass.
c. FRE Composites.

P. Conduit Bodies:
1. One of the following or equal:
a. Crouse-Hinds.
b. Appleton.
c. O-Z / Gedney.
d. Ocal.
e. Robroy.
f. Calbond.
g. Carlon.

Q. Joint Compound:
1. Thomas and Betts.
2. Or Equal.

R. Galvanized Rigid Steel Conduit Expansion Fittings:
1. One of the following or equal:
a. Crouse-Hinds.
b. Appleton.
c. O-Z / Gedney.

S. Conduit Sleeve:
1. One of the following or equal:
a. Crouse-Hinds.
b. Appleton.
c. O-Z / Gedney.

T. Conduit Seals:
    1. One of the following or equal:
        a. Appleton.
        b. Crouse-Hinds.
        c. O-Z / Gedney.
U. Conduit Hangers And Supports:
V. Conduit Through Wall And Floor Seals:
    1. The following or equal:
        a. O-Z/Gedney:
            i. Type "WSK".
            ii. Type “CSM”.

2.02 COMPONENTS

A. GRC:
    1. All threads: NPT standard conduit threads with a 3/4-inch taper per foot:
        a. Running conduit threads are not acceptable.
    2. Hot-dip galvanized inside and out:
        a. Ensures complete coverage and heats the zinc and steel to a temperature that ensures the zinc alloys with the steel over the entire surface.
        b. Electro-galvanizing is not acceptable.
    3. Manufactured in accordance with:
        a. UL-6.
        b. ANSI C80.1.
B. PCS:
    1. The steel conduit, before PVC coating, shall be new, unused, hot-dip galvanized material, conforming to the requirements for type GRC.
    2. Coated conduit NEMA Standard RN-1:
        a. The galvanized coating may not be disturbed or reduced in thickness during the cleaning and preparatory process.
    3. Factory bonded PVC jacket:
        a. The exterior galvanized surfaces shall be coated with primer before PVC coating to ensure a bond between the zinc substrate and the PVC coating.
        b. Nominal thickness of the exterior PVC coating shall be 0.040 inch except where part configuration or application of the piece dictate otherwise.
        c. PVC coating on conduit and associated fittings shall have no sags, blisters, lumps, or other surface defects and free of holes and holidays.

d. The PVC adhesive bond on conduit and fittings shall be greater than the tensile strength of the PVC plastic coating:

i. Confirm bond with certified test results.

4. A urethane coating shall be uniformly and consistently applied to the interior of all conduit and fittings:

a. Nominal thickness of 0.002 inch.

b. Conduit having areas with thin or no coating are not acceptable.

c. All threads shall be coated with urethane.

5. The PVC exterior and urethane interior coatings applied to the conduit shall afford sufficient flexibility to permit field bending without cracking or flaking at temperature above 30 degrees Fahrenheit (-1 degree Celsius).

6. PCS conduit bodies and fittings:

a. Malleable iron.

b. The conduit body, before PVC coating, shall be new, unused material and shall conform to appropriate UL standards.

c. The PVC coating on the outside of conduit bodies shall be 0.040 inch thick and have a series of longitudinal ribs to protect the coating from tool damage during installation.

d. 0.002 inch interior urethane coating.

e. Utilize the PVC coating as an integral part of the gasket design.

f. Stainless steel cover screws heads shall be encapsulated with plastic to assure corrosion protection.

g. A PVC sleeve extending 1 conduit diameter or 2 inches, whichever is less, shall be formed at each female conduit opening.

i. The inside diameter of the sleeve shall be the same as the outside diameter of the conduit to be used.

ii. The sleeve shall provide a vapor and moisture tight seal at every connection.

C. IMC:

1. Hot-dip galvanized and chromated, including threads.

2. Conduit interior coated with a silicone epoxy-ester lubricant.

3. NPT standard conduit threads with a 3/4-inch taper per foot.

a. Running conduit threads are not acceptable.

b. Hot galvanized after cutting.

D. EMT:

1. Hot-dip galvanized inside and out and finally exterior chromated and lacquered:

a. Electro-galvanizing is not acceptable.

2. Organic corrosion resistant I.D. coating.

E. RAC:

1. Material:
   a. Extruded from 6063 alloy in temper designation T-1.
   b. Maximum 1/10 percent copper content.
   c. Containing lubricating inside liners.
2. NPT standard threads with a 3/4-inch taper per foot:
   a. Running conduit threads are not acceptable.
3. Provide aluminum fittings and conduit bodies.

F. PCA:

1. The aluminum conduit, before PVC coating, shall be new, unused, aluminum conduit and shall conform to the requirements for Type RAC.
2. Factory bonded PVC jacket:
   a. Nominal thickness of the exterior PVC coating shall be 0.040 inch except where part configuration or application of the piece dictate otherwise.
   b. PVC coating on conduit and associated fittings shall have no sags, blisters, lumps, or other surface defects and free of holes and holidays.
3. The PVC adhesive bond on conduit and fittings shall be greater than the tensile strength of the PVC plastic coating:
   a. Confirm bond with certified test results.
4. A urethane coating shall be uniformly and consistently applied to the interior of all conduit and fittings:
   a. Nominal thickness of 0.002 inch.
   b. Conduit having areas with thin or no coating are not acceptable.
   c. All threads shall be coated with urethane.
5. The PVC exterior and urethane interior coatings applied to the conduit shall afford sufficient flexibility to permit field bending without cracking or flaking at temperature above 30 degrees Fahrenheit (-1 degree Celsius).
6. PCA conduit bodies and fittings:
   a. Copper-free cast aluminum.
   b. The conduit body, before PVC coating, shall be new, unused material and shall conform to appropriate UL standards.
   c. The PVC coating on the outside of conduit bodies shall be 0.040 inch thick and have a series of longitudinal ribs to protect the coating from tool damage during installation.
   d. 0.002 inch interior urethane coating.
   e. Utilize the PVC coating as an integral part of the gasket design.

f. Stainless steel cover screws heads shall be encapsulated with plastic to assure corrosion protection.

g. A PVC sleeve extending 1 conduit diameter or 2 inches, whichever is less, shall be formed at each female conduit opening.

i. The inside diameter of the sleeve shall be the same as the outside diameter of the conduit to be used.

ii. The sleeve shall provide a vapor and moisture tight seal at every connection.

G. FLX:

1. Materials:

a. Single strip aluminum alloy.

b. Single strip steel hot-dip galvanized on all 4 sides before conduit fabrication.

2. Interlocking design formed from continuous metal strip for integrity and flexibility.

3. Manufactured in accordance with:

a. UL-1.

H. NFC:

1. Provide liquid-tight and corrosion resistant flexible nonmetallic conduit and fittings.

2. Fabricated from a hard PVC spiral completely surrounded by flexible PVC:

a. UL listed for sunlight resistance.

b. Suitable for use at conduit temperatures of 80 degrees Celsius dry, 60 degrees Celsius wet, and 60 degrees Celsius oil resistant.

3. Temperature range -20 degrees Celsius to +80 degrees Celsius.

I. SLT:

1. Temperature rated for use in the ambient temperature at the installed location but not less than the following:

a. General purpose:

i. Temperature range -20 degrees Celsius to +80 degrees Celsius.

b. Oil resistant:

i. Temperature range -20 degrees Celsius to +60 degrees Celsius.

2. Sunlight resistant, weatherproof, and watertight.

3. Manufactured from single strip steel, hot-dip galvanized on all 4 sides before conduit fabrication.

4. Strip steel spiral wound resulting in an interior that is smooth and clean for easy wire pulling.

5. Overall polyvinyl chloride jacket.

6. With integral copper ground wire, built in the core, in conduit trade sizes 1/2 inch through 1-1/4 inch.

J. EFLX:
    1. Suitable for the hazardous Class and Group where installed:
    2. Metallic braid shall provide continuous electrical path.
    3. Stainless steel construction.
    4. Provide fittings and unions as required for the installation.
K. PVC:
    1. Extruded from virgin polyvinyl chloride compound:
        a. Schedule 40 unless otherwise specified.
        b. Schedule 80 extra heavy wall where specified.
    2. Rated for 90 degrees Celsius conductors or cable.
    3. Rated for use in direct sunlight.
L. Ent:
    1. Corrugated thermoplastic construction.
    2. Trade sizes 1/2 inch through 2 inches.
M. HDPE:
    1. High density polyethylene.
    2. Smooth wall.
    3. Schedule 40**.**
    4. Manufacturered in accordance with:
        a. UL 651B.
        b. NEMA TC-7.
N. Inner Duct:
    1. HDPE and fabric inner duct are considered interchangeable.
    2. HDPE inner duct:
        a. High density polyethylene.
        b. Corrugated.
        c. Resin properties:
            i. Density, g/cm^3: 0.941 to 0.955.
            ii. Melt index g/10 minute Condition E: 0.05 to 0.5.
            iii. Flexural modulus, MPa (pounds per square inch): 80,000 minimum.
            iv. Tensile strength at yield (pounds per square inch): 3,000 minimum.
            v. Environmental stress crack resistance condition B, F_{10}: 96 hours minimum.
            vi. Brittleness temperature: -75 degrees Celsius.
        d. Size: 1.25-inch.

e. Colors: gray.

3. Fabric inner duct:
    a. White polyester and nylon resin polymer textile.
    b. Standard outdoor textile inner duct:
        i. 3-inch multi-cell inner duct containing pull tape in each cell.
    c. Color-coded.
    d. Pull tape:
        i. 1250 lb.
        ii. Synthetic fiber polyester, flat woven.
        iii. Printed sequential footage marks.

O. PVC Conduit DB-120:
1. Use only where approved for use as service entrance conduit, by the serving utility company.
2. Red in color.
3. Install per utility company standards unless otherwise indicated on the Drawings.

P. FRD:
1. Suitable for use at -40 degrees Celsius to 110 degrees Celsius.
2. Integral bell and spigot either glued together or assembled with an integral urethane tri-seal gasket held in place with a retainer ring.
3. For underground use only.
4. Conduit and fittings shall be pigmented with UV inhibiting carbon black.

Q. Conduit Bodies:
1. Material consistent with conduit type:
    a. Malleable iron bodies and covers when used with type GRC conduit.
    b. Cast aluminum bodies and covers when used with type RAC.
    c. PVC bodies and covers when used with type PVC.
    d. PVC-coated malleable iron bodies and covers when used with type PCS.
    e. PVC-coated copper-free cast aluminum bodies and covers when used with type PCA.
    f. Malleable iron or aluminum bodies with pressed steel or aluminum covers when used with EMT conduit.
2. Conduit bodies to conform to Form 8, Mark 9, or Mogul design:
    a. Mogul design conforming to NEC requirements for bending space for large conductors for conduit trade sizes of 1 inch and larger with conductors #4 AWG and larger, or where required for wire bending space.
3. Gasketed covers attached to bodies with stainless steel screws secured to threaded holes in conduit body.

2.03 ACCESSORIES

A. Connectors And Fittings:

1. Manufactured with compatible materials to the corresponding conduit.

B. Insulated Throat Metallic Bushings:

1. Construction:

a. Malleable iron or zinc plated steel when used with steel conduit.

b. Aluminum when used with aluminum conduit.

c. Positive metallic conduit end stop.

d. Integrally molded non-combustible phenolic insulated surfaces rated 150 degrees Celsius.

e. Use fully insulated bushings on nonmetallic conduit system made of high impact 150 degrees Celsius rated non-combustible thermosetting phenolic.

C. Insulated Grounding Bushings:

1. Construction:

a. Malleable iron or steel, zinc plated, with a positive metallic end stop.

b. Integrally molded non-combustible phenolic insulated surfaces rated 150 degrees Celsius.

c. Tin plated copper grounding saddle for use with copper or aluminum conductors.

D. Electrical Unions (Erickson Couplings):

1. Construction:

a. Malleable iron for use with steel conduit.

b. Aluminum for use with aluminum conduit.

c. Concrete tight, 3-piece construction.

d. Rated for Class I Division 1 Group D in hazardous areas.

E. FLX Fittings:

1. Provide insulated die-cast connectors with ridges that thread into the inside of the conduit to achieve a force fit.

2. Binding screw connectors are not acceptable.

F. SLT Fittings:

1. Construction:

a. Malleable iron.

b. Furnished with locknut and sealing ring.

c. Liquid-tight, rain-tight, oil-tight.

d. Insulated throat.

e. Furnish as straight, 45-degree elbows and 90-degree elbows.

f. Designed to prevent sleeving:

i. Verify complete bonding of the raceway jacket to the plastic gasket seal.

g. Equipped with grounding device to provide ground continuity irrespective of raceway core construction. Grounding device, if inserted into raceway and directly in contact with conductors, shall have rolled over edges for sizes under 5 inches.

h. Where terminated into a threadless opening using a threaded hub fitting, a suitable moisture resistant/oil resistant synthetic rubber gasket shall be provided between the outside of the box or enclosure and the fitting shoulder. Gasket shall be adequately protected by and permanently bonded to a metallic retainer.

2. Corrosion resistant and outdoor SLT fittings:

a. Construction:

i. PVC-coated liquid-tight fittings with a bonded 0.040-inch thick PVC coating on the metal connector to form a seal around the SLT conduit.

ii. Insulated throat and an integral sealing ring.

G. Hubs For Threaded Attachment Of Steel Conduit To Sheet Metal Enclosures:

1. Construction:

a. Insulated throat.

b. PVC coated when used in corrosive areas.

c. Bonding locknut.

d. Recessed neoprene O-ring to assure watertight and dust-tight connector.

e. One half (1/2)-inch through 1-1/4-inch steel zinc electroplated.

f. One and one half (1-1/2)-inch through 6-inch malleable iron zinc plated.

g. Aluminum with aluminum conduit.

2. Usage:

a. All conduits in damp, wet, outdoor, and corrosive areas shall use threaded hubs for connections to sheet metal enclosures.

H. Sealing Fittings:

1. Construction:

a. 40 percent wire fill capacity.

b. PVC-coated when used in corrosive areas.

c. Malleable ductile iron with steel conduit.

d. Aluminum with aluminum conduit.

e. Crouse-Hinds Type EYSR where required for submersible cables.

f. Crouse-Hinds Type EYD where drains are required.

g. Crouse-Hinds Type EYS where drains are not required.

h. UL listed for use in Class I, Division 1, Groups A, B, C, D; Class I, Division 2, Groups A, B, C, D; Class II, Divisions 1 and 2; Groups E, F, and G.

2. Sealing compound:
   a. Fiber filler and cement as recommended by the sealing fitting manufacturer.
   b. Approved for the conditions and use.
      i. Not affected by surrounding atmosphere or liquids.
   c. Melting point shall be 200 degrees Fahrenheit minimum.

I. PVC Fittings:
1. Shall include the following:
   a. Couplings.
   b. Terminal adapters.
   c. Female adapters.
   d. Caps.
   e. Reducer bushings.
   f. Duct couplings.
   g. End bells.
   h. Expansion couplings.
   i. Duct couplings 5 degree.
   j. C - pull fittings.
   k. E - pull fittings.
   l. LB - pull fittings.
   m. LL - pull fittings.
   n. LR - pull fittings.
   o. T - pull fittings.
   p. X - pull fittings.
   q. Service entrance caps.
2. Materials:
   a. All devices shall be made of PVC, using the same materials as used for Type PVC conduit.
   b. All metal hardware shall be stainless steel.

J. Through Wall And Floor Seals:
1. Materials:
   a. Body: casting of malleable or ductile iron with a hot-dip galvanized finish.
   b. Grommet: neoprene.
   c. Pressure rings: PVC coated steel.

d. Disc material: PVC coated steel.

e. Aluminum when used with conduit type RAC.

K. Expansion/Deflection Couplings:

1. Use to compensate for movement in any directions between 2 conduit ends that they connect.
2. Shall allow movement of 3/4 inch from the normal in all directions.
3. Shall allow angular movement for a deflection of 30 degrees from normal in any direction.
4. Constructed to maintain electrical continuity of the conduit system.
5. Materials:
   a. End couplings: Bronze or galvanized ductile iron.
   b. Sleeve: Neoprene.
   c. Bands: Stainless steel.
   d. Bonding jumper: Tinned copper braid.

L. Expansion Couplings:

1. Shall allow for expansion and contraction of conduit:
   a. Permitting 8-inch movement, 4 inches in either direction.
2. Constructed to maintain electrical continuity of the conduit system.
3. Materials:
   a. Head: Malleable or ductile iron.
   b. Sleeve: Steel.
   c. Insulating bushing: Phenolic.
   d. Finish: Hot-dip galvanized.
   e. Aluminum when used with conduit type RAC.

M. Inner Duct Couplings And Fittings:

1. HDPE inner duct:
   a. Couplings:
      i. Self-threading.
      ii. Nonmetallic.
   b. Fittings:
      i. Multi-access fitting:
         I. 4 hole.
         II. Sized for conduit containing inner duct.
      ii. Duct plugs:
         I. Sized for inner duct diameter.

II. Install in all both ends of all unused ducts.

iii. Split plugs:

I. Sized for inner duct and cable diameters.

II. Install at both ends of all utilized ducts.

2. Fabric inner duct:

a. Termination bags:

i. Inflation-type bags for sealing and securing around one or more textile inner ducts and cables within 2-inch outside diameter or larger conduit.

N. EMT Connectors And Couplings:

1. Construction:

a. Compression connectors and couplings shall be concrete tight.

b. All connectors shall have insulated throats.

c. All connectors shall be compression type.

2.04 CONDUIT APPLICATION

1. Aluminum: Exposed indoor and outdoor runs in non-corrosive areas.
2. PVC Schedule 40: Underground, embedded in or under structural concrete slabs or in concrete-encased duct banks.
3. PVC Schedule 80: Underground, exposed indoor and outdoor runs in “Corrosive” areas.
4. Aluminum conduit installed in concrete or below grade shall be completely covered with two (2) coats of bitumastic paint or with heat shrink tubing (Raychem or equal).
5. EMT conduit shall be used in administrative areas, laboratories, lunchrooms and similar dry, clean areas, above ground.

PART 3 - EXECUTION

3.01 INSTALLATION

A. General:

1. Conduit routing:

a. The Electrical Drawings are diagrammatic in nature:

i. Install conduit runs as specified with schematic representation indicated on the Drawings and as specified.

ii. Modify conduit runs to suit field conditions, as accepted by the Engineer:

I. Make changes in conduit locations that are consistent with the design intent but are dimensionally different, or routing to bypass obstructions.

II. Make changes in conduit routing due to the relocation of equipment.

iii. The Electrical Drawings do not indicate all required junction boxes and pull boxes:

I. Provide junction boxes and pull boxes to facilitate wire pulling as required:

- To meet cable manufacturer's pulling tension requirements.
- To limit total conduit bends between pull locations.

II. Install junction boxes and pull boxes at locations acceptable to the Engineer.

b. The Contractor is responsible for any deviations in general location, conduit size, routing, or changes to the conduit schedule without the express written approval or direction by the Engineer:

i. The Engineer is the sole source in determining whether the change is constituted as a deviation:

ii. Perform any changes resulting in additional conduits, or extra work from such deviations.

iii. Incorporate any deviations on the Record Documents.

c. Owner reserves the right to deduct the amount of applicable reimbursement, equivalent to the cost of the engineering effort required to show those unauthorized changes on As-built Drawings.

2. Use only tools recommended by the conduit manufacturer for assembling conduit system.

3. Provide adequate clearances from high-temperature surfaces for all conduit runs. Provide minimum clearances as follows:

a. Clearances of 6 inches from surfaces 113 degrees Fahrenheit to 149 degrees Fahrenheit.

b. Clearances of 12 inches from surfaces greater than 149 degrees Fahrenheit.

c. Keep conduit at least 6 inches from the coverings on hot water and steam pipes, 18 inches from the coverings on flues and breechings and 12 inches from fuel lines and gas lines.

d. Where it is necessary to route conduit close to high-temperature surfaces, provide a high-reflectance thermal barrier between the conduit and the surface.

4. Support conduit runs on water-bearing walls a minimum of 7/8-inch away from wall on an accepted preformed channel:

a. Do not run conduit within water-bearing walls unless otherwise indicated on the Drawings.

5. Do not install 1 inch or larger conduits in or through structural members unless approved by the Engineer.

6. Run conduit exposed to view parallel with or at right angles to structural members, walls, or lines of the building:

a. Install straight and true conduit runs with uniform and symmetrical elbows, offsets, and bends.

b. Make changes in direction with long radius bends or with conduit bodies.

7. Install conduit with total conduit bends between pull locations less than or equal to 270 degrees.

8. Route all exposed conduit to preserve headroom, access space and work space and to prevent tripping hazards and clearance problems:

   a. Install conduit runs so that runs do not interfere with proper and safe operation of equipment and do not block or interfere with ingress or egress, including equipment removal hatches.

   b. Route conduit to avoid drains or other gravity lines. Where conflicts occur, relocate conduit as required.

9. Conduit may be run in concrete members or slabs with permission of the Engineer or as indicated on the Drawings:

   a. Refer to the typical details for conduit spacing and size requirements.

10. When installing conduit through existing slabs or walls make provisions for locating any possible conflicting items where conduit is to penetrate. Use tone signal or X-ray methods to make certain that no penetrations will be made into existing conduit, piping, cables, post-tensioning cables, etc.

11. Plug conduits brought into pull boxes, manholes, handholes, and other openings until used to prevent entrance of moisture.

12. Install conduit through wall and floor seals where indicated on the Drawings.

13. For existing and new 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:

    a. Remove and replace conduits through which mandrel will not pass.

14. Provide all sleeves and openings required for the passage of electrical raceways or cables even when these openings or sleeves are not specifically indicated on the Drawings.

15. Install complete conduit systems before conductors are installed.

16. Provide metallic conduits terminating in transformer, switchgear, motor control center or other equipment conduit windows with grounding bushings and ground with a minimum No. 6 AWG ground wire.

17. Underground and embedded conduits:

    a. Install underground conduits, including conduit runs below slabs-on-grade in concrete-reinforced duct bank construction:

    b. Make underground conduit size transitions at handholes and manholes.

    c. Install spare conduits in underground duct banks towards top center of runs to allow for ease of installation of future cables as conduits enter underground manholes and handholes.

B. Lighting And Receptacle Conduits:

1. Install conduit runs for lighting and receptacle circuits, whether or not indicated on the Drawings:

a. Minimum conduit size:

i. 3/4 inch for exposed conduits.

ii. 1 inch for underground or in slab conduits.

C. Conduit Usage:

1. Exposed conduits:

a. Rigid conduit:

i. Minimum size: 3/4-inch.

b. Flexible conduit:

i. Use flexible conduit for final connections between rigid conduit and motors, vibrating equipment, instruments, control equipment or where required for equipment servicing:

I. Use type SLT with rigid metallic conduit.

II. Use type NFC with PVC conduit.

III. Use type EFLX in Class I Division 1 locations.

IV. Use type FLX in finished areas.

ii. Minimum size: 3/4-inch:

I. 1/2 when required for connection to instruments.

iii. Maximum length:

I. Fixed equipment:

Conduit Trade Size	**Flexible Conduit Length (in)**
3/4	18
1	18
1-1/4	18
1-1/2	18
2	36
2-1/2	36
3	36
3-1/2	38
4	40

II. Removable instruments or hinged equipment:

- As required to allow complete removal or full movement without disconnecting or stressing the conduit.

2. Concrete encased and embedded conduits:
   a. Type PVC Schedule 40 and PVC coated rigid metallic conduit as specified below:
      i. Use Type PCS in underground and embedded installation as follows:
         I. Stub-up and risers to grade floor or equipment from nonmetallic conduits.
         II. Entering and exiting underground or embedded conduit runs a minimum 12 inches above and below grade or finished floor.
         III. For any and all bends where the total deflection is greater than 45 degrees.
   b. Minimum size:
      i. 2 inches in duct banks unless otherwise indicated on the Drawings.
      ii. 1 inch for in slab conduits unless otherwise indicated on the Drawings.
3. Direct buried and sand bedded ductbank conduits:
   a. Type PCS**.**
   b. Minimum size: 1 inch.
4. Directional drill conduits:
   a. Type HDPE.
5. PVC coated rigid metallic conduit:
   a. Use specifically manufactured or machined threading dies to manufacturer's specifications to accommodate the PVC jacket.
6. EMT:
   a. May be used when specified in Section 26 05 00.
   b. Provide supports spaced at minimum 5 feet on center and within 2 feet of each outlet box, junction box, pull box, cabinet, or other enclosure.
7. GRC:
   a. Conduit shall be cut square and reamed before threading.
8. PVC:
   a. Conduit terminations shall be via threaded adapters into threaded hubs on the junction boxes or conduit bodies.
   b. Conduit terminations into boxes without threaded hubs shall utilize a threaded adapter and a flat neoprene washer on the outside of the box.
      i. Use a locknut on the inside of the box to tighten the adapter to the box.

c. Route conduit to afford it the maximum physical protection.

i. If necessary, cover conduit to afford additional protection when it cannot be shielded by the structure or machinery frames.

I. Use Schedule 80 where exposed runs may be subject to physical damage.

9. ENT:

a. Install each conduit in 1 piece without couplings.

b. Utilize concrete type threaded adapters for connections to boxes and type PCS conduit.

10. RAC:

a. Do not use aluminum conduit below grade, cast in concrete or on concrete or masonry in contact with earth.

b. When installing RAC on concrete surfaces mount RAC on nonmetallic channel so that only the nonmetallic channel is in contact with the concrete.

c. When penetrating concrete walls and/or floors use O-Z Gedney rubber gasketed through wall and floor seals so that the aluminum conduit is completely isolated from the concrete by the rubber seal material.

11. Inner duct (applicable for fiber optic cable only):

a. Install inner duct in PVC conduit as indicated on the Drawings.

b. Each inner duct conduit shall be a separate color.

D. Conduit Joints And Bends:

1. General:

a. Where conduit is underground, under slabs on grade, exposed to the weather or in NEMA Type 4 or NEMA Type 4X locations, make joints liquid-tight.

b. Keep bends and offsets in conduit runs to an absolute minimum.

c. All bends shall be symmetrical.

d. For all types of high-voltage conductors, provide bends as required for lead-covered conductors of equivalent outside diameter.

e. The following conduit systems shall use large radius sweep elbows:

i. Underground conduits.

ii. Conduits containing medium voltage cables.

iii. Conduits containing shielded cables.

iv. Conduits containing fiber optic cables.

f. Provide large radius factory-made bends for 1-1/4-inch trade size or larger.

g. Make field bends with a radius of not less than the requirements found in the NEC:

i. The minimum bending radius of the cable must be less than the radius of the conduit bend.

ii. Make all field bends with power bending equipment or manual benders specifically intended for the purpose:

I. Make bends so that the conduit is not damaged and the internal diameter is not effectively reduced.

II. For the serving utilities, make bends to meet their requirements.

h. Replace all deformed, flattened, or kinked conduit.

2. Threaded conduit:

a. Cut threads on rigid metallic conduit with a standard conduit cutting die that provides a 3/4-inch per foot taper and to a length such that all bare metal exposed by the threading operation is completely covered by the couplings or fittings used. In addition, cut the lengths of the thread such that all joints become secure and wrench tight just preceding the point where the conduit ends would butt together in couplings or where conduit ends would butt into the ends or shoulders of other fittings.

b. Thoroughly ream conduit after threads have been cut to remove burrs.

c. Use bushings or conduit fittings at conduit terminations.

d. On exposed conduits, repair scratches and other defects with galvanizing repair stick, Enterprise Galvanizing “Galvabar” or CRC “Zinc It.”

e. Coat conduit threads with an approved electrically conductive sealant and corrosion inhibitor that is not harmful to the conductor insulation:

i. Apply to the male threads and tighten joints securely.

ii. Clean excess sealant from exposed threads after assembly.

f. Securely tighten all threaded connections.

g. Any exposed threaded surface must be cleaned and coated with a galvanizing solution so that all exposed surfaces have a galvanized protective coating.

3. PVC:

a. Use approved solvent-weld cement specifically manufactured for the purpose. Spray type cement is not allowed.

b. Apply heat for bends so that conduit does not distort or discolor. Use a spring mandrel as required to assure full inside diameter at all bends:

i. Utilize a heater specifically for PVC conduit as recommended by the conduit manufacturer.

E. Conduit Sealing And Drainage:

1. Conduit drainage and sealing other than required for hazardous and classified areas:

a. Provide sealing and drainage in vertical drops of long (in excess of 20 feet), exterior, above grade conduit runs at the points at which the conduit enter buildings, switchgear, control panels, lighting panelboards, and other similar enclosures.

b. Provide seal fittings with drains in vertical drops directly above grade for exterior, above grade conduit runs that are extended below grade.

c. Provide conduit seals with drains in areas of high humidity and rapidly changing temperatures:

i. Where portions of an interior raceway pass through walls, ceilings or floors that separate adjacent areas having widely different temperatures.

d. Provide conduit seals similar to O/Z Gedney (Type CSM) on all conduits between corrosive and non-corrosive areas.

e. Seal one end only of all underground conduits at highest point with O/Z Gedney sealing (non-hazardous) filling, or equal.

2. Install seals with drains at any location along conduit runs where moisture may condense or accumulate. This requirement includes, but is not limited to, the following locations: control panels, junction boxes, pullboxes, or low points of conduit.

F. Conduit Supports:

1. General:

a. Provide appropriate hangers, supports, fasteners, and seismic restraints to suit applications:

ii. Provide support materials consistent with the type of conduit being installed.

b. Support conduit at the intervals required by the NEC.

c. Perforated strap and plumbers tape are not acceptable for conduit supports.

2. Finished areas:

a. Above suspended ceilings:

i. Support conduit on or from the structure, do not support conduit from hanging wires or suspended ceiling grid.

b. Concealed conduit on wood:

i. Use 2-hole galvanized steel straps screwed or nailed to the wood or hammer-driven stamped galvanized type supports having serrated or sawtooth edges on the driven portion and designed specifically for the size and type of conduit being supported. Drive these latter supports so that the conduit is tightly and rigidly supported. Replace any dented or damaged conduit.

c. In steel stud construction:

i. Tie conduit at maximum 4-foot intervals with No. 16 gauge double annealed galvanized wire or conduit clips so that conduit cannot move from vibration or other causes.

3. Conduit on concrete or masonry:

a. Use 1-hole malleable iron straps with metallic or plastic expansion anchors and screws or support from preset inserts.

b. Use preset inserts in concrete when possible.

c. Use pipe spacers (clamp backs) in wet locations.

d. On plaster or stucco, use 1-hole malleable iron straps with toggle bolts.

4. Conduit on metal decking:

a. Use 1-hole malleable iron straps with 1-inch long cadmium-plated Type A panhead sheet metal screws. Fully or partially hammer-driven screws are not acceptable.

5. Suspended conduit:

a. Use malleable iron factory-made split-hinged pipe rings with threaded suspension rods sized for the weight to be carried (minimum 3/8-inch diameter), Kindorf, or equal.

b. For grouped conduits, construct racks with threaded rods and tiered angle iron or preformed channel cross members. Clamp each conduit individually to a cross member. Where rods are more than 2 feet long, provide rigid sway bracing.

6. Supports at structural steel members:

a. Use beam clamps.

b. Drilling or welding may be used only as specified or with approval of the Engineer.

7. PVC conduit supports:

a. Mount all conduit with hangers specifically designed for use with PVC to minimize the problems of bowing resulting from the expansion and contraction of conduit caused by varying temperatures:

i. Hangers to be constructed of PVC incorporating serrated teeth to grip the conduit securely and yet allow for conduit movement due to thermal considerations:

ii. As manufactured by: Carlon E978D, E, F, G, H, and J.

8. PVC coated rigid metal systems:

a. Provide right angle beam clamps and U bolts specially formed and sized to snugly fit the outside diameter of the coated conduit. Provide "U" bolts with PVC encapsulated nuts that cover the exposed portions of the threads.

b. Securely fasten exposed conduits with Type 316 stainless steel clamps or straps.

G. Expansion Or Expansion/Deflection Fittings:

1. General:

a. Align expansion coupling with the conduit run to prevent binding.

b. Follow manufacturer’s instructions to set the piston opening.

c. Install expansion fittings across concrete expansion joints and at other locations where necessary to compensate for thermal or mechanical expansion and contraction.

d. Furnish fittings of the same material as the conduit system.

2. For metallic conduit provide expansion or expansion/deflection couplings, as appropriate, where:
    a. Install expansion fittings a minimum of every 200 feet in straight conduit runs.
3. For PVC provide expansion or expansion/deflection couplings, as appropriate, where length change due to temperature variation exceeds 2 inches:
    a. Rigidly fix the outer barrel of the expansion coupling so it cannot move.
    b. Mount the conduit connected to the piston loosely enough to allow the conduit to move as the temperature changes.

H. Empty Conduits:
1. Provide a polyethylene rope rated 250 pounds tensile strength in each empty conduit more than 10 feet in length.
2. Provide one empty 3/4-inch conduit for each four spare unused circuits or spaces of each flush mounted branch circuit panelboard. Terminate empty 3/4-inch conduits in individual junction boxes that are accessible to enable extension of future branch circuits.
3. Seal ends of all conduit with approved, manufactured conduit seals, caps or plugs immediately after installation:
    a. Keep ends sealed until immediately before pulling conductors.

I. Miscellaneous:
1. Seal roof penetrations for raceways and other items that penetrate the roof in accordance with roofing manufacturer's instructions and as indicated on the Drawings.
2. Provide electrical unions at all points of union between ends of rigid conduit systems that cannot otherwise be coupled:
    a. Running threads and threadless couplings are not allowed.
3. Replace any conduit installed that the Engineer determines does not meet the requirements of this Specification.
4. Provide conduit housekeeping curb around all embedded or below-grade conduits exiting or entering the slab.

END OF SECTION

SECTION 5.4

BOXES FOR ELECTRICAL SYSTEMS

To the County Standard Specifications, ADD the following:

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Device boxes.
2. Raceway system boxes.

B. Related Sections:

1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
2. It is the Contractor's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of Contractor's Work.
3. The following sections are related to the Work described in this Section. This list of related sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the Contractor to see that the completed Work complies accurately with the Contract Documents.

1.02 REFERENCES

A. ASTM International (ASTM):

1. A 47 - Standard Specification for Ferritic Malleable Iron Castings.
2. D 149 - Standard Test Method for Dielectric Breakdown Voltage and Dielectric Strength of Solid Electrical Insulating Materials at Commercial Power Frequencies.
3. D 495 - Standard Test Method for High-Voltage, Low-Current, Dry Arc Resistance of Solid Electrical Insulation.
4. D 570 - Standard Test Method for Water Absorption of Plastics.
5. D 648 - Standard Test Method for Deflection Temperature of Plastics Under Flexural Load in the Edgewise Position.
6. D 790 - Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.
7. D 792 - Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement.

B. Joint Industry Conference (JIC).

C. Underwriters Laboratories, Inc. (Ul):

1. 94 - Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances.

1.03 DEFINITIONS

A. Specific Definitions:

1. Arcing parts: Circuit breakers, motor controllers, switches, fuses, or any device intended to interrupt current during its operation.
2. Raceway system boxes: Boxes that are used for wire and cable pullboxes, conduit junction boxes, or terminal boxes.

1.04 SYSTEM DESCRIPTION

A. Provide boxes as indicated on the drawings or as needed to complete the raceway installation.

1.05 SUBMITTALS

A. Product Data:

1. Manufacturer.
2. Materials.
3. Dimensions:
    a. Height.
    b. Width.
    c. Depth.
    d. Weight.
    e. NEMA rating.
4. Conduit entry locations.
5. Catalog cut sheets.
6. Installation instructions.

B. Shop Drawings:

1. Include identification and sizes of pull boxes.

1.06 QUALITY ASSURANCE

A. Regulatory Requirements:

1. Outlet boxes shall comply with all applicable standards of:
    a. JIC.
    b. NEC.

c. NEMA.

d. UL.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. One Of The Following Or Equal:

1. Pressed steel boxes:
   a. Steel City.
   b. Appleton.
   c. Crouse - Hinds.
   d. Thomas & Betts.
2. Plastic and/or fiberglass boxes:
   a. Hoffman.
   b. Carlon.
   c. Stahlin.
3. Plastic coated boxes:
   a. Rob Roy.
   b. OCAL.
4. Cast device boxes:
   a. Appleton.
   b. Crouse - Hinds.
   c. OZ/Gedney.
5. Floor outlet boxes with 1-inch conduit knockouts:
   a. Steel City, 640 Series.
   b. Hubbell type B25 with S2530 coverplate.
6. Floor outlet boxes in open areas:
   a. Hubbell.
7. Formed steel enclosures:
   a. Hoffman.
   b. Thomas and Betts.
   c. Stahlin.
   d. Rittal.
8. Stainless steel enclosures:
   a. Hoffman.
   b. Stahlin.

c. Rittal.

9. Pressed steel boxes and concrete boxes:
    a. Appleton.
    b. Steel City.
    c. Cooper/Crouse Hinds.
    d. OZ Gedney.

2.02 MANUFACTURED UNITS

A. Pressed Steel Boxes:
    1. One-piece galvanized pressed steel.
    2. Knockout type boxes.
    3. Minimum size 4-inch square by 2-1/8-inch deep.

B. Concrete Boxes:
    1. For outlets and pull boxes in concrete construction.
    2. Pressed steel or cast construction, concrete tight.
    3. Knockout sizes range from 1/2 inch to 1 inch.
    4. Depth as needed.
    5. Types:
        a. Four-inch octagon.
        b. Four-inch octagon ceiling boxes with hanging bars.
        c. Gangable masonry boxes:
            i. 3-1/2-inch deep, 3-3/4-inch high, length as required:
                I. 2-1/2-inch deep boxes may be used where wall thickness precludes the use of the deeper boxes.
            ii. With partitions as needed.

C. Cast Device Boxes:
    1. Construction:
        a. With internal green ground screw.
        b. Furnished with a suitable gasketed cover.
        c. With integral cast mounting lugs when surface mounted.
        d. Conduit sizes range from 3/4 inch to 1 inch.
        e. Tapered threaded hubs with integral bushing.
    2. Aluminum (copper free) boxes:
        a. High strength copper free 4/10 of 1 percent maximum alloy for use with aluminum rigid conduit.

3. Malleable iron boxes:
    a. Conforming to ASTM A 47 Grade 32510.

D. Powdered Coated 316 Cast Device Boxes:
1. Construction:
    a. With internal green ground screw.
    b. Furnished with a suitable gasketed cover.
    c. With integral cast mounting lugs when surface mounted.
    d. Conduit sizes range from 3/4 inch to 1 inch.
    e. Double coated with a nominal 0.002-inch (2 mil) urethane on both the interior and exterior before application of PVC coating.
    f. With a minimum 0.040-inch (40 mil) PVC coating bonded to exterior.
    g. With pressure sealing sleeve to protect the connection with conduit.

E. Formed Steel Enclosures:
1. Steel:
    a. NEMA Type 12.
    b. Fabricated from 14-gauge steel, minimum.
    c. All seams continuously welded ground smooth.
    d. Door:
        i. Rolled lip around 3 sides.
        ii. Attached to enclosure by means of a continuous stainless steel hinge and pin.
    e. Neoprene door gasket to provide a watertight, dusttight, oiltight seal:
        i. Attached with an adhesive.
        ii. Retained by a retaining strip.
    f. Fabricate all external removable hardware for clamping the door to the enclosure body from zinc-plated heavy gauge steel:
        i. With a hasp and staple for padlocking.
    g. Provide large enclosures with door and body stiffeners for extra rigidity.
    h. No holes or knockouts.
    i. Finish:
        i. ANSI-61 gray electrostatically applied polyester powder inside and out over cleaned and primed surfaces.
        ii. White electrostatically applied polyester powder mounting plate.
    j. Heavy gauge steel external mounting brackets when surface mounted.
2. Stainless steel:
        a. NEMA Type 4X:

i. Boxes in locations subject to flooding or temporary submersion:

I. NEMA Type 6.

b. Fabricated from 14-gauge Type 316 stainless steel.

c. All seams continuously welded.

d. Door:

i. Rolled lip around 3 sides.

ii. Attached to enclosure by means of a continuous stainless steel hinge and pin.

e. Neoprene door gasket to provide a watertight seal:

i. Attached with an adhesive.

ii. Retained by a retaining strip.

f. Fabricate all external removable hardware for clamping the door to the enclosure body from heavy gauge stainless steel:

i. With a hasp and staple for padlocking.

g. Provide large enclosures with door and body stiffeners for extra rigidity.

h. No holes or knockouts.

i. Finish:

i. Brushed.

j. Stainless steel external mounting brackets when surface mounted.

F. Floor Outlet Boxes:

1. Watertight cast iron, semi adjustable.

2. Telephone outlets shall be fitted with 6-inch bushed nipples.

3. Provide a pedestal housing for floor outlets in open areas.

4. Suitable for receptacles, communications, and data outlets as specified and indicated on the Drawings, complete with gaskets and cover plates:

a. Dual-gang, heavy-duty cast iron, suitable for wiring devices to be installed to make a complete and operable system and installation.

2.03 **ACCESSORIES**

A. Fasteners:

1. Electroplated or stainless steel in boxes with wiring devices.

2. Screws, nuts, bolts, and other threaded fasteners:

a. Stainless steel.

B. Provide Breather and Drain Fittings Where Appropriate.

C. Internal Panels:

1. Provide internal panels where required for mounting of terminal strips or other equipment.
2. With plated steel shoulder studs.
3. Steel with white polyester powder finish.

D. Floor Stand Kit When Shown:

1. Fabricated from 12-gauge steel.
2. Bottom plate 11 gauge.
3. Heights:
    a. 12 inches.
4. Do not provide external mounting brackets, when a floor stand kit is used.

PART 3 - EXECUTION

3.01 INSTALLATION

A. General:

1. Provide materials and construction suitable for environmental conditions at the location of the box as specified in Section 26 05 00.
2. Provide outlet box materials to match the conduit system:
    a. EMT - Pressed metal boxes.
    b. GRC - Cast ferrous boxes.
    c. RAC - Aluminum (copper free) boxes.
    d. PCS - PVC coated cast ferrous boxes.
    e. PVC - PVC boxes.
    f. PCA - PVC coated aluminum boxes.
3. Solid type gang boxes:
    a. For more than 2 devices.
    b. For barriered outlets.
4. Support all wall mounted NEMA Type 4 or NEMA Type 4X boxes to maintain a minimum of 7/8-inch free air space between the back of the enclosure and the wall:
    a. Use machined spacers to maintain air space; built-up washers are not acceptable.
    b. Use stainless steel or nylon materials for spacers.
5. Use cast malleable iron boxes when box must support other devices.
6. Boxes serving luminaires or devices:
    a. Use as pull boxes wherever possible.

7. In finished areas:
    a. Provide specific pull or junction boxes only as indicated on the Drawings or as directed.
8. Fit all cast boxes and pressed steel boxes for flush mounting in concrete with cast, malleable box covers and gaskets.
9. In terminal boxes, furnish terminals as indicated on the Drawings, with a minimum of 50 percent spare terminals:
    a. Furnish wireways for discrete and analog/DC wiring.
    b. Separate analog wiring from 120 V discrete or power wiring.
10. Size boxes in accordance with NEC requirements and to provide sufficient room for the future components and cables indicated on the Drawings.
11. For fire-rated construction, provide materials and installation for use in accordance with the listing requirements of the classified construction.

B. Outlet Boxes:
1. Locate outlet boxes as indicated on the Drawings:
    a. Adjust locations so as not to conflict with structural requirements or other trades.
2. Use deep threaded-hub malleable iron or aluminum boxes:
    a. In hazardous areas.
    b. Where exposed to the weather.
    c. In unheated areas.
    d. Where subject to mechanical damage:
        i. Defined as exposed boxes less than 10 feet above the floor.
    e. To act as a pull box for conductors in a conduit system.
    f. Accommodate wiring devices.
3. Use deep threaded-hub plastic coated malleable iron boxes in corrosive and NEMA Type 4X area and when the conduit system is PVC coated steel.
4. Outlet boxes may be used as junction boxes wherever possible.

C. Pull Boxes And Junction Boxes:
1. Size pull boxes in accordance with NEC requirements and to provide sufficient room for any future conduits and cables as indicated on the Drawings.
2. Install pull boxes such that access to them is not restricted.

D. For Boxes Not Indicated:
1. Provide types and mountings as required to suit the equipment and that will be consistent with the conduit system and environmental conditions.
2. Outlet, switch, and junction boxes for flush-mounting in general purpose locations:
    a. One-piece, galvanized, pressed steel.

3. Ceiling boxes for flush mounting in concrete:
    a. Deep, galvanized, pressed steel.
4. Outlet, switch, and junction boxes where surface mounted in exposed locations:
    a. Cast ferrous boxes with mounting lugs, zinc or cadmium plating finish.
5. Outlet, control station, and junction boxes for installation in corrosive locations:
    a. Fiberglass reinforced polyester, stainless steel, or plastic coated steel to match the conduit system.
    b. Furnished with mounting lugs.
6. Boxes for concealed conduit system:
    a. Non-fire rated construction:
        i. Depth: To suit job conditions and comply with the NEC.
        ii. For luminaries: Use outlet boxes designed for the purpose:
            I. 50 pounds or less: Box marked “For Fixture Support.”
            II. More than 50 pounds: Box listed and marked with the weight of the fixture to be supported (or support luminaire independent of the box.)
        iii. For ceiling suspended fans:
            I. 35 pounds or less: Marked “Acceptable for Fan Support.”
            II. More than 35 pounds, up to 70 pounds: Marked “Acceptable for Fan Support up to 70 pounds (or support fan independent of the box).”
        iv. For junction and pull boxes: Use galvanized steel boxes with flush covers.
        v. For switches, receptacles, etc:
            I. Plaster or cast-in-place concrete walls: Use 4-inch or 4-11/16-inch galvanized steel boxes with device covers.
            II. Walls other than plaster or cast-in-place concrete: Use type of galvanized steel box which will allow wall plate to cover the opening made for the installation of the box.

END OF SECTION

SECTION 6.0

SELECTIVE SITE DEMOLITION

To the County Standard Specifications, ADD the following:

PART 1 – GENERAL

1.1 SUMMARY

A. Work Included:

This section shall consist of:

- Existing Utility Verification and Location,
- Remove Existing Fence,
- Removal of Existing Utility,
- Abandonment of Existing Utility,
- Demolition of Existing Water Tank Facilities,
- ~~Temporary Tank~~ **Not included in the scope.**

B. Existing improvements, adjacent property, utilities, and other facilities that are not called for or otherwise required for removal to accommodate this project shall be protected in-place from injury or damage. Any cost related to protection of these facilities is considered included in the price bid for the various work items and no additional payment will be made therefor. Existing facilities damaged by the Contractor shall be restored to pre-damage condition by the Contractor without cost to the County.

3. Reference Standards:

This Special Provision makes references to the Standard Specifications for Public Works Construction (Greenbook), referred to collectively hereinafter as SSPWC.

1.2 PROJECT CONDITIONS

A. Protect all utilities, structures and facilities, and other site features that are to remain in place from damage caused by impact, settlement, lateral movement, undermining, washout, and other hazards created by excavation, construction of facilities, and compaction operations.

B. The County and Engineer do not warrant the accuracy or completeness of the locations and type of existing utilities and substructures shown on the Plans.

1.3 SUBMITTALS

A. Mix design for concrete used for utility plugs

B. Procedures and schedule for Water Tank decommissioning and demolition

C. Temporary Tank and Temporary Piping drawings and specifications.

Not included in the scope.

PART 2 – PRODUCTS

2.1 CONCRETE

A. Concrete used for plugging abandoned utilities shall conform to SSPWC Section 201-1 for Class 520-C-2500 as shown on the Plans.

2.2 TEMPORARY TANK

A. Contractor shall install a temporary tank to provide water to the community prior to existing tank demolition and new tank installation.

B. Temporary tank shall have a minimum storage capacity as indicated on the plans. Volume to be verified by the County prior to selection and installation of temporary tank.

C. Temporary piping shall consist of HDPE and shall be anchored to the ground or restrained to prevent movement. Piping shall intercept the existing pipe supply/return to the existing tank outside the existing tank yard and shall consist of a DIP tee installed on the existing line with 2 shutoff valves. The valves shall be positioned to isolate the existing tank like to allow demolition and on the lateral tee to the temporary tank to allow the tank to be filled and operate during new tank construction.

D. Temporary controls to allow operation of the tank (filling/emptying) with the existing wells that serve the existing tank.

PART 3 – EXECUTION

3.1 EXISTING UTILITY LOCATION AND VERIFICATION

The Contractor is responsible for accurately locating, by potholing or other suitable methods, all existing utilities such as service connections and substructures, to prevent unwanted damage to such facilities and to identify any conflicts with the proposed work.

The Contractor shall perform all utility markout, locating, status verification, and potholing work prior to the start of construction. This includes walking the existing pipe alignment and work site with County representatives to identify the location and type of utilities that may not be shown on the plans.

The Contractor shall fill all potholes on the same day of excavation, and, if no trenching is performed within 10 working days, fully restore all potholes and any damaged surrounding areas to their original condition unless otherwise allowed by the County.

The Contractor will coordinate with the County or other utility owners to obtain record information and to verify the operational status of utilities in conflict with the proposed construction.

The Contractor shall notify the County, in writing, of any conflicts between existing utilities and the proposed work a minimum of 5 working days, and 300 feet in advance of the work to provide adequate time, and space for any changes to the work needed to avoid unforeseen conflicts. The Contractor shall perform utility location and status verification far enough in advance of the Work to provide the written notification specified in this section.

The Written notification shall include; date of utility location, method of utility location, method of operational status verification, type, size, and material of utility, horizontal location, depth from existing pavement or ground surface to top and bottom of utility, suspected ownership of utility, and date on which any conflict with the utility will impact the critical path.

The Contractor shall not be entitled to an extension of Contract time or compensation for delay if direction is provided by the County within 5 working days from receipt of the Contractor's written notification of the utility conflict.

3.2 ABANDON EXISTING UTILITY

A. When existing utilities have been or are to be abandoned and are found to interfere with construction, the interfering portion shall be removed and the remaining open portions securely sealed. The Contractor shall conduct this abandonment process at the location shown on the plans and as required to accommodate the construction. Interfering utilities shall be removed by saw cutting to a flat surface that is approximately perpendicular to the long axis of the utility.

B. The status of existing utilities requiring removal shall be verified by the Contractor prior to removal. The Contractor shall immediately notify the County of any utility, requiring removal, found to be or believed to be live.

C. Where the internal dimension of the conduit is greater than 12-inches, the seal shall consist of an 8-inch thick wall of solid masonry brick and mortar as shown on the Plans.

D. Where the internal dimension of the conduit is less than or equal to 12-inches, the seal shall consist of a wall (plug) of concrete not less than 8-inches thick as shown on the Plans.

3.4 REMOVE EXISTING STEEL WATER TANK

A. After the temporary water tank is constructed, operational and accepted by the County, the following existing steel water tank facilities shall be removed and disposed of offsite at a suitable disposal area:
   a. Tank Dewatering
   b. Perimeter Fence, Gates, Poles, Fence Pole Foundations
   c. Steel Water Tank including steel shell, roof, ladders, vents, piping, foundation, steel rock retainer ring, dewatering tank, etc.
   d. Piping connections to Tank

B. Demolition of any items to facilitate the proposed work shall include removal and disposal of all facility components to a depth of 3 feet below the adjacent ground.

C. Voids left by the demolition of any items shall be backfilled with clean fill in accordance with the geotechnical report. Finished grading elevations shall be sloped to match the existing grades of the site.

D. Contractor shall determine if the existing Tank coatings (interior and exterior), including pipings, are positive with hazardous materials such as lead, chromium, and zinc.

E. Contractor shall provide a hazardous test report to confirm that the existing coatings of the tank and piping are not positive for lead, chromium, and zinc.

END OF SECTION

SECTION 7.0

UTILITY PIPING

To the County Standard Specifications, ADD the following:

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pipe and fittings.
2. Accessories
3. Underground pipe markers.
4. Connection to existing pipes.
5. Bedding, backfill, and cover materials.

1.2 REFERENCES

A. American Association of State Highway and Transportation Officials:

1. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop.

B. ASTM International:

1. ASTM B177 – Standard Test Method for Operating Salt Spray (Fog) Testing.

2. ASTM C14 - Standard Specification for Concrete Sewer, Storm Drain, and Culvert Pipe.

3. ASTM C76 – Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.

4. ASTM C443 - Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets.

5. ASTM C923 - Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals.

6. ASTM C924 – Standard Practice for Testing concrete Pipe Sewer Lines by Low-Pressure Air Test Method.

7. ASTM C 969 – Standard Practice for Infiltration and Exfiltration Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines.

8. ASTM C1103 – Standard Practice for Joint Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines.

9. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3)).

10. ASTM D714 – Standard Test Method for Evaluating Degree of Blistering of Paints.

11. ASTM D1238 – Measuring Flow Rates of Thermoplastics by Extrusion Plastometer.

12. ASTM D1248 –Polyethylene Plastics Molding and Extrusion Materials.

13. ASTM D1505 – Density of Plastics by Density-Gradient Technique.

14. ASTM D1599 – Test for Short Term Rupture Strength of Plastic Pipe, Tubing, and Fitting.

15. ASTM D1693 – Environmental Stress Cracking of Ethylene Plastics.

16. ASTM D1784 – Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.

17. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3 (2,700 kN-m/m3)).

18. ASTM D1785 - Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) .

19. Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.

20. ASTM D1928 – Preparation of Compression Molded Polyethylene Test Samples.

21. ASTM D2152 – Test Method for Degree of Fusion of Extruded Poly (Vinyl Chloride) (PVC) Pipe and Molded Fittings by Acetone Immersion.

22. ASTM D2241 – Poly (Vinyl Chloride) (PVC) Plastic Pipe (SDR-PR).

23. ASTM D2321 - Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.

24. ASTM D2564 - Standard Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems.

25. ASTM D2657 – Heat Joining of Thermoplastic Pipe and Fittings.

26. ASTM D2665 – Poly (Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings.

27. ASTM D2729 - Standard Specification for Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.

28. ASTM D2837 – Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials.

29. ASTM D2855 - Standard Practice for Making Solvent-Cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and Fittings.

30. ASTM D2922 - Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).

31. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).

32. ASTM D3034 - Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.

33. ASTM D3035 – Polyethylene Plastic Pipe (SDR-PR) Based on Controlled Outside Diameter.

34. ASTM D3212 – Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.

35. ASTM D3261 – Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing.

36. ASTM F3350 – Polyethylene Plastic Pipe and Fittings Materials.

37. ASTM F477 - Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

38. ASTM F585 – Insertion of Flexible Polyethylene Pipe in Existing Sewers.

39. ASTM F679 – Standard Specification for Poly (Vinyl Chloride) (PVC) Large Diameter Plastic Gravity Sewer Pipe and Fittings.

40. ASTM F714 – Standard Specification for Polyethylene Plastic Pipe Based on Outside Diameters.

41. ASTM F1417 – Standard Test Method for Installation Acceptance of Plastic Gravity Sewer Lines Using Low-Pressure Air.

42. ASTM G95 – Standard Test Method for Resistance to Cathodic Disbondment by the Attached Cell Method.

C. American Water Works Association:

1. AWS Standard Qualification Procedure.

D. American Water Works Association:

1. AWWA C104 – American National Standard for Cement-Mortar Lining for Ductile-Iron Pipe and Fittings.

2. AWWA C105 - American National Standard for Polyethylene Encasement for Ductile-Iron Pipe Systems.

3. AWWA C110 - American National Standard for Ductile-Iron and Grey-Iron Fittings, 3 in. through 48 in. (75 mm through 1200 mm), for Water and Other Liquids.

4. AWWA C111 - American National Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.

5. AWWA C150 - ANSI Standard for the Thickness Design of Ductile Iron Pipe.

6. AWWA C151 - American National Standard for Ductile-Iron Pipe, Centrifugally Cast, for Water.

7. AWWA M23 – AWWA Manual of Supply Practices PVC Pipe – Design and Installation, Second Edition.

8. AWWA C900 – Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 inch through 12 inch for Water Transmission and Distribution.

E. National Fire Protection Association:

1. NFPA 24 - Installation of Private Fire Service Mains and Their Appurtenances.

F. National Sanitation Foundation, most recent version:

1. NSF-14 – Plastics Piping System Components and Related Materials.

G. Plastics Pipe Institute, most recent version:

1. PPI TR-2 – PVC Range Composition Listing of Qualified Ingredients.

H. UNI-BELL PVC Pipe Association, most recent version:

1. UNI-B-6 – Recommended Practice for Low-Pressure Air Testing of Installed Sewer Pipe.

2. UNI-PUB-08 – Tapping Guide for PVC Pressure Pipe

1.3 SUBMITTALS

A. Polyvinyl chloride pipe materials

B. Ductile Iron Pipe Materials

C. Pipeline layout diagrams

D. Valve types and materials

E. Precast structure design shop drawings

F. Grout materials

G. Pipe bedding

1.4 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years documented experience.

B. Installer: Company specializing in performing work of this section with minimum three years documented experience.

1.5 DELIVERY, STORAGE, AND HANDLING

A. The Contractor shall exercise special care during the unloading, handling, and storage of all pipe to ensure that the pipe is not cut, gouged, scored, or otherwise damaged. Any pipe segment which has cuts in the pipe wall exceeding 10 percent of the wall thickness shall be cut out and removed from the site at the Contractor's expense.

B. The pipe shall be stored so that it is not deformed axially or circumferentially which may hinder pipe installation. No vertical load shall be placed on pipe during storage. Contractor shall test all pipe for ovality prior to installation. Pipe not meeting specified requirements shall be replaced with new material.

C. All plastic pipes shall have an ultraviolet inhibitor and shall also be stored in a covered area on blocks, such that no individual pipes weight shall bear on another pipe segment. Pipes shall be supported so as not to allow the pipe to sag along its length between blocks during storage.

D. Block individual and stockpiled pipe lengths to prevent moving.

1.6 FIELD MEASUREMENTS

A. Verify field measurements and elevations are as indicated.

1.7 COORDINATION

A. Coordinate the Work with other trades and operations at the site.

PART 2 PRODUCTS

2.1 DUCTILE PIPE AND FITTINGS

A. Dual spigot centrifugally cast ductile iron pipe conforming to AWWA C150 or AWWA C151, 250 minimum pressure class flanged ends. Joints shall conform to ANSI/AWWA C111/A21.11.

1. Manufacturers:

   a. U.S. Pipe

   b. American Ductile Iron Pipe Company

   c. Or approved equal

2. Outside Coating: Paint in accordance with system no. 5, as described in these Special Provisions.

3. Lining:

   a. Pipe and fittings: Cement-mortar lining in accordance with AWWA C104 – Cement-Mortar Lining for Ductile-Iron Pipe and Fittings

   b. Valves: Fusion Bonded Epoxy in a uniform thickness, conforming to AWWA C116.

4. Field cut pipe: Pipe shall be cut and reconditioned to make up the next joint per pipe and pipe liner manufacturer's recommendations. Remove any sharp, rough edges that might otherwise damage the joint of coupling. Freshly cut ends shall be immediately coated with Cement Mortar Liner joint compound, and compatible with interior lining of pipe. Pipe that is to be cut in the field shall be "Gauged Full Length" pipe. Field gauge all field cut ends and ensure it to be within manufacturer's tolerances. Cut ends found to be outside of manufacturer's tolerances shall be rounded in accordance with manufacturer's recommendations.

5. Cast iron and ductile iron specials and fittings shall conform to ANSI A21.10 (AWWA C110) or ANSI 21.53 (AWWA C153) with joints as shown on the Drawings or a required elsewhere in these specifications or for the installation.

6. Interior lining of specials and fittings shall match the adjoining specified pipe lining. All standard fittings shall be factory lined with cement mortar lining.

7. Flanges shall meet or exceed ANSI B16.1, Class 250 unless otherwise indicated, or required for the installation.

8. Flanges for spool pieces shall be factory installed threaded flanges. Flanges for fittings shall be cast integrally with the fitting.

9. Where specified, called for on the drawings, or otherwise required for thrust restraint, mechanical joints shall be made using retainer glands with set screws or clamping lugs. Retainer glands shall be as manufactured by EBAA Iron, Tyler Pipe, or equal.

10. Rubber gasket for mechanical or push-on joints shall meet ANSI A21.11 (AWWA C111), vulcanized natural or vulcanized synthetic rubber.

11. Flanged gaskets shall be full face, 1/16-inch thick cloth inserted rubber or metallic packing.

12. Bolts and nuts for all service conditions (above ground, submerged and buried) shall be Type 316 stainless steel.

13. Valves shall be factory lined with Fusion Bonded Epoxy.

2.2 GATE VALVES

A. Gate valves shall be resilient seated solid wedge gate valves. The valve shall have non-rising stem type for buried service or outside screw and yoke (OS&Y) for non-buried service and shall exceed the AWWA C509 and C515 standards.

B. The valve body, bonnet, gland, and handwheel shall be cast from thick wall patterns resulting in a minimum wall thickness as shown on page 9 in Section 4.4 Table 1 of AWWA C500 and C509 and be constructed of ductile iron ASTM A536 grade 65-45-12. The wedge on 2-36" shall be ductile iron, encapsulated with EPDM rubber. The wedge shall be male guided into the body seat of the valve, plastic wedge guiding mechanism not allowed.

C. Valve stems shall be AISI stainless steel with an integral stainless steel tem thrust collar (machined as part of the stem). Shaft seals must be EPDM triple o-rings positively located in the grooves on the shaft not in the gland for NRS valves. The valve must have two thrust washers constructed of copper: non-metallic thrust washers are not acceptable. Non-asbestos graphite packing must be used on OS&Y valves.

D. All nuts, bolts and washers shall be 316 Stainless Steel.

E. Gate valve shall be lined and coated with Fusion Bonded Epoxy.

2.3 RESTRAINED FLANGE ADAPTERS

A. Restrained flange adapters shall be fully restrained and constructed of ASTM A536 ductile iron and have flanged bolt circles that are compatible with ANSI/AWWA C110/A21.10 (125# /Class 150 bolt pattern).

B. Restraint for flange adapter shall consist of a plurality of individual actuated gripping wedges to maximize restraint capability. Torque limiting actuating screws shall be used to insure proper initial set of gripping wedges.

C. The flange adapters shall be capable of deflection during assembly or permit lengths of pipe to be field cut to allow a minimum 0.6-inch gap between the end of the pipe and the mating flange without affecting the integrity of the seal.

D. All internal surfaces of the gasket ring (wetted parts) shall be lined with a minimum of 15 mils of fusion bonded epoxy conforming to the applicable requirements of ANSI/AWWA C213. Sealing gaskets shall be constructed of EPDM. The coating and gaskets shall meet ANSI/NSF-61. Exterior surfaces of the gasket ring shall be coated with a minimum of 6 mils of fusion bonded epoxy conforming to the applicable requirements of ANSI/AWWA C116/A21.16.

E. Pressure rating shall be a minimum of 250 psi.

2.4 POLYVINYL CHLORIDE PIPE (PVC) PRESSURE PIPE

A. Segmental PVC pressure pipe shall conform to AWWA C900. Minimum pressure class shall be 200 psi, DR 18.

B. Segmental PVC used shall be fully restrained at fittings and bends to the limits as indicated on the plans.

2.13 PIPE CONNECTIONS TO EXIST PIPE

1. Connections to existing pipe shall be made by a transition fitting manufactured by ROMAC, Mueller, or approved equal.

   Type for each connection made shall be as called out on plans and details.

2.14 UNDERGROUND PIPE MARKERS

A. Manufacturers:
   1. Presco – Underground Warning Tape, Detectable.
   2. Reef Industries, Inc. – Terra Tape, Detectable
   3. Or equal.

B. Furnish materials in accordance with OSHA standards.

C. Plastic Ribbon Tape: Bright colored blue, continuously printed, minimum 3 inches wide by 4-mil thick, manufactured for direct burial service.

2.15 BEDDING AND COVER MATERIALS

A. Bedding: Specified as shown on plans.

B. Cover: Specified as shown on plans.

C. Soil Backfill from Above Pipe to Finish Grade: Specified as shown on plans.

2.16 ACCESSORIES

A. Grout

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify excavation base is ready to receive work and excavations, dimensions, and elevations are as indicated on drawings.

3.2 PREPARATION

A. Correct over excavation by conformance with project's geotechnical report.

B. Remove large stones or other hard matter capable of damaging pipe or impeding consistent backfilling or compaction.

C. Remove soft or loose soil and over excavate per project's geotechnical report.

D. Protect and support existing sewer lines, utilities and appurtenances.

E. Maintain profiles of utilities. Coordinate with other utilities to eliminate interference. Notify Engineer where crossing conflicts occur.

3.3 BEDDING

A. Excavate pipe trench in accordance with project's geotechnical report.

B. Excavate to lines and grades shown on Plans or required to accommodate installation.

C. Dewater excavations to maintain dry conditions and preserve final grades at bottom of excavation.

D. Provide sheeting and shoring in accordance with project's geotechnical report.

E. Place, level, and compact bedding material at trench bottom per project's geotechnical report.

3.4 PAINT COATING FERROUS SURFACES

A. Field apply paint and protective coating systems for all above ground pipes and appurtenances where shown on the plans that are not otherwise shop coated. Do not apply coating material if the relative humidity exceeds 80 percent or if the surface temperature is less than 5º F. above the dew point.

B. Surface to be coated must be cleaned as specified in subsection 310-2.5.1, part (c) of the SSPWC and these Special Provisions.

C. Surfaces to be coated must be cleaned and coated in conformance with manufacturer's recommendations for coating for the type of material being used. The metal must be cleaned after blasting with clean, dry compressed air. Use of rugs to remove residual dust after sandblasting will not be permitted.

D. Before blast cleaning, remove all oil, grease or other contaminants by solvent cleaning per Subsection 310-2.3, "Solvent Cleaning," of the SSPWC.

E. Shop applied primer must be by spray equipment.

F. Apply intermediate and top coat after priming and cure. White zinc salt, if present, must be cleaned off primed surface before applying intermediate coat.

G. Apply the appropriate System No. protective system as specified in these Special Provisions.

1. System No. 5 – Submerged Metal, Potable Water

    a. Type: Two component, three coat epoxy system.
    b. Surface Preparation: SSPC-SP 10.
    c. Coating System: Apply three coats. Apply to a minimum dry film thickness of 12 mils.

3.5 INSTALLATION - GENERAL

A. All pipe installation shall be in accordance with manufacturer's recommendations. CONTRACTOR shall immediately notify County of any conflicts between manufacturer's recommendations and drawings.

B. For plastic pipe, Install pipe, fittings, and accessories in accordance with ASTM D2321 Seal joints watertight.

C. Lay pipe to slope gradients noted on drawings. Begin at downstream end and progress upstream.

D. Assemble and handle pipe in accordance with manufacturer's instructions except as modified on the Drawings or by Engineer.

E. Keep pipe and fittings clean until work is completed and accepted by Engineer. Cap open ends during periods of work stoppage.

F. Connect pipe to new manhole as detailed in this Specification.

G. Install plastic ribbon tape continuous over top of pipe, buried 6 inches below finish grade.

H. For plastic pipe, Install pipe, fittings, and accessories in accordance with ASTM D2321 Seal joints watertight

3.6 BACKFILLING

A. Backfill around sides and to top of pipe in accordance with project's geotechnical report.

3.7 PROTECTION OF FINISHED WORK

A. Protect pipe and aggregate cover from damage or displacement.

PART 4 MEASUREMENT AND PAYMENT

4.1 MEASUREMENT

A. 12-inch CL350 DIP will be measured by the linear footage of pipe installed as determined from field measurement.

B. 12-inch Gate Valve will be measured by the number of 12-inch Gate Valves installed as determined from field measurement.

C. 12-inch Gate Valve with Hand Wheel will be measured by the number of 12-inch Gate Valves with Hand Wheels installed as determined from field measurement.

D. 12-inch Force Balanced Flextend Expansion Joint will be measured by the number of 12-inch Force Balanced Expansion Joints installed as determined from field measurement.

E. Misc. Piping Spools and Fittings will not be measured for payment. Misc. Piping Spools and Fittings includes horizontal and vertical segments of DIP and DIP fittings, and supply pipe diffuser and check valves and return pipe and check valves inside tank, all sizes of transition couplings not otherwise depicted on the plans as part of the horizontal data tables.

F. 3-inch Tank Drain Valve will be measured by the number of 3-inch Tank Drain Valves installed as determined from field measurement.

4.2 PAYMENT

A. The Contract unit price paid for 12-inch CL350 DIP shall include full compensation for furnishing all labor, materials, equipment, tools and incidentals and for doing all the work of CL350 DIP complete in place, (including fittings, restrained joints, testing, excavation, trenching, rock removal, trench backfill material in trench zone, pipe embedment material in pipe zone, shoring, thrust and support blocking, connections to existing piping, dewatering) as shown on the Plans and as specified in these Special Provisions and the SSPWC.

B. The Contract unit price paid for 12-Inch Gate Valve shall include full compensation for furnishing all labor, materials, equipment, tools, and incidentals and for doing all the work of providing 12-Inch Gate Valve as complete in place, as shown on the Plans, and as specified in these Special Provisions.

C. The Contract unit price paid for 12-Inch Gate Valve with Hand Wheel shall include full compensation for furnishing all labor, materials, equipment, tools, and incidentals and for doing all the work of providing 12-Inch Gate Valve with Hand Wheel as complete in place, as shown on the Plans, and as specified in these Special Provisions

D. The Contract unit price paid for 12-Inch Force Balanced Expansion Joint shall include full compensation for furnishing all labor, materials, equipment, tools, and incidentals and for doing all the work of providing 12-inch Force Balanced Expansion joint complete in place, as shown on the Plans, and as specified in these Special Provisions.

E. The Contract lump sum paid for Misc. Piping Spools and Fittings shall include full compensation for furnishing all labor, materials, equipment, tools and incidentals and for doing all the work of Misc. Piping Spools and Fittings complete in place,

(including fittings, flanges, restrained joints, DIP veritical pipe risers, pipe diffusers and check valves inside tank, pipe supports, testing, excavation, trenching, trench backfill material in trench zone, pipe embedment material in pipe zone, trench patching, dewatering) as shown on the Plans and as specified in these Special Provisions and the SSPWC.

F. The Contract unit price paid for 3-Inch Tank Drain Valve shall include full compensation for furnishing all labor, materials, equipment, tools, and incidentals and for doing all the work of providing 3-Inch Tank Drain Valve complete in place, as shown on the Plans, and as specified in these Special Provisions.

END OF SECTION